MONITORING PROGRESS IN NATIONAL INITIATIVES ON DIGITISING INDUSTRY

Country report

Finland

July 2019

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Summary

Ranking 3rd out of the 28 Member States (down one position from 2017, but with very narrow margins to the 2nd and 4th places), Finland belongs to the high-performing cluster of countries in terms of digitisation according to the Digital Economy and Society Index (DESI). Finland achieves excellent results in terms of human capital, integration of digital technology and digital public services, and above EU average results in use of internet services and connectivity.

In terms of economic growth, Finland has been in steady recovery from 2016, driven especially by domestic demand. The recent setback of the electronics sector still has an impact on the potential GDP growth, and has led to the country shifting its specialisation from higher value-added goods towards intermediate goods. Currently more than two thirds of the Finnish GDP are created in the service sector. Exports of services are expanding, and increasingly high-tech. Employment growth is supported by increased demand, rising investment and export growth, despite some skills shortages and mismatch of supply and demand.

Finland has launched a general digitalisation strategy in 2018, as well as an AI strategy in 2017. A total of at least EUR 344 million have been invested or is planning to be invested across the different digitising initiatives in the country between 2016 and 2022, in addition to the EUR 130 million invested from the digital transformation programme for the regional government, health and social services reform and the 100 million invested in the "Digitalisation, experimentation and deregulation" strategy for public sector ICT. Several initiatives can be considered under pillars 2 and 3 of the Digitising European Industry (DEI), such as *Kasvumoottorit* ("Growth Engines") platform development programme with a budget of EUR 60 million of loan funding for 2018-2019, the digital transformation programme for the regional government, health and social services reform with a budget of EUR 230 million for 2017-2019, the Industrial internet funding programme with a budget of EUR 31.5 million, the innovation platform DIMECC, the open innovation cluster CLIC Innovation and KIRA-digi digital platform for the real estate and construction sector with a budget of EUR 16 million. However, there are fewer concrete initiatives on the national level under pillars 4 and 5. The Information Management Act, under Pillar 4, will be implemented in 2019, and *Yrittäjän digikoulu* (Entrepreneur's digital school) and *Digiaikakauden taidot* (Skills of the digital era) started in 2018. There are a lot of smaller scale programmes under pillars 2, 3 and 5, such as Digital Innovation Hubs without an overarching national strategy or initiative, and training programmes organised by individual regions, educational institutions, and companies.

Concerning initiatives, it should be noted that traditionally public policy and administration in Finland rely rather on continuous organisations and other structures instead of temporary initiatives and programmes. For example, the aforementioned *Kasvumoottorit* ("Growth Engines") initiative is run by Business Finland, the main public funding agency for innovation in Finland. VTT Technical Research Centre of Finland is another major public player in the service for the digitisation of industry. A relevant example of its activities is five VTT Lighthouses, which are public-private collaboration areas around global challenges and growth opportunities.[1]

Table 1 presents an overview of the main initiatives identified that will be further detailed in this report. Table 2 presents a short SWOT analysis of Finland on digitalisation.

Table 1: Overview of initiatives

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
Digital Finland Framework	2018	General strategy	National strategy	N/A	N/A	N/A	No budget
Finland's age of artificial intelligence	2017	AI strategy	National programme, research and innovation support	N/A	AI	N/A	No budget
Digitalisation, experimentation and deregulation (Public sector ICT)	2015	National strategy	Government priority in the government programme	Public sector	N/A	N/A	EUR 100 million 2015-19
The digital transformation programme for the regional government, health and social services reform	2016	National strategy	National strategy, public and private sector cooperation	Social and healthcare	N/A	All	EUR 130 million for 2017-2018, 100 million for 2019. National, public.
CLIC Innovation Ltd	2007	Pillar 2	Open innovation cluster	Bioeconomy, energy, cleantech	N/A	N/A	Unknown
DIMECC Ltd	2008	Pillar 3	Innovation platform	N/A	N/A	N/A	EUR 30 million programme portfolio in 2017
KIRA-digi	2016	Pillar 2 & 3	Digital platform	Real estate and construction	N/A	N/A	EUR 16 million, public, 50% from the government, 50% from the sector (2016-2018)
The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (Hyteairo)[2]	2018	Pillars 2 and 3	Government programme	Social and healthcare	AI, robotics	N/A	Unknown

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
Industrial Internet	2018	Pillar 3	Funding programme	N/A	N/A	All	EUR 31,468,765, national, public.
Kasvumoottorit ("Growth Engines")	2018	Pillar 3	Platform development programme	N/A	Digital platforms, AI applications, data utilisation	All	EUR 60 million (2018-2019), national, public.
Business Finland AI Business Programme	2018	Pillar 2 & 3	Funding programme	N/A	AI	All	EUR 200 million (2018 to 2022)
Information Management Act	planned in 2019	Pillar 4	Information management act	N/A	N/A	N/A	No Budget
Act on Transport Services	2018	Pillar 4	Act on digitalisation of transport services	Passenger and goods transport	N/A	N/A	No Budget
Yrittäjän digikoulu (Entrepreneur's digital school)	2017	Pillar 5	Training events	N/A	N/A	Micro and small	National, public, amount unknown
Digiaikakauden taidot (Skills of the digital era	2018	Pillar 5	Funding / Training voucher	N/A	N/A	Individuals	National, public, EUR 7 million
Innovation Voucher	2016	Support mechanism (trial)	Support voucher	N/A	N/A	SMEs	Unknown

