

BUSINESS FINLAND PROGRAMS ADVANCING DIGITALIZATION

Evaluation of a continuum of
13 programs and 15 years

Program evaluation report

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BUSINESS FINLAND

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EXECUTIVE SUMMARY

During 2005–2019 Business Finland (formerly Tekes and Finpro) has advanced digitalization among other actions, by implementing a number of different programs, of which 13 were evaluated in 2020–2021. The purpose of the evaluation was to conduct a comprehensive evaluation of the relevance, results, impacts and added value of these programs. The evaluation produced information from the longer-term perspective, taking into account the combined effect of several successive and simultaneously implemented programs. The evaluation also produced information of the different implementation concepts of these programs. The results of the evaluation are presented in this report.

The programs were evaluated in groups which were:

- The forerunner programs (ex post evaluation): Giga (2005–2010), Vamos (2005–2010), Embedded ICT (2007–2013), Trial (2011–2014) and BioIT (2013–2014)
- Simultaneously started programs (final evaluation and concerted action evaluation): 5th Gear (2014–

2019), Industrial Internet, (2014–2019) and Bits of Health (2014–2018)

- Export and invest in -programs (final evaluation): Connectivity from Finland (2015–2017), Industrial Internet (2015–2019) and eCommerce Growth (2016–2019) together with the invest-in program Datacenter 3.0 (2015–2017)
- Connected Intelligent Industries Finland (CIIF) -program (2018–2019) (final evaluation)

The evaluation consisted of both ex-post and final evaluation approaches. The emphasis in the ex-post evaluation was in the analysis on the previous evaluations, supplementary interviews, statistical company level analysis and case-studies. In the final evaluations a wider range of methods and materials have been used to collect primary data, as there are no previous evaluations of these younger programs. A special emphasis in this evaluation was placed on the company-level statistical analysis, using control groups and control samples and advanced statistical methods. The final goal of the evaluation was to

produce a set of conclusions on how digitalization should be advanced by Business Finland in the future; how the program processes, program concepts and program implementation should be developed in the future and how the R&D&I-actions should be strategically developed. The final results and conclusions of the evaluation are based on a holistic interpretation of the different data.

PROGRAMS HAVE COVERED A WIDE RANGE OF DIGITALIZATION THEMES AND HAVE MAINLY HIT TIME WINDOWS WHERE THEIR ADDED VALUE HAS BEEN SIGNIFICANT

According to the results of the evaluation, the evaluated programs have responded well to the needs of operating environment and target groups. Business Finland's foresight activities with key partners have been an important factor in this. The first three forerunner programs (Giga, Vamos and UbiCom) were a large-scale program package and mainly fell within the time window, where their effectiveness in relation to the needs of the operating environment has been at its most relevant. The two subsequent forerunner programs (Trial and BioIT), with a clearly tighter schedule and more limited resources, acted as a timely development impetus for more precisely defined application areas and as a basis for later broader programs. In the recently ended programs (5th Gear, Industrial Internet, Bits of Health) the emphasis

has been stronger towards creating business growth and internationalization of businesses. The programs have responded well to the important need to take the benefits of digitalization more widely to the business field and to apply new solutions more widely in industry sectors. Also, the development of 5G technology has been highlighted in a timely manner, although action could have been even more proactive. The evaluated growth and Invest on programs (Connectivity from Finland, Industrial Internet, eCommerce, DataCenter 3.0) were also quite well timed to the needs of operating environment, though in some programs, the real market demand has existed more strongly after the programs.

Continuities of development work have been formed between the programs, which can be seen in the linking of the themes of the older and newer programs, as well as in the continuations of the innovation-commercialization processes between the projects of different programs.

PROGRAM IMPLEMENTATION HAS BEEN LARGELY SUCCESSFUL AND INFORMATION HAS BEEN RECEIVED ON THE FUNCTIONALITY OF DIFFERENT TYPES OF PROGRAM IMPLEMENTATION CONCEPTS

At individual program level, implementation has been for the most part successful and there haven't been major similar challenges that would have covered several programs. Only bigger challenge, regarding several pro-

grams, have been the limited human resources in relation to the broad objectives of the programs. Among the program services, those that have enabled and promoted co-development and access to development networks, networking and internationalization have been the most beneficial. These services can provide most added value to program participants, especially SMEs.

A key factor in the implementation of several programs and a factor that has contributed to the effectiveness of the programs has been the co-operation implemented through the programs with EU networks and the utilization of EU funding. Through the programs, opportunities for networking and cooperation as well as access to new information have been improved. At its best, the activities launched with Business Finland funding have been scaled up with EU funding.

Simultaneously started programs (5th Gear, Industrial Internet and Bits of Health), as a concept, worked reasonably well, even though all the expected benefits and added value were not achieved. Program collaboration (e.g. networking events, marketing) gave a stronger profile and visibility to the digitalization theme when compared to a situation where the programs had been implemented separately. Also, programs could be better managed as a whole program package and facilitate the flow of important information between the programs. The challenge was that there was not enough time and human resources for continuing co-operation between the three programs.

In addition, promoting technology transitions between programs was partly challenging, since technology development was in the early stages of innovation process in the research-based program, while other programs promoted the application of more complete solutions. As a whole, such an implementation concept can bring added value, but it requires a planned implementation, readiness of technologies for application and a strong commitment from all the parties as well sufficient human resources to implement cooperation.

The broader and horizontal type program concept (CIIF 2022 -program), meets the needs to achieve the desired wider impacts on systemic changes that are in Business Finland agenda. However, only a limited information was received of the program concept, as the CIIF 2022 -program lasted short period of time and its main purpose ended up being the closing of the merged programs successfully. However, the CIIF 2022 -program provided experience for future programs, on how innovation and exports can be promoted simultaneously and how to take into account different thematic areas of digitalization simultaneously, in a large-scale program. More importantly it showed, that this kind of program can gather and steer more widely the development work towards the systemic level goals. The implementation concept can offer possibilities to promoting the innovation and commercialization process as a whole, help develop ecosystems more holistically and respond to broad-based phenomenal

challenges. The challenge in large scale program can be the disappearance of individual important thematic areas to whole and lack of focus, as well as communicating successfully the core issues of the program to the target groups. More detailed information on the functionality of this type of program concept will be obtained from newer Business Finland programs.

The growth and invest-in programs followed the traditional operating model of these kind of programs. Good practices have been the use of local expertise in other countries, various peer development structures and active national networking. In the future there is a need to advance internationalization more strongly based on the needs arising purely from business initiatives.

PROGRAMS HAVE STRENGTHENED THE LONG-TERM CAPACITY AND READINESS FOR DIGITAL TECHNOLOGY DEVELOPMENT AND UTILIZATION IN FINLAND

In the evaluated programs, a number of different kind of results and direct impacts have been achieved. These have included new research data, pilots and new information on the usability of technologies, the improved ability and knowledge to develop and use digital technology, new services and products, new testing environments, improved collaboration between actors, business growth and business internationalization as well as new contacts in foreign markets and networks.

From a longer time-perspective, the role of forerunner programs has been particularly significant in responding to the ongoing and upcoming technological breakthroughs and building a foundation for the development actions for the newer programs. These programs have acted as a bridge and as a guide for technological development at technological turning points from 2005 to 2014. Their significance is especially important in improving the competence for 4G mobile network technology and building the readiness for IoT -development and advancing the use of digitalization in different industry sectors (e.g., in biosector). Important to this has been the strengthening of technological know-how and capabilities, the production of cutting-edge research data, building a proactive vision for the future developments and the mobilization and gathering of the development community and resources to further the desired development.

The simultaneously started programs have impacted especially to the development of 5G technology and its applications, the creation of new ICT/IoT solutions, raising awareness of digitalization in various industry sectors and to the strengthening of a culture of co-development. At the level of the companies and research organizations participating in the programs, the key impact has been the improvement of understanding and competence to develop and utilize digitalization and also the improved knowledge and ability to expand into international markets.

In growth and invest in programs, the results and impacts are mainly related to the strengthening of domestic and international networks, improved ability of participating companies to grow internationally and their international growth. Growth programs have also enabled and contributed for some substantial international deals to take place for Finnish actors (for example, in the Red Compartida Network Project).

A special emphasis in this evaluation was placed on the statistical company level counterfactual analysis. The goal was to understand the impacts of the programs on the key business metrics (turnover, personnel, export etc.) of participating companies. According to the analysis, the evaluated programs have created positive impacts to the growth of substantial part of companies participating in the programs. It has to be noted however, that the impacts of different programs have varied depending on the time when programs were implemented. In the forerunner programs, program and other Business Finland funding have created positive synergies for many companies, which are reflected in higher turnover, exports growth and improved productivity. For the newer programs, some positive impacts in the shorter time period are observed in staff growth.

The added value of the evaluated programs is detectable in several aspects. The evaluated programs have increased the volume of development work, enabled development work to take place which would not have hap-

pened otherwise, accelerated the development of ecosystems and co-development networks, brought together the development community and guided the overall direction of digitalization development. Programs have also influenced to the improved global competitiveness and new international business opportunities for the participating companies.

DIGITALIZATION SHOULD REMAIN AS AN IMPORTANT INDEPENDENT THEME IN BUSINESS FINLAND'S AGENDA AND THE PROMOTION OF DIGITALIZATION SHOULD BE STRONGLY LINKED TO THE EU LEVEL AND TO GLOBAL SYSTEMIC WHOLE, SO THAT THE RESULTS OF DEVELOPMENT WORK CAN BE SCALED UP TO GLOBAL-LEVEL

Digitalization has rightfully been one of key areas in Business Finland agenda. In the coming years wider themes/missions aimed at systemic change will be emphasized more in Business Finland's operations. As advancing and utilizing digitalization is a crucial theme for the success of Finland and its businesses, it should continue to be its own focus area and have important weight in the future in Business Finland's agenda. Focused actions and programs are needed to develop solely digitalization.

For the overall impacts of the evaluated programs, it has been important, that the programs have not only concentrated in applying technology, but they have built capability for future technological breakthroughs. In re-

cent years, a stronger emphasis in programs has been placed to the application and commercialization. In the future, there is also a need to ensure, through adequate strategic basic and applied research, a basis and readiness for technological development and technological breakthroughs for the coming years.

The programs have played an important role in connecting Finnish digitalization development at the EU level. Through the programs, Finnish actors have had a better access to EU-level development networks, programs, partnerships and resources. This has increased the overall resources available and enabled a larger volume of development work to be carried out. As the global competition in advancing digitalization intensifies and as the need to tackle wider system level challenges grow, wider and larger scale measures are required, than what

Business Finland and Finland as a nation themselves can implement. The connection to EU should be a high priority in the future for Business Finland programs as well. One notable EU-level theme in this regard is the twin transition (the combination of digital transformation with sustainable development), where Finland and EU are aiming to have a significant global role.

In Finland, a comprehensive vision/strategy and approach is needed, on how digitalization should be advanced in the future. To advance the vision/strategy, the resources of various Finnish actors should be gathered behind it. For development work, the goal should be global systemic entity, so that the results of development work do not remain only national, but can be scaled in Europe and globally.

1 INTRODUCTION

Finland is an EU leader in the digitalization field. Its particular strengths include its extensive know-how within this labor-market segment and its already installed high-quality infrastructure. Finland has numerous businesses based on digital technology, creating new jobs and attracting investments. Finland's status as a market leader is constantly under pressure from emerging economies and established global giants. Moreover, several countries have recently made and will continue to make substantial investments to promote digitalization across various application areas. For Finland it is vitally important to maintain competitiveness in light of these market developments and to ensure that its position as a pioneer in the digitalization sector is maintained.

Digitalization has been identified as a crucial factor for Finnish companies in terms of their ability to succeed in global competition across various industrial sectors. With digitalization, companies gain access to new technologies, big data and new business models based on these assets. For consumers and corporate customers this means new products and services that blend the physical with the virtual. It is crucial for Finnish busi-

nesses, industries and society as a whole, to adapt to the development of digitalization and to take advantage of the opportunities it brings.

The process of digitalization has evolved rapidly in recent years and keeping pace requires continuous state-level support and concerted action from Finnish actors across the board. Business Finland (formerly Tekes and Finpro) has supported Finnish companies by enabling them to improve the digitization of their businesses in order to create globally competitive advantages. Research organizations have also received funding to promote digitalization by scientific means. Promoting cooperation between companies and research organizations has been an important aspect of these funding instruments.

During the last fifteen years Business Finland (formerly Tekes and Finpro) has implemented a number of different digitalization programs, of which 13 were evaluated in this evaluation. Among them was the set of simultaneous programs including 5th Gear (2014–2019), Industrial Internet (2014–2019), Bits of Health (2014–2018) and, to a certain extent, Connected Intelligent Indus-

tries Finland (CIIF) (2018–2019). Included were also the programs preceding them, including Tekes programs Giga (2005–2010), Vamos (2005–2010), Embedded ICT/Ubicom (2007–2013), Trial (2011–2014) and BioIT (2013–2014). Additionally, the evaluation included Finpro’s export promoting programs Connectivity from Finland (2015–2017), Industrial Internet (2015–2019) and eCommerce Growth (2016–2019) together with the invest-in program Datacenter 3.0 (2015–2017). These programs and the public funding channeled through them formed a key framework for the promotion of digitalization in Finland.

In order to promote digitalization as successfully as possible, efforts have been made to improve the effectiveness of program activities. One tried-and-tested approach has been the simultaneous launch of various programs in the hope of increasing the synergies between them. This approach was particularly relevant for the 5th

Gear, Industrial Internet and Bits of Health programs. When Tekes and Finpro merged at the beginning of 2018, Tekes’ 5th Gear and Industrial Internet and Finpro’s Industrial Internet, Connectivity from Finland, Datacentre 3.0 plus two smaller programs (Public Safety Asia and Finland-Japan Gateway for Open Innovation) were merged into a bigger, broader and more comprehensive program called Connected Intelligent Industries Finland (CIIF). This action combined innovation, export and investment promotion in the same program. Through this change, a more concentrated and parallel program was formed in order to enhance effectiveness and create greater added value over the previous disaggregated approach.

As such, after Business Finland’s extensive investment over the last 15 years in digitalization, now, in 2020–2021, is a suitable time to look at the impacts and added value of the measure taken.

2 GOALS AND IMPLEMENTATION OF THE EVALUATION

The purpose of the evaluation was to conduct a comprehensive evaluation of the relevance, results and impacts of the chosen 13 Business Finland programs advancing digitalization. The evaluation produced information from the longer-term perspective, taking into account the combined effect of several successive and simultaneously implemented programs. The evaluation has produced information on the benefits and added value of the concerted actions produced by these programs.

The major themes and questions in the evaluation were as follows:

- Has the long-term and broad-scale programmatic effort of Business Finland to advance digitalisation through its programs been fruitful?
- Has added value been generated from launching three separate programs (5th Gear, Industrial Internet and Bits of Health) simultaneously as a concerted action?

- Has the merging of several programs into a larger program (CIIF 2022 -program, 8/2018–12/2019) combining innovation, export and investment promotion delivered added value?

The detailed research questions that were taken into account across all programs were:

- What concrete results have been generated in the programs?
- How relevant have the programs been in relation to the operating environment, target group needs and the other programs (complementarity and continuum)?
- How well have the objectives of the programs been attained?
- What impacts have the programs had (including the impacts on international business development, networks and collaboration platforms, learning and business capabilities)?

- What added value was obtained from the programs?
- Regarding implementation and additional services provided by the programs, what has worked well and what has not? What are the reasons for this?
- What were the impact mechanisms in terms of successful program services?
- How well did the programs support each other? Were their synergies recognized and utilized?
- What critical bottlenecks or obstacles were faced?
- What were the most successful case examples?

As the programs ended at different times, the evaluation consists of both final evaluation and ex post evaluation type approaches. In the final evaluation, emphasis was placed more strongly on how the program processes and program concepts have worked and how the program actions should be strategically developed. Results and short-term impacts could also be observed. When evaluating the impacts of these programs, one important aspect was to recognize the mechanisms behind the impacts, identify the anticipated long-term impacts and assess their importance and value. The ex-post evaluation focused more on the programs' long-term effects, by evaluating, after a sufficient period of time, the impacts of the funded projects and the impacts of the other actions taken in the programs. Long-term analyses allowed the programs to be

evaluated by using methods that will reveal the impacts the programs have from a present-day perspective.

Though all the programs have been analyzed separately, the summaries and conclusions were compiled at the program group level. These program groups are as follows:

- The forerunner programs (ex post evaluation): Giga (2005–2010), Vamos (2005–2010), Embedded ICT (2007–2013), Trial (2011–2014) and BioIT (2013–2014)
- Simultaneously started programs (final evaluation and concerted action evaluation): 5th Gear (2014–2019), Industrial Internet, (2014–2019) and Bits of Health (2014–2018)
- Export and invest in -programs (final evaluation): Connectivity from Finland (2015–2017), Industrial Internet (2015–2019) and eCommerce Growth (2016–2019) together with the invest-in program Datacenter 3.0 (2015–2017)
- Connected Intelligent Industries Finland (CIIF) -program (2018–2019) (final evaluation)

The final goal of the evaluation was to produce a set of conclusions in relation to the questions posed above and to provide concrete recommendations on how digitalization should be advanced by Business Finland in the future; how the program processes, program concepts and

program implementation should be developed in the future and how the R&D&I-actions should be strategically developed.

The evaluation was carried out using several different research methods. The final results and conclusions of the evaluation are based on a holistic interpretation of the different data. The emphasis in the ex-post evaluation has been the analysis on the previous evaluations, supplementary interviews, statistical company level analysis and case-studies. In the final evaluations a wider range of methods and materials have been used to collect primary data, as there was no previous evaluations on these programs.

The methods and data used included:

Document analysis: Analysis of the program documents provided by Business Finland and other relevant materials concerning the operative environment were carried out. The analysis data was collected in analysis matrices formed in accordance with the research questions. Based on the document analysis, a preliminary understanding of the programs in relation to the research questions was formed.

Thematic interviews: A total of 22 interviews were undertaken in order to gain more detailed insight into the programs, digitalization trends and operating environment. The interviewees were program executives, experts

responsible for the promotion of the digitalization theme in Business Finland and other experts in the area of digitalization. The main topics in the program executive interviews were the relevance of the programs, the success of the implementation, results and impacts and added value. Other interviews focused more on questions of the global and domestic development of digitalization, the strategic relevance of the programs and the added value of the programs as well as the improvement needs in relation to advancing digitalization strategically.

Electronic questionnaires: Three different questionnaires were designed and conducted, all of which were transmitted to the target groups of the simultaneously started programs and export- and invest in -programs. The questionnaires were implemented during February and March, 2021. Questionnaire data was collected relating to the implementation, results, impacts and added value of the programs. The questionnaires can be outlined as follows:

- The first questionnaire was targeted at those companies that had carried out projects in the simultaneously started programs. 66 answers were received from 497 potential respondents (497 potential respondents representing 316 different companies).
- The second questionnaire was targeted at the research organizations and other organizations that

had carried out projects in the simultaneously started programs. 56 answers were received from 308 potential respondents (308 potential respondents representing 40 different organizations).

- Third questionnaire was targeted to the companies that had participated in the activities taken in the growth programs. 16 answers were received from 145 potential respondents.

Descriptive statistical analysis: Business Finland's extensive project and funding data was analyzed using descriptive statistical methods to deepen the understanding of the evaluated programs and projects implemented. In addition, the data was also analyzed as background research for the econometric analysis.

Case-studies: Case studies were carried out to describe in greater detail the impact-mechanisms of the programs. These impacts often emerge through complex and multi-stage processes, that often cannot be fully detected by quantitative methods and data analysis alone. Special emphasis was placed on depicting the impacts that were created in project continuums under several different programs. In addition, it was also important to identify the most effective program services and good practices in order to deepen understanding of why they worked. 9 case studies were completed with 9 associated interviews.

Econometric analysis: Special emphasis was placed in this evaluation on the statistical analysis, using control groups, control samples and econometrically-based statistical methods. Statistical impact analysis was also used to shed light on whether the programs have impacted the growth and performance of participating firms, when compared to similar type of firms that did not participate in the programs. The approach here was based on counterfactual method and treatment-effect analysis. A more detailed description of the methods and data used, as well as the results of the analysis, is presented in chapter 6.

Workshop: Preliminary conclusions on the research questions and recommendations, formed in previous work stages, were finalized and validated in a workshop on 22nd March 2021. The workshop was attended by Business Finland program executives and other experts in the field of digitalization.

An interim report was written in January 2021 outlining the key findings of the work at that time. The final report was completed at the end of March, presenting the final results of the evaluation. The evaluation was supervised by a steering group of Business Finland experts, who provided important additional information and insights which helped in the final production of the evaluation. The evaluation was carried out between November 2020 and March 2021.

3 OPERATING ENVIRONMENT AND OVERVIEW OF THE PROGRAMS ADVANCING DIGITALIZATION

In this chapter we will briefly describe the context in which the evaluated programs were implemented. The scope of the evaluated programs encompasses such a wide range of business, innovation and economic objectives in the field of ICT and digital development that the contextual lenses for key phenomena have to be kept rather general. These different phenomena can include various levels, such as:

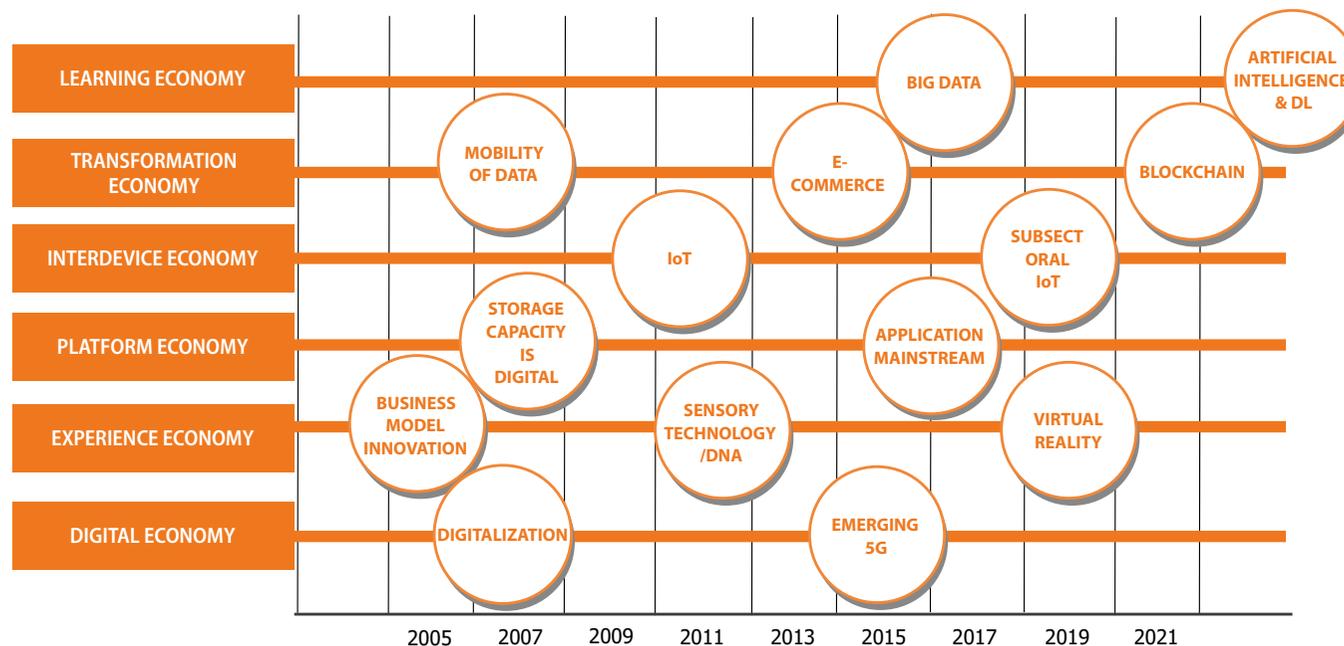
1. Technological transformation within the technological innovation sub-sector
2. The development of business models and environments within different fields of the participant programs
3. Societal development and awareness of the international potential of emerging fields within the above-mentioned areas

From the societal perspective the operative environment relates to different discourses about how the technologies and their applications are utilized as part of the daily lives of their users leading also to demand for the

businesses and infrastructure behind them. We call these “economies” in this sense. The following figure (Fig. 1) illustrates both of these as well as the approximate emergence of the key technologies.

The implementation period of the evaluated programs has been highlighted in the discussions on the **digital economy** relating to digitalization and its basic building blocks. From the mid 2010’s onwards, the emerging 5G discussion, featured already in previous Tekes’ programs was imminent. One interesting example and an early sign of wider digitalization dates back before 2005 when, in 2002, digital information storage surpassed non-digital for the first time and electronic payments in the head-market in the U.S. surpassed the use of cash and checks for the first time, providing a key opportunity to advance the **platform** economy. Many public assets also started to be digitalized at this time. For example, during this period, Google started to digitalize the main U.S. libraries. From a technological perspective, this meant both a demand for and the emergence of new technologies. The evaluat-

FIGURE 1. Operative environment and the different “economies”.



ed programs to some extent at least built on this foundation. To function efficiently, the **transformation economy** needed basic data mobility and the infrastructure of faster mobile networks and mobile storage capacities to enhance it, the emergence of the cloud and ubiquitous technologies supported this. From the **experience**

economy perspective, business model innovation began during 2005 with Osterwalden’s business model canvas¹ being a prime example of this development. From an ICT perspective, this led to new possibilities for telecom and ICT companies in understanding their role as part of the value chain.

¹ e.g. Osterwalder, Alexander (2004). The Business Model Ontology: A Proposition In A Design Science Approach (Ph.D. thesis). Lausanne: University of Lausanne.

If, however we look at evaluated programs, specifically their objectives and key issues, during their implementation more closely we can clearly distinguish several key trends *within the context of these programs*. These trends, the evaluated programs and their objectives are described below in figure 2.

The first programs launched by Tekes were focused on building the basis for wireless broadband technologies and on developing ICT and IoT solutions for wider use. During the period in which these programs were ongoing, 3G network technologies were dominant although 4G network technologies and mobile internet technologies were starting to emerge. At the same time, mobile applications and solutions were seen as representing an important opportunity to develop business in different industry sectors, offering business opportunities for application designers. Enabled by the mobile internet, the embedded internet was also seen as an important future theme.

In the late 2010s, new advances in sensory technology were made and the programs play a key part in this development. In recent years, one of the key emerging phenomena has been virtual reality, again the evaluated programs provided the enabler technologies for many of these developments. Usage of different applications became mainstream and the Internet of Things discussion also began to emerge at this time. Online advertising

(\$26 billion) in the United States also surpassed newspaper advertising (\$22.8 billion) for the first time. In terms of the transformational economy, we saw the first real steps in respect of eCommerce and in 2011 Amazon.com for the first time sold more Kindle books than print book and in late 2012 annual ecommerce sales topped \$1 trillion worldwide for the first time. Given these developments, we could argue that the work done in the evaluated programs was not ground-breaking but rather an attempt to “jump aboard an already moving train”. The 2010s also saw significant advances in terms of data analytics and the use of big data which was needed to develop embedded ICT solutions, smart mobility and 5G network technology each of which started to emerge more strongly.

In 2015, a McKinsey Global Institute (MGI) report², we find the first major attempt to measure the ongoing digitization of the U.S. economy at the sector level. The report introduces the MGI Industry Digitization Index which combines dozens of indicators to provide a comprehensive picture of where and how companies are building digital assets, expanding digital usage and creating a more digital workforce. In this report the need for digitalization in traditional industries and themes already present in the industrial internet program are still stressed, suggesting that these programs were well ahead of their

² McKinsey&Company (2015) McKinsey Global Institute: DIGITAL AMERICA: A TALE OF THE HAVES AND HAVE-MORES. December 2015. McKinsey&Company.

FIGURE 2. Programs in the context of the changing operative environment (from the perspective of the rising major digitalization themes).

