June 2021

Finnish technology policy in 2020s – A global leader through technology and information

Briefly in English

Technology Advisory Board

Ministry of Finance, Finland

Description sheet
1 June 2021

Finnish technology policy in 2020s
- A global leader through technology and information

Abstract

The Ministry of Finance has appointed a high-level Technology Advisory Board from 16 September 2020 to 31 December 2023. The goal is to prepare a technology policy that will create wellbeing and channel competitiveness in Finland.

Technology has taken over all areas in society and life. Technology plays a key and ever increasing role in solutions for wide-ranging social challenges, such as productivity growth, sustainability of public finances and climate change. Technology allows undertakings and therefore the entire society to prosper, along with an effective administration that is close to the citizens and undertakings. In particular, technology policy is about constructing an operating environment for the development and utilisation of new technologies.

The Board utilized an Objectives and Key Results (OKR) model to formulate the technology policy. The goal is that in 2030, Finland would be the most successful and best known country for generating wellbeing from the development and utilisation of technology. Key results are presented to support the achievement of said goal.

The Advisory Board has created three tools to implement the technology policy and is proposing three structural reforms and about 40 measures.

The Advisory Board participates in public debate after the publication of the report and supports the implementation of the technology policy.

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Introduction

Technology should be examined from two different perspectives. On the one hand, technology is a tool allowing individual undertakings and the public sector to manage their tasks as efficiently and successfully as possible. On the other hand, technology is a source of well-being for Finland. With its good educational base, Finland is well-placed to use technological solutions to transform skills into successful business generating jobs and tax revenue.

The advisory board set out on its task realising that it could only achieve results if there was common understanding among its members of the way in which it should work and the goals that it should achieve. We decided to base our work on the following three fundamentals: we share the same situation picture, we agree on common operating principles, and we can energise the group to ensure that it will work exceptionally hard.

There are three key features in the situation picture: continued emphasis on the role of technology, an operating environment that is becoming more fluid and increasingly unpredictable, and the extremely challenging outlook for the Finnish economy, which is undermining the foundations of our social model.

The remote work experiences during the COVID-19 pandemic, cyber attacks paralysing major industrial companies and growth companies creating substantial value are some of the areas highlighting the role of technology.

As society at large and the lives of individuals are increasingly affected by technology, many of the traditional operating models and processes are becoming inefficient or even impractical. This applies to many of the key societal processes and the legislation and regulation steering them, in which more consideration should be given to the role played by technology. Decision-makers can only use the opportunities arising from technology if they embrace new skills and adopt new attitudes. This means that decision-makers must be better-placed to anticipate the impacts of technology so that

they can create regulation standing the test of time and update the regulation at short notice.

The task of the state is to build an operating environment providing undertakings taking risks when testing technological solutions and business models with maximum competitive advantage. If the state decides to prevent technological experiments by excluding specific alternatives or by making choices on behalf of undertakings, it should have valid reasons for doing so. For this reason, it is essential for our success that the public authorities adhere to technology neutrality and only deviate from this principle when there are particularly good grounds for such an approach.

By making better use of technology, Finland can best tackle the economic sustainability challenge arising from an ageing population. We need a new shared sense of urgency. It was partly for this reason that we brought forward the timetable of our assignment and published the report in late spring and not at the end of the year as was originally intended.

The operating principles guiding our work were as follows: Finland's long-term interests are the core issue, sense of responsibility and effectiveness, open-minded approach to potential solutions, high level of ambition, and full transparency during the process.

I would like to say a few words about these principles. Our task is to outline a technology policy for the 2020s. A long-term approach and not being influenced by current party politics were a natural starting point for the work. By seeking to determine Finland's long-term interests, we can also approach the matter from the investment perspective, whereas the current political debate is characterised by short-term and cost-focused thinking.

Sense of responsibility means that we stand behind our proposals but are also prepared to accept criticism. Sense of responsibility also means that, in accordance with the mandate, we will continue our work until the end of 2023. We consider that our task is to monitor the progress of the measures as well as to encourage and support the process of implementing them. However, if necessary, we should also work to update and revise them using the latest available information as a basis.

We do not want to rule out any options as we are prepared to give objective consideration to all proposals. Effectiveness has been a high priority in our work. For example, we have selected tools and working methods that, when used more extensively in the public sector, would boost its efficiency, openness and productivity. We hope that our report will stimulate debate.

Finland must be more ambitious. We are in danger of falling behind our Nordic reference group in many key areas, such as competitiveness, balance of the national economy, RDI investments, functioning of the labour market and the employment rate. Finland must become the world leader in specific areas. It is clear that we need to be realistic in this respect because we cannot be the world's best country in all areas. Finland can be the world's best place to start a technology business but we cannot be the world leader in artificial intelligence research as superpowers are investing enormous sums in this sector every year.

Full transparency has been one of the principles guiding our work. We have received more than 700 proposals from a wide range of different parties through a variety of different channels. The proposals have been evaluated twice by a large number of experts on the Inclus platform. Tens of thousands of evaluations have been produced and we have received thousands of comments and suggestions for improvements.

Our aim has also been to act as a bridge between different administrative branches. This is because technology is in many ways a cross-administrative subject, which is one reason why it is so difficult for us Finns to deal with. The desire of administrative branches to act independently means that the long-term interests of the country are not always a top priority. We have discussed our thoughts and proposals in a proactive manner with senior officials in relevant ministries and a large number of government agencies. During the project, our secretariat was augmented by representatives of the Ministry of Education and Culture and the Ministry for Foreign Affairs. Ministry of Transport and Communications, Ministry of Social Affairs and Health, Ministry of Economic Affairs and Employment, and the Ministry of Finance have been represented in the secretariat from the outset.