Table 2: SWOT of Finland on digitalisation

Strengths: • High degree of innovation especially in digital industries • Strong presence of relevant industries in the country, including big players • Strong tradition of public-private partnership (PPP), including in digital industry • Strong tradition of cooperation in digital industry • Open civil society, strong cyber security, autonomous systems, data reserves and circular economy	**Weaknesses**: • Reductions in public funding (funding for Business Finland reduced by over a third from the peak year 2010 to 2016, after which a recovery has started) • Weaknesses in the combination of software skills and management skills • Lack of service and service development culture • Unpredictable and too big changes in the innovation framework
Opportunities: • Advanced 5G technology development environment and operating environments supporting the development of other technologies • Good telecommunication infrastructure • Low threshold for private-public cooperation	**Threats**: • Partial deterioration of the PPP tradition • Political instability as an investment environment

1 General context

The objective of this report is to analyse the current status of national initiatives on digitising industry in Finland. The analysis has been conducted against the background of the Digitising European Industry (DEI), which was the first industry-focused initiative of the Digital Single Market launched by the European Commission in 2016.

Similar country reports will be produced for each of the 28 EU Member States. These national reports allow to:

- Monitor the development of national initiatives on digitising industry;
- Compare different national approaches; and
- Identify best practices of national initiatives.

Monitoring and reporting back on the development of the existing national initiatives is an important element of the DEI initiative, and this report should be seen as one part of it.

For more details about the DEI and our methodological approach for the country report, please consult the document attached.

1.1 Economic context and status on digitisation

General economic context

Finland's economic performance has been good over the past few years, with a steady recovery from 2016 onwards. The economy is projected to continue to expand by 2.5% in 2019. The main growth driver is the domestic demand, which is not expected to change. However, the contribution from net exports to growth is also expected to remain positive, as the external demand is expanding and the country benefits from its recovered cost competitiveness.[3]

On the other hand, potential Gross Domestic Product (GDP) growth is hindered by the setback faced by the electronics sector, which together with the economic crisis has reduced the expected contribution of total factor productivity to the potential growth in the coming years. In addition, the decreased size of the workforce will keep the growth potential lower, despite longer working hours and higher employment in 2018-2019.[4]

Employment growth also began in 2016, supported by increased demand, rising investment and export growth, and is expected to continue at least until 2019. However, the labour market is rigid, increasingly suffering from skills shortages, especially in construction, health and some information and communications technology (ICT) niches, and from difficulties in matching the unemployed to job vacancies.[5]

The country has shifted its specialisation from higher value-added goods towards intermediate goods after the setback of the electronics sector.[6] The impact of the service sector on the GDP has increased as the share of the industry sector has gradually reduced. Currently more than two thirds of the Finnish GDP are created in the service sector, nearly three quarters of which is produced by the private sector.[7] Exports of services are expanding, and are increasingly high-tech.[8]