Rise and mainstreaming of digitalisation themes

sustainable development climate change population aging networks digitalisation changing economic systems

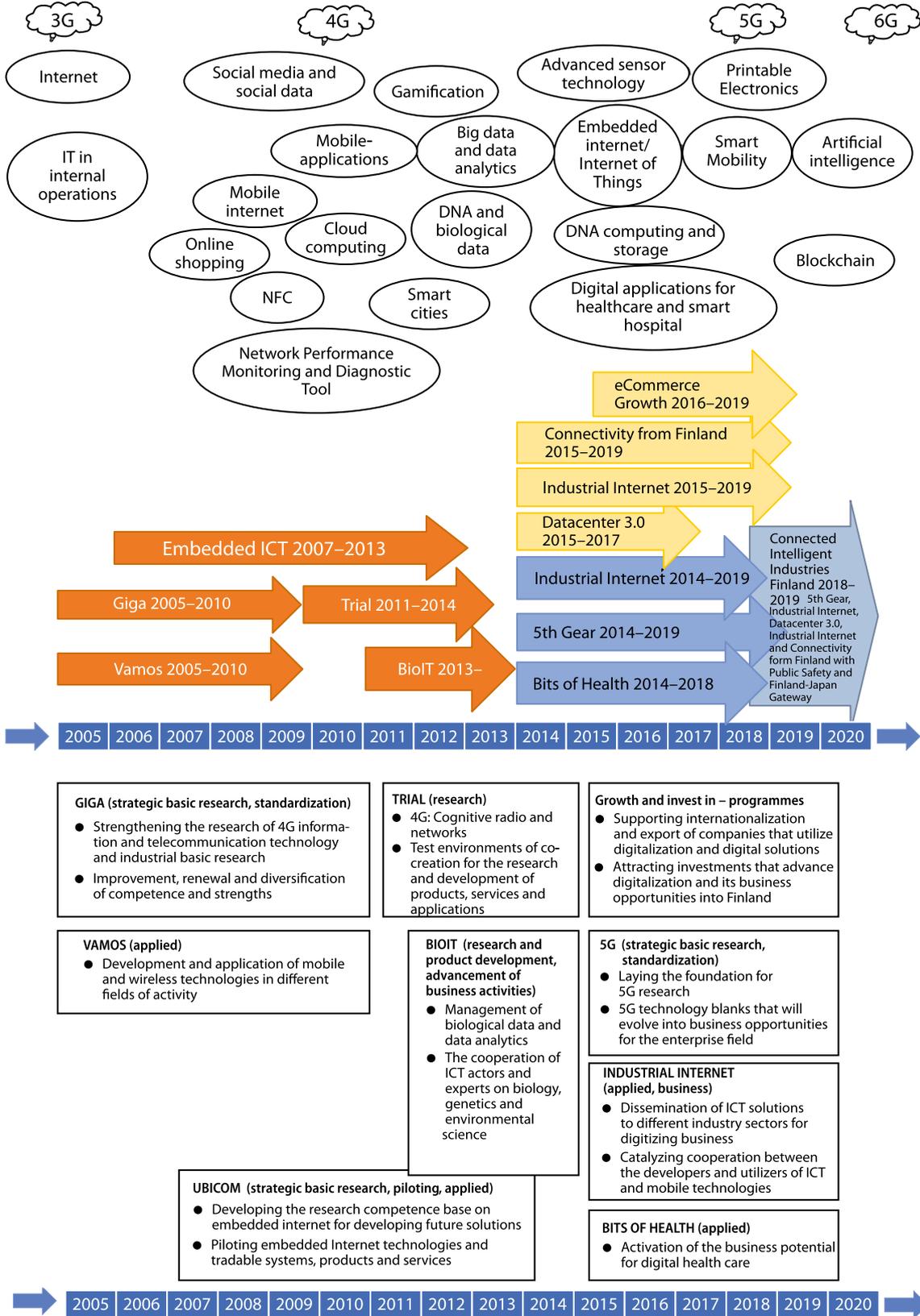
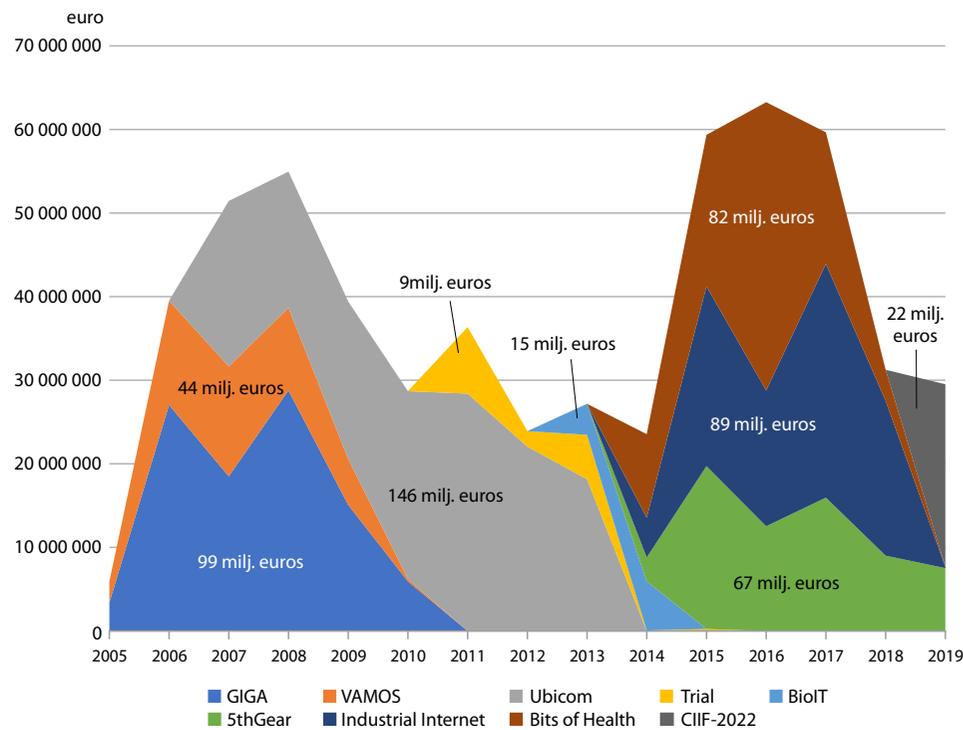


FIGURE 3. Distribution of project funding over different years in different programs.

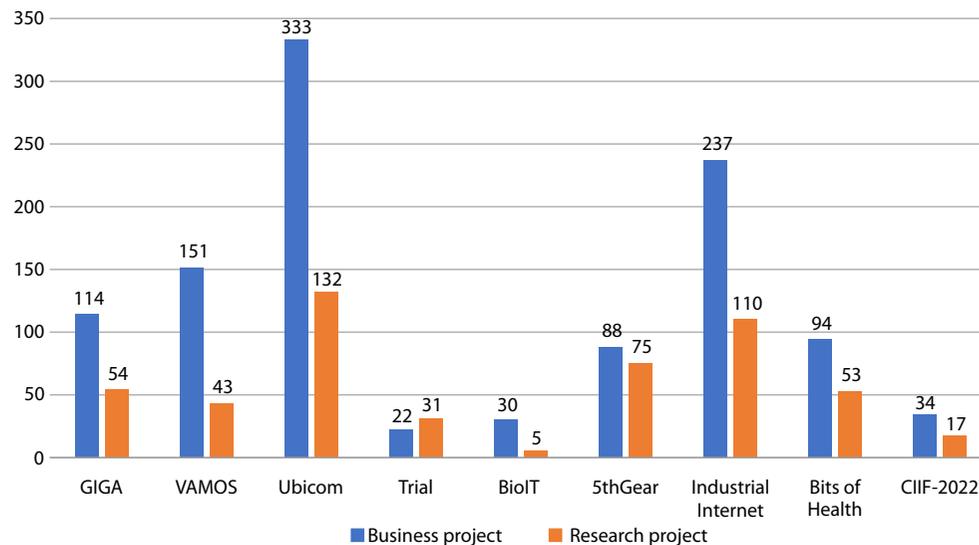


times. By the mid-2010s, daily usage of the digital infrastructure was so high that it created a demand for the different sectors of the telecoms and ICT industries to become a central part of daily life, putting in place the core elements of today's platform economy. For example,

every minute Twitter users send 347,222 tweets, YouTube users upload 300 hours of new videos, Pinterest users pin 9,722 images, Netflix subscribers' stream 77,160 hours of video, Snapchat users share 284,722 snaps and Facebook users like 4,166,667 posts. During last five years, as the technologies already researched become more affordable, the discussion around the Internet of Things evolved with new applications such as the internet of medical things. The discussion over big data was concretized into applications worldwide, while business and artificial intelligence starts to emerge as leaders of the current discussion over the utilization of deep learning and blockchain as part of day-to-day business.

In the context of the operational environment described above, Business Finland and its predecessors Tekes and Finpro have implemented a number of different programs related to digitalization in Finland, of which 13 were evaluated in this evaluation. Of these, nine were technology and innovation-driven programs launched by Tekes, the remaining ones being programs advancing exports. Especially Tekes programs have sought to anticipate future digitalization developments and provide funding and services to companies and research organizations. Companies and research organizations have carried out strategically-focused, basic industrial research, applied research, experiments and pilots, as well as technological application and commercialization activities in the context of these programs.

FIGURE 4. The number of projects in different programs.



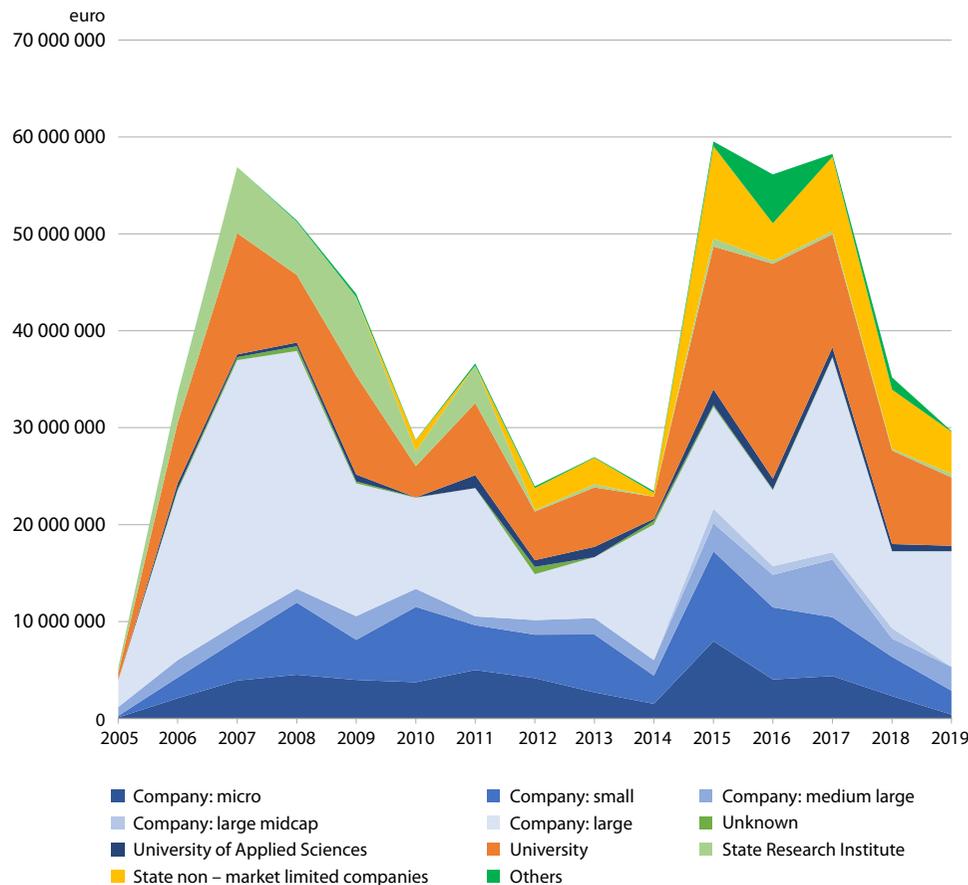
Altogether some 550 million euros have been channeled through the Tekes-launched programs to project implementers during the period 2005–2019 (Figure 3). These programs have been of different sizes in terms of both the number of projects and funding volumes. The largest program in terms of project funding was Ubicom (146 million euros) while the smallest was BioIT (under 10 million euros). At its peak, the total funding volume of the programs was over 50 million euros per year in 2007–2008 and around 60 million per year in 2015–

2017. During these years, several programs were in their most active operational phase and thus the amount of project funding channeled to them reflected this. Less funding was disbursed by the programs between 2010 and 2014. It should be noted however that companies and research organizations received other Business Finland funding during that period, that may also have promoted digitization (e.g. funding from other programs advancing digitalization and non-program funding). For example, via the evaluated programs, the funded companies received, on average, around 20–40% of their total annual funding received from Business Finland.

With their more business-oriented focus, Ubicom and Industrial internet have clearly been the largest programs by project volume, while research-oriented Trial and sector-specific business-oriented BioIT had far fewer projects. The evaluated programs have also had different types of emphasis placed on them depending on whether they were focused on research or business projects. For example, Vamos and BioIT were more strongly oriented towards business/company-focused projects whereas Trial and 5th Gear were clearly oriented towards research projects. All programs have however included both types of projects.

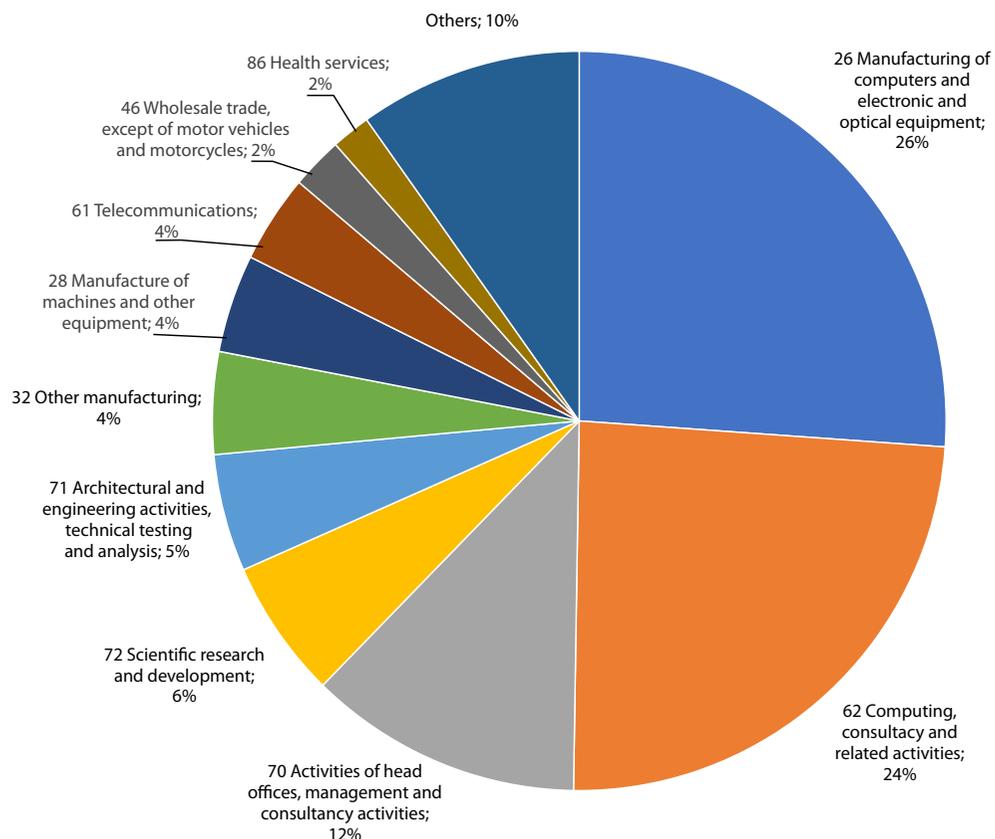
Most of the funding has been allocated to companies, almost 2/3 of the total funding. Companies have also implemented more projects than any other type of financing recipient. The biggest funding recipients were large com-

FIGURE 5. The amount of annual funding that different types of organizations have received from the programs.



panies who received around 20–50% of the annual funding disbursed by the evaluated programs. Their preponderance, in terms of funding received, was particularly strong during the period 2006–2008 when the Giga, Vamos and Ubicom programs were all running. Smaller companies are however also significant recipients of program funding, receiving around 20–40% of total annual funding. The third most important funding recipients are the universities who received around 10–30% of the available funding annually. On average then, less than a quarter of total funding has been allocated to universities and universities of applied sciences. Funding to universities, universities of applied sciences and state research institutes did however peak around 2015 and after. On the whole, the role of large companies as recipients of funding was slightly greater in the first programs, while in the newer programs the role of universities has been emphasized more. On an individual program basis however the role of universities and state research institutes seems to have been slightly higher in the early years of several programs, while the company role grew stronger in later years. This suggests that in the initial years of program funding several programs focused more on research activities while in later years they switched funding to more applied activities. On average, projects with a slightly larger funding volume have been implemented by state non-market limited companies as well as universities.

FIGURE 6. Share of the funding different industrial sectors have received from the evaluated programs.



Of the funding companies have received from the evaluated programs approximately half was directed to two TOL 2 number industry sectors. These sectors are ‘Manufacturing of computers and electronic and optical equipment’ and ‘Computing, consultancy and related activities’. These can be viewed as industry sectors that actually develop digital solutions rather than simply utilizing them. On the whole, it can be estimated that just over half of the funding disbursed has gone to industries like these. The balance was allocated to industries where the emphasis is more strongly placed on the utilization of digital solutions. According to the evaluation’s survey of those companies that had received funding from recently ended programs, most said that they both develop and utilize digital solutions. Taken as a whole, funding has been allocated to 48 different TOL 2-digit industry sectors.

Growth programs launched by Finpro have offered export and internationalization services for the participating companies, but not direct funding. These programs have tried to support Finnish companies through export promotion trips, networking services and information in order to help them reach the international markets. Furthermore, invest in programs have attracted foreign investment to Finland. 6 million euros have been used in the implementation of these programs with over 160 companies participating.

4 FORERUNNER PROGRAMS (2005–2014)

The forerunner programs discussed here include the three earlier programs, Giga, Vamos and Ubicom as well as two smaller and shorter programs, Trial and BioIT. These five programs were implemented during the period 2005–2014. The main evaluation themes here were

relevance, long term impacts and added value. A company level statistical impact analysis, focusing on the companies in these programs was carried out as part of the evaluation and its results are presented in Chapter 6.

GIGA	
Implementation period	2005–2010
Main goals	<ul style="list-style-type: none"> – Strengthening the research and basic industrial research of wireless 4G telecommunications technology – Development, renewal and diversification of competencies and strengths
Funding (Business Finland / total funding)	99 million euros/280 million euros
Number of projects	168 projects
VAMOS	
Implementation period	2005–2010
Main goals	<ul style="list-style-type: none"> – Development and application of mobile and wireless technologies for various industries – Main focus industry sectors: logistics and transport, construction and real estate, manufacturing industry and business services
Funding (Business Finland / in total)	44 million euros / 93 million euros
Number of projects	194 projects



UBICOM/EMBEDDED ICT	
Implementation period	2007–2013
Main goals	<ul style="list-style-type: none"> – Developing a research knowledge base for the Embedded Internet for the development of future solutions – Piloting embedded Internet technologies and commercialisable systems, products and services
Funding (Business Finland / total funding)	146 million euros / over 330 million euros
Number of projects	465 projects
TRIAL	
Implementation period	2011–2014
Main goals	<ul style="list-style-type: none"> – Development of cognitive radio and networks – Creating co-development test environments for product and service research and development – Making sure that Finland stays at the top in this technology theme
Funding (Business Finland / total funding)	15 million euros / 34 million euros
Number of projects	53 projects
BIOIT	
Implementation period	2013–2014
Main goals	<ul style="list-style-type: none"> – Development of biological data management and data analytics and promotion of related business – Promoting cooperation between ICT actors and experts in biology, genetics, the environment and environmental sciences
Funding (Business Finland / total funding)	9 million euros / 17 million euros
Number of projects	35 projects

RELEVANCE

The forerunner programs were implemented during a period when digitalization and ICT-technology development was rapid and several technological leaps either took place or were envisaged. These digitalization development factors included evolving mobile technologies, mobile applications, online shopping and social media and the introduction of 4G mobile technologies into wider usage. Moreover, the strengthening of future technological developments and markets were, to some extent, already detectable. These included embedded ICT, new smart devices, advanced applications, advanced sensor technologies and more advanced data-analytic systems. At the same time, the 2007–2008 financial crisis took place, influencing economies around the world.

During the decade before the forerunner programs were developed, the major factor in the success of the Finnish tech industry was Nokia. This also influenced the first programs which were, to a large extent, built around the Nokia cluster (Nokia with sub-contractors and collaborating research organizations). When the forerunner programs commenced, Nokia was still the leading mobile phone manufacturer and developer, but its status was to rapidly change, as foreign manufacturers and developers won over global markets with new smartphones, operating systems and applications. This also started to change the focus of Nokia's business plan from mobile phones

to telecommunications networks which was ultimately to have a significant influence on Nokia's sub-contracting networks.

In the forerunner programs, technological developments and breakthroughs were quickly identified with the programs also anticipating future developments quite successfully. In addition, the roles of the programs, specifically, in relation to each other, were appropriate. Giga was, primarily, a research-based program focusing on the basic technologies required for 4G telecommunication networks. The program was important as it formed a basis for the following decade's utilization of 4G networks. Vamos was implemented alongside Giga and had a stronger emphasis on the application development and utilization of mobile applications across various industry sectors. Ubicom focused on the research, piloting and testing of IoT solutions. Together, these initial programs, tackled the most important digitalization themes during their implementation period and formed the basis for the identification of future needs in this era.

At the same time as the forerunner programs were running, Business Finland was also actively involved in the development and implementation of parallel mechanisms advancing digitalization which were closely linked to these program activities. These mechanisms, for example, included the SHOK companies (Strategic Centres for Science, Technology and Innovation) which became operational in 2008. SHOK's arose from the findings

within the Business Finland programs and from the need to enhance closer business-to-business and business-to-research organizations cooperation. SHOK as a co-development and cooperation model, implemented alongside the main program activities, had a number of positive impacts on the implementation of the programs. On the other hand, they also made it more difficult to advance digitalization comprehensively within the program instrument because the SHOK's formed another development instrument alongside the programs.

These programs also represent a clear continuation of previous programs and have continued the technological development path their predecessor programs outlined and promoted. In particular Giga, but also Vamos, were follow-up by the NETS-program which focused on 3G networks and applications. At the end of the NETS program, a decision was made to continue to promote digitalization in two further but separate programs. These took digitalization development further toward 4G technologies while also promoting the wider usage of the applications in different industries.

Moreover, it is clear that the Giga and Ubicom programs benefited from a fortuitous 'time window' where

their effectiveness in relation to the operating environment and to the needs of the target group was seen as particularly relevant. As 4G technologies and networks as well as embedded ICT came into wider use in the next decade, Giga and Ubicom were well placed to boost the technology sector and help application users to get ready for future developments. The Giga evaluation pointed out that the program was well placed to address the needs of the operating environment, even though the small size of the domestic market posed some challenges in finding suitable project candidates³. Additionally, in the Ubicom program, the growing need for embedded processors and solutions, ubiquitous computing and an increasing number of devices connected to information networks was well understood while the program responded proactively to emerging developments⁴.

The Vamos program, on the other hand, faced significantly greater challenges in this respect, even though the program was well matched to the needs of the participating companies and the companies themselves were mainly satisfied with the program services⁵. The importance of mobile applications emerged more strongly during the Vamos program period with significant the-

³ Annu Kotiranta, Olli Oosi, Mia Toivanen, Jaakko Valkonen and Mikko Wennberg (2011) *Co-operation to Create Converging and Future Networks – Evaluation of Five Telecommunications Programmes*. Tekes Programme Report 6/2011

⁴ Kimmo Halme, Henri Lahtinen, Martin Fröberg, Anna Zingmark, Christian Haeger, Tarmo Lemola, Jussi Autere and Ilkka Tuomi (2015) *Similar paths, different approaches. Evaluation of the ICT sector programmes in Finland and Sweden*. TEKES REPORT 3/2015

⁵ Tuomas Raivio, Johan Lunabba, Erkka Ryyänen, Juhani Timonen, Markku Antikainen and Santeri Lanér (2012) *Software, mobile solutions and games industry. Evaluation of Tekes software related programmes*. Tekes Programme Report 2/2012

oretical visioning done on their inherent possibilities. The challenge here was centered around the ability and willingness of the target companies to test and deploy solutions which was not sufficient. Another challenge was the lack of a suitable platform for application development (including challenges with the Symbian operating system and particularly in relation to the ongoing development and sophistication of other platforms). Given these factors then the program failed to provide a major boost. Markets and the demand for mobile solutions have however were, subsequently, to show phenomenally strong growth many years after the program concluded.

Two subsequent forerunner programs, Trial and BioIT, were constructed using a much tighter timetable and more limited resources to boost digitalization development in more focused target and application areas. Trial in particular represented something of a continuation of the first programs, particularly Giga. Cognitive networks had already been identified in both NETS and Giga as an important future development target and in Giga this was to be one of the four featured theme areas. Investments in cognitive radio span multiple programs where the demand for more advanced development work was clear. As the need for cognitive networks grew during the Giga program, a clear need emerged for an entirely new program focused exclusively on cognitive radio. Trial was based on research but also tasked with creating concrete solutions. In this way program was very well placed to

continue the previous work done and to take it closer to producing applications. The Trial program responded well to the growth of wireless communication and to the need to develop more efficient solutions. The program can be seen as the endpoint for 4G technology development in Business Finland programs and at the same as the transition point to 5G development.

The BioIT program was implemented during a period when the amount of biological data available grew at a tremendous rate and the need for and ability to process and interpret this data required significant development. This need generated tremendous business and research opportunities. The BioIT program focused on strengthening the development of the biodata processing sector and on promoting the growth of related business. As development of this sector was in its infancy, BioIT was actually well placed to support sector growth and to help it network more effectively with and into the ICT sector. For later programs, BioIT acted as a trigger for the development of digital technologies in the bio- and health sector with the program being recognized as an important promoter of further digitization in the bio sector. The short implementation period of the BioIT program was deliberate (it was designed to work by providing a sharp initial push to sector development followed by a bigger program), but it also created challenges in respect of the effectiveness of the program. In two years, the program was up and running, but this meant it only had a lim-

ited ability to generate longer, more profound impacts. For this reason, it was seen as important that the actions launched in relation to the BioIT program were continued in the newer programs.

The first three programs (Ubicom, Giga and Vamos) represented, in their time, a distinctive large-scale and wide-ranging public investment in digitalization development and application in Finland. These programs were also, for the most part, relevant in relation to the needs of the actors involved in telecommunications technology and mobile solutions. The other two programs were formed more specifically to address the needs of their technology and industry sectors and responded well to the needs of the operational environment and the relevant actors. Each program was also successful in outlining the key future development paths.

The programs were also able to respond quite well to the changes and technological breakthroughs that took place during their implementation periods. Although the timing of the programs has been good, for some programs an even more proactive start could have further added to the development of the sector when compared to competing countries.

LONG-TERM IMPACTS AND ADDED VALUE

Now, some ten years after the first forerunner programs ended and six years since the last forerunner programs

were finalized, would seem to be an appropriate time to identify the long-term impacts of these programs and the added value in terms of the development of digitalization in Finland. What makes these interpretations challenging is that all of the results and impacts have to be analyzed in the context of the time during which the programs were implemented. The challenge is also to identify the individual effects of the programs and separate these effects from other developments arising from changes in the operating environment. Note should also be taken of the impacts on those programs under evaluation of both the preceding and following programs and the synergies created between them.

The first three programs had a broader focus and their desired impacts were expected to emerge comprehensively in the advancement of technologies, wider knowledge and understanding of technologies and in various impacts across several industry sectors. In the two later programs the expected impacts were more limited to a specific technology and industry sector, but in time, their influence was expected to grow.

In the Giga program, significant individual outcomes generating wider impacts included, for example, internationally recognized results in cognitive radio, business creation based on academic research, standardization and patents, especially in the field of future wireless technologies. In the case of Vamos, improved knowledge in respect of the capability of Finnish companies to uti-

lize mobile technology was attained and technology developers and utilisers (especially from the logistics and transportation sectors) were better connected, in some cases quite fruitfully. In terms of Ubicom, knowledge and understanding in respect of IoT and technology (Bluetooth, IoT device networks, etc.) was improved and further developed to better address future needs. In relation to Trial, cognitive radio technology was further developed and significant results were achieved for example in creating co-development platforms, standardization and new solutions. BioIT was also especially important in helping to create business opportunities for companies involved in and advancing the formation of the bioanalytics sector in Finland.

The role of bigger Finnish telecommunications companies was important in many of the forerunner programs. Program funding has enabled them to execute higher risk projects in applied research. Many impacts and benefits can be seen in their businesses in terms of new patents, new knowledge and more advanced cooperation with research organizations and SMEs because of this. Furthermore, research organizations have also been able to carry out the type of strategic industrial research that has helped introduce new commercially exploitable research information to a range of different actors. This has helped to plot the direction of digitalization development and highlight business opportunities for companies of various sizes.

In terms of direct program effects, the following can be identified:

- improved knowledge of new technologies
- increased cooperation between companies of different sizes and the formation of value networks
- stronger cooperation between research organizations and companies
- strengthening the culture of joint projects and co-development between different actors
- effects on business growth (of new solutions, products, the deployment of applications, intangible capital (patents))
- improved competence of actors and the better relevance of know-how in relation to the needs of digitalization development
- formation of new competence / value networks
- influencing the direction of technology development (standards)
- clarifying the direction and common vision of the future technological development and adaptation to it

International co-operation (for instance Artemis) and the utilization of international funding also played an important role in these programs. Through these international networks, technological information from around the world was obtained thus influencing the ongoing R&D&I-work in Finland and at the same time enhancing long-

term international cooperation. These programs also laid the foundations for subsequent programs particularly in relation to international cooperation and funding.

From a long-term perspective, the importance of the evaluated programs is underlined by the fact that they have been implemented during major ongoing or expected technological turning points. These turning points and future developments emanating from them were identified in the forerunner programs with measures subsequently targeted at the right things. These programs have been particularly important in that they have brought important Finnish actors (big companies, universities, research institutions) together in order to better determine the direction in which Finland should invest in relation to digitalization. The programs have helped to define how to react to future needs and how to direct digitalization development.