Feasible measures must also be measurable in terms of implementation and the targets set. We have spent a great deal of time on thinking about monitoring mechanisms, not only from the perspective of our own work but also hoping to provide the public sector with new tools and a new approach for registering and measuring decisions and proposals and for publishing up-to-date information on them.

We believe that the measures that we have proposed will serve as key factors boosting the success of our nation already during this decade but especially from the perspective of the 2030s. We are happy to accept ideas, views, criticism and suggestions. In accordance with our mandate and adhering to the above-mentioned principles, we will work to promote Finland's long-term interests by technology policy means until the end of 2023.

Risto Siilasmaa
Chair of the Advisory Board, June 2021

VNK TÄYTTÄÄ, MINISTERIÖN JULKAISUSARJAN NIMI JA JULKAISUN VUOSI : SARJANUMERO.

Mandate

The Programme of Prime Minister Sanna Marin's Government lays out seven strategic themes of which the theme 'Dynamic and thriving Finland' strengthens our prerequisites to succeed as a global leader in skills and innovation by drawing on our strengths.

One of the aims in this theme area is to make Finland a recognised front runner in technological advances, innovative procurement, and the culture of experimentation. It is also stated in the Government Programme that a joint high-level advisory board, including a secretariat, will be appointed for the public and private sector to act as an advisory body in technology.

The Ministry of Finance appointed a high-level technology advisory board for the term 16 September 2020 – 31 December 2023. Preparing a technology policy generating well-being for Finland and steering Finland's competitiveness were set as the objectives of the advisory board. The aim is to enhance Finland's technological competence, develop cooperation between public and private sectors and strengthen Finland's position as a leading user of technology in all areas of society.

The advisory board is tasked with finding answers to the following questions:

- How can Finland become a model country in technology utilisation?
- How can Finland create an operating environment providing technology companies with maximum competitive advantage?
- How can public administration fully anticipate the opportunities and challenges arising from technology?

For this purpose, the advisory board was tasked with preparing the report 'Finnish technology policy in the 2020s – A global leader through technology and information'. The advisory board was expected to examine the above-mentioned issues from a wide variety of different perspectives.

After the publication of the report, the advisory board will take part in the public discussion on the topic and work to support the implementation of the technology policy in Finland.

To meet this objective, members representing a wide range of public and business sector actors and research institutes were appointed to the advisory board.

Chairs

- Risto Siilasmaa, Chairman of the Board, F-Secure Plc (Chair)
- Päivi Nerg, Permanent Under-Secretary, Ministry of Finance (Vice-Chair)

Members

- Henrik Ehrnrooth, President and CEO, KONE Corporation
- Ilkka Kivimäki, Founding Partner, Maki.vc
- Ilona Lundström, Director General, Ministry of Economic Affairs and Employment
- Kristiina Mäkelä, Provost, Aalto University
- Nina Nissilä, Director, Social Insurance Institution of Finland (Kela)
- Ilkka Paananen, CEO, Supercell
- Mikko Rusama, Chief Digital Officer, City of Helsinki
- Antti Vasara, President and CEO, VTT Technical Research Centre of Finland Ltd
- Laura Vilkkonen, Director-General, Ministry of Transport and Communications

The ministries' representatives have taken part in the work in expert capacity. Advancing measures proposed by the advisory board will require separate decisions in the ministries concerned or at Government level.

A secretariat was appointed to support the work of the advisory board and the following persons were invited as members of the body:

- Paavo-Petri Ahonen, Senior Ministerial Adviser, Ministry of Education and Culture (from 16 April 2021)
- Laura Eiro, General Secretary, Senior Specialist, Ministry of Finance (from 1 February 2021)
- Sami Kivivasara, Senior Government Adviser, Head of Unit, Ministry of Finance
- Stefan Lee, Team Leader, Ministry for Foreign Affairs (from 16 April 2021)
- Jukka Lähesmaa, Senior Specialist, Ministry of Social Affairs and Health
- Matti Mannonen, Executive Director, Technology Industries
- Maaria Mäntyniemi, Ministerial Adviser, Ministry of Transport and Communications (until 1 June 2021)
- Petri Räsänen, Development Director, Ministry of Economic Affairs and Employment (until 30 April 2021)

- Satu Vasamo-Koskinen, Senior Specialist, Ministry of Economic Affairs and Employment (from 1 May 2021)

How well-placed is Finland to utilise technology?

Technology is now an integral part of all areas of society and daily life. Technology plays a key and ever-increasing role in solutions to wide-ranging societal challenges, such as productivity growth, sustainability of public finances and climate change. Technology creates business growth, which benefits all of us, and it also provides the basis for efficient public administration that is close to citizens and business operators.

With technology, Finland is significantly better-placed to benefit from global growth beyond its relative size than other countries. Finland must choose the path of success and make determined efforts to achieve success by using its strengths and tackling challenges.