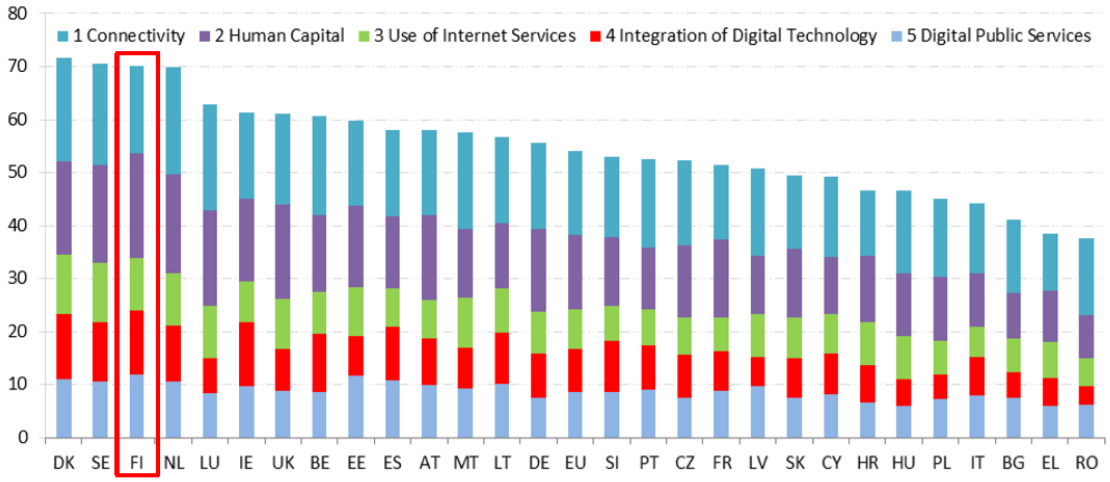
Status of digitisation

Finland has a history of ranking high on the Digital Economy and Society Index (DESI),[9] including the 2nd place in 2017 and the 3rd in 2018, with a 73.8 overall performance score in 2018. It has the highest scores in human capital, integration of digital technology and digital public services, ranking 1st, 2nd and 1st respectively in 2018. It also holds the 5th place for the use of internet services. Finland ranks 1st in the EU in the share of ICT specialists, 2nd in science, technology, engineering and mathematics (STEM) graduates, 4th in individuals with "at least basic digital skills" and 6th in internet users. It only ranks 15th in use of social networks by individuals, but 6th in the use of social media by enterprises. Finland performs very well in enterprise use of cloud services (ranking first), and reasonably well in SMEs selling online (ranking 8th), but it performs poorly regarding SMEs selling online cross-border (ranking 23rd).

Finland's lowest ranking is in connectivity, at the 9th position. The relatively low score is at least partially due to the low uptake of fixed broadband (57% as opposed to the EU average of 75%) and the low rate of subscription to fast broadband among households with fixed broadband (23% as opposed to the EU average of 33%). However, this can be partially explained by the high mobile broadband take-up (146 subscriptions per 100 subscribers in June 2017, as opposed to the EU average of 99). Stakeholders also observed that Finland has advanced development environment for 5G technology, as well as good telecommunication infrastructure (see section 2.1).

The figure below presents Finland's EU ranking according to the DESI.

Figure 1: Digital Economy and Society Index (DESI) 2018



Source: DESI 2018 Country report - Finland

Finland presents also a good performance in terms of digital transformation enablers and digital technology integration, ranking respectively 2nd and 3rd in the Digital Transformation Enablers' Index (DTEI) and the Digital Technology Integration Index (DTII).

An assessment carried out by the World Economic Forum in 2018 gives Finland the score of 7.2 out of 10 for drivers of production and 7.0 out of 10 for the structure of production. A breakdown of drivers is provided in the figure below:

Figure 2: Finland's readiness for future production

Source: World Economic Forum, Readiness for the Future Production Report 2018

The table below summarises some of the economic and digital indicators for Finland.

Table 3: General economic and digital indicators for Finland

	% GVA from manufacturing	% GDP growth	DESI position – and change	DESI sub-indicators Human Capital, Use of Internet, Integration of Digital Technology in 2018
Finland	21.1 in 2017	3.6% (2015-2016), predicted 2.5% in 2019	3rd in 2018, down from 2nd in 2017.	• Human Capital: 1st (no change compared to 2017) • Use of Internet Services: 5th (no change compared to 2017) • Integration of Digital Technology: 2nd (up from 3rd in 2017)

1.2 National strategy on digitising industry

The table below describes the relevant national strategies in Finland. The strategies described are the Digital Finland Framework, the Artificial Intelligence strategy, The Digitalisation, Experimentation and Deregulation programme for public sector ICT, and the digital transformation programme for the regional government, health and social services reform.

The last one of the four strategies mentioned is greatly affected by the failure of the government to get the reform of health and social services approved in the Parliament ahead of the April parliamentary elections. This has led to the resignation of Prime Minister Sipilä's government on 8 March 2019. The reform of the regional government was linked to the reform of health and social services, which equally collapsed. Both reforms have been on the agendas of previous governments, and the combined reform was one of the main objectives for Sipilä's government. The preparations for the implementation of the reform have been discontinued and they will be dismantled. The objective is to utilize the work done so far in the future.[10] There is a need for reforms on the field, and the topic features in public debate ahead of the parliamentary elections.

Table 4: Description of the national strategies/initiatives

Name	Digital Finland Framework[11]	Suomen tekoälyaika (Finland's age of artificial intelligence)[12]	Digitalisation, experimentation and deregulation (Public sector ICT)[13]	The digital transformation programme for the regional government, health and social services reform[14]
Type	Overall digitalisation strategy - A White Paper style description of the national strengths and overall goals	Artificial intelligence strategy - National programme, research and innovation support	National programme	National strategy, public and private sector cooperation
Starting date	2018	2017	2015	2016
Objective	Short timeframe: Recognized global markets needs that can be addressed based on current strengths Medium timeframe: Renewal of key domains such as health, transport, mobility, energy and manufacturing, based on digital innovations and platform economy Long timeframe: Global challenges - climate action, resource sufficiency, safety and security, industrial renewal, good life – and associated solutions	The aim is to turn Finland into a leading country in the application of artificial intelligence.	Digitalisation of public services. With the help of new operating practices, public services will become user-oriented and primarily digital. Principles for the digitalisation of all public services will also be established and a one-stop-shop service system and information management legislation will be developed.	The goal is to realize the multi-operator and multi-layered services package as cost-effectively as possible.
Ministry/ministries in charge (website, contact person)	Ministry of Economic Affairs and Employment. Business Finland played an elemental role in creating the paper.	Ministry of Economic Affairs and the Employment	Public Sector ICT Department of the Ministry of Finance	The Ministry of Social Affairs and Health, the Ministry of Finance, The Social Insurance institution, THL, VKR, Municipalities, ICT service centre company, SoteDigi development company
Scope of the strategy/action plan	Manufacturing, also other sectors	All sectors	Public sector	Social and healthcare