These programmes provided a significant boost to the telecommunications technology and mobile solutions sectors and to the ability of Finnish actors to keep up with expected developments globally. The forerunner programmes undoubtedly improved knowledge and un-

derstanding of future digitalisation developments, preparing Finnish actors for change in these areas. Without these programmes, it is estimated that, in relation to many digital technologies, Finnish actors in general would not have been able to keep up with the rapid pace of digitalisation development as well as they did.

The forerunner programs weren't so successful in spreading the benefits of digitalization more widely to different target industry sectors and promoting the use of mobile applications in these industries. Especially in this respect new innovations were created in only limited numbers.

The forerunner programs also formed the foundation for the following programs. This can be seen in the continuation of the development work from forerunner into the newer programs. Clear development paths can be traced from Giga to Trial and subsequently to the 5th Gear and Industrial Internet programs. In addition, there is clearly also a link from BioIT to the following larger program, Bits of Health. From UbiCom and Vamos however the paths are more fragmented leading into several programs, but most obviously to Industrial Internet.

Wirepas Oy Successful R&D and commercialization -project continuum from forerunner programs to recently ended programs

Wirepas is a company focusing on the development and provision of IoT connectivity technologies to its customers. Established in 2010, with its head office in Tampere. The company is based on research and development work carried out at Tampere University of Technology. Its main technological solution is the Wirepas Mesh network which is an IoT network protocol that can be used in several different application fields. Today, the company operates in several countries and has received significant private funding for business development. It has, to date, over a hundred customers. In Finland, the company employs more than 40 people.

Wirepas has implemented projects in several different programs. These programs include Ubicom, Industrial Internet, 5th Gear and the growth program, Industrial Internet. In Ubicom, the company was still in its formative stages. Its R&D project in the program was carried out to develop the company's technology and bring it closer to the commercialization stage. As a result of the project, commercial activities based on licenses could be launched and the company got its first important customers. Subsequent projects were carried out in the context of the Industrial Internet programs (technology and growth programs). These projects aimed at scaling the technology for wider use and improving the technology to meet the needs of potential international customers. Business Finland funding encouraged the company to expand its business to other countries, gaining proof

of concept for its technology and enabling it to invest in sales organization and in working in other countries. These projects were very important for Wirepas in terms of getting new contacts and gaining a foothold in international markets. In the project carried out in the 5th Gear program, important steps were taken to improve the technology taking it to a new level, using the 5G test network (5GTNF). This was a joint project involving large companies and research organizations. The technology was developed to a point that allowed a new 5G standard to be created based on it. To achieve this, it was important that the project involved large actors who were able to influence the standardization process. New patent applications were also filed. Ultimately, the company is now in a very good competitive position in international 5G technology-based markets because of this project.

These projects and the funding received from BF have thus clearly played an important role in the development of the company. In the first project funding was obtained at a time when it was challenging to source it elsewhere. Funding with Business Finland's expert support, helped the company to promote its technological development project bringing it closer to the commercial stage. In the other projects, the support for and encouragement to invest in international growth has been important. In the last project the most important aspect of the 5th Gear program was the introduction to the co-development network with the major actors in Finland. ■

VTT advancing digitalization in several programs

VTT Technical Research Centre of Finland Ltd. played a crucial role in programs advancing digitalization and remains an important actor in the Finnish innovation system context. Its basic task is to produce applicable and relevant research and provide technology and research services to both domestic and international companies and the public sector. With its expertise, VTT has helped define what types of programs are required in relation to the evolution of the operating environment while helping to shape the content of the programs together with Business Finland and other actors. VTT has also implemented important flagship projects in the programs which have both influenced and paved the way for other projects in the programs. In the programs VTT has played a key role in producing strategic research agendas (SRAs) and roadmaps together with universities and large companies.

Altogether, VTT has implemented over 100 projects in the context of Finland's national technology program during the period 2005–2020. These projects have dealt extensively with various aspects of digitalization. VTT played a significant and indeed a leading role in the programs linked to the SHOK activity, 2010–15. These included IoT, real-time economy, data to intelligence and cyber security. Other major research projects have focused on various areas of mobile technology. In some projects, solutions have been created for specific domain areas like smart mobility, smart cities, industrial automation solutions, IoT and industrial internet, healthcare and smart hospital. In some of the projects, the task has been to coordinate a wider cooperation network.

VTT projects have, for their part, shown the way forward for digitalization in Finland. For example, in the Giga program administered by Business Finland, VTT played a major role in supporting the Finnish telecoms industry and thus helped it to gain a strong position in 4G communications technology. Likewise, in the Business Finland Uvicom program, VTT-led research projects were important in terms of laying the groundwork for future developments in respect of IoT solutions across various application areas. In the Trial program, cognitive radio test pads were developed and research was conducted in collaboration with a number of partners. In the 5th Gear program VTT was an important player in the initiation and coordination of the 5GTNF testbed network. At the same time as 5G technology was developed, VTT's projects provided high profile support to the Finnish telecom industry by means of new technology generation. In the Industrial Internet program, research was conducted in the IoT theme and solutions created. The development of important operating models such as Reboot IoT Factory were thus supported and coordinated. In Bits of Health, new health care solutions were developed and ecosystem development was supported.

As a whole, VTT's projects and activities have formed an important framework for the implementation of several programs. Its activities in these digitalization programs have also been important in guiding the broader vision of development work regarding digitalization in Finland. ■

Abomics Ltd BioIT and Bits of Health project continuum

Abomics is a company focusing on medical research and on creating solutions for the healthcare sector. Its main area of expertise is pharmacogenetics, especially related to the best known 24 genes. Abomics was founded 2013 by pharmaceutical experts in Turku and currently employs 4 people. The idea behind the company was the increasing need to develop digital solutions and automatic services for the healthcare sector, to aid both patients and healthcare personnel. Pharmacogenetic tests can reduce the side effects of drugs and thus the costs resulting from these side effects. The main services of the company are Abomics' PGx interpretation tool which converts raw pharmacogenetic data into an easy-to-understand report that guides physicians in their work, GeneRx database for the use of health care personnel and GeneAccount which maintains patient records and interprets test results. Pharmacogenetic tests can reduce the side effects of drugs and costs resulting from side effects.

The company's development is strongly in line with the digitalization development of the health sector in Finland. The use of digital solutions has expanded at an even greater pace in the health sector over last decade. The first years of the start-up company were a time of quieter growth, but as understanding of the benefits of different types of solutions in the industry sector improved, the company also started to grow.

In the early years of its operations, the company participated in the BioIT program and carried out two projects. These projects were very important for the early stages of its product/service development enabling further development work to take place. In the first project, a database

was gathered using literature analysis and coding, to determine how different genes react to different medicines. Based on this, it was possible to define medication for different needs. The second project was to develop laboratory expert opinion reports. These two projects formed the basis for the future development of the company. Business Finland's funding came at the right time for the company's technological development. The funding enabled research and development work to take place that would not have been possible to the same extent without it.

The third project was conducted in the context of the Bits of Health program and with Young Innovative Companies funding. In this project the emphasis was placed more on commercialization and the export of services to different countries. The company participated in export promotion trips. This project resulted in the company gaining a better understanding of foreign markets and, ultimately, in new contacts. Currently the company focuses more in domestic and Nordic markets, but because of the project, sales in Europe is increasing and the readiness for international growth has improved.

As a whole, activities undertaken in respect of Business Finland's programs have helped the company to develop more strongly during the crucial early development stages. Funding and expert advice has enabled the company to create new services and steer its operations towards the most appropriate directions. A very important benefit of the programs has also been the new contacts and new information gained as well as the publicity received. ■

5 RECENTLY ENDED PROGRAMS (2014–2019)

Recently ended programs were implemented during 2014–2019. They included eight programs. Three innovation and technology programs were launched by Tekes and four growth and invest in programs by Finpro. One program (CIIF 2022) was launched during the transition period when Tekes and Finpro merged into Business Finland. This program represented a broader program concept that brought together several programs launched by Tekes and Finpro.

5.1 SIMULTANEOUSLY STARTED PROGRAMS

In 2014, Tekes launched three programs at the same time, all of which were to be implemented in the same time period (Table, p. 31). These programs focused on different digitalization themes advancing wireless networking technologies, embedded solutions, digital health while also disseminating ICT/IoT-solutions to promote wider use across various industry sectors. The aim of the program concept was to improve the effectiveness of these programs by increasing synergies between them, creating a more coherent whole. This type of planned, con-

certed action was a new type of experiment in developing Business Finland's program instrument.

In addition to the evaluation of the program concept, the implementation, results, impacts and added value of these programs were all evaluated. A company-level statistical impact analysis, of the companies in these programs, was carried out as part of the evaluation. Its results are presented in Chapter 6.

RELEVANCE

These three programs were implemented during a period when 5G technology was in development and was expected to deliver more efficient data transfer and new digital solutions in different application areas. Moreover, Finland already had a number of internationally successful companies utilizing digitalization applications across their businesses. Nevertheless, ICT investments were still lower in Finland when compared to relevant comparison countries (Sweden, USA) while in manufacturing industry the benefits of digitalization were clearly not being utilized as widely as they could be although the use of

5th GEAR	
Implementation period	2014–2019 (from 2018 onwards as part of CIIF -program)
Main goals	<ul style="list-style-type: none"> – Creating a foundation for 5G strategic research – Development of 5G technology ideas that can be refined as business opportunities
Funding (Business Finland / total funding)	67 million euros/ over 100 million euros
Number of projects	163 projects
INDUSTRIAL INTERNET	
Implementation period	2014–2019 (from 2018 onwards as part of CIIF -program)
Main goals	<ul style="list-style-type: none"> – Dissemination of ICT solutions to various industry sectors to digitize business – Catalyzing the collaboration between developers and users of ICT and mobile technologies
Funding (Business Finland / total funding)	89 million euros / over 100 million euros
Number of projects	347 projects
BITS OF HEALTH	
Implementation period	2014–2018
Main goals	– Activating the business potential of digital healthcare
Funding (Business Finland / total funding)	82 million euros / over 100 million euros
Number of projects	147 projects

digital solutions was disseminated more widely across the healthcare sector, delivering more significant opportunities to related businesses.

These simultaneously started programs were mainly relevant in terms of the operating environment and the needs of the target groups. These programs made an effort to disseminate the benefits of digitalization to a wider range of industries while also responding, through the development of research information and know-how, to the emerging technological breakthroughs (primarily 5G technology). Industrial internet focused on disseminating digital telecommunications and mobile technology solutions to various industries and on promoting the utilization of these solutions. The 5th Gear program was more research-based in trying to create the foundation for 5G strategic research, promoting 5G experiments and incubating new solutions while Bits of Health focused more on activating the business potential of digital healthcare.

The Industrial Internet program responded well to the need to promote the digitalization of various industries more widely. Finland's particular challenge has been the slow adoption of the new value creation made possible by digitalization⁶. According to the EU's DESI monitoring, Finland is the EU's digital leader in infrastructure, know-how and public services, but only a middle-level player in the digitalization of business. Developing digital solu-

⁶ Digital Economy and Society Index (DESI), Finland.

tions, making the benefits of digitalization visible and disseminating them to different industries remains an important task in terms of industrial renewal and productivity improvement.

The 5th Gear program was relevant and very necessary program in its time, particularly when considering the ongoing global developments in respect of 5G. Indeed, the launching of a 5G program had already been on the cards for some time. In Asia and the USA, 5G development discussions began as early as the beginning of the 2010s. Launching the Finnish program earlier and more proactively could therefore have made it possible for Finnish players to gain a clearer lead in terms of 5G technology over its international competitors. Notwithstanding this however, the program was nevertheless important, positioning Finland well in terms of the development of 5G technology.

The Bits of Health program commenced quickly after the BioIT program continuing Business Finland's investments in the bio- and health sectors. Compared to BioIT, Bits of Health was a larger and better resourced program promoting digitalization across a much broader thematic scope. The main focus was promoting digital solutions in health care and the growth and internationalization of the digital health business. As Finland already had strong expertise in ICT technology and data processing as well as in the health sector, opportunities were identified to improve performance and business opportunities via

digital solutions. The program was justified in this way on its implementation. The program was linked to the national health sector's growth strategy 2014, on the basis of which it was well connected and positioned in respect to national goals set for sector development. At the same time, the program complemented well the other research and development work that was done in the field by Sitra, the Academy of Finland and others.

SUCCESS OF THE OPERATING METHOD AND IMPLEMENTATION CONCEPT

In launching the programs simultaneously, the goal was to rationalize resources, launching a more focused investment strategy in terms of digitalization, promoting greater synergies between program services, networking between actors from different programs and enabling better technology flow between the programs and the various application areas.

In general, simultaneous implementation proved, in part, to be an effective solution, though the full benefits of the approach were, ultimately, not obtained. The 5th Gear and Industrial Internet programs in particular did however benefit from this approach, as they were implemented in a more tightly synchronized fashion. The Bits of Health program had fewer connections with the other two and therefore did not generate as much benefit from the concept.

Simultaneous implementation clearly also lent strength and increased visibility to the digitalization theme. This was achieved especially in relation to major joint events in which all of the programs were involved. For example, the events organized as part of Reboot Finland, as well as Customer Club seminars, were functional and useful in this regard. Information in respect of different digitalization themes could thus more effectively be disseminated to a wider audience. These events also garnered wider attention as a range of digitalization themes were on the agenda.

The networking of actors from different programs could also be undertaken in a more coordinated and efficient way. As the program representatives already had a good picture of the actors in their own thematic area and joint events between programs were arranged, the various actors could then be brought together more efficiently. Cooperation arose in particular between actors in the 5th Gear and Industrial Internet programs. If the implementation of the programs had been undertaken separately there would probably have been less cooperation between these actors.

At the program management level, cooperation was very close, particularly between those involved in the 5th Gear and Industrial internet programs. This allowed the programs to be implemented synchronously, effectively as a single program package. It was also important that the same experts were involved in the management

teams/steering groups of both 5th Gear and Industrial Internet. These programs could thus be directed in concert with information exchange between the programs occurring almost seamlessly.

The major challenge facing this operating model was the lack of resources available to implement continuing and deeper cooperation between the programs. The promotion of the programs' own thematic areas required the majority of the available human resources rendering it challenging to find time to advance and promote things in cooperation.

Another challenge was that the 5th Gear programs research and development was in the early stages of the innovation process while the other programs were focused on promoting the application of more complete solutions. This meant that technology transfer to the other two programs was challenging as the technology was still in the research and development phase. Moreover, in respect of technology transfers more generally, programs emphasizing the application of technology should clearly be implemented only after the technology is mature enough. It should however be noted that information on the potentials of 5G technology was transferred from 5th Gear to the other programs which in turn ultimately led to wider future impact and benefits.

An additional important aspect here relates to those programs implemented by Finpro during the same period. For all three simultaneously started programs there

were ‘sister programs’ on Finpro’s side with whom close cooperation was established. In essence, this mode of operation piloted the future model for Business Finland. Good forms of cooperation increasingly included joint events, delivering information between programs on potentially ‘commercialisable’ solutions and potential overseas markets. This collaboration also prepared the way for the new CIIF 2022 program.

SUCCESS OF PROGRAM IMPLEMENTATION AND SERVICES

Implementation of the simultaneously started programs has largely progressed according to plan. Some individual challenges have arisen but few major challenges emerged affecting all of the programs.

5th Gear had time-span of 6 years with operations planned for 2-year time periods. Technology development was a priority in the first phase. In the next phase the development and implementation of experiments was the main focus while at the end of the program, a stronger emphasis was placed on technology adoption and application. This kind of programmatic life cycle method represented a good practice approach in terms of program implementation. Most of the projects involved academic partners. The most important operating models here were the 5G experimental environments facilitated by the research partners (5GTNF). In these environments, testing and co-development was carried

between the research organizations and companies, as well as their international partners. New research information was produced but over time the focus shifted in a business-oriented dimension. These environments did however become a good way to produce information and network Finnish actors with each other and with foreign partners.

In Industrial Internet the key goal was the production and dissemination of information on ICT solutions to different actors and industries, promoting networking between technology developers and users thus promoting the wider use of ICT technology in manufacturing industry in particular. The important thing here was to organize events and cooperate with other programs (including Finpro programmes). An example of good practice in the program was support for companies in relation to the preparation of different events where information was shared concerning the supply and demand of various technological solutions. The Reboot Finland IoT ecosystem projects were also a key component of and approach utilized in the program activities. This operating model brought the needs of different actors and technologies together for application purposes.

In Bits of Health, the important factor in the successful implementation of the program was active Team Finland cooperation, especially with Finpro and Sitra. This opened up a number of new possibilities for companies to get involved in relevant networks as well as providing

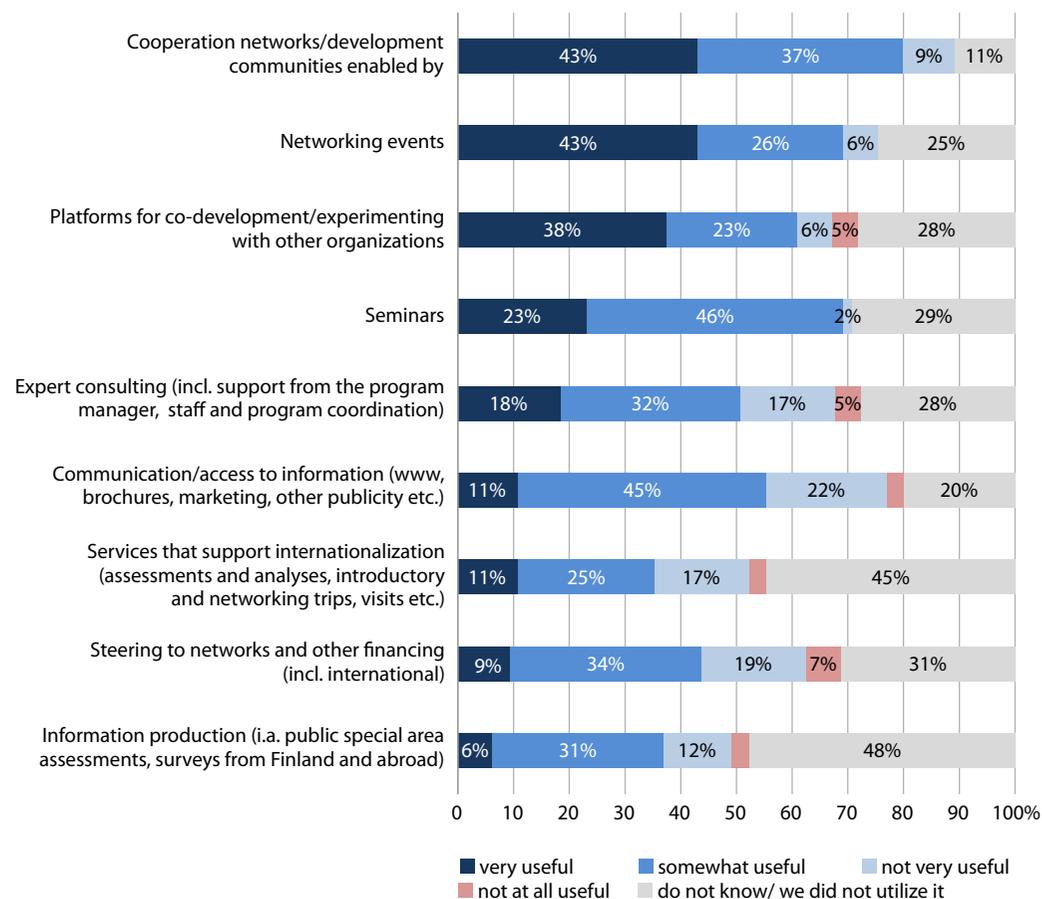
additional opportunities for commercialization. Important services in this regard were for example the export promotion and networking trips to the UK, the USA and the Middle East (Gateway to UK, Gateway to USA etc.). Another important factor here was that the companies and public actors were 'ready' for the program, they participated actively in the program and there was a strong demand for program services. For example, more companies were funded than had originally been planned. A key element of the program was also the Clinical Entrepreneur Finland -concept/pilot. It aimed at creating an operating model where, generated from the needs of development challenges in the health sector (especially in the University hospitals) new, high-quality, business projects could be funded by Business Finland which would eventually lead to the creation of new businesses. Furthermore, an important operation model here was the National testbed network which facilitated and promoted the establishment of a national co-development network, international partnerships (one point of contact for foreign companies) and worked as a test platform in which to develop healthcare innovations bringing together health actors and digital solution developers.

The primary challenge in terms of program implementation related to the limited human resources available, particularly when compared to the resources available in terms of project funding. Programs often have ambitious

goals and vast financial resources available to launch project development work. At the same time, programs are often implemented by only a small number of full-time personnel. Programs usually have an executive person working full-time for the program combined with a few other experts, who support program implementation in addition to their other responsibilities. Although the available funding can trigger significant measures, other types of support are also required in order to fully promote the objectives of the programs. These include, gathering information, arranging events, coordinating different actors and cooperating with domestic and foreign actors relevant to the program. Experience from several programs over time suggests that human resources are often rather limited in relation to the scope of the objectives actually pursued.

Project implementors have, for the most part, been satisfied with the services provided by the programs. The cooperation networks made possible by the programs and the networking opportunities provided by them have been perceived as useful. This is reflected in the responses of both companies and research organizations to the evaluation questionnaire. Cooperation and problem solving with several different actors is considered to be valuable benefit made possible by the programs. Networking events and seminars have also been identified as important, particularly in terms of finding partners and as a chance to learn from others.

FIGURE 7. Views of project managers from companies on the functionality of the programs services (evaluation questionnaire for companies).

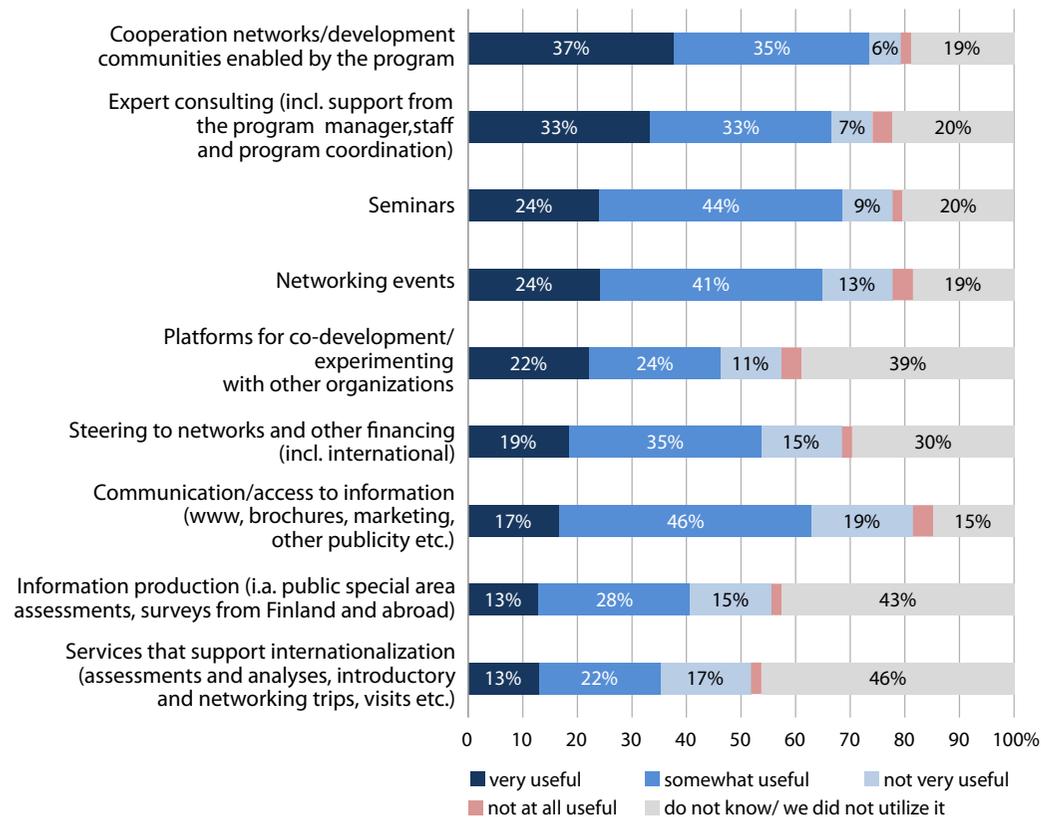


The companies involved also emphasized the significance of co-development platforms and test-beds for their activities. While research organizations also value these, private companies probably gain more in the way of direct benefits from such co-development platforms.

For research organizations as opposed to private companies, the expert support provided by the programs has more often been identified as a valuable benefit of the programs. For example, guidance in project planning has been useful as it has shifted the project focus in a more appropriate direction.

There were few challenges encountered in the program’s implementation. This was clearly highlighted by the questionnaire responses. For various actors in co-development, challenges did however begin to emerge as the development work shifted from basic research to company-specific product and development work. At this point less information is shared for understandable reasons by the companies involved.

FIGURE 8. Views of project managers from research organizations on the functionality of the programs services (evaluation questionnaire for research organizations).



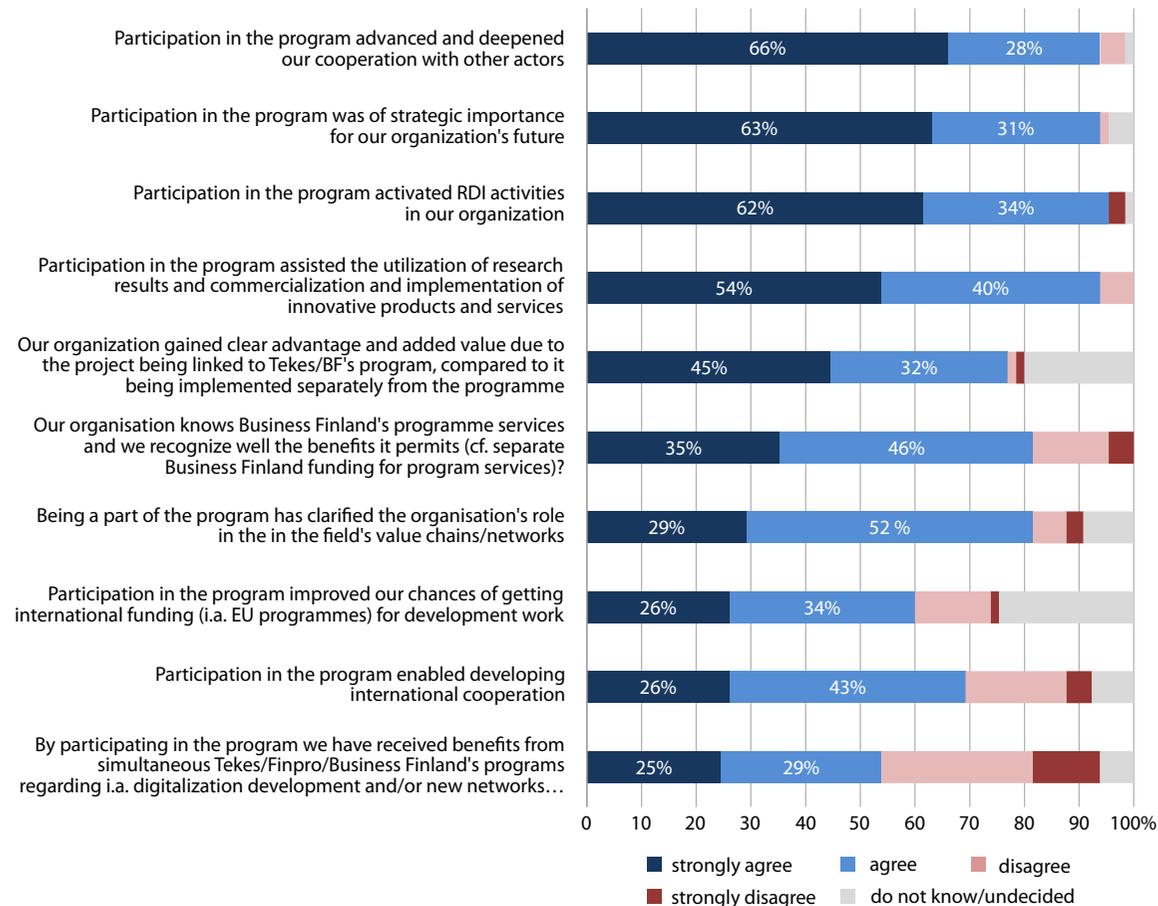
Customer club

Customer club was an operating model implemented as part of the Industrial Internet program. Customer club organized a series of events to which key players and participants from Industrial Internet (both Tekes and Finpro programs), 5th Gear and the Bits of Health programs were invited. In addition, key program stakeholders were also invited to the events. Events were organized during the period 2015–2018.

The main goal of Customer Club was to network different participants and to provide new information related to the topic of digitalization. Participants had a chance to present their own activities and good practices in the use of digitalization. At the same time, expert ‘presentations deepened participants’ understanding of the themes discussed while more detailed information was presented on the program services. Of particular importance here was the desire to provide digitalization developer organizations and users with the opportunity to meet and learn from each other. Customer Club meetings were based around various topics partly related to current issues in the operating environment and partly to the focus areas of different programs. Examples of the topics include, Industrial IoT meets 5G and IoT Forge and Digital Twin.

The main impact of the operating model has been the new information that has been passed to the participants and the new contacts participants have created and developed. In particular, new cooperative links emerged between the customers of the 5th Gear and Industrial Internet programs. ■

FIGURE 9. Impacts and benefits of participating in the programs according to the views of companies (evaluation questionnaire for companies).