Traditional Finnish strengths and/or areas where significant progress has been achieved in recent years:

- Strong educational base and internationally acclaimed ICT expertise
- World's most ambitious carbon neutrality targets. Finnish companies are committed to achieving them and the road maps are already in place
- Establishment of new technology start-ups and significant value creation
- Entrepreneurship is highly appreciated, especially among young people
- Reform of the Universities Act in 2010 has made universities more competitive
- Positively developed country brand
- Digital infrastructure and data resources
- Stable and safe constitutional state
- Well-educated work force and digital skills
- Protection of intellectual and tangible property

Challenges Finland is facing in the utilisation of technology:

- Our operating environment is not competitive in attracting international investments
- Legislation and public administration practices slow down innovation and automation
- Making long-term forecasts about the operating environment is difficult
- Sustainability gap is a threat to the Finnish economy and our competitiveness, and successive governments have been unable to change the trend

- Skills gap, shrinking working-age population and low level of work-based immigration
- Substantial reductions in public funding for research and innovation investments in undertakings
- Early exit of technology company ownership from Finland and Europe
- Limited success in commercialising research results
- Decentralised responsibilities and siloed digital and data economy projects in public administration
- Absence of broad-based technology understanding and skills in political decision-making and public administration
- Lack of research cooperation between undertakings and universities

Basis for a technology policy

The technology advisory board appointed by the Ministry Finance is the first of its kind in Finland. The advisory board has examined the technology policy from a wide variety of different perspectives connected with society at large, other policy areas and current developments. Technology policy cannot be a set of recommendations pertaining to individual technologies as it is primarily an operating environment in which technologies are developed and used.

The operating environment must support broad-based use of technologies in the public sector with the aim of developing better services and enhancing efficiency, and to promote the creation of technology companies and innovations. An effective technology policy requires close cooperation between public and private sectors and an active Finnish role in the EU and globally. This is also the area where Finland is particularly well-placed to achieve international success: we have a strong basis on which to build our country image as a technology expert and pioneer.

The advisory board has extensively examined the national and international operating environment[1].

In the opinion of the advisory board, Finland is well-placed to become a global leader by using technology and knowledge, thus creating well-being for all its citizens, and enhancing its international impact. However, this cannot be achieved with current growth rates, as significant development work and even a change of direction in several areas are needed.

Prerequisites for Finland's success:

- **Continuous cross-administrative technology policy and effective policy implementation.** Developing technology for the benefit of society at large, including its use in the boosting of productivity and tackling of climate change, primarily requires a cultural change and change in attitudes that allow us to do things in an entirely new manner by combining resources. Technology, data and digitalisation as cross-cutting phenomena do not produce optimum added value if we are confined to silos and sectors. An active and open technology policy will also attract foreign investments to Finland.
- **Finland must adopt technology neutrality as the key principle steering its technology policy and create a culture of enablement**

[1] In Finnish only

and experimentation. At Government level, the public sector should not try to predict winners, but rather to create the prerequisites for market-based development and the fast-track testing of different technologies and business models. Public-sector inputs should be channelled to support the best ideas and innovations arising from undertakings and their scaling. We should take seriously the goal of making Finland a country that is positive about new technologies and new business models related to them and is encouraging their use. At present, our legislation and the operating culture of our public authorities are not particularly well-suited for such an approach. The situation will only change if there is enough determination to achieve results and systematic action is taken.

- **Significant increase in product development investments.** Finland must set itself an ambitious R&D target, prepare a proactive and effective strategy supporting it, and increase product development appropriations. Above all, corporate RDI investments should be leveraged through public-sector support and high-quality research should be commercialised, as the results of such research would benefit all areas of society. Reaching the level of five per cent would require significant product development inputs by international companies operating in Finland. This can only be achieved if the determination is there and decisive action is taken.
- **Strengthening the innovation environment and ecosystems.** Finland needs strong RDI infrastructures and testing and piloting environments in which breakthroughs achieved in research infrastructures are developed into commercially viable products. Finland should build more effective centres of expertise attracting international partners and investment by channelling funding to larger entities that can boost cooperation between higher education institutions and undertakings. Innovation capacity of SMEs in particular should be accelerated and SME participation in innovation partnerships should be supported.
- **A significant increase in the number of experts and the amount of talent.** Increasing the volumes of work-based and education-based immigration is a crucial for Finland's future as a technology country. Finland must be made attractive to foreign experts and their families, they must be provided with seamless processes for entry into the country and they must stay here. Finnish employers must dismantle their mental barriers to hiring experts that do not speak Finnish. Here too, we need legislative changes and a change in the operating culture of public authorities. If Finland does not build an immigration system specifically designed to attract talent to our country, we will never succeed in the international competition for top talent at the level we want.
- **The Finnish education system must support the prerequisites for developing and using technologies at all levels and Finland must**

provide Finnish top talent with development opportunities. Without talent, there are no innovations or spread of technologies. Finland should adopt a broad range of different policy measures to ensure a smooth path towards a knowledge-based society. A digital leap in higher education and massive inputs in continuous learning are needed to meet the new skills needs arising from the change in work. A front-runner status in the use of technology in the transformation of working life and remote work is a factor attracting talent.

- **Automation and integration of public administration and service production across administrative branches for the benefit of citizens and undertakings and to enhance the efficiency of public administration.** Automation and digitalisation should be utilised in human-centred service development and to build proactive and user-friendly services. This requires new capabilities and cross-administrative management in public administration. Public administration must be a bold user of technological applications and a good partner for companies developing technologies. As part of the transition, it must be ensured that nobody falls behind and that everybody has access to the services they need in a manner that suits their needs and abilities.
- **Enabling public administration and legislation.** Measures must be taken to dismantle regulation that is not technology neutral and prevents automation. Legislation enabling innovations and experiments leaves room for the development of new solutions. Technology understanding and competence among decision-makers and public administration actors must be increased. Public administration steering and training must support innovation-friendliness and technological skills.
- **Entrepreneurship and making Finland attractive to international investments.** Entrepreneurship must be made a civic skill, and entrepreneurship and ownership must be made attractive and desirable. Finland must become an attractive operating environment for starting companies and as a business location. Finland must be the best place for companies to operate and grow. Being the second best is not enough. Geographical isolation; a centralised, rigid and difficult labour market; concerns about the sustainability of the national economy; concerns about the predictability of taxation associated with the sustainability gap; and a fixation with regulation (also mentioned in other contexts) are some of the factors discouraging large companies from investing in Finland. Finland can influence its country image by ensuring smooth-working logistics, by introducing local-level bargaining, by taking the sustainability gap seriously, by balancing its economy in the same manner as other Nordic countries and by setting a timetable for the introduction of enabling regulation.
- **Strengthening soft digital infrastructure.** Digitalisation of the public and private sectors and the use of technologies require inputs in soft