Name	Digital Finland Framework[11]	Suomen tekoälyaika (Finland's age of artificial intelligence)[12]	Digitalisation, experimentation and deregulation (Public sector ICT)[13]	The digital transformation programme for the regional government, health and social services reform[14]
Measures included in the strategy/action plan	Areas of action: Digital platforms and ecosystems of industry (sectors), rapid introduction of new technologies, digital skills, ensuring adequate funding for the implementation of digital transformation, international cooperation.	1. To generate a snapshot of the current status and prospects for AI and robotics around the world and in Finland. 2. To propose a goal state, which Finland should strive to achieve in the application of AI in collaboration with companies, research institutes, educational institutions and public organizations. 3. To enter a proposal on measures the implementation of which is necessary in order to achieve the stated objectives. Special attention must be given to the field's innovation activities, preparedness for changes to working life, increasing education and upgrading the qualifications of those in the labour market. 4. To draw up a model for the implementation of the plan that will ensure the efficient realisation of the operational programme.	1. Principles for the digitalisation of all public services will be established (principles of digitalisation). 2. The administrative branches and municipalities will be committed to reforming internal administrative processes. In the development projects that receive separate funding, priority will be given to projects in which the productivity gains are most substantial (digitalisation of processes). A one-stop-shop service model will be developed and the information management legislation reformed (one-stop-shop service system).	The goal of social and health care reform is a change in activity that will improve access to services and equality. An important tool for change is digitalisation. The functionality of a social and health care service system requires ICT solutions that allow customers to access information independently of organizational and regional boundaries.

Name	Digital Finland Framework[11]	Suomen tekoälyaika (Finland's age of artificial intelligence)[12]	Digitalisation, experimentation and deregulation (Public sector ICT)[13]	The digital transformation programme for the regional government, health and social services reform[14]
Overall funding and distribution by volume and source of funding (public/private, EU/national)	Does not include a financial target nor a distribution. Drafting of the national DEI strategy paper pending.	Does not include specific funding or funding instruments		EUR 130 million for 2017-2018, 100 million for 2019. National, public.

Impacts, challenges and perceptions

Finland's national Smart Specialisation priority areas are:

1. Manufacturing & industry
2. Key Enabling Technologies
3. Sustainable innovation
4. Human health & social work activities
5. Information & communication technologies[15]

As can be seen from the table above, many of these priorities are reflected in the strategies.

It was observed by interviewees that the reduction of initiatives with funding (such as the initiative for The Strategic Centres for Science, Technology and Innovation (SHOKs), shut down in 2015), and the launching of strategies and initiatives without allocated funding, as well as the reduction of funding for Business Finland (previously Tekes), the main public funding agency for innovation in Finland, hinders concrete action.

However, the AI strategy *Tekoälyaika* (Finland's Age of Artificial Intelligence) was credited for bringing the views of the private sector to the attention of politicians and administrators. The strategy has been structured as a network of networks, where public-private partnership has materialized concretely on different levels. Finland's strong tradition of public-private partnerships and ease of cooperation is visible in other relevant areas, too, such as in RTECO – Real-Time Economy Ecosystems[16] by Technology Industries of Finland. Government's 2018 report to the Parliament on Information Policy is a good example of an open preparation process with efficient intra-government cooperation.[17]

1.3 EU cooperation in the field of digitising industry initiatives

Finland is a signatory to the Declaration of cooperation on Artificial Intelligence (AI)[18] and involved in the European Commission's Coordinated Plan on Artificial Intelligence.[19] Finland has also published an agreement with France on bilateral cooperation on AI issues. The central focus areas of the cooperation are:

1. Digital renewal of industry
2. Healthcare
3. Future mobility
4. Start-up ecosystems

France and Finland also require that the next Horizon framework programme includes an ambitious European initiative for revolutionary innovation, which would contribute to the national goals of the countries and support the rapid launch of pilots by 2019.[20]

Finland is also a participating state in the Electronic Components and Systems for European Leadership (ECSEL), a PPP supporting the electronics components and systems industry in the EU, and the DIGINNO innovation network for the Baltic Sea Region, exploring and testing transnational aspects of digital collaboration by developing in cross-border business cases, solutions and policy approaches to speed up the process of moving towards the single digital market in the Baltic Sea Region.

In addition, there is a range of cross-border H2020 projects, and the Helsinki Node of EIT Digital on the Aalto University campus works on the broadening of industry partnerships.

2 Other policy support to digitising industry

2.1 Boosting innovation capacity

This chapter discusses initiatives adopted under Pillars 2 and 3. Table 5 provides a description of the relevant initiatives. It should be noted that due to the large number of initiatives the selection is not exhaustive, but illustrative examples have been selected based on their national scale, available information and stakeholder perceptions.