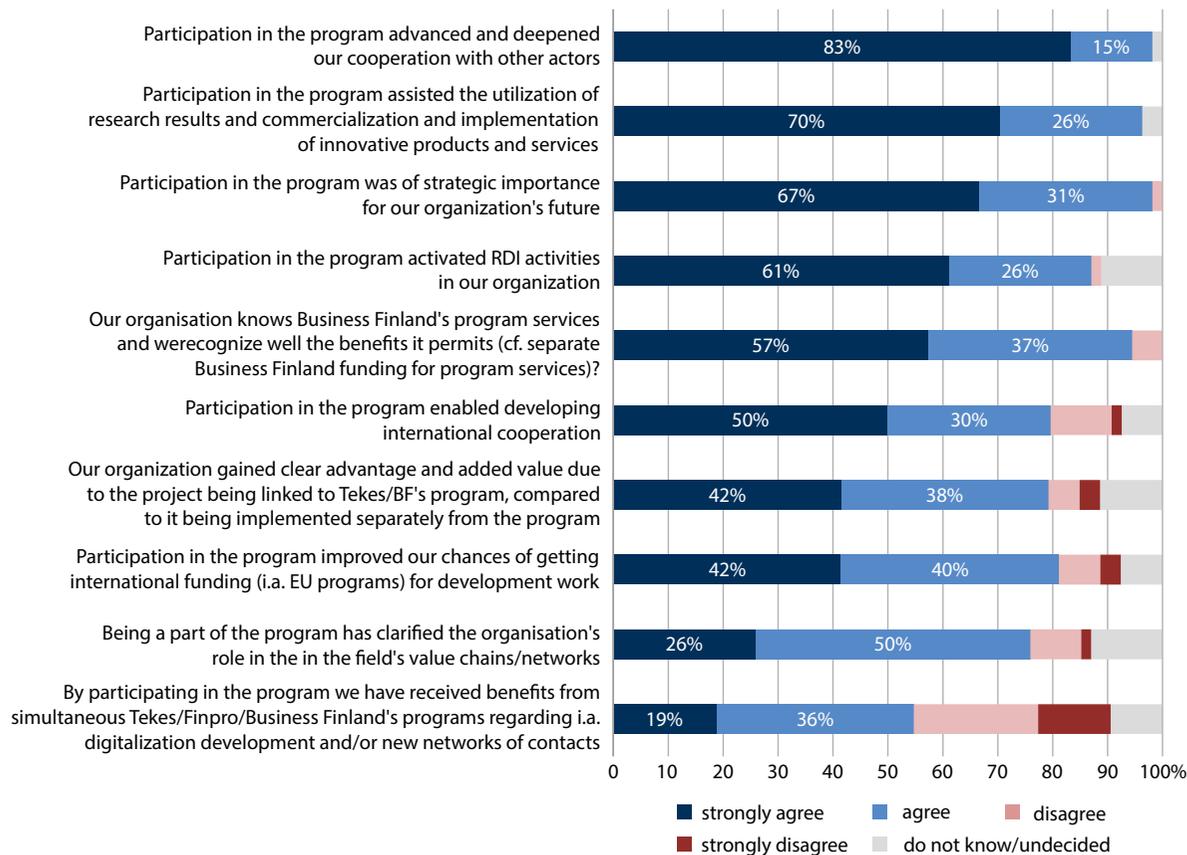


The programs have influenced the participating organizations in many ways. For both companies and research organizations a clear benefit and impact of participating in the programs has been the deepening level of cooperation enjoyed with other key players. The programs have offered a platform for this and supported the formation of cooperation networks.

Many organizations also recognize that the programs have played a strategically important role in terms of future development work. This demonstrates that there is a clear need for the programs and that they have played an important role in the development of digitalization. Furthermore, the programs have clearly influenced and activated R&D-activity in many organizations. They have also played a meaningful role both in utilizing and disseminating research results to a wider audience. According to the results of the questionnaire, the programs have also succeeded in catalyzing development work that might not otherwise be undertaken and have supported the exploitation of project results.

Business Finland programs and the benefits they enable are fully acknowledged among the organizations involved. One notable piece of information emerging from the questionnaire however was that around 40% of respondents from the private companies did not recognize which program they have attended (for research organizations the share of respondents answering in this way

FIGURE 10. Impacts and benefits of participating in the programs according to the views of research organizations (evaluation questionnaire for research organizations).



was 15%). This shows that Business Finland programs are not, perhaps, as widely identified in the target groups as they could be and thus that the potential benefits of the programs probably are not recognized as widely as initially thought. A higher level of recognition would clearly be useful here.

Project implementation has also been largely successful in these programs. In most projects the objectives and the level of technical risk have been relevant and correctly defined when compared to the operating environment. More broadly, this supports the view that the actions taken in line with the program objectives have been relevant to the implementation environment of the programs.

At same time, most of the projects have attained the goals set. Program objectives have also been promoted well in the actions taken in respect of these projects. Overall, challenges seem to have occurred only in a small number of projects. Perhaps the most notable thing here is that about half of the respondents have collaborated with projects in other programs. This shows that some projects have benefitted from other programs running at the same time as originally desired in promoting the concept of simultaneously started programs.

FIGURE 11. Implementation of projects according to the views of the project executives in companies (evaluation questionnaire for companies).

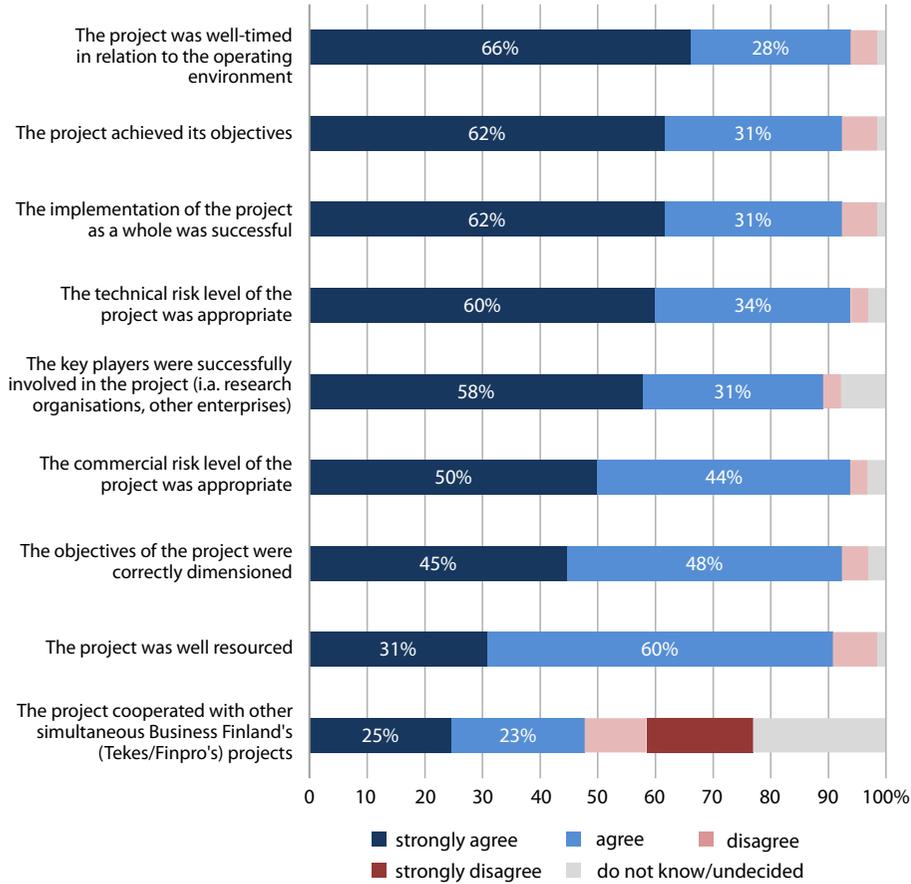


FIGURE 12. Implementation of projects according to the views of the project executives in research organizations (evaluation questionnaire for research organizations).

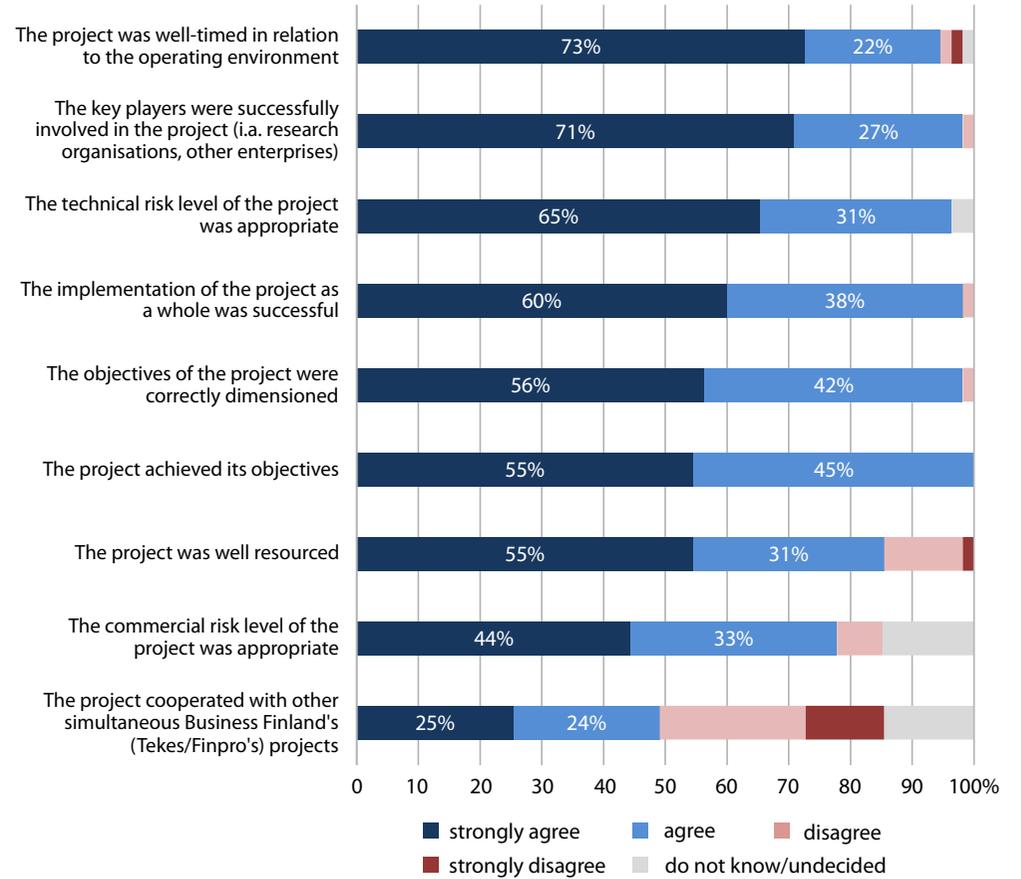
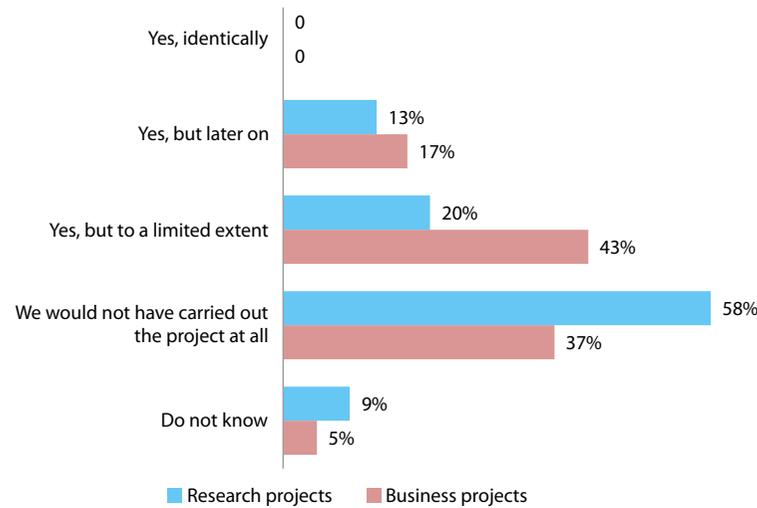
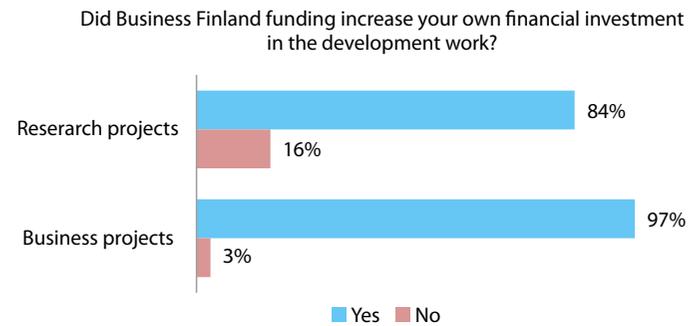


FIGURE 13. Views of the program executives on the significance of Business Finland’s funding for project implementation (evaluation questionnaires for company and research organizations).



The program instrument and funding have clearly activated development work that would not have been executed without them. A significant number of the projects would not have been executed at all and many projects would have been implemented on different time schedule or on a smaller scale. Business Finland funding in these programs has been successfully targeted to those areas where its added value is significant. Funding has primarily been targeted to development areas where other funding would have been challenging to secure.

FIGURE 14. The impact Business Finland funding to project implementers own financial investment to development work (evaluation questionnaires for company and research organizations).



Project implementers have also increased their own financial resources in respect of the development work, after receiving Business Finland funding. According to the questionnaire, over 50% estimated that they invested 40% or more of their funding into their development work, compared to the situation where the work would have been done only with their own resources (considered only those who would have implemented projects with fewer resources in any case). This shows, that Business Finland funding has also had a significant leverage effect on the development work undertaken. Development work has therefore been undertaken to a great extent and with a larger volume of financing than would otherwise have been the case.

RESULTS AND IMPACTS

The simultaneously started programs had number of different types of results as well as the wider impacts expected from them being quite diverse. The expected results related to new research results, pilots and new information on the usability of technologies, the improved ability and knowledge to develop and use digital technology, new services and products, new testing environments, improved collaboration between actors, business growth and internationalization as well as new international networks.

In the 5th Gear program, the expected results related to world-class 5G research results, pilots and demonstrations, activation of collaboration between 5G developers, new 5G research innovation, improved global competitiveness and new business opportunities. One of the main achievements in the whole program has been the creation of the 5GTNF co-development test platform. This has enabled different actors to develop and test 5G solutions cooperatively. It has also served as a platform for many of the results achieved in the context of the program. The platform could be used in several parts of Finland. More broadly, the results of the program have often been related to new solutions, new research information and new know-how.

In Industrial Internet the renewal of businesses with the opportunities offered by digital solutions, new multidisciplinary networks and business growth and internationalization were the key results of the program. These results were achieved e.g., in Reboot Finland IoT factory research ecosystem -projects where new commercially exploitable research information has been produced, new collaboration has been started between companies and research organizations and new solutions have been produced. The improved level of understanding between different actors in respect of the possibilities IoT-solutions can bring to different businesses were also important. In industrial internet the results are mainly related to the development of technologies for businesses, promoting new cooperation networks, new research information, improved competence to conduct research and the increasing competence levels of different industries to utilize digitalization.

In Bits of Health, the program objectives related to the strengthening the ecosystem surrounding the digitalization of the health sector, the promotion of exports and improving Finland's reputation across the sector. Significant results were also achieved in terms of activating companies. A large number of companies participated in the program specifically to develop their businesses. Ecosystem development in Finland was also clearly supported

with the program activities (testbeds and projects bringing actors together). The creation of the National Testbed Network represents a significant program achievement with operations still continuing. The program also invested significantly in the internationalization of companies and has also produced some good results in this area. In

Bits of Health the results relate, primarily, to the development of new digital solutions and in the creation of new cooperation networks and ecosystems.

In the simultaneously started programs the following kinds of individual outcomes and results have been attained.

TABLE 1. Examples of results in business projects.

5 th GEAR	INDUSTRIAL INTERNET	BITS OF HEALTH
<ul style="list-style-type: none"> • Improved ability to develop services and products in a 5G environment • IoT/ICT solutions • A new service product /concept using 5G technology • Development of new standard versions of the 5G network as a basis for future 5G network products • From strategic industrial research: new knowledge and know-how from new areas of technology • Improved ability to utilize digital technology • Patents and intangible capital • Technology standards • New co-development networks 	<ul style="list-style-type: none"> • New technological solutions developed/ acquired for IoT devices and/or for other company needs • Improvements in the technology used in the old products • New ICT solution that helped to improve the efficiency of business processes • New information and knowledge on how ICT technology could be used in business processes, services and products • Improved understanding of IoT solutions and their business opportunities • Raising the basic level of digitalization in the organizations involved and rising awareness and understanding of the opportunities created by digitalization. • New cooperation networks • New contacts in foreign markets 	<ul style="list-style-type: none"> • New innovation created through cooperation between ecosystem/test bed actors • New devices and service products for health care sector • New networks for application developers and users • New contacts and improved understanding of foreign markets

TABLE 2. Examples of results in research projects.

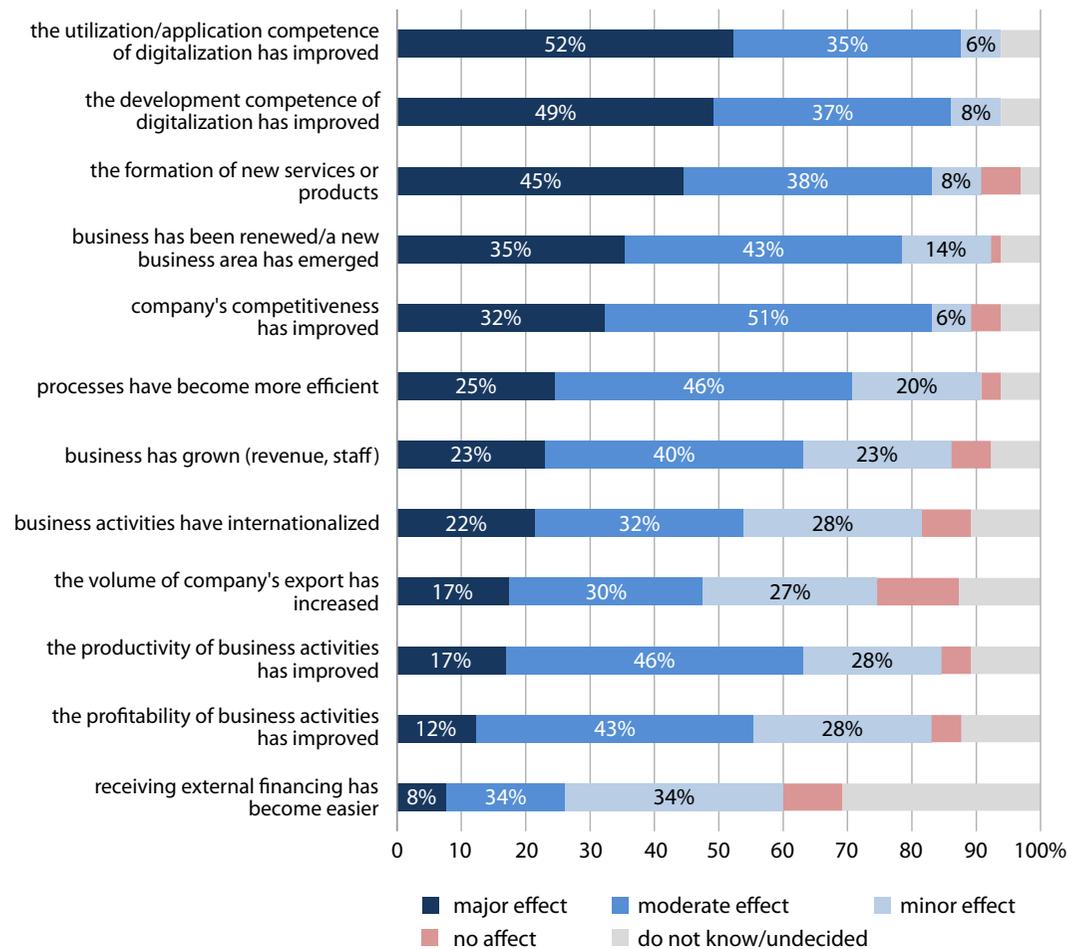
5 th GEAR	INDUSTRIAL INTERNET	BITS OF HEALTH
<ul style="list-style-type: none"> • New comprehensive research information about 5G networks and the business potential they could generate • Publications and materials on 5G and IoT technology • New cooperation networks between actors • Implementation of 5G test networks in Finland, new test beds • Rising levels of mobile network research • Improved awareness of research results and international recognition of these research results • Improved ability to conduct 5G-related research in different application areas 	<ul style="list-style-type: none"> • Increased understanding among researchers and participating companies of how to develop digital solutions for business needs • New research information and publications on specific technology areas (AI, big data etc.) • New co-operation and co-development networks 	<ul style="list-style-type: none"> • Research publications • Improved level of competence • New cooperation networks • Research information that has helped in the creation of new business solutions and services

According to the evaluation questionnaire, these results have influenced the participating companies in various ways. Almost all of the companies involved in these programs, have been able to improve their ability to utilize and develop digitalization through their projects. The projects have also influential in the creation of new products, opening up of new business opportunities and creating new work processes. These kinds of direct business impacts are also quite frequent. On the other hand, impacts relating to growth, productivity and profitability are less frequent. These are often the result of the more direct impacts and it may take time before improved competences and products etc., start to influence these numbers. In

general, SMEs have experienced the effects of the projects more in relation to the development of their businesses rather than in terms of direct profitability.

From the research organizations' point of view, new research has been conducted on the basis of the results of the projects completed. This shows that the programs have in the long run also influenced research work. It is also notable that over half of the research projects answered (53%), that the research conducted in the simultaneously started programs was a continuation of research conducted in the context of the preceding Business Finland programs. This shows that the evaluated programs have supported long-term research activities to promote

FIGURE 15. The effects of projects that have promoted digitization in companies, according to the views of those responsible for projects (evaluation questionnaire for companies).

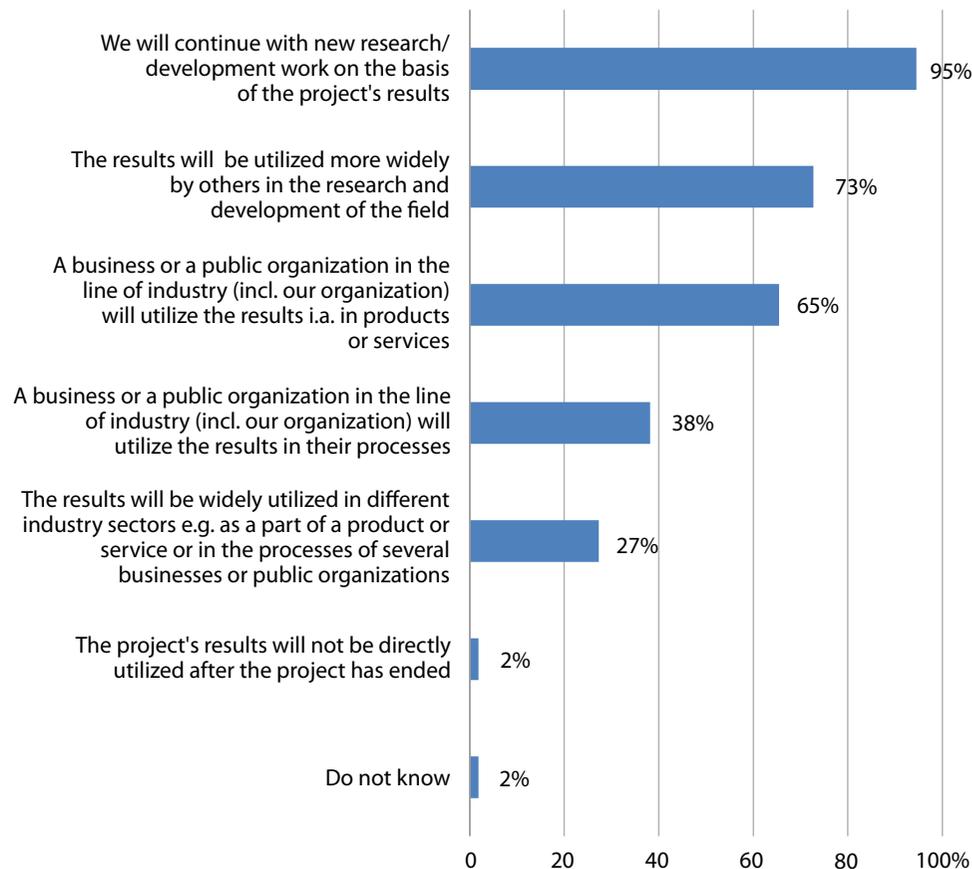


digitalization. The results of the questionnaire also show that most of the project results have also been utilized by other actors. From this it can be concluded that a major part of the research result was significant, as there has been a desire to utilize them more widely in both research and development work. These research results seem also to have been transferred quite easily to private companies and public organizations. This means that the research results have also been useful for more practical activities and applications.

The wider impacts derive from the important results of the programs e.g., the shared test beds/environments that have resulted in important technological developments and solutions, new information from research, disseminating technologies to new application areas, new cooperation networks and new concrete solutions that have influenced businesses. From these kinds of results the wider impacts will emerge over time.

In general, the simultaneously started programs provided an important boost, particularly in their focus areas, to advancing digitalization. The programs have supported the development work in the identified target areas and enabled important actions to be taken. As the simultaneously started programs ended quite recently, only some of the expected impacts can be detected at the current time of writing. From this perspective however, it is also important to identify emerging impacts that cannot yet be clearly detected.

FIGURE 16. Impacts of research projects after the end of the projects, according to the project executives (evaluation questionnaire for research organizations).



The 5th Gear program has contributed significantly to the development of 5G technologies and expertise in Finland. The program has improved the general understanding of 5G technology and its development and opportunities. It has also been important for the companies and other actors involved to be able to test the possibilities of 5G with their own projects. This increase in the level of 5G knowledge and understanding will undoubtedly have a longer-term impact, particularly when actors are able to better utilize 5G technology. The creation of a cooperation culture in the development of 5G technology has also been an important force multiplier here. From these new research results, applications and other benefits can emerge. In conclusion, the program has made it possible for Finland to become more competitive in the research and development of 5G enabling it to increase the utilization of 5G information more widely.

The Industrial Internet program reached a fairly wide field of actors and increased the networking and cooperation of a number of organizations. It also raised awareness and understanding of the potential of the industrial internet in different application areas. As a direct result, more actors are now able and better positioned to develop their business with ICT-solutions. The research organizations involved also have a better understanding of what kinds of needs Finnish companies have and what types of solutions are demanded. For small companies, the program has offered collaboration possibilities with bigger

actors, enabling new business opportunities for them. At the same time, for large companies, the opportunities around digitalization are now better understood, these businesses have formed new partnerships with research organizations and smaller companies and they are able to direct operations in relation to this. In addition, some important ICT-solutions were created in the program making it possible for companies to develop their business process and improve their products and services. In conclusion, Finnish actors participating in the program are in a better situation to utilize the opportunities around the Industrial Internet. It should however be noted though that the program reached only a limited scope of companies and only a few of these gained clear and substantial benefits from the program. As such, there remains a broader need to help Finnish companies to improve their ability to utilize digitalization.

The Bits of Health program played an important role in advancing the development of the health sector industry and its digitalization as well as its business potential by networking actors (health sector and digital developers) and ecosystem building. The healthcare sector is now better placed to take advantage of digitalization and companies enjoy better prospects for growing their business in Finland and abroad. There has been growth in the digital healthcare companies participating in the program and the industry sector, in Finland, has undoubtedly devel-

oped in recent years Finland is now also clearly identified as a significant country in the thematic area of the program. There were many other factors that impacted the above-mentioned issues, but the Bits of Health program was undoubtedly one of the major players influencing this general development.

Given these points, it is clear that the programs have attained their objectives. They have been able to contribute to the desired development in their thematic areas. Providing more detailed interpretations of the impacts is however still rather challenging because many objectives did not have target levels or precise definitions. In some of the followed indicators, such as the number of organizations funded and the business growth figures, the target levels have been reached. On other objectives, it can be said that the programs have successfully promoted development in line with their objectives and that the overall development has in many ways been in the desired direction. On the other hand, the wider utilization of digitalization, further company internationalization, broader growth impacts in terms of the participating companies and a stronger pioneering position in digitalization for Finnish actors will require more time and new actions. It should however be noted that these programs have also contributed to the emergence of successor Business Finland programs forming part of a continuum of programmatic development work.

5G Test Network Finland (5GTNF) as a platform for research, co-development and the testing of 5G solutions

During the 2010s, the culture of co-development between different actors in advancing digitalization and mobile technology was markedly strengthened. An important aspect of this development has been the emergence of different types of co-development and testing platforms. Business Finland programs (most notably the program continuum of Giga, Trial and 5th Gear) have played an important role in this by helping to develop these testbeds and developing new ways of creating operational models for testbeds as well as providing project funding for the actions taken on these testbeds.