digital infrastructure, such as trust services, interfaces ensuring interoperability, structures ensuring the quality and reliability of information, and information security. We also need better operating methods and codes of conduct to enable the exchange of information between different actors. The development work must be carried out across sectoral boundaries as a joint effort by public and private sectors.

- **Cooperation across national and international boundaries.** An effective technology policy requires close cooperation between public and private sectors and an active Finnish role in the EU and globally. In the midst of a technological transformation, it is important that we share information and increase our understanding of technological changes and the opportunities and threats arising from technologies and work together to find solutions to them. A strong national technology profile serves as an image-booster and an instrument of influence and creates opportunities for companies. Finland must link with international organisations and encourage companies to choose Finland as a location of their development operations. Finland must influence international regulatory developments and establish close partnerships with other leading technology countries.

Becoming a global leader through technology and know-how – OKR of technology policy

Technology policy objectives and key results

A front-runner status in the use of technology and knowledge requires a high level of ambition and bold choices as well as effective implementation. With this in mind, the advisory board has sought to build clear goals and measurable key results indicating development trends in accordance with the OKR (Objectives and Key Results) management model. In this way, we can raise the level of ambition and introduce sufficiently concrete measures to achieve the goals.

The OKR model has been adopted by companies of different sizes around the globe as a flexible and efficient tool for monitoring and setting targets. The OKR model is also well-suited for public administration.

OKR is based on initiatives and monitoring. The objectives are intended to be ambitious and qualitative. They should be inspiring and motivating. At the same time, the key results are focused and quantitative and must be limited in number. The key results must be challenging but achievable. They provide a picture of progress with regard to the objectives. Monitoring is an essential part of the OKR model.

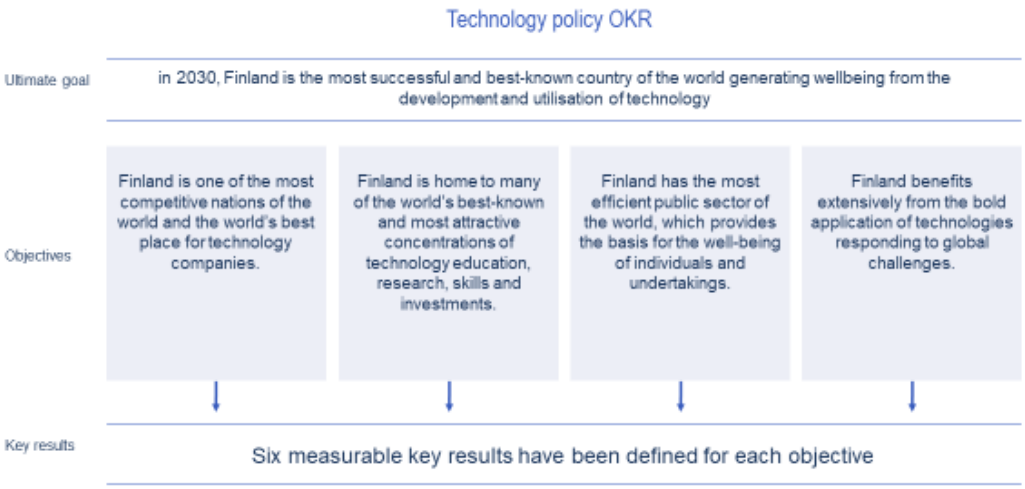
The OKR model has been successfully used by Finnish companies. The model helps to introduce new strategies in a more agile manner and to promote a culture of continuous learning and development. Kela is one of the Finnish public administration actors currently testing the model but it is not yet using OKR in large scale. However, the model is well-suited for the effective management of different types of organisation and project.

The advisory board proposes that Finland's technology policy be examined and managed in accordance with the OKR model. As the development of the key result indicators (especially international indexes) is usually on a delayed basis, the achievement of the objectives is monitored through separately-set anticipatory indicators. The aim is therefore to select the anticipatory indicators so that the impact of the measures is visible in them before they become concrete key results. The implementation monitoring model presented in the report must also be linked to this.

The ultimate goal of the technology policy is that in 2030, Finland is the most successful and best-known country of the world generating well-being from the development and utilisation of technology.

The advisory board has set out four objectives designed to ensure that Finland can achieve this goal:

1. Finland is one of the most competitive nations of the world and the world's best place for technology companies.
2. Finland is home to many of the world's best-known and most attractive concentrations of technology education, research, skills and investments.
3. Finland has the most efficient public sector of the world, which provides the basis for the well-being of individuals and undertakings.
4. Finland benefits extensively from the bold development and application of technologies responding to global challenges.