Table 5: Overview of initiatives

Name	Business Finland AI Business Programme[21]	Kasvumoottorit ("Growth Engines")[22]	Industrial internet[23]	The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (Hyteairo)[24]	DIMECC Ltd.[25,26]	CLIC Innovation Ltd[27]	KIRA-digi[28]
Type	Funding programme	Platform development programme	Funding programme	Government programme	Innovation platform	Open innovation cluster	Digital platform
Starting date	2018	2018	2018	2018	2008	2007	2016
Objective	• The AI Business program aims to make Finland the best place to research, develop and utilize artificial intelligence and platform economy in business. The program also targets to build global ecosystems and to attract investments in Finland	• Capitalization of platform companies and orchestration of ecosystems	• The Industrial Internet program goals are to support Finnish companies in business development and innovation as well as in achieving a global forerunner status in developing and using IoT solutions. This will be accomplished by building up new ecosystems and new ways of cooperation.	• To speed up the utilisation of artificial intelligence and robotics in the well-being sector's services and operating processes • To determine and eliminate obstacles and create the prerequisites for the development and use of artificial intelligence and robotics in the well-being sector • To promote the sector's AiRo technology	To serve as the leading co-creation platform for digital transformations	The mission is to create comprehensive solutions with global business impact far beyond the capabilities of individual actors. In doing so, it addresses systemic challenges that arise from the scarcity of natural resources. It acts as the core local node of global cross-industrial and disciplinary competence network with	The goal is an open and interoperable ecosystem for information management in a built environment

Name	Business Finland AI Business Programme[21]	Kasvumoottorit ("Growth Engines")[22]	Industrial internet[23]	The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (Hyteairo)[24]	DIMECC Ltd.[25,26]	CLIC Innovation Ltd[27]	KIRA-digi[28]
				business activities in Finland and export of the technology.		business relevance.	
Relevant for Pillar 2[29] or Pillar 3[30] or both	Pillar 2 and 3	Pillar 3	Pillar 3	Pillars 2 and 3	Pillar 3	Pillar 2	Pillars 2 and 3
Short description	The AI Business program offers innovation funding, networking and internationalization services for R&D and utilizing artificial intelligence and platform economy in business. AI Business will run from 2018 to 2022 with a total budget of EUR 200 million, of which Business Finland will cover appr. half. Business Finland can also fund the development of	BusinessFinland will nominate business ecosystems aiming at more than EUR 1 billion turnover as *Kasvumoottorit* ("Growth Engines"). The *Kasvumoottorit* are implemented through an enterprise-driven partnership model of companies, research organizations and public actors, aiming at solutions to global market changes and creating new	The Industrial Internet programme offers Finnish companies innovation funding, networks and export services for developing and selling global smart digital solutions.	The Hyteariro project's emblem, the Well-being and Health Sector Artificial Intelligence and Robotics Programme (#hyteairo) will support and speed up the utilisation of artificial intelligence and robotics. The Well-being and Health Sector AiRo Programme is a joint programme between all parties for communication and development.	Platform serving as innovation hub for digitalizing industry in Finland, combining the competencies of 400 organizations and 2 000 people. 12 funding programmes in 2017.	Cross-disciplinary non-profit network creating breakthrough solutions in bioeconomy, circular economy and energy systems. Coordinates R&D&I project portfolios to construct systemic solutions which are beyond the resources of individual operators. The shareholders	KIRA- digi supports pilot projects that accelerate the digitalisation of the real estate and construction industry, develop common vocabulary, collect information on the issues of legislation, develop digital planning and open information management in the industry.

Name	Business Finland AI Business Programme[21]	Kasvumoottorit ("Growth Engines")[22]	Industrial internet[23]	The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (Hyteairo)[24]	DIMECC Ltd.[25,26]	CLIC Innovation Ltd[27]	KIRA-digi[28]
	digital platforms that have a significant global networking impact.	growth areas in Finland. BusinessFinland provides funding for these business ecosystems for capitalization of platform companies and orchestration of ecosystems. The government has directed a total of EUR 60 million in loan-type equity financing in 2018 and 2019 to finance them. In addition, all other financial services of Business Finland are available to companies, research organizations and public actors operating in these ecosystems.				include 30 companies and 16 universities and research institutions.	

Name	Business Finland AI Business Programme[21]	Kasvumoottorit ("Growth Engines")[22]	Industrial internet[23]	The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (Hyteairo)[24]	DIMECC Ltd.[25,26]	CLIC Innovation Ltd[27]	KIRA-digi[28]
		The service model has been in operation since the beginning of 2018.					
Granting organisation	Business Finland	Business Finland	Business Finland	Ministry of Social Affairs and Health	PPP	PPP	The Government
Participating organisations					Network of 2.000+ R&D&I professionals, 400+ organizations, 69 shareholders and 10+ co-creation facilitators.	30 companies and 16 universities and research institutions.	The KIRA forum, Ministries
Sectors targeted	All sectors	Several sectors	All sectors	Social and Health Care	N/A	Bioeconomy, energy, cleantech	Real estate and construction
Technologies targeted	AI	Digital platforms, AI applications, data utilisation	IoT	AI, robotics	N/A	N/A	Digital platforms, AI applications, data utilisation
Funding (split by private/public and national/EU), state period/annual funding	EUR 200 million	EUR 60 million (2018-2019), national, public.	EUR 31,468,765, national, public.	Unknown	EUR 30 million programme portfolio in 2017. Public-private partnership, on average 47% of funding per programme coming from	Unknown	EUR 16 million, public, 50% from the government, 50% from the sector