As 5G network technology developed during the 2010s, the need for 5G research and technology testing platforms also grew. It was rapidly seen to be necessary to bring the actors together and provide opportunities for collaboration. 5G platforms like this had begun to emerge in other countries and research on the 5G theme progressed at a rapid pace. As preparations for the 5th Gear program began, the development of a 5G test environment was set as an important priority target for the program. Compared to the rather more disaggregated platforms in other countries, the goal was to create a broader and more integrated cooperation network of 5G technology test platforms across the country. In this network, the required technologies, innovations and solutions for vertical industries could be more easily developed.

After its creation, the 5G Test Network Finland formed the necessary infrastructure and ecosystem for the development of

5G technology and its applications. The parties involved are network and technology manufacturers, operators, application developers, public organizations and research organizations etc. Special application areas have included smart industry, smart cities and living, smart mobility, smart health and wellbeing etc. These test environments were created in eight cities and municipalities each with their own thematic areas: Espoo (Otaniemi Aalto University campus, Nokia Karaportti campus), Tampere (Hervanta campus, Korkeakoulunkatu street areas), Helsinki (Helsinki university campus in Kumpula), Oulu (Oulu university campus and VTT office site), Kuopio (Savonia University of Applied Science), Turku (TUAS campus), Ylivieska Centria campus area) and Sodankylä. 5GTNF can be viewed as one of the main outcomes of the 5th Gear program.

Business Finland's funding and program support has been crucial for the operations of 5GTNF. The 5th Gear program was, moreover, the driving force in terms of generating the idea for the network, refining its actions and gathering actors into the network. Its operation was boosted by the earlier 5GTN, TAKE-5, CORNET WIVE Business Finland funded projects which in addition to 5G technology research, laid the foundation for 5GTNF's. Thereafter, activities were scaled up using both Business Finland and EU funding (with the financial resources of the different participants involved). The projects have mainly been implemented as joint projects involving different types of organizations. ▶▶

...5G Test Network Finland (5GTNF)

Experiences with the operation of the 5G test network have in the main been positive and the impact logic of the network has functioned well. The network has brought relevant actors together, launched new cooperation arrangements and strengthened old ones, promoting new research work and testing and enabling the flow of information between actors in the network. Through the actions taken, the network has produced new research data, new innovations and know-how (especially in 5G radio and network technology, AI application and smart mobility) and new 5G-based solutions for industrial automation, smart cities, healthcare and wellbeing and government applications (e.g., defence forces, police, border guards and the rescue services). Participants have received the latest information on the evolution of 5G: technology developers have learned about the requirements and functionality of different applications while vertical industry actors have received information about the opportunities offered by 5G and learned how to apply it. Different actors have also been able to participate in the preparation of numerous new R&D projects and obtain funding, as well as increasing their 5G skills, utilizing the test network in their product development (technology development and applications) and gaining visibility through the ecosys-

tem while, at the same time, improving their reputations as 5G experts. More broadly, 5GTNF has expanded and deepened cooperation between research organizations and industry, promoted the international networking of participants and improved access to international funding. With the help of the network and ecosystem, actors have participated in several large EU projects.

5GTNF continues to operate at the current time of writing with project funding with the future of the funding for network coordination set to be clarified by the Ministry of Economic Affairs and Employment in the near future.

As a whole, 5GTNF has clearly contributed to advancing Finland's position in 5G research and applications. Finnish actors have a knowledge and understanding of 5G applications while the country's 5G research is widely acknowledged as being top class. It is estimated that over, roughly, the next five years, the development of 5G technology in an applicable and commercial form will be a key goal for business. This will require 5GTNF-type platforms and other support for ecosystems and co-development. Thereafter, it is estimated, that 6G research and development will become a more important priority. ■

National Test Bed Network for the health and biosector

The National Test Bed Network was formed as a part of the Bits of Health program and on the initiative of the program. The idea for the network was based on the recommendations of the National growth strategy for health research and innovation and the Ministry of Social Affairs and Health as well as Sitra, who also strongly supported its formation. Test beds were formed in the five University hospitals of Finland as well as in South Karelia hospital.

The test beds are focused on bringing together different actors from university hospitals and their regional partners (cities, polytechnics, universities) to share experiences, learn from each other and develop cooperation. Private sector companies are also important participating organizations here. In the test environment, digital products and services are researched, developed and tested in either a real or simulated environment. Test beds have supported companies' development activities at various stages, such as idea development, clinical research, prototype development, user testing and co-development. As it has been difficult for companies to start collaboration with hospitals, The Test bed network has tried to develop a more systematic, high-quality and effective form of Test bed cooperation between companies and hospitals. In the long run, the goal was also to attract foreign companies to the test beds. The vision was to make Finland the most attractive testing environment for companies in the world.

The development of the Test Bed network in the Bits of Health

program progressed mainly through workshops where operational models were refined. Test bed working groups were set up in all areas while a national steering group was formed to support national cooperation. The operational models were systematized and a roadmap was developed for Test bed operations to support further development.

The Test Beds remain at various stages of development across the different regions in Finland and, as such, further work is required to integrate them more fully into wider RDI activities. Work also remains to be done in terms of 'productization' and basic processes as well as in the visibility and marketing of Test beds.

During the operation of the test platforms, new solutions have been developed and tested. These have the potential to lead to the development of new business as well as to changes to hospital operations. The main achievement has however been that co-development has been strengthened and several approaches have been developed to achieve this. Along with the formation of Test beds, this can also be viewed as one of the main achievements of the Bits of Health program.

Test beds have continued to operate after the Bits of Health program concluded and they will continue to promote the wider goals set by it, namely, accelerate the development and deployment of better healthcare solutions, enable business, promote patient safety and enable the development of know how. ■

Reboot Finland IoT Factory

Reboot Finland IoT factory is an operating model that is linked to the wider Reboot Finland concept. The goal of this concept is to enable the benefits of digitalization to be fully utilized in Finland and to encourage digitalization development and collaboration between important stakeholders (Public-Private-Citizen-Partnership). Four ecosystems have been chosen as the focus areas: smart health, intelligent production (Reboot IoT Factory), marine and education. Business Finland played a key role in launching the concept.

Reboot IoT Factory focuses on Finnish manufacturing industry. At the heart of the operational logic was changing mindsets of different actors regarding information sharing and co-development. The operations have been targeted to eight forerunner factories and four leading research organizations. Factories refer to larger Finnish industrial companies. Around all the eight factories ecosystemic development has been implemented and at the same time the ties between the different factories are strengthened. There are three major parties that create fast trials together. Big companies' businesses mainly constitute the demand for new digital solutions and experiments. Research organizations provide research information and ideas for the solutions giving extra competitive edge. SMEs are the ones who deliver solutions for the large companies and conduct the needed experiments. All the factories share information with each other on new solutions and information, in reciprocal manner.

The operating model has produced clear benefits to different parties. Big companies have been able to find solutions to their businesses, test new ideas and get proof of concept -information in co-operation with research organizations and SME's. Because of Business Finland funding they have been encouraged to start co-operation with great number of new SME's that have special expertise in the necessary areas of digital solutions. Funding has also encouraged to experiment more boldly new ideas. SME's get new business opportunities and networks in the direction of large companies and research organizations. Research organizations are provided with information of the digitalization needs of companies on the basis of which research work can be steered.

A key impact of the approach has been the to the mindsets: actors are more willing to share information more openly. All the participants benefit, as they have access to information and expert competences that they would not otherwise have had at their disposal. Important effect has been that new useful information is delivered more efficiently and learning processes have become faster among different actors. This has led to significant increase in digitalization speed of Finnish manufacturing.

Reboot IoT factories have been funded from Industrial Internet program. All the factories as well as research organization have implemented Reboot IoT factory-projects. Reboot Finland IoT Factory activities as whole, are coordinated by VTT. ■

ADDED VALUE

On a whole, the simultaneously started programs did, in many respects, create added value. On a general level, these programs have undoubtedly improved the level of understanding in respect of future developments surrounding digitalization and have helped promote a more cohesive vision among the various actors involved of the future possibilities around digitalization. Through these programs, actor views on digitalization have been harmonized. At the same time, the direction of digitalization at the international level has been influenced in program activities (e.g., 5G standards) and Finland's views have been taken into account in terms of global regulation.

Additionally, these programs have also brought actors together and provided new ways of engaging in co-development to better meet future needs. There has also been a perceptible change in attitudes towards co-development, especially during recently ended programs. The needs of larger companies, research organizations and small companies have been brought together and operating models have been developed that can provide benefits to all parties. This has required funding and support from the programs and in many ways catalyzing such activities would have been challenging without external program support.

The programs have also enabled a wider range of industries to access the advantages of digitalization in the future. Through the activities of the programs, like-minded actors have been brought together and information has been disseminated more broadly. It must however be said that there still remains a lot of work to be done in this area and that the programs have only a limited scope to make a difference in this case.

The programs have also provided opportunities for companies to further develop their businesses. New applicable research results, co-operation networks, support for internationalization and ecosystem building have all been important benefits in this respect.

The added value of these programs can also be seen in terms of Business Finland's strategy. The programs have produced information, on the basis of which the promotion of digitalization can be undertaken more effectively. A good example of this is the development of the bio and health sector.

In sum, in their target areas, the programs have raised competence levels and increased the ability of many Finnish actors to succeed, enabling them to better take advantage of the opportunity's digitalization provides.

5.2 GROWTH AND INVEST IN -PROGRAMS

This chapter describes the key findings from three growth programs and one invest in -program. Key figures from these programs are presented in the following table.

CONNECTIVITY FROM FINLAND	
Implementation period	2015–2017 (then as part of the Business Finland)
Main goals	– Program supported Finnish companies to capture business opportunities within the connectivity and digital services sector
Funding	Approximately 1,1 million
Number of companies involved	34 (or 38 depending on the definition)
INDUSTRIAL INTERNET (CYK)	
Implementation period	5/2015–4/2018
Main goals	Strengthens internationalization capabilities and support target market entry of the participating companies The program aims to <ul style="list-style-type: none"> – Grow export and employment in the participating firms – Increase foreign investments in Finland – Strengthen Finnish country profile as the leader in ICT and industrial internet
Funding	Approximately 2 million over the program period (was cut during the process)
Number of companies involved	31
eCommerce	
Implementation period	2015–2018
Main goals	– The objective of the program is to promote the internationalization and growth of Finnish SMEs that trade online, and to develop the ecommerce ecosystem in Finland.
Funding	Approximately 2,1 million €
Number of companies involved	97



DataCenter 3.0	
Implementation period	Program period: 6/2015–12/2018
Main goals	<p>Make Finland a leading data center investment destination in the Nordics</p> <p>Develop the Finnish data center offering portfolio in terms of the technical scope and sales</p> <p>Increase the readiness for investment of individual opportunities</p> <p>Differentiate Finland as a location for datacenters and to tailor the offering for different market segments</p>
Funding	Approximately 8000000 €
Number of companies involved	Not relevant, stakeholder network-based program

RELEVANCE

Overall, the relevance of the export-driven programs can be seen as high. The criterion for relevance here is however seen as whether the programs have managed to make a timely impact in terms of utilizing Finnish competencies and capabilities in the field of ICT. At the time of program execution, the business models and offerings in this field were slightly more straightforward in terms of products, technologies and offerings. To some extent however, the interviews confirm that the current themes in this field are much more complex, particularly from an expert perspective.

This leads to a finding where some of these programs can be seen to have been ‘before their time’ and for which the real market demand exists more now than it did then. This can be seen for example in particular in relation to the Industrial Internet program.

These Growth programs were implemented by Finpro and they worked together with Tekes’ programs at the time.

One of the key aspects of program relevance here is that, particularly in the field of digital technologies and ICT-technologies, these subfields are much harder to internationalize (or at least were at the time) for smaller than for larger companies. This naturally led to the demand for a networked approach to the internationalization activities where most of the programs consisted of organizations from different parts of the value chain. This can be seen in terms of the Industrial Internet and Connectivity program as eCommerce and Datacenter worked in different contexts.

Datacenter’s relevance can be viewed in a different way. It was relevant at the time and it still is. Investments made by companies like Google and Janex made to data-

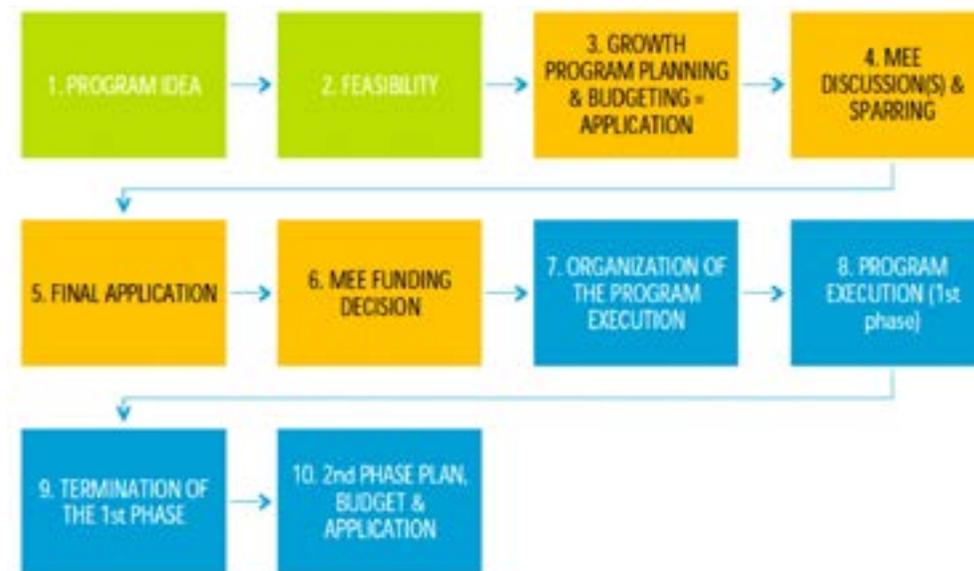
centers in Finland helped, in part, to launch the program. The goals set for the program were more societally-orientated than in the other programs and were designed to make Finland an attractive country for datacenter investments. The program developed the detailed offering for potential datacenters. In a way it could be argued that the objectives of the program are still relevant today since the economic and technological climate in Finland has not changed and the need for further datacenter capacity is certain to increase in future.

SUCCESS OF THE OPERATING METHOD AND IMPLEMENTATION CONCEPT

The Growth and invest-in programs had a shared basic program process but each had their own specificities in their implementation model. The general process of growth programs is described in the Figure 17.

Each program had some specific 'edge' to its implementation approach. The evaluators' viewpoints in respect of these different implementation concepts are

FIGURE 17. General process of growth programs.



described in table 3. Based on the interviews with the program managers and analysis of the secondary data and individual survey responses from the program participants.

TABLE 3. Growth and invest-in -programs implementation successes and challenges.

PROGRAM	PROGRAM SPECIFIC APPROACHES	SUCSESSES/GOOD THINGS	CHALLENGES
Connectivity	Key focus was shared participation in the key fairs in the field. Markets were focused on during the implementation period.	Program utilized local target market consultants to support companies in reaching right persons and right customers. Program worked closely with political level as well as embassy network-among the countries. One very practical success was the role of the local consultants in providing follow-up for target market activities.	Training measures were not as successful as initially anticipated. Budgets were refocused during program implementation without necessarily clear communication as to why they were cut. Unpredictability means difficulty in activity planning.
eCommerce	Broader scale of program participants with high-focus of networking and peer-learning (since there was relatively little direct competition, since the development focused on ecommerce of different sectors.	Useful peer-learning between different sectors (wide participation pool, well organized trips and events).	The challenge was to gain the interest of the larger companies so that different sectors could have been turned towards ecommerce.
Capitalize your Knowledge	Focus on sale and offering ‘pitching advice’ and support. Note also the importance of local consulting in target markets to support these activities.	Local consultant’s knowledge in target markets received positive feedback and helped to facilitate the expert’s efforts	Long sales time for industrial internet and big data solutions as well as slightly misplaced demand in terms of how these solutions can be applied in their businesses. The funding was cut during program by 90%. This meant that only a few markets could be focused on reducing interest from program participants. This was mainly due to public discussions and the challenging nature of the subject.
Datacenter	Creation of Finnish opportunities for investment. Focus on stakeholder cooperation Strengthening of the national datacenter community through improved communication (Podio)	Collaborative approach for improving investment readiness of sites: Ecosystem approach for networking different players (site owners, targets and stakeholders) for creation of potential offering of relevant datacenter locations. Establishment of National Investment Portfolio of datacenter opportunities	

Each program measured satisfaction of the program concept and program services using slightly different metrics. In general, however the findings, in respect of program implementation, were relatively positive. Variation of course exists among some services or events because of the ways in which the programs were organized, but usually this can be explained by the existence of certain contextual factors while program management has certainly learned from these varied experiences.

This confirms what was said above about the program concept in general where, on average, the feedback companies gave in respect of the growth programs was relatively positive. The key aspects here relate to the organizational capabilities of the program management team and the focus on the target markets. Additionally, around half of the participants were satisfied in terms of target market selection, the program team's expertise and competence, the quality of the events and activities and market information received through the activities. (Comparable to results from Salminen et al. 2016)⁷.

Earlier evaluations point out that the concept itself is welcoming, but the challenges relate to the cooperation among the programs and steering and funding -model of these programs (see Salminen et al. 2016). These challenges relate to these programs being implemented by Finpro with still limited cooperation between Tekes' programs. From the current perspective, these challenges can be overcome.

Datacenter operated based on different format. The key point here has been the close cooperation among the different stakeholder groups in respect of recognizing and defining Finnish strengths and describing the offer for datacenters. One of the interesting features here was that these results relate not only to the owners of the potential targets for investments but to all of the organizations which are part of the local ecosystems for potential datacenter investments. This has been confirmed in the context of the interview responses as an innovative approach, despite its simplicity. Moreover, its role in providing relevant invest-in information for key stakeholders can also be seen as important.

⁷ Salminen et. al. (2016) Evaluation of Team Finland growth programmes. Prime Minister's Office, 30.09.2016

Case of successful coordination of national offering: **Red Compartida (Connectivity)**

As part of the Connectivity program Mexico's Red Compartida, the nationwide 4.5G network -project was recognized as a major opportunity for the Finnish organizations who participated in this exercise. From a case study perspective, the point of focusing on this case was its long, strategic planning of activities together with the key stakeholders as well as participant companies.

The roles of the different organizations involved such as the program itself and the Finnish embassy were relatively clear, as in this particular target market, hierarchies are important and the ambassador was required to open the doors into the key consortia. The program and other relevant organizations focused on studying the opportunity and developing a Finnish offer of services related to Red Compartida. This offering is not an 'individual product', but rather an offer from eleven enterprises, of which most were part of the program activities. Development of the offer included several steps and took over a year to formulate from the workshops, to meetings in Mexico and

several presentations of the Finnish offer and its consequences. The approach was based on understanding the technical challenges beforehand and anticipating possible solutions. Feedback from the participant companies has been relatively good.

At the end of 2016 Mexico chose a consortium which included Nokia as their second main network technology contractor. This deal was, at the time, the largest in Latin America. In addition to this, Red Compartida has created other orders for the offering companies with an overall estimate here being over 2 billion euros worth of orders from the same, or adjacent, markets. One of these examples is CouldStreet Ltd which participated in the program and was part of the consortium. During the interviews it was pointed out that without the benefit of the high-level political networking received and the systematic working of the offering, none of these companies would likely have been part of this emerging opportunity. ■

RESULTS AND IMPACTS

The growth and export and invest-in -driven programs focused on basic challenges such as whether the realistic expected result from these activities (providing information, providing client contacts, providing leads and matching potential clients and creating new networks within the growth program) is the realized sales itself (export) or the competence and capabilities in respect of pursuing these activities in the future. Both these aspects can be seen in the programs since the participants and their current situation with regards to capabilities for internationalization vary significantly (see also Salminen et al. 2016, Koski et al. 2020)⁸.

The evaluated programs' participants saw both turnover growth and expert growth and with expectations for these targets being, for the most part, exceeded, as noted in the interviews. This represents a very positive result in respect of program implementation. In what follows, a number of key aspects are highlighted for each program.

As laid out in the statistical analysis (chapter 6), participants in the growth programs have been growing faster than average for their own business sector. This is easy to understand due to selectiveness of the

growth programs. Based on the statistical analysis it can be seen that general expert growth started in 2015, in connection with growth program participation. In recent years, export growth in participant companies has however been slower than in their sector. To some extent this may simply reflect a general rise in sector exports. If we look at this in connection with the qualitative analysis however, we can see that, for some, the growth programs work as catalyst programs while for others, they provide new expert areas (content or marketwise) though actual export growth might be limited. Some companies have however made significant progress in terms of business and export growth, especially during 2015 and 2016. This is very much in line with the qualitative analysis of the programs and of their participants in general. Below we will discuss each program based on the qualitative analysis.

Connectivity. Connectivity focused, as a program, on providing concrete sales leads to companies. This focus on sales activities was particularly relevant and received positive feedback in terms of the program feedback. The program provided approximately five leads for each key event or touchpoint for each participant. This varies of

⁸ Salminen et. al. (2016) Evaluation of Team Finland growth programmes. Prime Minister's Office, 30.09.2016; Koski et. al. (2020) Evaluation of Tekes R&D funding for the European commission -Impact study. Busines Finland. 3/2020.

course between different events. Analysis is based on the program reporting and monitoring data. Some of the participant targets were not met since the sub-sector is smaller in this field. The program also helped with some investments in Finland.

Average growth during the programs is 10–15% with exports rising at the same level based on their own monitoring data.

One of the key successes here has been the connecting of local knowledge (expert/consulting services) with international events held. Moreover, according to the interviews, the support provided by the TEAM Finland network and the embassies represented important leverage. The Red Compartida -case which continues to have a number of ripple impacts in Finland illustrates these successes quite well.

eCommerce. The growth program was inspirational, generating interest among Finnish companies in the field of ecommerce and online shops. Based on the monitoring data during program participation, growth has been quite decent (median 13.6%), from which the electronic/online -part has been around a median of 21.2%. There are drastic outliers in both directions, some participants

being now totally out of business while others have witnessed exponential double- or triple-digit growth (with online-shopping being the key leverage for this growth). For example, according to the survey of the program itself, average export growth has been +343% during the program (based on information from key participants of the companies and their assessments). Moreover, many of these people also state that the program ensured the survival of many smaller participants during Covid-19 crisis.

In terms of export growth, the results were very good. The programs own monitoring data shows that the average ecommerce-driven export growth was over 60% percent, depending on the analysis year (based on 54 of the 74 participant companies). The survey made by the program indicated that the participant companies saw that the program helped their export efforts. One of the most interesting aspects in respect of the ecommerce issue is that the program created a lot of new export markets, over 200 in fact (meaning new clients from different countries for these companies) even though it might not include high volumes of business *per se*. This relates to the business logic of the ecommerce field rather than to the programs success.

Successful Growth Program based on the initiatives of the participants – eCommerce

This case is based on several case-study interviews with ecommerce -program participants. Instead of separate company cases we can recognize similar key themes from these three company interviews bundling them together as a thematic case, highlighting a couple of interesting elements within this program. There are two distinctive features which made the program rather successful. These were: the starting of the program based on the needs of the potential participants who suggested this program should be developed and the interrelated aspect of peer-learning ecommerce clubs as a method of sharing experiences within the program.

Based on the interviews, the program has been perceived as a very welcome and successful entity in the field of ecommerce business. Participants' experiences emphasize the importance of diverse learning and up-to-date knowledge in learning experiences. Various measures such as trips and training days were also found to be very useful. Exploring the local ecommerce market on international trips has been an enriching experience. Contact with the same industry on the one hand and different stakeholders on the other was seen as a key benefit in relation both to travel and other activities.

From a business perspective, participation in the growth program was seen as very significant: internationalization in particular and a focus on market choices and sectoral emphasis have accelerated growth.

In addition, the lessons learned from the growth program related to consumer ecommerce expertise and sales were highlighted in the interviews. The clearest perceived value came from the uptake of know-how from the growth program. Above all, 'practicalization' and concrete operating models have given the expected boost to the business. Interviewees highlighted the successful preparation of the program which has led participants to feel heard. Program activities were proportionate to the needs of the participants and the information received was up-to-date. Coordinating activities, bringing together those that worked in the field were also welcomed. One lesson from the program was that the interviewees now recognized that the amount of information and the identification of the right information in relation to the speed of action is significant. The amount of information is huge and the cycle of information change is extremely fast. Staying up to date with the market and understanding the general market operation principle is seen as a key lesson. ■

The Capitalise your knowledge (CY) program resulted in some concrete sales cases. However, the challenge of the program were the long sales times for the solutions, as customer companies were still looking for answers to the questions ‘what is the Industrial Internet and Big Data in practice for them and how they could be commercialized. Because of this, program was slightly ahead of its time while sales processes among the key companies ended up longer than in many other growth programs. Among the participant company monitoring data (available from 25 companies) the growth percentage was 37%. It should however be noted here that clients were very cautious during program implementation and thus were focused on more limited procurement decisions than was originally anticipated. Thus, in practice, their focus was mainly on test-systems or similar limited procurements.

Despite these developments, participant company exports grew during the implementation period by, on average, 68%, but this was not entirely the result of the program but based also on the general efforts of the companies.

Datacentre 3.0. created internal competencies in the invest-in -activities for datacenters in Finland. This competence can still be used as part of the invest-in activities. One of the key results was the nationwide co-operation for the promotion of datacenter opportunities (a series

of 10 workshops) and the common understanding of the need for national collaboration in this exercise that was achieved. This led to increased international awareness of Finland as a business location and promotion of the national datacenter ecosystem together with partners such as Qinia, Ficora, Hetzner Online, SSH Communications, Telia, and Yandex.

In addition to the new competencies the program managed to instill major investments, Worth of €540 million investments were made and over 300 jobs were created in Finland. These figures are based on the program monitoring data. Key public investments here include the following: Equinix (Helsinki), Hertner Online (Tuusula), Telia (Helsinki), Ormuco (Tampere), Equinix expansion of datacenter warehouses, Google’s expansion of data warehouse and Olive Datacenter and Digiplex.

In addition, the interviews and secondary evaluations also point to the importance of networking and wider visibility (for example, joint participation in trade shows/exhibitions and reaching the right clients). As noted previously, the added value comes from the fact that very few companies within these technological fields (especially CYK and Connectivity) had been able to reach their target markets by themselves. This also means that one of the underlying intermediate results of the programs was the trust building among participant companies who may have been either competitors or different parts of the Finnish sub-sectors.

ADDED VALUE

The added value of the growth programs relates to the contribution of small-scale intervention and international sales support activities and in the fact that its logic is different from innovation funding. There are different aspects of added value at play here.

Firstly, many programs created, consolidated or collected offerings. Local knowledge in the target markets was utilized to sell these offerings or products. One practical added value was the local follow-up undertaken by local consultants in terms of the potential sales leads which, in essence, provided subsidies for the international sales support function for the companies involved. This relates to previous findings where it has been seen that approximately half of the participants in the growth programs managed to find new international clients.

Trust building and peer-learning is another key added value of the growth program concept. This was particularly prevalent in the ecommerce-program where this approach was adopted as part of the implementation process. It is even more important if the program subject is something that is relatively new in Finland, as was the case here.

The programs have also provided added value to Business Finland where some of the approaches and work

carried out in these export programs are reflected in the current Mega-opportunity work where the idea is also to create demand and recognize this demand. In the secondary evaluations, the companies involved commented that the growth programs are relatively useful especially for those who are just embarking upon their export efforts. Creating the opportunities for international growth and internationalization is one of the key aspects of the value added in respect of such supportive activities and instruments and is seen as being particularly beneficial for those companies targeting steady home growth but which do not yet have a strong international footprint (see also Salminen 2016, p. 35- for similar discussion)⁹.

5.3 CONNECTED INTELLIGENT INDUSTRIES FINLAND (CIIF 2022) -PROGRAM

In early 2018, 5th Gear, Industrial Internet and Finpro's Industrial Internet as well as Connectivity from Finland, Datacentre 3.0 (and Public Safety Asia and Finland-Japan Gateway for Open Innovation) merged into a broader and more comprehensive program called, Connected Intelligent Industries Finland (CIIF 2022). This operation related to the simultaneous merger of Tekes and Finpro. Through this change, a more concentrated and parallel

⁹ Salminen et. al. (2016) Evaluation of Team Finland growth programmes. Prime Minister's Office, 30.09.2016

program was formed in order to enhance effectiveness and create greater added value over the previous, more disaggregated approach. The CIIF 2022 program combined all of the elements of the previous programs, in terms of innovation, export and invest in activities, into the same program.

The expected benefits of this program model included, more direct opportunities for the transfer of digital technologies between different application areas, the creation of a more efficient innovation-commercialization process and also, due to the scope of the program, better visibility for the digitalization theme. Broader holistic programs were seen to better meet the needs of the operating environment in the context of promoting digitalization, as digitalization cuts through different societal activities and industries thus reducing importance of traditional industry sector divides. At the same time, the need to respond to phenomenon-level challenges and systemic change is emphasized more and, in this sense, a broader program is more suitable.

The CIIF 2022 programme was implemented during the period 2018-2019. As plans for new programs were being developed in the context of the new organization the CIIF 2022 programs implementation however fell short of original expectations. In the end, the main task

of the CIIF 2022 program was to conclude the older program portfolio, bringing these programs to an end. Due to the short implementation period, only a limited amount of information was received on the implementation concept of this large-scale program.