Measurable key results have also been set for each of the objectives:

Key results and indicators for Objective 1:

Key result	Indicator	Current level	Target level for 2030
KR 1: Enhanced international competitiveness	Finland will be back among the top three in WEF Global Competitiveness Index	#11	#1–3[2]
KR 2: Exports to GDP ratio will return to pre-financial crisis levels	The ratio of goods and services exports to GDP will reach German and Swedish levels	About 40% (Statistics Finland)	45–47%[3]
KR 3: RD investments will increase substantially	Ratio of RD inputs to GDP will reach the level of world's leading countries	2.8% (Statistics Finland)	5% (2033) On average, 0.17 percentage points per year
KR 4: Finnish companies will substantially increase their RD investments	Ratio of companies' RD inputs to GDP will reach the level of world's leading countries	1.8% (OECD, Main Science and Technology Indicators)	3.67% (2033)

[2] Finland was second in 2006 and third in 2012.
[3] Ratio of Finnish goods and services exports to GDP decreased substantially after the financial crisis. Before the crisis, Finland was on a level with Germany but slightly below Sweden.

KR 5: Companies will substantially increase their fixed investments	Ratio of fixed investments to added value will reach the level of other euro area countries and Sweden	22–23% (Eurostat)	25–26 %[4]
KR 6: Finland is the best place to start a business	Finland will rise to the top of the 'Starting a Business' category in the World Bank's Doing Business index	#31	#1

Key results and indicators for Objective 2:

Key result	Indicator	Current level	Target level for 2030
KR1: Finland's human digital capital will remain high	DESI ranking	#1	#1
KR 2: Finland will become more attractive to foreign talent	Finland will rise to the top of the Global Talent Competitiveness Index	#7	#1

[4] Fixed (tangible and intangible) investments by Finnish companies totalled about EUR 28 billion in 2019. To reach the level of Sweden (26%), the investments should total EUR 32 billion each year.

KR 3: Finland's technology clusters will expand	Finland will improve its ranking in the category '12.02 State of cluster development' of WEF's Global Competitiveness Index	#21	#1–3
KR 4: Work-based and education-based immigration will boost the number of technology experts in Finland	Work-based immigration will increase Number of new foreign degree students/year Students graduating in Finland deciding to remain in Finland (%)	About 9,500[5] About 5,000 About 60%	50,000 total increase from 2030 at least +10,000/year[6] Tripling the figure, 15,000/year 75%
KR 5: The number of start-ups emerging from higher education institutions and their ecosystems will increase	Number of research-based start-ups, monitoring should include all higher education institutions Number of start-ups emerging from higher education ecosystems,	20–30/year Not known[7]	The total will at least triple

[5] Residential permits for employed persons (employees, experts, seasonal work) were granted as follows: 8,508 in 2020; 9,461 in 2019 and 7,697 in 2018. Because of the COVID-19 pandemic, the figure for 2019 is used as the reference figure.
[6] Finland must have better procedures to anticipate the need for talent, and the needs should be reviewed each year, and, if necessary, the target should be increased accordingly.
[7] According to manually collected information, about 70 start-ups emerge each year from the accelerator programs of Aalto University (accelerators of Aalto Start-Up Center and student-driven Start-up Sauna/Kiuas).

	monitoring should be initiated		The total will at least triple
KR 6: More Finnish universities of technology will reach top positions in international rankings	ARWU Engineering, Technology and ICT	One university in positions 150–200	Three universities among the top 150

Key results and indicators for Objective 3:

Key result	**Indicator**	**Current level**	**Target level for 2030**
KR 1: Public services will be automated	Number of automated proposals, will require a new indicator	No information is available	Will be defined on the basis of information base
KR 2: Customer satisfaction in public administration will improve	A tool for monitoring the entire public administration is under development[8]	Not available for all services	Will be defined on the basis of information base

[8] In the future, the digital situation picture created for the Digitalisation Promotion Programme will be used in KR1 and KR2 indicators

KR 3: Public sector will be digitalised	Finland's ranking in all dimensions of OECD Digital Government Index[9] will improve	#6, 23, 27, 28, 33, 33	#1–3
KR 4: Companies will become more digitally mature	Digital barometer	#7	#1–2
KR 5: Public sector will become more efficient	Ratio of public expenditure to GDP will decrease, approaching the level of reference countries Economic dependency ratio[10] Reduction in service-specific lead time	53.3% 133 Not currently available	Less than 48%[11] 115 Will be defined on the basis of information base
KR 6: More cooperation between public and private sectors	Public-sector purchases from competitive markets (% of public expenditure) Public funding of PPP projects	25% (2018) EUR 230 million/year	40% EUR 600 million/year

[9] The dimensions are as follows: Digital by design, Data-driven public sector, Government as platform, Open by default, User-driven and Proactiveness

[10] The population structure is measured using the economic dependency ratio, which gives the number of unemployed persons and persons outside the labour force per employed person. The economic dependency ratio decreases when the number of employed persons increases in proportion to the number of unemployed persons and persons outside the labour force. Finland's economic dependency ratio stood at 133 in 2019. Of the regions in mainland Finland, Uusimaa had the lowest (109) and North Karelia the highest (169) economic dependency ratio.