Name	Business Finland AI Business Programme[21]	Kasvumoottorit ("Growth Engines")[22]	Industrial internet[23]	The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (Hyteairo)[24]	DIMECC Ltd.[25,26]	CLIC Innovation Ltd[27]	KIRA-digi[28]
					Tekes (Business Finland) in 2017.		
Current status of initiatives	Ongoing	Ongoing	Completed in 2019.	Ongoing	Ongoing	Ongoing	Funding period finished in 2018.

Impacts, challenges and perceptions

The table above presents some example of initiatives under Pillars 2 and 3. The European Commission Smart Specialisation Platform tool[31] lists 15 Digital Innovation Hubs in Finland. As part of the EU project "AI DIH Network", 30 Digital Innovation Hubs with focus on AI were selected in March to participate in a mentoring and coaching programme.[32] Two of them are Finnish, Super IoT coordinated by the University of Oulu, and the Finnish Centre for Artificial Intelligence (FCAI), which is "a nation-wide competence center for Artificial Intelligence in Finland, initiated by Aalto University, University of Helsinki, and VTT Technical Research Centre of Finland".[33]

VTT Technical Research Centre of Finland and the Ministry of Economic Affairs and Employment will publish the report "Digital Innovation Hubs in Finland" in April. The Ministry is preparing a strategy on how to implement and develop DIHs.

The status of digitalisation has remained somewhat stable in Finland over the past few years. The share of enterprises doing electronic sales to other EU countries has remained stable, as well as their share of total turnover from e-commerce. On the other hand, the share of enterprises selling online, using two or more types of social media, and buying cloud computing services of medium-high sophistication, has increased.

The evolution of ICT investment as a percentage of total investment decreased, from 9.4% in 2015 to 8.3% in 2017. Total capex spending increased from EUR 44,402.03 million to EUR 46,372.89 million over the same time period.

In terms of employee digital skills and use, the level has also remained mostly stable in terms of share of enterprises providing training to their personnel to develop/upgrade their ICT skills and employing ICT specialists.

National Authorities consulted consider Finland to have a high degree of innovation in both digital industries (score of 5 in a 1-5 scale) and other sectors (score of 4 in an 1-5 scale). Advanced 5G technology development environment and operating environments supporting the development of other technologies, good telecommunication infrastructure and low threshold for private-public cooperation are seen as the main national opportunities relating to the introduction of digital technologies, whereas weaknesses in the combination of software skills and management skills are seen as a weakness. As the added value brought by digitalisation, the authorities identified improved scalability, up-to-date information on customer needs, and the opportunity to develop life-long customerships.

Industry representatives consider Finland to be a forerunner in innovation in digital industries on the European level, if not necessarily globally, giving it an average score of 4 in a 1-5 scale. Identified strengths include the strong presence of relevant industries in the country with big players and strong tradition of public-private partnership and cooperation in digital industry, as well as open civil society, strong cyber security, autonomic systems, data reserves and circular economy, all of which support the industry digitalisation. Identified weaknesses include the deterioration of the PPP tradition, largely due to reduction and changes of funding instruments, lack of service and service development culture, and the country's instability as an investment environment, due to unpredictable and too big changes in the innovation system, repeated university reforms, reluctance to allow the market to make the choices, and resistance to change.

The industry representatives' perception on weaknesses is supported by the Ministry of Economic Affairs and Employment report *Securing Finland's competitiveness and economic growth in the 2020s*[34] by Professor Erkki Ormala on the adequacy of resources for applied research and innovation activities, which notes that the significant and often unexpected cuts of technology and innovation funding and the weakening of collaboration between different actors have reduced Finland's international competitiveness and weakened its innovation environment. The discontinuation of the funding instrument for Strategic Centres of Science, Technology and Innovation is observed to have led to a complete lack of actors responsible for coordination and utilisation of research and innovation projects.

2.2 Regulatory framework for digital age

This chapter discusses Pillar 4. Table 6 provides a description of the two relevant initiatives identified.

Table 6: Overview of relevant initiatives for a digital regulatory framework

Name	Information Management Act[35]	Act on Transport Services[36]
Type	Information management legislation	Transport service legislation
Starting date	Preparation launched in 2016, entry into force planned in 2019.	Entered into force on 1 July 2018
Objective	Regulatory reform and harmonization, ensuring versatile, secure and smooth use of information.	"The Act on Transport Services brings together transport market legislation and creates the preconditions for digitalisation of transport and new business models. Its key aim is provision of customer-oriented transport services."[37]
Short description	The purpose of drafting is to establish a new general law on information management, which will regulate public law, archives and information administration.	The act aims to create a framework for a more efficient arrangement of publicly subsidised passenger transport by utilising digitalisation, combined transport and different fleet types.
Sectors targeted	Public sector	Passenger and goods transport

Impacts, challenges and perceptions

The interviewed industry representatives were not aware of any initiatives relating to Pillar 4. It was noted that any barriers relate to the application of initiatives such as the EU General Data Protection Regulation (GDPR) in a manner that does not take the global market situation into consideration, making matters "unnecessarily difficult" for the native companies and their businesses in terms of global competitiveness.