The CIIF 2022 program did however provide information on how to promote innovation and export activity together in the one program, how to merge the broad themes of the old programs into one program and how to communicate the message to customers of a large-scale program. One significant challenge in the extensive program was the lack of focus on what it was concretely trying to achieve. For example, the focus areas of the old programs disappeared into a large program entity and it was challenging to attract target groups in a specific target area. At the same time, some good experiences in terms of how to manage a comprehensive program were generated. Perhaps most importantly in this respect, there were identifiable experts responsible for the various thematic areas of the older programs. In the context of large programs it is often a key task and a necessary prerequisite for success to connect the appropriate human expertise to the various thematic areas of the program.

6 STATISTICAL IMPACT ANALYSIS

6.1 SCOPE

The aim is to analyze the Business Finland programs advancing digitalization in order to discern whether they have had an impact on the business indicators of the participating firms. The level of analysis is the firm, and the results are presented on the program category (i.e., Forerunner, Recently Started and Export promoting programs).

The outcomes of the Forerunner and Recently started programs to be studied are the following:

- Turnover
- Jobs (measured as the number of employees)
- Productivity (measured as value-added per employee)
- Export (measured as export per sales)

For the Forerunner programs, the study analyses the long-term impact on the firms five and eight years after the first project start. For the Recently started programs, the study focuses on three-year impacts as the data for longer-term analysis do not yet exist. The analysis is

based on the comparison with a control group consisting of similar firms that have not participated in the programs.

Two different types of firms are studied: developers and utilizers. The industry is used as a proxy to determine if the firm belongs to the developers and utilizers group. We have also made an indicative comparison of the forerunner and developer programs to their industries.

The export-promoting programs are analyzed only in terms of export growth. The change in exports is compared to the average export growth of firms across the industries as a whole.

6.2 DATA AND METHODS

FORERUNNER AND RECENTLY ENDED PROGRAMS

The control groups of the Forerunner and Recently started programs include firms that have applied for funding from Tekes/Business Finland. In an initial step, firms were selected for the potential control group. This selection was based on the funding application data. The

potential control firms were then screened, based on industry sector, firm size and age. Where there was an excess number of certain industry-size-age combinations the firm was removed from the potential control group to avoid unnecessary data acquisition costs for Business Finland. The actual removal was based on random choice. The control firms were reduced until there were only 20 potential similar control firms remaining. This limit was set to ensure that there were a sufficient number of potential control firms in terms of the matching process for the final analysis.

The data used consisted of:

- Selected key figures from the financial statements, starting from 1999. The data was retrieved from the BF database, the source was, Suomen Asiakastieto (data from 2002 was used)
- Annual Export data, source Customs
- Tekes/Business Finland funding data starting from 2002

All financial data have been converted to the year 2020 values by using the discount rates published by Statistics Finland.

The outcome indicators used in the analysis were the changes between the year of funding decision and the year of observation.

- Turnover, annual change percentage
- Number of employees, annual change percentage

- Value added per employee, annual average change, euros (in 2020 value)
- Export per turnover, annual average change, percentage points

For the recently started programs, the year of observation is three years from the funding decision. This limits the analysis only to those firms with a funding decision before 2017 as financial statements were only available until 2019 at the current time of writing. Using a two year follow up period would have increased the number of firms, but this period was considered too short to observe the impact. For the forerunner programs, the focus is on the long-term impact. Thus, the observation periods were five years and eight years from the funding decision. The five-year period includes all firms, but the eight-year follow-up analysis covers only firms with funding a decision before 2012. In addition to the long-term perspective, the forerunner programs were also analyzed by using the three years after the funding decision to study whether the findings from the recently started programs also held for the forerunner programs.

Even though there were 326 firms in the forerunner programs and 309 firms in the recently started programs, the actual availability of data reduced the number of firms included significantly. Moreover, some firms do not report turnover, as the law allows micro- and small firms to report only their gross profit. It is also not man-

datory to report the number of employees. Often personnel cost or wages and salaries are used as a proxy for the number of employees but in this case, the data set did not include such information. There are also a number of inconsistencies in the export statistics due to errors or annual allocations. In addition, firm closures also generate data loss. Appendix 2 presents the original number of firms, firms eligible for matching for each variable based on data availability and matched firms.

MATCHING

The final analysis was based on a comparison of the outcomes mentioned above between the program firms and their counterfactual i.e., estimate what would have happened if the firms had not participated in the program. This counterfactual was built by using the matching approach between the program firms.

The objective of matching is that program and control group firms match, based on those known factors that affect the development of the outcome. Through matching, the impact of these factors can be controlled for. The factors that are used in matching are:

- Firm size
- Firm age
- Funding, other than funding from the programs advancing digitalization
- Industry

- Outcome variable, trend before program participation

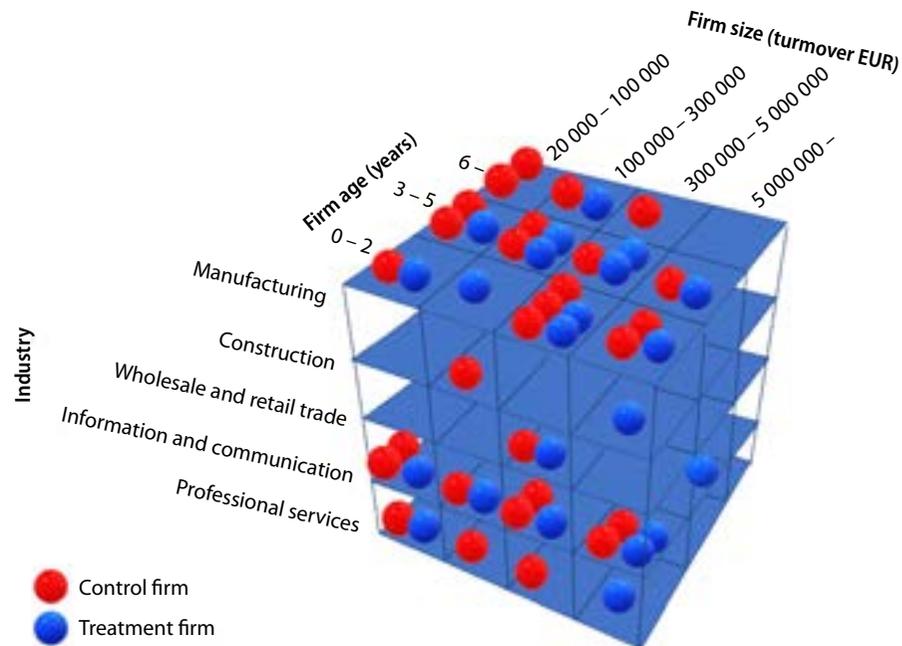
We assume that other, potentially unknown, factors do not significantly impact the outcomes. This assumption is based on the fact that both program and control group firms are Business Finland customers, or at least applied for funding. Thus, we can assume that they are all innovation and growth-seeking firms and the groups do not generally differ from this perspective.

In this study, the specific matching technique employed has been Coarsened Exact Matching (CEM). In the following description, we term the factors above, matching criteria. CEM has some virtues in this case. It is based on coarsened, categorical data which fits well with heterogeneous firms and non-linear linkages between the factors and the result indicators. Unlike some other often-used matching techniques, it allows us to match several control and treatment units to each other making the loss of control data in matching often relatively small. As the samples contain more firms the results of the analysis become less sensitive to exceptional cases. It is also a relatively straightforward technique and intuitively understandable.

Figure 18 illustrates matching when applying the CEM technique. This is a simplified version of the final matching applied in this study. There are three matching criteria in the figure: firm size, firm age and industry. Our

other matching criteria, other Business Finland funding received by the firm and outcome variable trend are not presented in the figure. The industries in the figure are illustrative examples. The combinations of the different criteria levels (small horizontal squares in the picture) are called strata in CEM. Each control and treatment firm is assigned to a stratum based on matching criteria val-

FIGURE 18. Finding matches when applying Coarsened exact matching technique.



ues. The treatment firms are matched with the firms in the same stratum. Sometimes there is only one control firm and one treatment firm to be matched. There are often many control or treatment firms in a stratum. The technique calculates weights for each control firm. These weights take into account the varying number of the control firms and treatment firms in the strata. This procedure ensures that there are equal proportions of similar firms in the treatment and control groups based upon the matching criteria.

The specific categories and their boundaries were identified by analyzing the relation between the matching factors and outcome variables. Appendix 1 summarizes the categories by matching criteria.

Note, however that business cycles impact firm performance. In the forerunner programs in particular, firms experienced changing conditions such as the financial crisis of 2008, the euro crisis and slow recovery towards the end of the 2010s. The base year (year of funding decision) was not used as a primary matching criterion as it would decrease the probability of finding matches. We tested the sensitivity of the findings regarding the forerunner programs by additional matching, adding strata based on funding year (categories 2006, 2007–2009, 2010–2011, 2012–2013). These periods were selected after statistically significant differences in outcome variables during the five-year review period.

The treatment effect can be estimated by comparing the median and mean of the outcome indicator change between the treatment group (firms in the programs) and the matched control group. Unlike mean, median is not sensitive to the types of extreme observations that are typical in firm-level financial indicators, particularly in respect of changes but, on the other hand, it ignores the differences in the tails of the distribution. We also use 'common language effect size' to depict the impact. The Common language effect size describes how likely it is that the program firms exceed a randomly chosen control group firm. We used Mann-Whitney U to test the statistical significance of the difference in the distribution between the program and control firms. The statistical results of each comparison are presented in Appendix 3.

When studying funding, risk is always involved. Some funded firms rocket while others simply fail. Understanding the distribution of the outcome is relevant. In this study, the key findings are presented by using distribution charts that compare the treatment and control groups.

EXPORT PROMOTING PROGRAMS

In the case of export-promoting programs, challenges would have existed to the establishment of a setup similar to the forerunner and recently started programs. The

difficulty here is to define firms that manifest similar intentions from the export perspective to the programs but for some reason did not participate. The industry diversity of the export-promoting programs is large (retail etc.,) and finding the match would probably need the use of external data which in this case would have created a costly and time-consuming process. Another challenge is that there was no clear data available on how and when the firm participated in the export-promoting programs. Thus, setting a firm-level control period would have been, at best, a rather vague solution.

Instead, we compare the growth of the program firms to the growth in their industries over time and study whether their change trends differ during the program years (starting from 2015). We also compare the annual changes among the program firms to see if there are clear progress steps during the program that could be attributed to program activity.

Thus, the export-promoting firms are compared to the development of their industries value of exports. The data to be used are:

- firm-level export statistics from the Business Finland database (original source Customs).
- industry-level export statistics (source Customs).

6.3 FINDINGS

FORERUNNER PROGRAMS

There is a high variation in the outcome indicators among both the treatment and control firms. When comparing them, there are hardly any statistically significant differences in the outcome indicator distribution between the forerunner program and control firms on a general level (see appendix 3). There are however some overall emerging patterns. At the aggregate level of the forerunner programs, the turnover and export growth of the forerunner program firm does not deviate significantly from the control group. Personnel growth does however tend to be slower as 46 out of 100 forerunner program firms have grown faster. The outcomes are achieved with less personnel productivity (value-added per employee) improvement which is stronger in the forerunner firms, however, not at a statistically significant level.

Under more detailed analysis however, some clear differences emerge. There is a clear joint effect in respect of participation in the forerunner programs and other Business Finland funding (i.e., other than funding received from the evaluated programs) especially five years after the project funding. Figures 18 to 21 present the distribution of forerunner firms that have received other Business Finland funding and their control group

that are firms that have received other Business Finland funding similarly (i.e., the substitutes and loans). The horizontal axis divides the firms into 25 equal proportions from least growing (actually deteriorating) firms to extremely fast-growing firms. The values are the medians of each 1/25 of the sample. The middle point of the axis represents the median of each group. Figure 19 reveals that the growth of the forerunner program firms has been generally stronger than in the control group and that there have been more high growth firms among the program firms. The common language effect size is 56 in favor of the program firms.

The growth in the number of employees from five years onwards is illustrated in Figure 20. The control firms tend to increase their personnel faster than the program firms. The groups are however equally present in top recruiters and firms that have reduced their staff. The proportion 10% to 20% growth is significantly larger among the control firms while a more modest growth of 0 to 10% is more common among the program firms. The common language effect size is 45.

Figure 21 elucidates the result of the higher sales growth and more modest personnel growth in the program firms that have received other funding. There are fewer decreasing productivity firms and more firms that have increased their productivity rapidly here. It should however be noted that approximately half only of both

FIGURE 19. Turnover change % five years after the project funding forerunner programs firms received other Business Finland funding distribution.

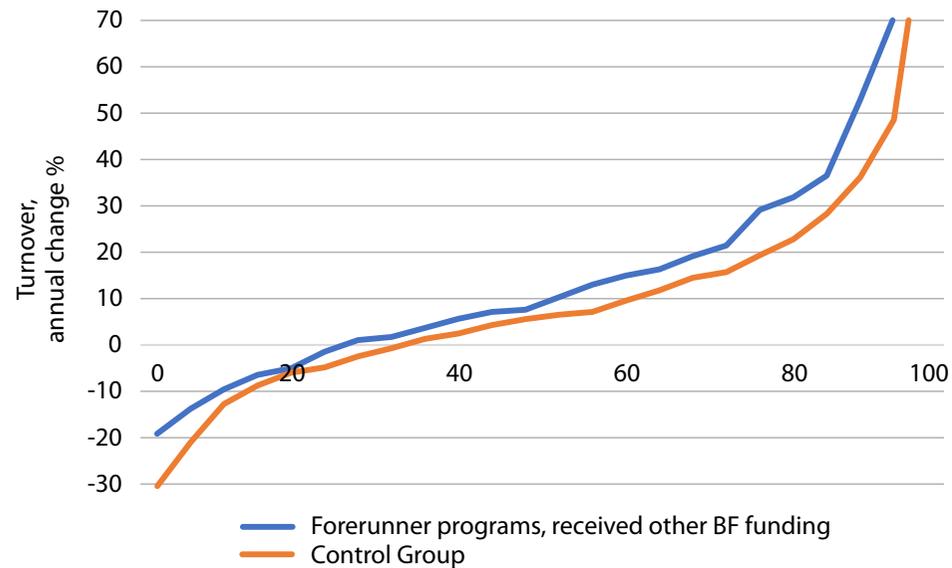
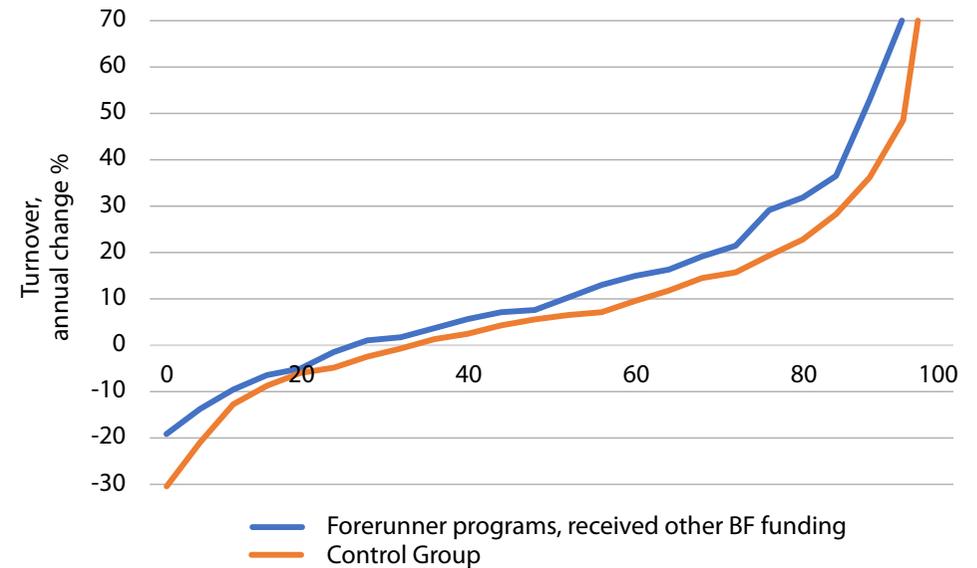


FIGURE 20. Number of employees change % five years after the project funding, forerunner programs firms received other Business Finland funding, distribution.



program firms and control firms have been able to increase their productivity when the change in the value of money has been eliminated.

Figure 22 tells us that there are more firms among the program firms that have significantly increased their proportion of exports in their business, when compared to those that have received other Business Finland funding similarly. There are, however, also a larger proportion

of firms with a reduction in exports.

The program firms that have not received other Business Finland funding do not generally perform better than their control group peers. One reason for this phenomenon may be related to the risk taken by Business Finland. When the risk is taken it can be expected that a proportion of the firms do not succeed. If the firm does not manifest progress in its project, it may have diffi-

FIGURE 21. Value added of employee annual change (EUR) five years after the project funding, forerunner programs firms received other BF funding, distribution.

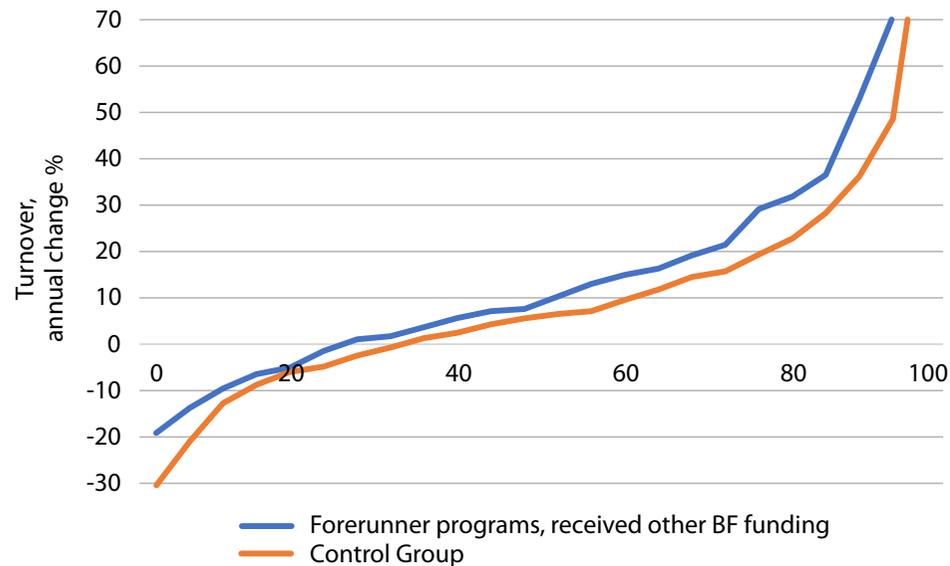
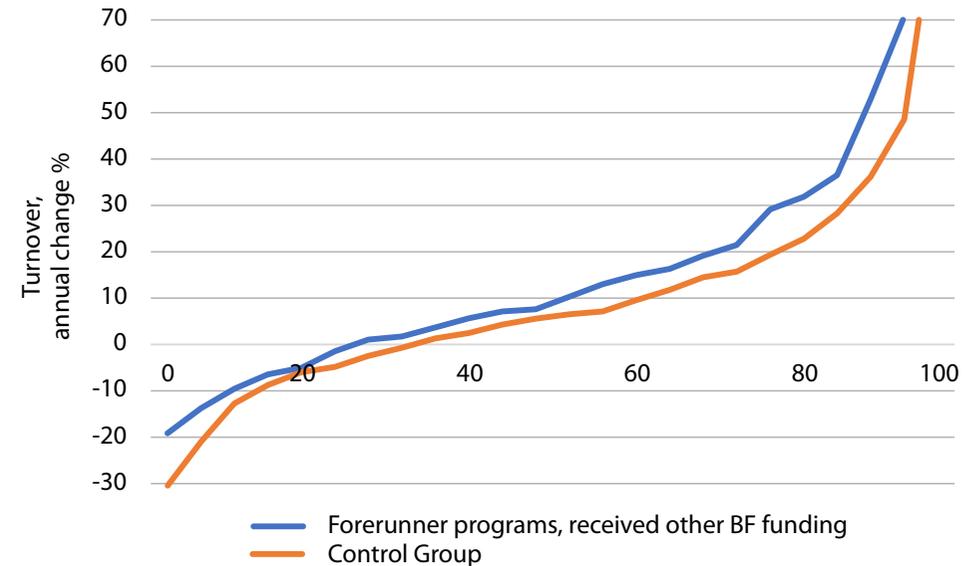


FIGURE 22. Export per sales, annual change percentage points, five years after the project funding, forerunner programs firms received other Business Finland funding, distribution.



culties receiving other Business Finland funding. Thus, poorly growing program firms are more strongly presented in the 'no other Business Finland funding' group than in the 'received other funding group'.

When comparing program firms and control firms only three years after funding is received, the pattern in respect of lower increase of employment in the program firms can be observed. Similar levels of superiority in

turnover could not however be found among the firms receiving other funding (see appendix 3). This indicates that, generally speaking, three years from the funding decision is not a sufficiently time to see the impact of Business Finland programs at least in the case of the forerunner programs.

When focusing on the eight years follow up period, we find that the control firms catch up to the program firms

in terms of turnover growth. This also reflects the finding in our matching criteria analysis that when focusing on the industries typical to the programs advancing digitalization (all firms including control firms) the impact of Business Finland funding reaches its peak approximately 4 to 5 years after the granted funding. The number of employees however remains lower and the productivity higher in the program firms received other funding. This seems to indicate that the projects in the forerunner programs may have had a lasting impact on the operational models.

The firms in the program can have two motivation for their participation – developers that use the funding for creating new products and services and utilizers who use the solution in their business. As the evaluation questionnaire revealed, a large proportion of the program firms attach themselves to both groups. To split the firms into these two types we used industry codes to classify the firms. The industry codes (SIC-2) 26, 61,62,63, 71, and 72 were considered developers while the rest were utilizers. Even though the developer industries were few in number, they make up the majority of the forerunner program firms. As the utilizers are scattered across various industry groups, they are also less likely to find matches in the matching process. For example, 152 of the 177 firms for the five-year turnover change belong to the developer industries grouping. The number of utilizers is small for the outcome analysis (max. 25 firms, depend-

ing on the outcome). We did, however, conduct the same analyses for the utilizers. Due to their strong proportion in the entire matched sample, the findings are practically the same as those presented above.

As noted previously, funding years were not used as a primary matching criterion as this would reduce the number of applicable firms. When controlling for the funding years and using a slightly smaller group of program and control firms, we found no significant differences in the results. This sensitivity analysis shows that the results are not affected by omission of the decision year from the primary matching criteria.

By using the yearly matched firms, we also studied those firms with a funding decision before 2012. These years represent the majority of the forerunner program firms. These firms faced a time of generally low growth in the Finnish economy. Moreover, in this comparison, the firms that received other Business Finland funding outperformed their control group peers in growth (but with a lower increase in the number of employees). We interpret that the forerunner programs and other funding have jointly helped a large proportion of these firms to succeed during harsh times.

In the previous results, the program firms were compared to the control firms that exist in the Business Finland customer base and typically manifest similar growth-seeking behavior. We also compared the results to the industry statistics provides by Statistics Finland. The

financial industry-level data are available from the year 2012 (2013 for the number of employees and value-added per employee). We compared the five-year change in outcome indicators firms that had started in the forerunner programs in 2012 or after and their industry. Table 4 summarizes the comparison between program firm growth and their industries.

This comparison is naturally very indicative. The growth of the industry is impacted by the large firms i.e., weighted by the firm size and does not present the median of the firms in the industry just as the median of the program firms is their unweighted median. The analysis indicates that both turnover and the number of employ-

ees has grown at a slightly stronger rate in the program firms than in the industry as a whole. This can be expected from the growth-seeking firms. However, the increase in productivity (value-added/employee) has generally been weak. A significantly lower median indicates that the vast majority of the program firms have fallen behind their industry average. This may be related to the large proportion of young firms that often have low or even negative value-added in their early years of trading. As noted previously, export growth is binary among forerunner firms and the median is practically zero. Moreover, industry growth is also practically zero.

RECENTLY ENDED PROGRAMS

The statistical analysis of recently ended programs suffers from the fact that they are as they are named ‘recently ended’. A large proportion of program firms joined so late that no three years follow up is possible. Also, the probabilities to find matches reduced when eligible matching forms include only three years (2014–2017). This caused more loss in matching than in the forerunner programs. The results are presented in appendix 2. All results are in this case only indicative.

Turnover growth in the program firms is on the same level with that of the control group and unlike that in the forerunner programs, the firms that received other Business Finland funding also retain the level of the control

TABLE 4. Forerunner program firms compared to their industries.

	NUMBER OF FIRMS	FORERUNNER PROGRAM, MEDIAN	CORRESPONDING INDUSTRY GROWTH, MEDIAN
Turnover, annual change %	52	9.4%	6.1%
Number of employees, annual change %	39	6.3%	4.1%
Value added per employee, change EUR/year	30	313	2889
Export/sales change percentage points/year	46	0.2%	-0.005%

group. This finding is similar to the three-year analysis of the forerunner programs. Even though the recently ended programs were expected to deliver quick results, the visible impacts in terms of the statistics may need to wait for another two years. Similarly, the analysis of productivity (value-added/employee) and exports do not yet demonstrate tangible results.

Behavior, in terms of the increase in employees, differs from that in the forerunner programs, when com-

paring them to their peers. Figure 23 reveals that personnel growth, in the recently ended programs, has not been slower but rather, slightly faster, than in the control group.

The growth indicators of the recently ended program firms were compared to their industries over a three-year period from the project start. The industry-level statistics were available for all eligible starting years (2014–2016). The number of firms exceeds the analyses above because the sample also includes unmatched program firms. The results are presented in Table 5.

FIGURE 23. Number of employees change % three years after the project funding, recently ended programs, distribution.

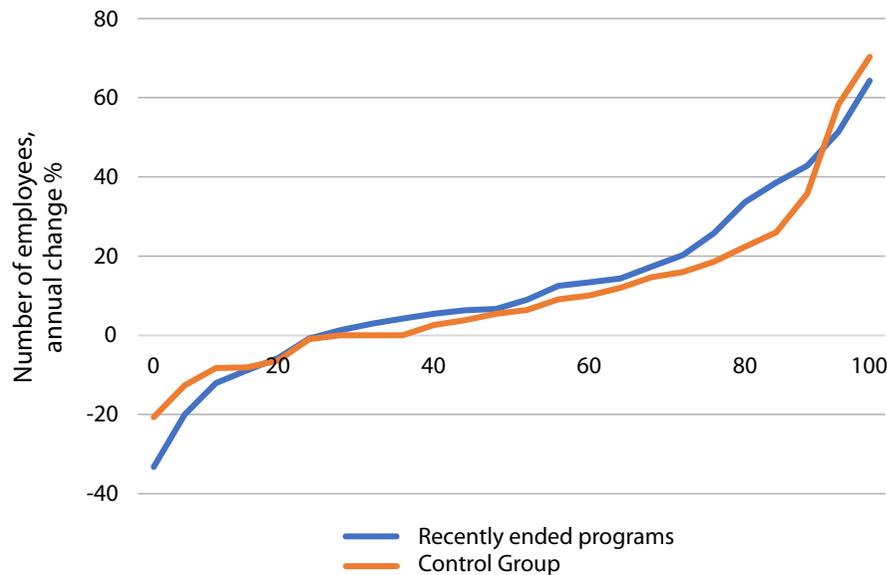


TABLE 5. Recently ended program firms compared to their industries.

	NUMBER OF FIRMS	RECENTLY ENDED PROGRAM, MEDIAN	CORRESPONDING INDUSTRY GROWTH, MEDIAN
Turnover, annual change %	122	9.6%	7.5%
Number of employees, annual change %	102	6.2%	3.1%
Value added per employee, change EUR/year	82	620	720
Export/sales change percentage points/year	122	0.1%	-0,0009%

The results are almost identical to those of the fore-runner programs. Turnover and employee growth exceed industry averages. The median of the growth of the proportion of exports to sales is also practically zero. The only exception here is that the increase in productivity does not fall behind industry levels. The reason does not however seem to be significantly higher productivity in the program firms but rather the decline of productivity in the corresponding industries (which is interesting as this period was in part, covered by the competitiveness pact).

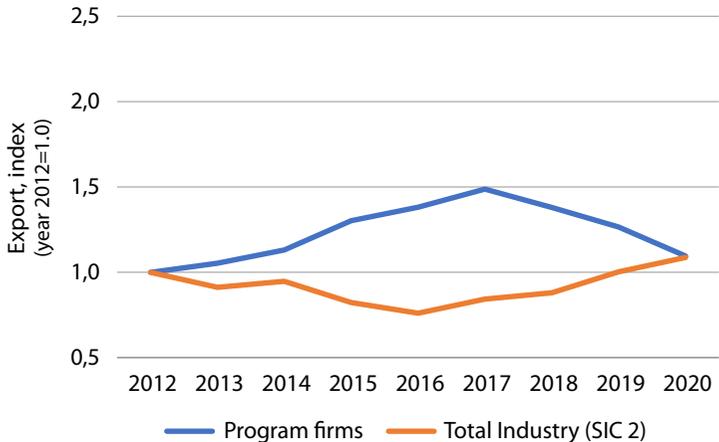
GROWTH PROGRAMS

Export promoting programs were analyzed by comparing their export growth percentages to their industry growth (industries at SIC-2 level). The year 2012 was the index year (value 1.0) that the yearly export value of each firm and corresponding industry was compared to. The years 2013 and 2014 represent the growth occurring before the program starts in the years 2015 and 2016. In addition to the analysis of the aggregate programs, we also analyzed firms by industry group and size. The industry groups were information industries, trade, manufacturing and services (excl. information industries). We used the official industry classifications of the firms here. Thus, the service industries group is a heterogeneous one including, for example, the parent companies of large corpo-

rates operating *de facto* in manufacturing. To see the trend from the year 2012 onwards, the analysis focuses on firms that existed and exported already in 2012. There were 77 such firms in the export-promoting programs. New firms and firms that began export after 2012 are not included. As previously, the figures have been converted to 2020 values.