[11] Sweden 49.4%; Denmark 49%; EU 27 46.7%; Germany 45.2%

Key results and indicators for Objective 4:

Key result	Indicator	Current level	Target level for 2030
KR 1: More inputs in carbon neutral innovations	Ranking in Global Cleantech Innovation Index	#2	#1
KR 2: Carbon handprint of export products increases	Carbon handprint of key technology export products[12]	At least 20 Mt CO2-eq/y	Will at least triple (2035)
KR 3: More companies will monitor their emissions and report on them	Percentage of companies reporting on their carbon handprint and footprint	No information is available	100%
KR 4: Greenhouse gas emissions will decline (greenhouse gas emissions scope 1 and 2 emissions in CO2 equivalents)	Annual emissions will decline in line with industrial low-carbon road maps	Approx. 33 Mt CO2/year (2015)[13]	About 8.5 Mt CO2/year (2035)
KR 5: Circular economy solutions will become more common	Indicators for circular economy busi-		

[12] The handprint impact of specific export products and the handprint effect of key technologies under development has been assessed in the low-carbon road map of the technology industry. The latter is estimated to exceed 50 Mt CO2-eq/y in 2035.
[13] Emissions, including technology, forestry, chemical and energy industries. Without energy industry 17 Mt CO2/year Target level without energy industry 6 Mt CO2/year

	ness, under development at Statistics Finland		
KR 6: Society will become more resilient to disruptions	State of cyber security in different sectors[14]	Average for all companies 3.75	All companies exceed 3.75

[14] kyberturvallisuuden-nykytila-eri-toimialoilla2-verkkosivuille.pdf (huoltovarmuuskeskus.fi) (in Finnish)

3 tools and 3 structural changes to implement the technology policy

The advisory board has prepared three tools that, when used more extensively, would enhance the efficiency of the public sector and is proposing three structural reforms and about 40 measures. With these reforms and measures, Finland would become a global leader through technology and information, thus boosting the well-being in all sectors of society.

Tools for implementing the technology policy:

- Finland will prepare its technology policy in accordance with the OKR (Objectives and Key Results) model, which would ensure ambitious goals, concrete action and effective monitoring.
- Monitoring is on the basis of a story points model and a virtual platform. With this model, an up-to-date situation picture can be produced to monitor individual measures and the overall situation, which will also provide a basis for the support required to achieve progress.
- Technology policy is based on making technology choices in a market-oriented manner. The task of the public sector should be to set up the prerequisites for the creation of winning technologies, and not to select them. Exceptions to technology neutrality and market-based choices include certain technology areas and measures that should be separately encouraged through public-sector action and inputs. These choices must be thoroughly justified. The advisory board has prepared a framework for making these choices, which can be used to assess the significance of individual technology areas and the required inputs.

It is proposed that the tools should also be used by central government actors outside the areas discussed by the advisory board so that their overall impact can be enhanced.

Structural changes:

Reaching the top global position requires a long-term policy across government terms and cooperation across administrative branches to achieve jointly agreed goals. Technology policy is closely related to several administrative branches and it is particularly important to create a close interface between information and technology policies. En-

hancing the strategic nature of the measures and coordination between them is critical if we are to increase RDI inputs supporting the development and commercialisation of technologies and make them more effective.

For this reason, the following measures should be carried out in the steering of information and technology policy:

- The post of a state secretary for information and technology policy should be established to ensure the coordination and implementation of the technology policy in the Government. The state secretary would work in the Prime Minister's Office with other ministries on a networked basis.
- A Parliamentary Information and Technology Committee should be established.
- The Research and Innovation Council should be developed into a more strategic body genuinely steering RDI activities and it should cover the entire innovation chain. The reform would require changes in the steering structure. For this reason, the council should have a vice-chair coming from outside public administration and possessing solid experience in the technology sector. At the same time, the composition of the council should be diversified, and its secretariat should play a stronger role.

Measures required to achieve the four main objectives:

Solving the challenges facing Finland and achieving the objectives require a broad range of different measures that, on the one hand, are linked to the development of the operating environment and, on the other, to the ability to utilise the opportunities arising from technology and digitalisation in companies and in the public sector.

The proposed measures include both previously identified activities and activities already under way, the speeding up of which the advisory board considers important for ensuring the full use of technologies, but there are also entirely new measures identified during the work of the advisory board. We are not proposing action overlapping with the measures under way but to build on existing achievements. Every effort has been made to select the most effective measures. At the same time, it is recognised that a great deal of work is under way that contributes to the achievement of the objectives.

Many of the measures should already be launched during the current government term, although implementing them is a long-term development process, which should continue for several parliamentary terms. At the same time, the measures should become more specific as results are achieved. The proposed timetable of the measures

and the implementation responsibilities are presented in a summary to be published on the project website.

Most of the measures will take several years to be fully implemented. The advisory board has presented them recognising that their contents may change as more information on the matter becomes available in connection with the preparation and implementation process.

We hope that the Government and political parties will commit themselves to the objectives and implement the proposed structural changes. After this, the proposed measures can be further processed as part of the work of various administrative branches to achieve the objectives approved by the Government.

None of the individual measures or packages of measures can on its own make Finland the world leader. Developing the operating environment is not a zero-sum game: we can and we must improve our performance in several areas at the same time.

In connection with the achievement of the objectives, areas that are important for building a competitive operating environment for companies (both for domestic enterprises and to attract investments to Finland) have also been identified by the advisory board. These also contribute to achieving the key results. The following are key areas in this respect:

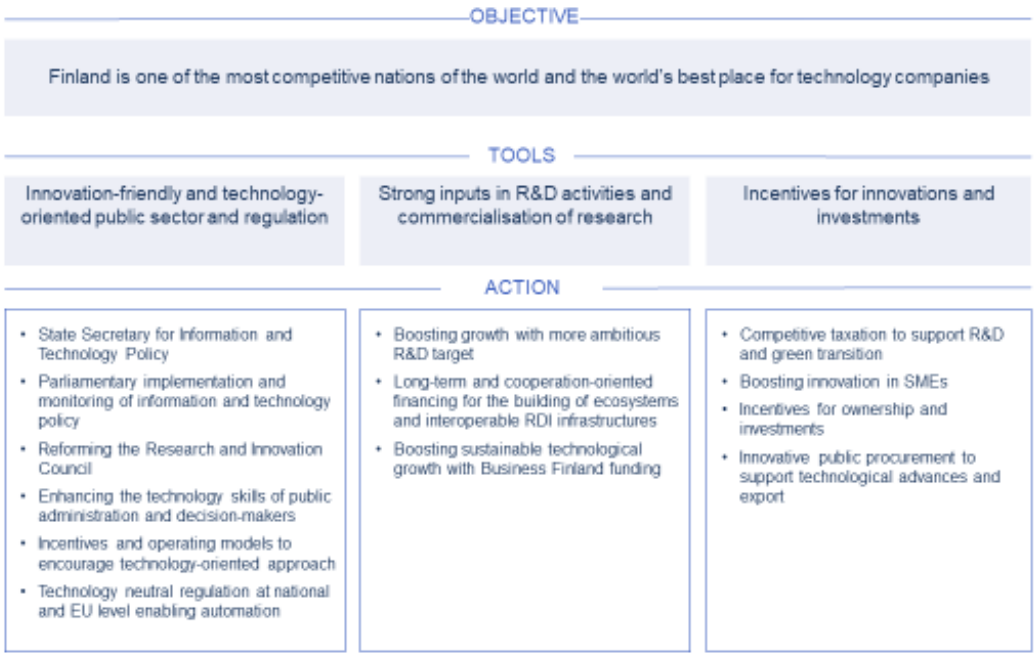
- Well-functioning transport and communications links, which are essential to the economic competitiveness of a country such as Finland and the location of technology companies. Our transport system is currently being developed on a long-term basis as part of Finland's first 12-year transport system plan (Transport 12).58 The plan contains a 12-year action plan setting out measures by central and local government as well as a state funding programme for the transport system. The development of the Finnish transport system has not been examined separately by the advisory board.
- The Finnish communications infrastructure is primarily operated on a market basis and the public sector is only the secondary source of funding. Within the framework of public-sector support, networks have been built in areas where connections would not otherwise be built. In Finland, the government has been supporting the construction of a broadband network since the start of 2010. Several projects are already under way to improve the digital infrastructure.59 For this reason, the advisory board has focused on the soft digital infrastructure, such as the trust infrastructure and interfaces, which is a prerequisite for the utilisation of

both public administration and industrial data as well as for the progress of digitalisation and automation.

- Taxation is a central part of the operating environment of technology companies and citizens. A competitive corporate taxation system providing maximum incentives for growth and investment is important for both technology companies and other undertakings. Tax incentives can be used to encourage companies to boost R&D investments, expand operations and create jobs. Technological advances are largely based on human capital and highlight the importance of employee skills. It is therefore important that the taxation of work encourages education, training and skills building. The stability and predictability of the tax system are also factors contributing to an economic environment that is reliable from the perspective of business operators and individuals. However, with the exception of certain issues that are particularly important for the operating environment of technology companies, the advisory board does not discuss taxation in its report in more detail.
- A well-functioning labour market is a prerequisite for the growth and investments of technology companies. In order to make itself an attractive business location, Finland should adopt some of the flexibility characteristic of the labour markets in our competitors.60 The advisory board has not addressed these issues in its work. It is clear, however, that the objectives set out in this work cannot be achieved unless Finland adopts at least some of the labour market practices now in use in other Nordic countries.

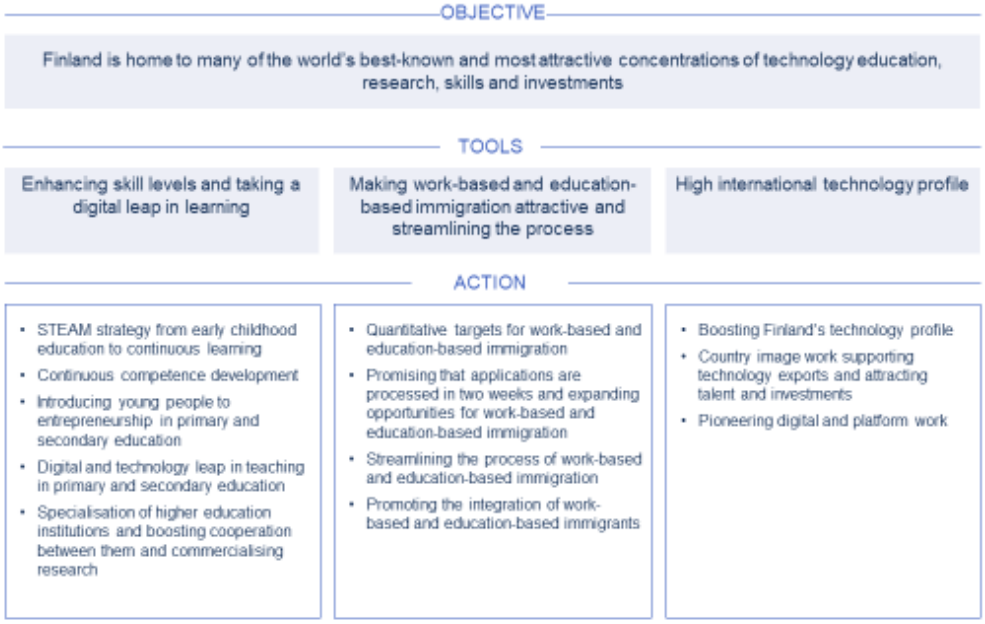
Measures to achieve the objective 'Finland is one of the most competitive nations of the world and the world's best place for technology companies':