2.3 Skills development

This chapter discusses the initiatives adopted under Pillar 5.

Table 7 provides an overview of the two identified relevant initiatives.

Table 7: Overview of initiatives to develop digital skills

Name	Digiaikakauden taidot (Skills of the digital era)[38]	Yrittäjän digikoulu (Entrepreneur's digital school)[39]
Type	Funding / Training voucher	Training events
Starting date	2018	2017
Objective	The program aims to strengthen the basic skills and digital skills of adults, especially the unemployed, those at risk of unemployment, retirees, retirees, jobseekers and immigrants. By increasing low-threshold education, it aims to prevent inequalities, give positive learning experiences and strengthen today's civic skills.	To combine the strengths of Finnish entrepreneurs with the opportunities of the digital age to create new success stories
Short description	The programme provides funding for training projects that strengthen the basic and digital skills of adults.	Training sessions for micro and small businesses in the use of digitalization in the development of new business opportunities
Granting organisation	Ministry of Education and Culture	Federation of Finnish Enterprises
Participating organisations		Reboot Finland campaign, Innokampus Ltd
Sectors targeted	All	All
Funding (split by private/public and national/EU), state period/annual funding	National, public, EUR 7 million	National, public, amount unknown
Current status of initiatives	Training projects will be executed between 2018 and 2020. Funding has been granted for 84 projects.	Ran in 2017

Impacts, challenges and perceptions

The interviewed industry representatives were not aware of any national initiatives relating to Pillar 5. It was, however, observed that there are numerous relevant initiatives at local level, run by schools, vocational institutions and other educational institutions. Private ones have also been set up, including specific "academies" for companies.

Government of Finland has allocated extra resources (altogether 30 M€) for to tackle skills gaps, via two supplementary state budgets in 2018. Resources were targeted to higher education organisations; for measures and projects in the universities and in the polytechnics for to develop sustainable models to widen the education so that skills and competences needed in industry will be produced; especially for ICT, software and technology industries, but also for the other skills gap branches. Even the grants were targeted for the universities and polytechnics, the idea was

that the target group of the new education modules is wide, not only for persons with higher education. The allocation process was carried out in co-operation with two ministries, industries and with labour administration on the regions.

It was also noted that for the digitalisation of industry, it is not sufficient to increase the digital skills of young people about to join the work force. There is also a need for retraining those already in the working life, following structural change, the loss of many traditional jobs due to automatisation and a shortage of labour in many fields related to digitalisation.

The idea of continuous learning is not new in Finland, but the scale is. It is estimated that nearly one million Finns need reskilling over the next ten years when technology changes their working life.

2.4 Support mechanisms

Business Finland has been running an **Innovation Voucher** trial from October 2016, currently planned to run until the end of 2019. A EUR 5,000 voucher is issued to encourage SMEs to innovate and develop their business. Another aim of the trial is to activate the supply of innovation services. Demand has been high and experiences so far positive, over 2,500 vouchers have been issued.

One Business Finland instrument, which also fits for development of digital skills and business models, is *Tempo funding*.[40] It is intended for Finnish startups, SMEs and mid cap companies aiming for international growth that have the desire and ability to build their expertise and solutions into an international success story in innovative ways. With the Tempo funding a company can improve its potential for international growth in various ways, including the development of management, practices and the organization.

The funding / training voucher initiative “Skills of the digital era” is presented in section 2.3, as it focuses on digital skills.

3 Conclusions

The following table provides an overview how the different digitalisation initiatives discussed in the report have been funded. Due to lack of data comparability, it is not possible to calculate exact total spending. The identified budgets of the initiatives under the different pillars have the total value of at least EUR 344 million.

Table 8: Breakdown for the financing of initiatives

	Pillar 2	Pillar 3	Pillar 4	Pillar 5
	Digital Innovation for all	**Partnerships and industrial platforms**	**Regulatory framework for digital age**	**Preparing for digital future (skills)**
Growth Engines (Kasvumoottorit)		EUR 60 million (2018-2019)		
Industrial Internet		EUR 31,468,765 (2018)		
DIMECC Ltd		EUR 30 million for 2017		
CLIC Innovation Ltd	Unknown			
KIRA-digi	EUR 16 million (2016-2018)			
The Well-being and Health Sector's Artificial Intelligence and Robotics Programme	Unknown			
Business Finland AI Business Programme	EUR 200 million (2018- 2022)			
Information Management Act			No budget	
Act on Transport Services			No budget	
Entrepreneur's digital school (Yrittäjän digikoulu)				Unknown
Skills of the digital era (Digiaikakauden taidot)				EUR 7 million
Innovation Voucher	N/A			
Total spending	At least EUR 344 million			

Many of the Finnish digitalisation initiatives and strategies currently in force are very recent, from the past two years. Finland also cooperates at EU level, especially in the context of Artificial Intelligence.