Figure 24 compares the yearly export index median of the program firms and their corresponding industries. As the firms in the export promoting programs are growth-seeking firms it is no surprise that the exports of the program firms grew faster already before the program. Growth in the program firms were particularly rapid

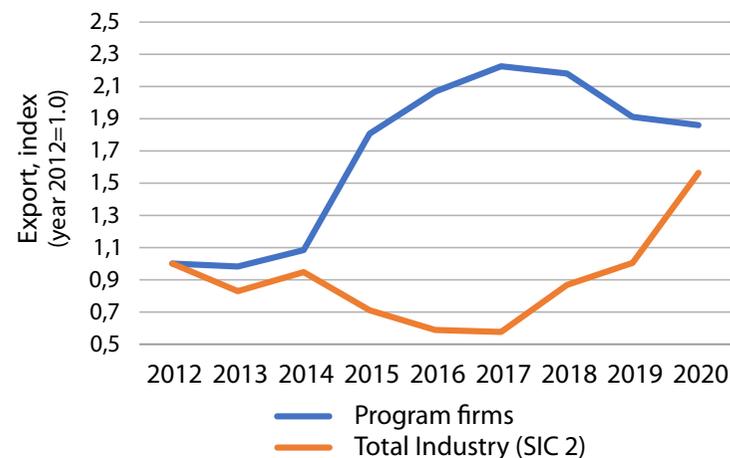
FIGURE 24. Exports compared to year 2012.



during the early years of the program. After the highest growth phase, the median of the export index declined and industry averages have caught up with the program firms. The export statistics include also the year 2020. The strong decline indicates that the Corona pandemic has for some reason hit more strongly the program firms than the rest of their industries.

Figure 25 depicts the development in the information industries. This is the largest industry group by the number of program firms and it has the clearest results. The increase in exports in the program firms was particularly strong in 2015 remaining high in 2016 and 2017. This aligns with the timing of the program.

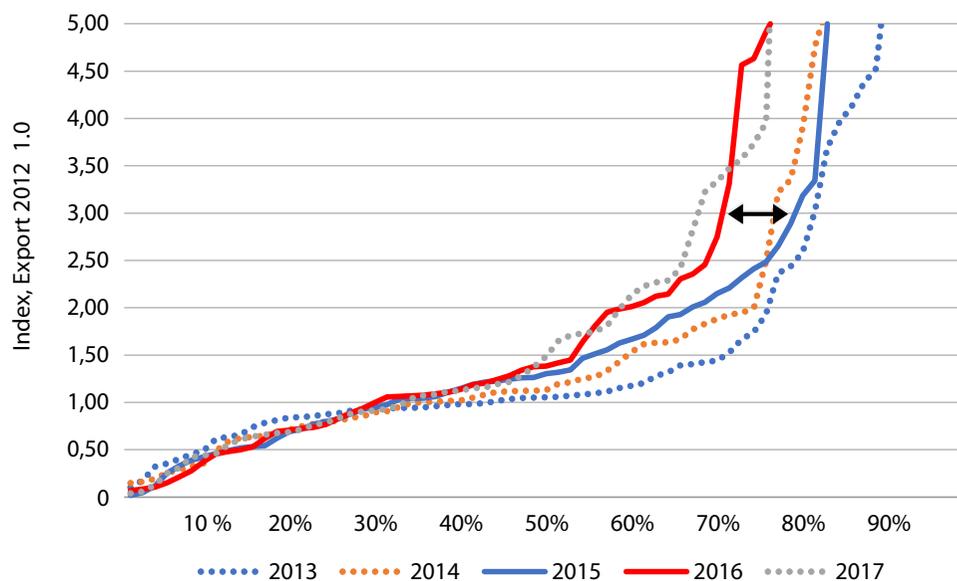
FIGURE 25. Exports compared to year 2012, information industries.



As we can see from figures 24 and 25, the curves of the program firms and the industries mirror each other. There can be a number of reasons for this. The first may be the diminishing returns of export efforts. When the program firm has been a fast-growing exporter, it eventually approaches its limits and it becomes more difficult to increase exports thereafter. Statistically, it may be related to the phenomenon of 'converge towards the mean'. Generally, the extreme high performers tend to decline rather than keep on a high growth path. An obvious reason for the export growth of the industries is the improved competitiveness of the Finnish economy in the late 2010s. Note also that the rest of the industry is not passive and bereft of any export promoting activities. The other industry category includes those firms that have received Business Finland or other Team Finland support but that have not participated in the export-promoting programs, for example, the majority of the firms in the recently ended programs advancing digitalization.

We also studied how the distribution of the export index evolved over time. Figure 26 presents the distribution curves of the firms export index between 2013 and 2017. When exports grow from the baseline year of 2012, the curve moves towards the upper left corner. When comparing the yearly curves there is an unusual shift between 2015 (blue curve) and 2016 (red curve). In one year, the proportion of very strong export growth (index 3.0 or

FIGURE 26. Export index compared to 2012, yearly distributions between 2013 and 2017.



more) increased from 19% for 2015 (100%–81%=19%)¹⁰ to 28% (100%–72%=28%) for 2016. We cannot be certain of the reason for this increase but the timing does also align with the program. When comparing the other changes, we can indicatively estimate that approximately half of the difference between 2015 and 2016 may be at-

tributed to the export promotion programs. In that case, the proportion of the very strong export growth firms increased a few percentage points.

It is difficult to present hard facts about the impact of the growth-promoting programs. Comparison between the index curves of the program firms and the industries and yearly distribution curves suggest that a certain proportion of the progress in the exports of the program firms in the years 2015 to 2017 could be explained by the program activity that took place during these years.

6.4 CONCLUSIONS

We studied the effect of firms’ participation in the programs advancing digitalization in this statistical impact analysis. Three types of programs were evaluated - forerunner, recently ended and export-promoting programs. The analysis was conducted on the level of program types that consisted of parallel projects. An insufficient number of companies existed for the analysis to be conducted on the individual program level. For the forerunner and recently ended programs the approach was based on comparison with a control group which included firms from the BF customer database. Matching was used to make the group of program and control group firms sim-

¹⁰ The index 3.0 vertical axis line and year 2015 curve (blue curve) cross at 81% (horizontal axis). The proportion of firms exceed in the export index value is 100%-81%=19%. This is the right-hand side of crossing point. Similarly, the 2016 (red curve and the 3.0 vertical axis cross at 72% and the proportion of firms exceed export index 3.0 is 100-72%=28%.

ilar in terms of size, age, industry group, other funding received from Business Finland and in the development of the outcome variable before the program firms joined the programs. The firms in the export-promoting programs were compared to their industry. In addition, the yearly change in exports was studied.

In the next text section, answers are presented, to the main research questions in the statistical analysis:

Have the forerunner programs had an impact on the sales, job creation, productivity and exports of the participating firms?

The answer is yes, but only when Business Finland funding is involved. Turnover, productivity (value-added/employee) and export/sales grow is faster in the program firms that have received funding than in similar firms that have not participated in the forerunner program. The number of employees has however grown at a slower rate in these firms. The results are strongest five years after the funding decision. The outcomes of the firms that have not received other funding do not differ from their peers.

Have the recently ended programs had an impact on the sales, job creation, productivity and exports of the participating firms?

Even though quick project outcomes were expected, it is not yet possible to answer this question comprehensively. There are some positive signals, particularly in relation to

stronger turnover growth in the program firms compared to their peers. It remains however too early to answer definitively given the paucity of strong evidence. There was a relatively low number of observations in the analysis because only the projects that had started before 2017 could be included. This reduced the number of both program and control firms and impacted matching.

Are the outcomes different in developer firms and utilizer firms in the forerunner and recently ended programs?

The developer firms dominate the sample. The conclusions above also provide a good depiction of the developer firms. The sample of utilizers is too small to draw statistical conclusions at this stage.

Have the export-promoting programs had an impact on the exports of the participating firms?

There is no conclusive evidence here because a quasi-experimental set up was not feasible in this case. There is however a spike in the proportion of firms that have increased their exports during the export-promoting programs. There is also a clear positive difference in the trend-line of exports of the program firms after the programs have started when compared to the industry as a whole. The impact on exports seem to be only temporary as the median of exports of the program firms declines and converges towards the industry median within a few years.

OVERALL FINDINGS

We consider that the results are primarily contextual. In particular, the results in relation to job creation are mixed. The comparison with industry employee growth shows that both forerunner and recently ended program firms increased their employees more than their industries. This is to be expected because the firms involved are mostly micro- or small enterprises. According to the statistics (see e.g., Suomen Yrittäjät), jobs are generally created in the SMEs rather than in the large firms that dominate the industry statistics. When compared to the similar firms in the control group we found that the forerunner program firms grew more slowly than their control group peers and that this phenomenon is related to the firms that have also received other funding. The recently started firms behaved in the opposite manner. Previous impact studies, for example, the evaluation of the human-centric programs, indicated that the impact on the number of employees is positive.

We wish here to highlight two insights from this study:

1. Impacts take time

We found that the impact was strongest in the forerunner programs after a 5 years observation period. For the shorter time period (3 years) the impacts studied both for the recently ended and forerunner programs were lower. In the three-year period, the project is sometimes still continu-

ing. We found that the impact on turnover vanished after eight years. The reason here may be that after 8 years, both the program and control firms have participated in other initiatives that may also have had an impact.

In addition to the primary analysis, we had to study how other Business Finland funding impacted the outcomes, especially turnover. This analysis was conducted by using all available observations. This analysis revealed that the other Business Finland funding 'doses' were most effective when received 3 to 5 years beforehand. The results were used to determine the strata for the other BF funding in matching.

Based on these findings we encourage the use of long-term analyses. An overall study of the Business Finland customer base would shed more light on this topic. The outcome could, for example, be used when designing new program evaluations.

2. Joint Business Finland efforts matter

Even though the overall effect was relatively small, there seems to be a clear and positive joint impact in terms of the program and other Business Finland Funding and this impact is generally manifested after five years. In this case, the common language effect size is approximately 55 in turnover productivity and exports (and the opposite, 45 for the number of employees).

In this project it was not possible to study this topic in detail, but it is probably worth further investigation.

LIMITATIONS

It is difficult to provide indisputable evidence of the effect of the program. First, the variation in outcome indicators among the firms is large even when the known factors are controlled for. The firm management, culture and network capital, other projects etc., impact significantly on outcomes. The other factor is the nature of the programs themselves, especially in funding terms. Risk is central to the process and it is taken by Business Finland. We can see from this that many firms succeed but there are always firms that fail. The proportions of successful and modestly growing or even deteriorating firms in the program may be close. At the level of a typical program firm, the median effect tends to be modest compared to the control group peers.

In this case, the statistical analysis suffered also from a low number of program firms especially when missing data was common. When combined with the high variation the effects are typically insignificant. The non-parametric test used to study the difference in the distribution has less power than parametric techniques i.e., it tends to retain 'no statistical significance. In this case, when we have multiple periods, sub-groups and outcomes we need to consider the consistency of the findings.

7 OVERALL EVALUATION OF THE PROGRAMS ADVANCING DIGITALIZATION

RELEVANCE

During the last 15 years, Business Finland programs advancing digitalization have made an important contribution to promoting digitalization in Finland. Different program groups as a whole have met the development needs of different time periods quite well and anticipated future developments. Only in a few programs would a different implementation time have added more value to the development of digitalization. To some extent at least, more added value could have been reached if programs had been started more proactively and in the case of few programs they were also slightly late from a business perspective.

In relation to the others, these programs have formed various continuums of development activities. As one program ended, the following programs have been able to build new development activities upon the work of the old programs. Similarly, the programs implemented simultaneously have also successfully complemented each other

and responded as a broad simultaneous measure to development needs. As promoting digitalization concerns a wide range of different industry sectors, different types of actors and different kinds technological application areas it has been important that Business Finland has implemented several different programs, each focusing on different kind of needs. As a whole, the programs have covered the main digitalization themes and application areas that have been deemed relevant over the last 15 years.

One important factor behind the successful relevance of the programs has been the well-structured Business Finland foresight and strategy processes. Close relations with internationally renowned foresight organizations and with European sister organizations, with whom active information exchange and benchmarking have been done, have contributed to strengthening the growth of digital awareness in the domestic innovation system and the relevance of the programs. The close dialogue with both the research community and the business community has also been important. This dialogue has created

a strong foundation of trust and activated companies to participate in program activities (information exchange, networking and financial cooperation).

IMPLEMENTATION CONCEPTS

The general development curve of Business Finland's programs in the period 2005–2019 can also be seen in the programs advancing digitalization. At the time of the forerunner programs, programs were more technology-driven and research-based, generally relating to a specific digitization theme. These programs were aimed at enhancing technological readiness and know-how from a longer time perspective (5–10 years). More recent programs have placed greater emphasis on technology application, networking, ecosystem development and on the commercialization of technology and the internationalization of companies. In these programs, the focus has been broader and/or closer to business promotion. The time-span for expected impacts has been shorter (roughly 5 years or less). It should however be noted that both the evaluated forerunner programs and the evaluated recently ended programs have had program pairs/entities running at the same time which have included basic research, pre-study, standardization and more applicable more business-oriented activities at the same time. Several individual programs have also had a life cycle: at the first stage, focus has been on research-activities and

the forming of networks and partnerships (collaboration community), this has been followed by testing and piloting solutions while during the final phase, focus was generally placed on application and commercialization. This has proved to be a good operating method. Even though the emphasis changes a bit between programs, similar kinds of content can be seen in the programs implemented across different time periods.

As a concept, the simultaneously started programs worked reasonably well, even though the expected benefits and added value were not all achieved. Program collaboration (e.g., networking events, marketing) gave a stronger profile and attention to the digitalization theme compared to the likely situation had the programs had been implemented separately. The programs could however have been better managed as a whole facilitating the flow of important information between them. Information on technological solutions was passed between the programs thus improving the wider awareness of the actors involved in respect of the possibilities of digitalization. The challenge here was that there was never enough time and human resources for continuous cooperation between the three programs. In addition, promoting technology transitions between programs was particularly challenging, since technology development was in the early stages of the innovation process in one program, while other programs promoted the application of more complete solutions.

The growth and invest-in programs followed the traditional operating model of these kinds of programs. Good practices here have included the use of local expertise in other countries, various peer development structures and active national networking. In the future there is a need to advance internationalization more strongly based on the needs arising purely from business initiatives.

The growth and Invest in -programs were also fairly well connected to the simultaneous technology/innovation programs. Close cooperation existed between the programs as they sought to promote technological development and business growth and investment in a common digital theme. Importantly, the innovation and technology -programs have benefited from the existence of counterpart programs focusing on growth and invest in. This has helped to promote digitalization more comprehensively taking into account innovation as well as commercialization and internationalization.

The other significant program implementation concept, was the merging of several programs into a larger program combining innovation, export and investment (the CIIF 2022 -program). From this concept only a limited amount information was received, as the program lasted for a short period of time and its original purpose changed from testing the new concept, to concluding the merged programs successfully. The program did however provide useful experience for future programs, particularly on how innovation and exports can be promoted

simultaneously and how to take into account different thematic areas of digitalization simultaneously in the context of a large-scale program. More importantly, these types of programs can more easily gather together and steer the development work towards the desired systemic level goals. The implementation concept can offer possibilities in terms of promoting the innovation and commercialization process as a whole as well as helping to develop ecosystems more holistically while responding to broad-based phenomena challenges. The challenge in terms of large-scale programs can often be the sublimation of individual important thematic areas to the whole, ultimately creating a lack of focus, as well as communicating successfully the core issues of the program to the target groups. More detailed information on the functionality of this type of program concept will be obtained from newer Business Finland programs.

On the services of the programs, those that promote co-development and networking with other actors (co-development platforms, networking events, etc.,) were found to be most useful among the target groups. The programs have also played an important role in the formation of new collaboration networks with connections to international cutting-edge research. These kinds of services have also brought clear added value to the program's target groups which would have been difficult to achieve without the programs and Business Finland resources.

Overall, the implementation of the programs has been largely successful and those involved in the programs have been generally satisfied with what they had to offer (when compared to funding alone). The only clear challenge in terms of implementation regarding several programs, has been the limited availability of human resources in relation to the broad objectives of the programs. Funding can be used on a wide range of projects, but in respect of other program measures that required resourcing opportunities to do this were much more limited.

IMPACTS

The role of Business Finland in the national innovation system is primarily to support the implementation of applied research. With the exception of the GIGA and 5th Gear programs, all implemented programs are of the type explicitly advancing applicable research. Therefore, their results and effectiveness should be evaluated for the most part from the perspective of applied research and to some extent also from the strategic basic research perspective.

Looking at the ‘big picture’, the forerunner programs have clearly helped promote technological development, a culture of collaboration and the ability to engage with/readiness for digitalization in the 2010s. On this basis,

they have helped built the foundations for the newer programs. Therefore, the overall impacts of the forerunner programs are solidified in many ways in the combined effects of the later programs.

One such important combined effect has been that they have increased the capacity of Finnish actors to keep pace with technological developments. This has, in practice, meant not only the ability to develop technology but also to utilize it. What has been important here is the raising of competence levels and increasing understanding of emerging new knowledge around digitalization.

As the programs were formed in cooperation with Finnish research organizations and companies, acting to gather important actors together, the understanding and common vision of future developments has also improved. This common understanding has also been updated as new programs have emerged.

A further important impact has been the activation of cooperation between Finnish actors and the pooling of their resources to be utilized in a common direction. In this regard the programs have played an important role, as they created platforms and environments for cooperation. Over time, the mindsets of the various organizations involved have also evolved, as co-development and experimentation are seen as more valuable strategies. This, in turn, has allowed new cooperation networks to emerge and a more efficient division of labor between

actors. These new forms of cooperation have allowed benefits to accrue to different actors as well as promoting the ability to develop and utilize digitalization more fully.

Similarly, the opportunities for international cooperation have also improved and cooperation networks have developed. Through networks technological information from around the world has been obtained, strengthening ties with international partners. Moreover, the international operation of the programs has provided new business opportunities for the participating companies, followed by the creation of new international business opportunities for these companies.

The impacts of the programs have arisen from different streams. One important stream has been the production of new research data for applied purposes. This information has opened up new business opportunities as applications based on the research information have been piloted and tested. From this, new products and solutions have been created and utilized.

The results of the strategic basic research have improved the general level of capacity for future technological leaps. The importance of this has been particularly evident in the development of mobile technology (4G, 5G).

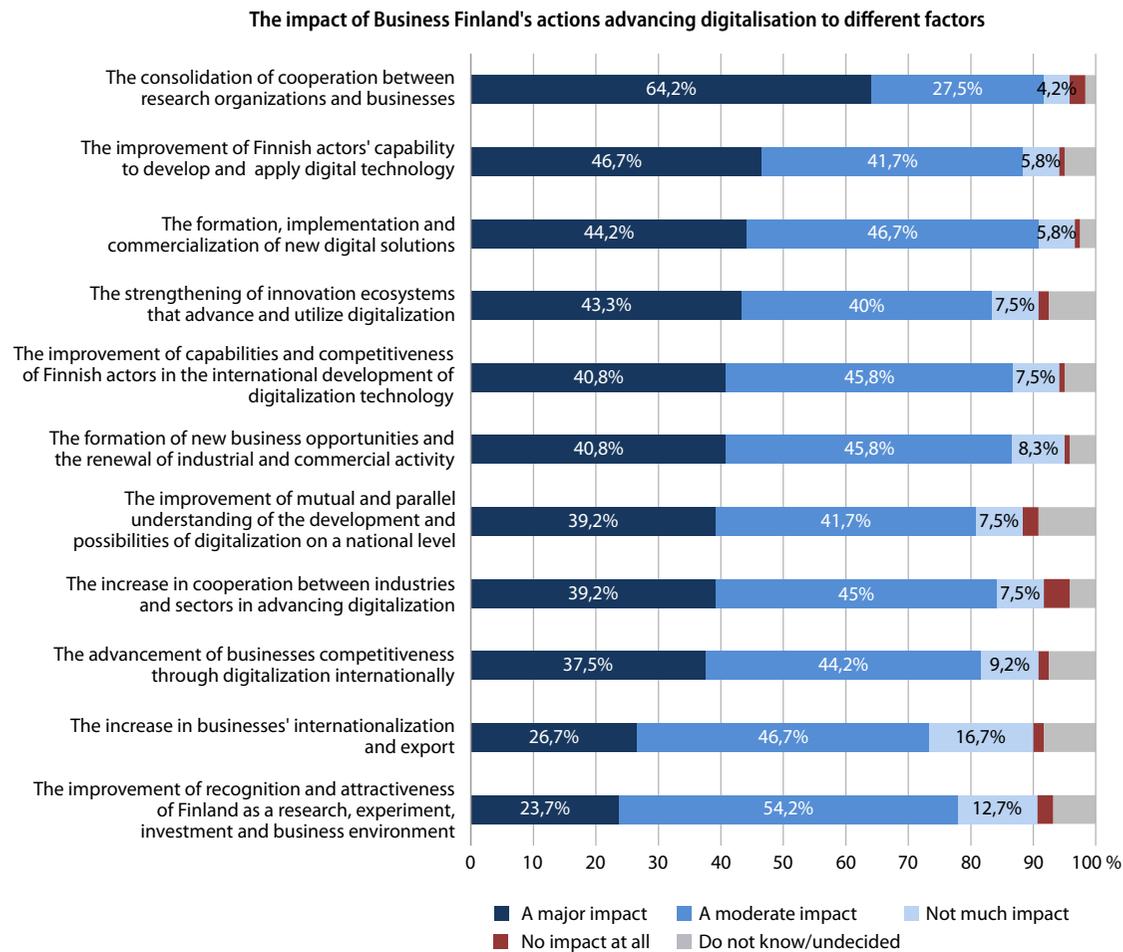
More broadly, the programs have improved cross-industry understanding of the potentials of digitalization.

This will potentially allow for the better practical application of digitalization in the future. In this respect, work remains to be done, as the impact of the programs is limited to a certain number of actors active within the programs.

Special emphasis in this evaluation was placed on the statistical analysis, using control groups, control samples and advanced statistical methods. The goal was to understand the impacts of the programs on the key business metrics (turnover, personnel, exports etc.). The evaluated programs, as part of other factors, have created positive growth impacts for a substantial number of the companies participating in the programs. It has to be noted however, that these impacts have varied depending on the time of program implementation. In the fore-runner programs, program and other Business Finland funding created positive synergies for many companies which are reflected in higher turnover, exports growth and improved productivity during the 5-year review period. For the newer programmes, some positive impacts in the shorter time period are observed in staff growth. It should however be noted that the positive results concern only some of the companies involved while differences in performance also exist between different companies.

When looking at the overall approach Business Finland has undertaken to advance digitalization (programs and other actions), significant impacts have clearly been

FIGURE 27. The overall impact of Business Finland's actions advancing digitalization to different factors (evaluation questionnaires for company and research organizations).



achieved, from the funding-receivers point of view. According to the evaluation questionnaire, the most significant impacts have been achieved in advancing cooperation between companies and research organizations. This linkage is obviously crucial to ensure that the latest research data can be used in business so that these organizations can produce new solutions in cooperation. Business Finland's actions are also important here since, according to the latest studies, in recent years the trend in terms of the collaboration between research institutes and companies has been on a downward slope¹¹. Other important impacts reflect the increasing capability and know-how of Finnish actors, development and commercialization of new digital solutions as well as the networking and cooperation of actors in different networks and co-development environments. Impacts have also been achieved in respect of business internationalization and advancing the national 'brand' of Finland internationally, though these impacts are not as significantly recognized in the questionnaire.

¹¹ Koski, I; Suominen, A & K. Hyytinen (2021) Selvitys tutkimusyrittösyhteistyön vaikuttavuudesta, tulokellisuudesta ja rahoittamisesta. VTT Oy.

ADDED VALUE

In terms of the big picture, the purpose of the evaluated program portfolio has been to increase Finland's digital competitiveness and strengthen the national knowledge base for digitalization. The programs and their continuum have aimed at enabling actions that would not be taken without them, thus bringing added value to digitalization development. The programs have added value and their significance can be seen in a number of ways.

As a whole, the programs have provided a long-time horizon for the development of digitalization and highlighted important areas for development work. This has meant that digitalization development has been carried out in a parallel manner. The programs have also offered a vision for the future for a wide range of actors.

As the evaluation results show program funding has enabled research and development actions to be taken which would not otherwise have been possible without program funding. The program funding has therefore been targeted at measures where its leverage has been significant. Important development impulses have been enabled that are in line with the objectives of the programs while the development work involved here could not have taken place without this funding.

At the same time, the programs have also generated new operation models, platforms and co-operation environments where work could be done more effectively. This has enabled the formation of new networks and the development of ecosystems based on advancing digitalization. These new operating models have been created with program funding and with the support of the programs. The operating model was also developed during the time-span of the evaluated programs.

Major added value from the program funding also includes that it raised the level of the project implementers own financial investment in the development work. Given this, research and development work was carried out with greater combined resources and thus more effectively. This positive impact associated with the funding is particularly important in the case of large companies, and through them, for the development of the national innovation system. Financial support to large companies often generates significant additional investment for risky applied research projects that would not otherwise have materialized. In terms of funding, Business Finland has directed large companies to cooperate with universities, research institutes and SMEs. The models of cooperation have created a close network of trust between all of these actors and thus contributed to the development of the national innovation system.

The added value of the evaluated programs is detectable in the following aspects:

- Gathering a key set of actors and strengthening a common vision on the development of digitalization and necessary action.
 - Providing a longer-term perspective for Finnish actors on digitalization development
 - Enabling the development of new cooperation networks and platforms
 - Enabling new research data and solutions and accelerating their use in different industries
 - Improving the skills and capabilities of actors to develop digital solutions and utilize them
 - Development of new ecosystems and industries that utilize digitalization
- Enabling routes to and support for companies seeking international markets that would not otherwise have been available, especially for the SME sector
 - Better accessibility to international networks and funding
 - Strengthening the image and brand of Finland in various areas of digitalization
 - Invest-in operations which have created new investments in Finland and raised the national business service network's knowledge of the possibilities of Invest-in activities related to digitalization.

8 CONCLUSIONS AND RECOMMENDATIONS

The 15 years of Business Finland programs advancing digitalization that has been evaluated in this study has covered a wide range of digitalization themes and has addressed fairly well the emerging and future needs of both the operating environment and the target groups. The programs have also hit the time windows where their added value has been significant. Although Business Finland has been quite successful in its foresight actions, the future development of digitalization must be understood as a continuous and cyclical thing while a more proactive, strategic, approach is nevertheless still required. As regards a number of the evaluated programs, an even bolder, more proactive approach would have been beneficial in ensuring that Finns were in an even better position to compete with their competitors. In order to succeed in this, Business Finland must have a good overall view of the future development of digitalization. Furthermore, managing the program portfolio requires a more strategic approach and the ability to lead and manage programs as a whole. Moreover, it is particularly important to ensure synergies between programs linked to different digitalization areas.

In terms of the overall impacts of the evaluated programs it has been important that the programs have not only concentrated on applying technology but that they have built capability for future technological breakthroughs. In recent years however, stronger emphasis has been placed to the application and commercialization of digital solutions. In the future, there is also a need to ensure, through adequate basic and applied strategic research, that a basis for technological development and technological breakthroughs exists in the coming years. This should also be reflected in the content of programs linked to the various areas of digitalization. Without this, Finns will face difficult challenges in keeping up with developments in the digitalization field. In the future, the challenge is that the pace of digitalization and market developments will likely accelerate, meaning that time windows are shortening in terms of the relevance of such programs. As such, it is important for program implementation that they can flexibly adapt to rapidly changing needs and environmental requirements.

In implementation terms, the programs have complemented each other fairly well, facilitating continuity in relation to R&D&I activities across program cycles. Several continuity paths in technology development and commercialization have been formed between the programs. This has been important in terms of the wider impacts generated in the evaluated programs, as new technological solutions can be built on top of the old ones as it is often possible to utilize the lessons learned from previous technology development exercises in the new transition stages. The technology transfers between programs have worked better in successive programs, rather than in those programs implemented simultaneously. This is mainly due to the fact that the maturity of the technology has not been sufficient to be transferred from research-oriented programs to application-oriented programs. The level of preparedness for the application of technologies should therefore be critically assessed when it is desired to promote technology transitions between programs.

Different types of program implementation concepts have been tested among the evaluated programs. **Benefits can be attained by launching programs simultaneously, strengthening the cooperation between different programs and steering them as an integrated program package.** Better visibility for the digitalization theme can be achieved by gathering the programs together, the ability to manage and coordinate program

activities can also be improved, information sharing can be enhanced, technology transfer can be promoted better and networking between actors in different programs can be improved. This concept can improve the effectiveness of the programs as compared to the situation where they would be implemented separately. Thus, the implementation concept can bring added value, but it requires a planned implementation and a strong commitment from all of the parties as well as a sufficient level of human resource to implement cooperation.