- Innovation-friendly and technology-oriented public sector and regulation: Modifying the structures to support steering and implementation. Enhancing the technological competence of public-administration actors and decision-makers. Considering the impacts of innovation in public-administration performance guidance and budget procedures. Ensuring regulation that is technologically neutral regulation and supports automation. (Measures 1–8)
- Strong inputs in R&D activities and commercialisation of research results: Increasing the R&D target to five (5) per cent of GDP by 2033. Building an operating environment to support the growth of companies' R&D inputs. Building RDI infrastructures and testing and piloting environments to support the development of breakthroughs in research infrastructures into commercial products. Supporting growth ecosystems. Leveraging undertakings' RDI investments with public-sector support. (Measures 9–12)
- Incentives for innovations and investments: Speeding up innovations and ownership. Encouraging R&D activities through taxation. Supporting innovation activities in SMEs. Building operating and financing models for public innovative procurement to support technological development. (Measures 13–16)



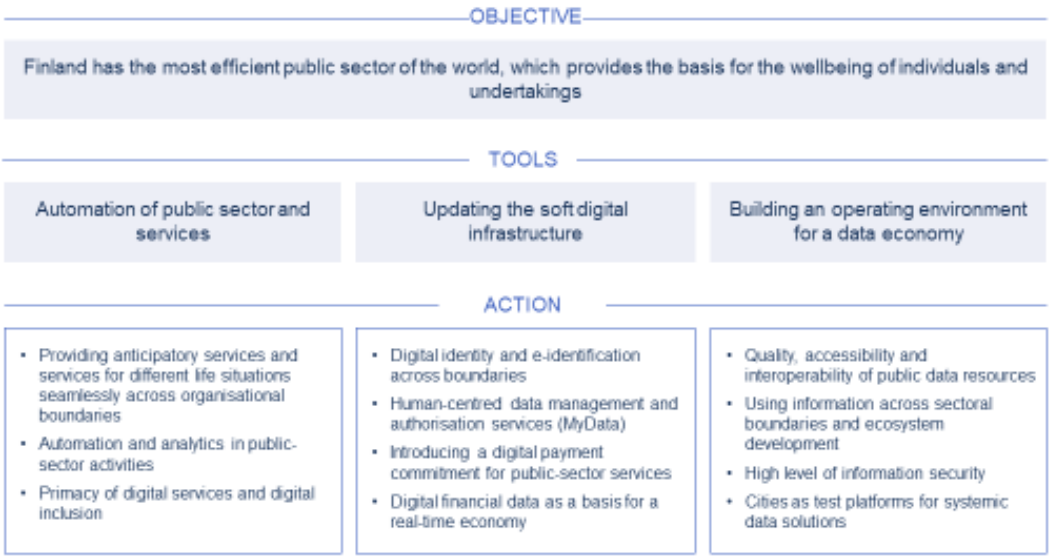
Measures to achieve the objective 'Finland is home to many of the world's best-known and most attractive concentrations of technology education, research, skills and investments':

- Enhancing skill levels and taking a digital leap in learning: Preparing a long-term national STEAM (*Science, Technology, Engineering, Arts, Mathematics*) strategy. Providing more opportunities for continuous learning. Making entrepreneurship education available in whole Finland. Taking a permanent digital leap in primary and secondary education. Improving effectiveness through profiling and digital leap of universities. Expanding cooperation between higher education institutions and undertakings to commercialise research. (Measures 17–21)
- Making work-based and education-based immigration attractive and streamlining the process: Setting ambitious quantitative targets and creating indicators and monitoring procedures for implementation. Promising that permit applications are processed in two weeks. Building digital and seamless processes. Improving integration services. (Measures 22–24)
- High international technology profile: Building a strong national technology profile and taking a strategic approach to technology partnerships. Building a country image based on Finland's own strengths. Using Finland pioneering role in the transformation of working life to improve the quality of working life and to attract talent across borders. Using the opportunities provided by platform work. (Measures 25–27)



Measures to achieve the objective 'Finland has the most efficient public sector of the world, which provides the basis for the well-being of individuals and undertakings':

- Automation of public sector and services: Introducing proactive services and services based on life situations. The public sector is a front runner in applying new technologies in its own work: piloting new technologies and changing processes through digitalisation. Ensuring the primacy of digital services. Ensuring digital inclusion. (Measures 28–30)
- Soft digital infrastructure: Speeding up the building of digital identity for individuals and businesses. Introducing human-centred data management and authorisation services (MyData). Introducing a digital payment commitment for public-sector services. Building the infrastructure for real-time economy. (Measures 31–34)
- Prerequisites for a data economy: Ensuring the quality, accessibility, and interoperability of public data resources. Channelling funding and building operating models for the use of information across sectoral boundaries and for ecosystem development. Ensuring a high level of information security. Building extensive systemic experiments in cities. (Measures 35–38)



Measures to achieve the objective 'Finland benefits extensively from the bold development and application of technologies responding to global challenges':

- Recommended technology areas: Channelling inputs to the development and introduction of the recommended platform technologies identified by the advisory board. (Measure 39)
- A front runner in climate and environmental solutions: Using technological advances to ensure Finland's front-runner status in carbon neutrality and circular economy in industries and the ICT sector. Implementing low-carbon road maps in all sectors. Ensuring sustainable digitalisation of public services and carbon neutrality in public procurement. Building an information base for monitoring the climate and environmental situation picture. (Measures 40–41)
- Using technologies to support security of supply: Ensuring that the digital infrastructure meets the needs of security of supply, and the ability to utilise new technologies as part of security of supply. (Measure 42)