There are multiple initiatives under Pillars 2 and 3, such as Kasvumoottorit ("Growth Engines"), which has so far funded eight business ecosystems, Industrial internet, which has provided funding for over one hundred projects and project partners, DIMECC Ltd, whose network consists of over 2,000 RDI professionals, over 400 organisations, 69 shareholders and 10+ co-creation facilitators, CLIC Innovation, whose shareholders include 30 companies and 16 universities and research institutions, and KIRA-digi, which provided funding for 139 pilot projects. Somewhat fewer have been identified under Pillars 4 and 5, however, according to DESI, digital skills remain the strongest competitive advantage of the Finnish economy.

According to the available quantitative indicators, the status of digitalisation has remained somewhat stable in the country over the past few years, however due to political changes there are indications that levels of PPP and international investment are decreasing.

The box below presents a good practice from Finland, as identified by the interviewed stakeholders.

Box 1: Good practice

Industrial Internet

The funding measures of Business Finland (formerly Tekes) are considered very important to Finnish innovation by the stakeholders. Industrial Internet (*Teollinen internet*) is particularly relevant to digitalisation. The programme offers Finnish companies innovation funding, networks and export services for developing and selling global smart digital solutions. Its main aim is to build up new ecosystems and new ways of cooperation. According to the Business Finland database[41], over a hundred projects and project partners have received funding through the programme, ranging from EUR 30,000 to EUR 982,989.

To conclude, the table below provides a general overview of the discussed digitalisation initiatives implemented in Finland, the level of take-up and perception of their impacts as well as the overall progress Finland has made so far with regard to digitalisation. Overall, Finland has recently launched a number of initiatives with focus on pillars 2, 3, and 5. However, most of these are quite recent, and there is no sufficient data to determine the full outputs and outcomes. Initiatives regarding pillar 4 are still under discussion or preparation. The national strategies do not come with funding allocation, making them principally discussion and awareness raising measures.

The DESI scores indicate that Finland is nevertheless doing well in comparison to the other EU countries. However, there are some indications from stakeholders and a recent report that recent policy changes may have a negative impact on the status quo.

Table 9: Total input output overview

		Pillar 2	Pillar 3	Pillar 4	Pillar 5
		Digital Innovation for all	**Partnerships and industrial platforms**	**Regulatory framework for digital age**	**Preparing for digital future (skills)**
Application	Name of key initiatives (start dates in brackets)	CLIC Innovation Ltd (2007)	Growth Engines (2018) Industrial Internet (2018); DIMECC Ltd (2008)	Act on Transport Services (2018); Information Management Act (planned 2019)	Entrepreneur's digital school (2017) Skills of the digital era (2018)
		KIRA-digi (2016) AI Business Programme (2018) The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (2018)			
	Funding (total amount and period)	EUR 337.47 million (2007-2022)			Skills of the digital era: EUR 7 million in 2018
	Industries addressed	All	All	All	N/A
	EU programme involved	N/A	N/A	N/A	N/A
Usage	Perception of initiative	3	1.5	N/A	N/A
	Take-up	338 projects participated so far, 15 DIHs	N/A		N/A
Outcomes	Perception of outcomes	The level of take-up of digital technologies is perceived as moderate (3.33/5)	The level of innovation in digital industries is perceived as elevated (4.33/5)	No observable change / slight improvement	N/A
	Outcome metrics	1.8% of GDP spent on ICT in 2015. DESI ranking: 2nd place in 2017 and 3rd in 2018. DTII ranking: 3rd in 2018.		Total capex spending increased from EUR 44,402.03 million in 2015 to EUR 46,372.89 million in 2017. Total number of new enterprises created increased from 18,243 to 30,160 in the same time period.	Persons employed with ICT specialist skills increased from 158,000 in 2015 to 168,000 in 2017, enterprises provided training to develop ICT skills from 37% to 38% in the same period.
	Change in outcomes	DESI business digitization score 10.54096 in 2016, 12.17576 in 2018. Digital technology integration index from 47 to 55.7 from 2016 to 2017.			
End-goal	Productivity growth	Between 2010 and 2017, the real labour productivity per person employed in Finland increased by 2.6%, with the highest increases in 2010 (3.7%) and 2016 (2.0%).			
Summary		Finland has recently launched a number of initiatives with focus on pillars 2, 3, and 5.initiatives regarding pillar 4 are still mostly under discussion or preparation. National strategies on digitalisation of industry and AI do not include funding instruments, but increase awareness and steer conversation.			

ANNEX 1 List of stakeholders interviewed

Type of stakeholder	Name of organisation
National Authority	Ministry of Employment and the Economy
Industry stakeholder	DIMECC Ltd
Industry stakeholder	Cargotec Finland Ltd

Endnotes

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