Lessons were also learned from the implementation of the wider horizontal program concept which has itself become a more common concept across Business Finland programs in recent years. The type of program evaluated here undoubtedly addresses the desired wider impacts on systemic changes that are core to Business Finland's agenda. The strength of the concept is also that it provides the possibility of facilitating a smoother transition in terms of digital technologies between application areas, the possibility of a more efficient and coherent innovation-commercialization process and greater visibility on the digitalization theme. These types of programs can more easily gather together different resources and steer development work towards the desired systemic-level goals. The real challenge here, on the other hand, has been the lack of focus and the breaking up of program implementation into small segments as well as the disappearance of individual thematic areas in these

more broad-based programs making it more difficult to reach the desired target groups with a clear message on how the program can benefit them. These broader programs have included both short-term commercialization/export projects and large-scale longer-term (basic) research projects. This poses challenges in terms of their efficiency and effectiveness as it is hard to create synergies between different actions that try to create impacts across variable time horizons.

Discussion has been ongoing over what type of Business Finland programs are needed in future to further advance digitalization, specifically, whether broad-based or more focused and smaller programs are required. Digitalization has a crucial role to play in most major societal themes and challenges (sustainable development, climate change, population ageing etc.,) as well as in promoting systemic changes. With these kinds of challenges, broader programs are needed. Digitalization should be a key tool in the broad-based programs designed to tackle these issues. At the same time, there also remains a need for programs emphasizing a stronger and more focused approach to certain, specific, digitalization areas and this requires smaller, more tightly focused programs. Both program types have their benefits and based on the evaluation there is a need for both types of programs in the future.

Overall, Business Finland should, in the future, also have a role in choosing the digitalization themes that are

important, focusing investments on them proactively. More generally, the programs should play an important leadership role (or should be attached) in pioneering and guiding the development work. There is also a need for more forward-looking programs as well as programs that take advantage of existing opportunities in the short term.

In those programs advancing digitalization, co-operation between research organizations and companies has worked fairly well as has the approach to co-development developed between technology developers and utilizers. In future, synergies between business-based short-term actions and longer-term research projects should however be further supported. One challenge here has been that the current funding instruments do not adequately support the transition of a technology from test environments to business markets. Discontinuity points emerge, for instance, when the results of good research projects do not lead to the development of a profitable business dimension. Similarly, technology transfers from developers to utilizers and between industry sectors continue to require support. This would seem to require the creation of even more precise operating and process models to support these transfers.

More broadly, in many industry sectors, investments in digitalization are small in relation to key competitor countries and there are (growing) differences in the utilization of digitalization among Finnish companies. Fin-

land's special challenge has been the slow adoption for new value creation made possible by digitalization. The biggest obstacle here has been the know-how of adapting digital solutions to use. As such, it is important for Finland's competitiveness to invest more heavily in the digitalization of different industries. In the future, digitalization will affect all industry sectors and companies. The potentials inherent in digitalization should therefore be aggressively exploited.¹²

From a longer-term perspective, the role of the forerunner programs has been particularly significant in responding to both ongoing and upcoming technological breakthroughs and in building a foundation for the development actions for the newer programs. The programs acted as a bridge and as a guide for technological development at various technological turning points from 2005 to 2014. A key factor here has been the strengthening of technological know-how and capabilities as well as the production of cutting-edge research data, building a proactive vision for future developments and the mobilization of development communities and resources to further the desired development.

The recently ended programs have particularly impacted the development of 5G technology and its applications as well as the creation of new ICT/IoT solu-

tions, raising awareness of digitalization in various industry sectors, the strengthening of a culture of co-development and the development of digitalization in certain industry sectors. At the company level and that of the research organizations participating in the programs, the key impact has been the improvement of understanding and competence enabling them to develop and utilize digitalization and the opportunities created with regard to expanding into international markets.

The evaluated programs have created a number of positive impacts in relation to the growth of those companies participating in the programs. It must however be noted that the impacts have varied depending on the time period during which the programs were executed. In the forerunner programs, program and other Business Finland funding created positive synergies which are reflected in higher turnover, export growth and improved productivity. For the newer programs the impacts, given the shorter time period, can mainly be observed in relation to staff growth. This shows that programs can bring added value to the development of some companies. The important thing is making the right choices in terms of which companies should be supported, determining what kind of support is required and what is the right time to target actions to the selected companies.

¹² e.g. Sustainable Digitalisation Strategy for Manufacturing Industry - Background Report, 2020. Ministry of Economic Affairs and Employment of Finland.

In conclusion, the programs have enabled and boosted digitalization development in Finland, steered its direction and affected the operating culture over the last 15 years. Without these program activities, attempts to promote digitalization would have been more fragmented and lacking in a common vision of the future. The programs have undoubtedly played an important role in promoting Finland's long-term competitiveness.

The programs have also played an important role in connecting Finnish digitalization development to the EU level. Through the programs, Finnish actors have enjoyed better access to EU-level development networks, programs and partnerships. Importantly, the programs also facilitated access to EU funding for development activities. This has increased the level of resources available and enabled a larger volume of development work to be carried out. Maintaining and enhancing this connection into EU-wide networks should be a high priority driver for future programs.

Combined with various other developments, the evaluated programs have enabled Finland to gain a leading role in utilizing the opportunities presented by digitalization. The question is, how this advantageous starting point can be secured and exploited in the coming years. In the near future, significant sums of money will likely be used in relation to digitalization elsewhere in the world, especial-

ly in Asia and North America. State-led efforts are already being made in relation to different digitalization themes such as smart cities and smart mobility which will contribute significantly to the development of digitalization in these parts of the world. The levels of resource used are also likely to be many times higher than that allocated to digitalization in Finland or even in the EU and other European countries. This represents something of a challenge to Finland and indeed to the entire EU region. In Finland and in the EU, a comprehensive vision and approach is urgently required in respect of how digitalization should best be advanced as well as the level of resource required for this task. Digitalization should be recognized as an integral part of advancing large-scale systemic change. In this, state-level interventions are required at both the national and EU levels. As the challenge concerns wider systemic change, actions should be taken not only in relation to the company level but also as regards society more broadly. Finland and the EU region as a whole have established a good starting point for the promotion and exploitation of digitization across a number of broad themes that can generate economic benefits and more business. For example, the twin transition which means the combination of digital transformation with sustainable development can offer huge opportunities for Europe, as the European Union's Green Deal provides 750 billion euros in funding for sustainability over the next seven

years¹³. While other countries are concentrating more on the data economy, Europe could become the leader in twin transition.

In advancing digitalization, a series of broader-scale measures are required, measures which Business Finland or even Finland itself cannot implement alone. Nevertheless, Finland does have the opportunity to play an important role here as an exemplar. In order to do this and help Finland to keep up with global developments in digitalization, Finnish actors should be helped to think and act bigger. The starting point for the planning and development of actions should be a global systemic entity, so that the results of the development work undertaken do not remain only national, but can be scaled to Europe and indeed globally. In this approach other Finnish actors besides Business Finland, such as, for instance, Team Finland and the Academy of Finland should also be included. It is important here however that the resources of national actors should be pooled under a common vision of development. Influencing in terms of the systemic approach should be done at both the European and global levels.

As a whole, the programmatic efforts undertaken have proved an effective way to advance digitalization (compared, for instance, to simply allocating funding without programs) and it is clear that programs can bring

added value to digitalization development. Through the programs a tighter focus could be placed on important aspects of digitalization and resources and support could be targeted to the necessary actions and development activities. These perspectives should be taken into account and thus should influence individual programs implemented by Business Finland in future. It remains a key aspect of Business Finland's work to promote better business conditions, know-how and capabilities, to create and strengthen networks and cooperation and to act as a gateway opener.

8.1 RECOMMENDATIONS

The recommendations of the evaluation reported here are divided into three categories: 1) Recommendations to Business Finland on the promotion of digitalization, 2) Recommendations regarding the development of the program instrument and 3) Recommendations relating to the development of R&D&I- and export promotion measures strategically. These recommendations are based on the development needs and learnings derived from the evaluation material. The role of the recommendations is to provide views to Business Finland on how digitalization should be promoted in the future as part of the organization's operations.

¹³ The European Green Deal. European commission. ><https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640&from=EN><

RECOMMENDATIONS TO BUSINESS FINLAND ON THE PROMOTION OF DIGITALIZATION

The digitalization theme has been a significant part of Business Finland's activities during the period of the implementation of the evaluated programs. Business Finland has invested in securing relevant expertise on the theme and at the same time cooperated with key parties to ensure the best possible understanding of it. In the coming years, wider themes/missions aimed at systemic change will be emphasized. As advancing and utilizing digitalization is a crucial theme for the success of Finland and its businesses, it should remain a separate focus area and should retain its importance in relation to Business Finland's ongoing agenda.

Recommendation 1. In the future, the digitalization theme must be given significant weight as an independent theme in Business Finland operations. Moreover, within Business Finland there should be a clear overall understanding of the future development of digitalization in different areas and a body responsible for promoting the digitalization theme as a whole. In addition, it is necessary to ensure sufficient expertise exists in Business Finland's operations for different digitalization areas.

In the coming decades, a significant amount of public resource will be invested in digitalization in other parts

of the world. In order to succeed in this competitive environment Finland and Business Finland need to think bigger and must utilize EU-level cooperation networks and resources.

Recommendation 2. Promoting digitalization through international and EU-level networks and funding must continue to be a key priority for action. Finnish actors should be linked more tightly to these international networks and additional resources should be sought from around the world to support our own efforts and resources.

More recent efforts regarding digitalization have focused more on creating shorter-term impacts and in particular on application and commercialization efforts.

Recommendation 3. In the future, adequate measures should be taken to ensure longer-term impacts that are aimed at the promotion of future technological developments and new research directions. Essential to this is that sufficient support is provided for proactive, basic strategic research, pilot studies and applicable research to create readiness and ensure capability when a new technological breakthrough occurs.

Promoting technology transfer between application areas has been identified as an important and also somewhat challenging issue in promoting digitalization

Recommendation 4. The transition of digital technologies from one application area to another requires more detailed level of process modelling in terms of how, in practice, transitions occur and succeed for different industry sectors and different types of companies.

RECOMMENDATIONS REGARDING THE DEVELOPMENT OF THE PROGRAM INSTRUMENT

In recent years, Business Finland has implemented large-scale programs which have included activities that promote research and innovation as well as commercialization, export promotion and investment attraction. They have also been extensive in their thematic areas, where digitalization has been 'only' one of the program themes. In the future, different types of programs should be promoted, but a significant amount of weight should be placed on advancing digitalization as its own theme.

Recommendation 5. In the future, advancing digitalization should be taken into account, in respect of the program portfolio, as its own strategic focus area. There remains a need for programs focused solely on a specific digitalization theme/technology aimed at specific target groups. In addition, there is also need for more broad-based, comprehensive programs that respond to wider societal needs and involve digitalization as one theme among others.

In the future, Business Finland's Mission will determine how digitalization is reflected in Business Finland operations. Missions are wide-ranging themes to which digitalization has a strong connection.

Recommendation 6. The role and function of the digitalization-advancing programs in respect of the Business Finland missions should be further clarified. Missions are broad themes and programs need to be connected in a planned way to promote them.

Large forerunner companies are important parties in promoting digitalization through which wider effects on the Finnish innovation system also arise.

Recommendation 7. The dialogue should be continued and strengthened with big companies as part of program planning and management.

The development of digitalization is very quick which means that time windows are shortened in the relevance of programs.

Recommendation 8. In the future, there is a need to ensure the agility and flexibility of programs which will allow them to be launched more rapidly and also terminated more speedily if they unable to meet these rapidly changing needs.

In relation to the broad objectives of the programs and the actions required to attain them, a major challenge in

several of the programs under evaluation was clearly an insufficient level of human resource.

Recommendation 9. In the future, adequate human resources should be allocated to the programs while at the same ensuring that the various sectors of the Business Finland organizational structure are sufficiently committed to promoting program activities. Resources and commitments should be confirmed before a program is approved.

In promoting digitalization, it is important that Finnish development work is connected to EU-level activities, networks and resources. Through this, more strength and volume are added to the Finnish development work and new knowledge is obtained. In the evaluated programs the attachment of program projects to EU funding has been a key added value of program activities.

Recommendation 10. An important criterion for initiating program activities should be that the programs are connected to EU-level actions and programs are able to support the attachment of projects to EU-funding and EU networks.

RECOMMENDATIONS RELATING TO THE DEVELOPMENT OF R&D&I- AND EXPORT PROMOTION MEASURES STRATEGICALLY

With regard to existing funding instruments, the challenge has been that they do not adequately support the transfer of technology from test environments to business practice. As such, a number of discontinuity points have emerged when the results of good research projects do not lead to the creation of a profitable business dimension.

Recommendation 11. In the future, it should be ensured that the Business Finland funding instruments adequately support the whole innovation-commercialization chain and support the development of (digital) technology from test environments to business. Attachment of funded projects and other actions to further EU funding, should also be further developed.

In the changed post-covid situation there is a great need to invest in digital development by governments and in this context a more comprehensive approach to promoting digitalization is required. The development and utilization of digital technologies in Finland requires a common, long-term vision and clearly also a vision at the national level to which the key players are committed and behind which national resources can be harnessed in a sufficiently parallel and effective manner.

Recommendation 12. In the coming years, a national strategy for promoting digitalization should be drawn up, to which the key players can commit themselves. It should clarify the goals and roles of different parties to advance digitalization. Furthermore, it should be linked to the wider objectives of promoting digitization at the EU level.

Systemic change and wider global challenges form important drivers in terms of digitalization development. These also offer major business possibilities.

Recommendation 13. Systems and systemic change should be taken as a major starting point in advancing digitalization and the Business Finland perspective must be expanded more strongly to include, for instance, Team Finland and the international level more broadly. The starting point for supporting development work should be more strongly linked to global systemic entity, so that the results of the development work undertaken do not remain national, but can be scaled up to Europe and globally.

APPENDIX 1. MATCHING CRITERIA IN STATISTICAL ANALYSIS

FIRM CHARACTERISTICS

Size based on Turnover at the time of 1st programme decision

1. < 1000000 EUR
2. 1000000 – 8500000 EUR
3. 8500000 – 120000000 EUR
4. 120000000– EUR

Age at the time of 1st digi programme decision

1. 0–2 years
2. 2–5 years
3. 6– years

Industry

1. Information industries (58–64)
2. Research and consulting services (70–74)
3. Electronics (26,27,32)
4. Trade (46–47)
5. Health services (86)
6. Manufacturing (excl. electronics) (24,25,28,29)
7. Services (33–38, 51–52, 80–85, 93–95)
8. Construction (41–43)
9. Financial services 94

OTHER BUSINESS FINLAND FUNDING

Subsidies 3–5 years before the observation year (e.g. 5 years after the funding decision), proportion of turnover (i.e. dose) (3–8 in an eight year impact study)

1. No subsidies
2. 0.0001 – 0.0020
3. 0.0020 – 0.065
4. 0.065 – 0.225
5. 0.225 –

Subsidies 1–2 years before the observation year

1. Yes
2. No

Loans 3–5 years before the observation year ((3–8 in an eight-year impact study)

1. No loans
2. 0.0001 – 0.025
3. 0.025 – 0.14
4. 0.14 – 0.40
5. 0.40 –

Loans 1–2 years before the observation year

1. Yes
2. No

OUTCOME INDICATORS THREE YEARS BEFORE FUNDING DECISION

Turnover, annual change %

1. No 3-year history
2. <-14%
3. -14% – 0%
4. 0 – 7%
5. 7% – 20%
6. 20% – 40%
7. 40%

Number of employees, annual change %

1. No 3-year history
2. <-20%
3. -20% – -4 %
4. -4% – + 4%
5. +4% – 15%
6. >15%

Value added / employee (EUR), annual change

1. No 3-year history
2. < - 5000 EUR
3. -5000 – 0 EUR
4. 0 – 5000 EUR
5. 5000 – 13000 EUR
6. 13000– EUR

Export/value added change percentage points in three years

1. No export on the funding year or three years before
2. No export on funding year but has exported within previous three years
3. below – 5 p.p.
4. -5 p.p. – + 8 p.p
5. 8 p.p. – 25 p.p.
- 25 p.p.

APPENDIX 2. MATCHED PROGRAMME FIRMS

FORERUNNER PROGRAMS THREE YEARS AFTER PROJECT FUNDING DECISION			
	Eligible firms	Matched firms	Matching %
Turnover	257	187	73 %
Number of employees	192	114	59 %
Value added/employee	160	87	54 %
Export	246	177	72 %
FORERUNNER PROGRAMS FIVE YEARS AFTER PROJECT FUNDING DECISION			
	Eligible firms	Matched firms	Matching %
Turnover	263	178	68 %
Number of employees	198	104	53 %
Value added/employee	167	81	49 %
Export	251	148	59 %
FORERUNNER PROGRAMS EIGHT YEARS AFTER PROJECT FUNDING DECISION			
	Eligible firms	Matched firms	Matching %
Turnover	250	147	59 %
Number of employees	181	81	45 %
Value added/employee	159	63	40 %
Export	243	132	54 %
RECENTLY STARTED PROGRAMS THREE YEARS AFTER PROJECT FUNDING DECISION			
	Eligible firms	Matched firms	Matching %
Turnover	160	64	40 %
Number of employees	128	48	38 %
Value added/employee	98	36	37 %
Export	150	72	48 %

APPENDIX 3. OUTCOME INDICATORS PROGRAMME FIRMS COMPARED TO CONTROL GROUP FIRMS

Notes:

- Common language effect size (CL effect size) means how likely it is that program firms grow faster than a randomly chosen control firm
- Sign. indicates if the distributions of the program firms and the control group firms differ statistically significantly. The test is Mann-Whitney U (2 samples)
- The comparison is valid only between the corresponding program firms and the control group as they are matched. For example, program firms received other BF Funding and no BF Funding are not comparable because they have different distributions of matching factors that impact on the outcome indicators.

3, 5, or 8 years after depicts the change after the project funding decision. These are the main results of the analysis.

3 years before depicts the change before the project funding. Because trend before the funding decision was one of the matching criteria no significant difference between the program firms and control firms should occur. CL effect size should be approximately 0.50 and statistical significance of the Mann-Whitney U should be high approaching 1.0 at least for the total. 3 years before includes firms that have data three years before. New firms are not included. Only common language effect size and statistical significance on Mann-Whitney U test are reported in the appendix. Other statistics regarding 3 years before are delivered upon request.

Forerunner programs, five years after the project funding decision

		5 YEARS AFTER THE PROJECT FUNDING					3 YEARS BEFORE	
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign.
TURNOVER, ANNUAL CHANGE%								
No other BF Funding	Control group	4.99%	10.98%	322				
	Forerunner programs	1.74%	8.01%	60	0.46	0.313	0.51	0.824
	Total	4.60%	10.52%	382				
Received other BF Funding	Control group	5.92%	12.90%	532				
	Forerunner programs	9.46%	18.66%	99	0.56	0.051	0.49	0.874
	Total	6.44%	13.81%	631				
Total	Control group	5.92%	12.18%	854				
	Forerunner programs	6.93%	14.64%	159	0.52	0.370	0.50	0.992
	Total	5.94%	12.56%	1013				
NUMBER OF EMPLOYEES, ANNUAL CHANGE								
No other BF Funding	Control group	2.53%	4.24%	142				
	Forerunner programs	3.11%	2.12%	32	0.51	0.860	0.51	0.844
	Total	2.53%	3.85%	174				
Received other BF Funding	Control group	8.45%	9.30%	254				
	Forerunner programs	4.02%	7.27%	57	0.45	0.272	0.52	0.728
	Total	7.07%	8.93%	311				
Total	Control group	5.67%	7.48%	396				
	Forerunner programs	4.02%	5.42%	89	0.47	0.411	0.52	0.695
	Total	5.39%	7.10%	485				



		5 YEARS AFTER THE PROJECT FUNDING					3 YEARS BEFORE	
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign.
VALUE ADDED PER EMPLOYEE, ANNUAL CHANGE (EUR)								
No other BF Funding	Control group	420	-2928	127				
	Forerunner programs	-654	-3541	30	0.46	0.459	0.50	0.943
	Total	329	-3044	157				
Received other BF Funding	Control group	-731	1425	200				
	Forerunner programs	537	5175	47	0.56	0.194	0.50	0.970
	Total	-456	2140	247				
Total	Control group	-218	-271	327				
	Forerunner programs	458	1779	77	0.52	0.602	0.50	0.946
	Total	-190	120	404				
EXPORT PER SALES, ANNUAL CHANGE (PERCENTAGE POINTS)								
No other BF Funding	Control group	-0.08	-1.09	187				
	Forerunner programs	0.20	0.49	39	0.54	0.443	0.56	0.311
	Total	-0.02	-0.82	226				
Received other BF Funding	Control group	0.00	0.39	388				
	Forerunner programs	0.42	-1.02	81	0.53	0.391	0.47	0.539
	Total	0.00	0.14	469				
Total	Control group	-0.01	-0.09	575				
	Forerunner programs	0.24	-0.53	120	0.53	0.278	0.50	0.949
	Total	0.00	-0.17	695				

Forerunner programs, eight years after the project funding decision

		5 YEARS AFTER THE PROJECT FUNDING				3 YEARS BEFORE		
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign
TURNOVER, ANNUAL CHANGE%								
No other BF Funding	Control group	1.12%	2.90%	191				
	Forerunner programs	2.27%	6.45%	37	0.52	0.751	0.52	0.688
	Total	1.12%	3.48%	228				
Received other BF Funding	Control group	6.63%	9.60%	409				
	Forerunner programs	4.54%	7.82%	79	0.47	0.343	0.49	0.795
	Total	5.89%	9.31%	488				
Total	Control group	4.68%	7.46%	600				
	Forerunner programs	4.40%	7.38%	116	0.48	0.555	0.50	0.938
	Total	4.68%	7.45%	716				
NUMBER OF EMPLOYEES, ANNUAL CHANGE								
No other BF Funding	Control group	0.00%	-0.03%	67				
	Forerunner programs	2.25%	1.71%	16	0.51	0.904	0.50	0.986
	Total	0.00%	0.31%	83				
Received other BF Funding	Control group	5.22%	6.24%	204				
	Forerunner programs	3.66%	3.13%	49	0.44	0.187	0.49	0.895
	Total	4.59%	5.64%	253				
Total	Control group	3.96%	4.70%	271				
	Forerunner programs	3.66%	2.78%	65	0.46	0.309	0.49	0.858
	Total	3.84%	4.33%	336				



		5 YEARS AFTER THE PROJECT FUNDING					3 YEARS BEFORE	
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign
VALUE ADDED PER EMPLOYEE, ANNUAL CHANGE (EUR)								
No other BF Funding	Control group	1134	4064	47				
	Forerunner programs	-46	-167	13	0.48	0.821	0.53	0.750
	Total	678	3153	60				
Received other BF Funding	Control group	-199	423	146				
	Forerunner programs	482	1703	40	0.56	0.278	0.52	0.774
	Total	58	699	186				
Total	Control group	82	1316	193				
	Forerunner programs	462	1244	53	0.54	0.428	0.52	0.728
	Total	175	1301	246				
EXPORT PER SALES, ANNUAL CHANGE (PERCENTAGE POINTS)								
No other BF Funding	Control group	0.33	0.12	128				
	Forerunner programs	0.22	0.83	28	0.46	0.558	0.51	0.925
	Total	0.29	0.25	156				
Received other BF Funding	Control group	1.04	3.32	327				
	Forerunner programs	0.79	2.35	71	0.48	0.633	0.52	0.714
	Total	1.02	3.15	398				
Total	Control group	0.87	2.42	455				
	Forerunner programs	0.34	1.92	99	0.48	0.472	0.51	0.700
	Total	0.62	2.33	554				

Forerunner programs, three years after the project funding decision

		3 YEARS AFTER THE PROJECT FUNDING				3 YEARS BEFORE		
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign.
TURNOVER, ANNUAL CHANGE%								
No other BF Funding	Control group	12.53%	36.30%	581				
	Forerunner programmes	10.19%	40.69%	78	0.49	0.691	0.49	0.844
	Total	12.26%	36.82%	659				
Received other BF Funding	Control group	3.44%	14.19%	738				
	Forerunner programmes	3.69%	20.26%	99	0.48	0.580	0.51	0.866
	Total	3.45%	14.91%	837				
Total	Control group	5.94%	23.93%	1319				
	Forerunner programmes	5.22%	29.26%	177	0.49	0.561	0.50	0.934
	Total	5.91%	24.56%	1496				
NUMBER OF EMPLOYEES, ANNUAL CHANGE								
No other BF Funding	Control group	6.91%	15.01%	257				
	Forerunner programmes	4.15%	6.12%	38	0.45	0.364	0.48	0.720
	Total	6.51%	13.86%	295				
Received other BF Funding	Control group	5.63%	8.23%	373				
	Forerunner programmes	2.51%	7.60%	55	0.46	0.309	0.50	0.934
	Total	4.48%	8.14%	428				
Total	Control group	5.92%	11.00%	630				
	Forerunner programmes	3.27%	6.99%	93	0.46	0.196	0.49	0.749
	Total							



		3 YEARS AFTER THE PROJECT FUNDING					3 YEARS BEFORE	
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign.
VALUE ADDED PER EMPLOYEE, ANNUAL CHANGE (EUR)								
No other BF Funding	Control group	1444	1612	227				
	Forerunner programmes	655	2349	34	0.49	0.912	0.55	0.533
	Total	1355	1708	261				
Received other BF Funding	Control group	-790	-3757	267				
	Forerunner programmes	203	-703	40	0.54	0.385	0.49	0.835
	Total	-410	-3359	307				
Total	Control group	517	-1290	494				
	Forerunner programmes	377	699	74	0.52	0.611	0.51	0.890
	Total	469	-1031	568				
EXPORT PER SALES, ANNUAL CHANGE (PERCENTAGE POINTS)								
No other BF Funding	Control group	0.81	9.19	326				
	Forerunner programmes	1.08	5.78	58	0.51	0.767	0.46	0.529
	Total	0.95	8.67	384				
Received other BF Funding	Control group	0.68	3.83	488				
	Forerunner programmes	0.88	8.70	87	0.50	0.983	0.52	0.582
	Total	0.68	4.56	575				
Total	Control group	0.69	5.97	814				
	Forerunner programmes	0.93	7.54	145	0.51	0.843	0.50	0.949
	Total	0.71	6.21	959				

Recently ended programs, three years after the project funding decision

		3 YEARS AFTER THE PROJECT FUNDING					3 YEARS BEFORE	
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign.
TURNOVER, ANNUAL CHANGE%								
No other BF Funding	Control Group	10.53%	22.20%	104				
	Recently started programmes	10.84%	24.82%	24	0.57	0.289	0.47	0.741
	Total	10.74%	22.69%	128				
Received other BF Funding	Control Group	12.72%	47.98%	138				
	Recently started programmes	17.79%	42.38%	32	0.53	0.628	0.53	0.625
	Total	14.07%	46.93%	170				
Total	Control Group	11.22%	36.93%	242				
	Recently started programmes	17.66%	34.85%	56	0.54	0.315	0.50	0.949
	Total	11.59%	36.54%	298				
NUMBER OF EMPLOYEES, ANNUAL CHANGE%								
No other BF Funding	Control group	14.00%	15.41%	57				
	Forerunner programmes	13.86%	17.48%	19	0.51	0.922	0.50	0.987
	Total	14.06%	15.93%	76				
Received other BF Funding	Control group	0.00%	7.13%	63				
	Forerunner programmes	6.80%	7.25%	21	0.61	0.129	0.53	0.716
	Total	3.73%	7.16%	84				
Total	Control group	6.15%	11.06%	120				
	Forerunner programmes	7.67%	12.11%	40	0.54	0.415	0.51	0.869
	Total	6.35%	11.33%	160				



		3 YEARS AFTER THE PROJECT FUNDING					3 YEARS BEFORE	
		Median	Mean	N	CL effect size	Sign.	CL effect size	Sign.
VALUE ADDED PER EMPLOYEE, ANNUAL CHANGE (EUR)								
No other BF Funding	Control Group	125	3630	56				
	Recently started programmes	-1347	-6806	17	0.41	0.247	0.50	0.989
	Total	-677	1198	73				
Received other BF Funding	Control Group	-774	-722	46				
	Recently started programmes	2997	3198	14	0.60	0.261	0.46	0.718
	Total	1280	192	60				
Total	Control Group	-586	1665	102				
	Recently started programmes	153	-2288	31	0.49	0.881	0.49	0.861
	Total	-336	743	133				
EXPORT PER SALES, ANNUAL CHANGE (PERCENTAGE POINTS)								
No other BF Funding	Control group	0.07	0.29	61				
	Forerunner programmes	0.37	-1.22	20	0.51	0.895	0.47	0.741
	Total	0.13	-0.08	81				
Received other BF Funding	Control group	0.32	0.09	115				
	Forerunner programmes	0.12	-0.52	38	0.52	0.761	0.53	0.625
	Total	0.23	-0.07	153				
Total	Control group	0.20	0.16	176				
	Forerunner programmes	0.18	-0.76	58	0.51	0.774	0.50	0.949
	Total	0.17	-0.07	234				

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