

**MONITORING PROGRESS IN NATIONAL INITIATIVES
ON DIGITISING INDUSTRY**

Country report

Denmark

July 2019



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Summary

Denmark is part of the group of lead-performers among EU Members States when it comes to digitalisation. In 2017, as well as in 2018, Denmark ranks 1st out of the 28 EU Member States in the Digital Economy and Society Index (DESI). In 2018, Denmark made progress in most dimensions with the exception of Integration of Digital Technology. Denmark's main assets include its well-established digital infrastructure in the public and private sector, and the use of internet services, integration of digital technology as well as the delivery of online public services. On the other hand, a challenge is the fact that more than one quarter of the Danes do not have basic digital skills. However, Denmark still ranks 6th place in this dimension confirming its leading status.

Economic growth has been rising gradually over the past years (now reaching 2 % of GDP), which makes it the highest increase for more than 10 years. The progress in the Danish economy is borne by private consumption, private investments and exports.

The above development in the economy is underpinned by national, political reforms as well as the fiscal policy. The Danish Government has a well-coordinated strategy when it comes to digitisation. For example, The Government launched a comprehensive national strategy in 2018 with 38 different initiatives to keep Denmark at the forefront of digital development and to create growth and prosperity for the benefit of everyone in the society. The strategy's actions are divided into the following six headings:

- Digital hub for a strengthened growth environment
- Digital lift of SMEs
- Digital competencies for everyone
- Data as a growth driver in business
- Agile business-oriented regulation
- Strengthened IT security in companies

Some of the 38 initiatives are mentioned in this report as they are aligned with the Digitising European Industry strategy and its five main pillars. Furthermore, we have identified other initiatives that relate to the DEI strategy. Pillars 2 and 3 are well covered with a total of four national initiatives that support the digitising industry in Denmark. Some of the initiatives have been running since 2014 or earlier such as MADE, RoboCluster and InfinIT while the majority of the initiatives have been launched in 2018 in connection to the new strategy for Denmark's Digital Growth (e.g. Digital Hub Denmark). In relation to Pillar 4, the Government launched three initiatives in 2018 with different principles for agile regulation of trade, industry and the public sector, rules for the use of data and a central portal on cybersecurity. Finally, Pillar 5 is covered by three national initiatives that focus on getting more people to be interested in STEM subjects and increasing the competences in data security. At the moment, many of the initiatives have recently been launched and are under preparation to be implemented. Overall, initiatives across the different pillars have received a budget of at least approximately 85.51 million EUR, while support mechanisms have provided around 2,990 million EUR.

Table 1 presents an overview of the main initiatives and strategies identified, that will be further detailed in this report. Table 2 presents a very short SWOT analysis of Denmark 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 Strategy 2016-2020	2016	General strategy	General strategy	All	All	All	Approx 370 million DKK [approx 50 million EUR] (This is not a consolidated number)
Strategy for Denmark's Digital Growth	2018	General strategy	General strategy	All	All	All	125 million DKK annually [16.74 million EUR] and 75 million DKK [10 million EUR] for the implementation.
Danish Cyber and Information Security Strategy	2018	General strategy	General strategy	All	All	All	100 million DKK [13.34 million EUR]
National Strategy for Artificial Intelligence	2019	General strategy	General strategy	All	Artificial Intelligence	All	DKK 60 million [EUR 9.2 million]
Digital Health Strategy	2018	General strategy	Health strategy	Health	All	All	70 million DKK in 2018 [9 million EUR]
MADE	2014	Pillar 2 & 3	DIH, PPP, research & innovation support	Manufacturing	Cloud, IoT, Cyber Security, Robotics and Automation Machinery, Big Data and Data Analytics, 3D-printing and AI.	All	2018: 7.6 million EUR
Digital Hub Denmark	2018	Pillar 2 & 3	DIH, PPP	All	IoT, Big Data and Data Analytics and AI.	All	110 million DKK [14.73 million EUR] + private funding 12 million [1.61 million EUR]
RoboCluster	2014 (2002)	Pillar 2 & 3	Innovation Network	All	Cloud, IoT, Robotics and automation machinery, 3D-printing and AI.	All	2014-2018: 41 million DKK [5.5 million EUR] 2019-2020: 28 million DKK [3.7 million EUR]
InfinIT	2014	Pillar 2 & 3	Innovation Network	All	Mobile services, Cloud, IoT, Cyber security, Big Data and Data Analytics and AI.	All	2014-2018: 48.3 million DKK [6.5million EUR] 2019-2020: 28 million DKK [3.7 million EUR]
Data as driver of growth	2018	Pillar 4	Rules on data use	All – more focus on maritime and tourism sector	Big Data and Data Analytics and AI	All	88 million DKK [11.78 million EUR]

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
Strengthened cyber security in companies	2018	Pillar 4	Cybersecurity portal	All	Cyber security	SMEs	35 million DKK [4.69 million EUR]
Agile business regulation	2018	Pillar 4	Business regulation	All	n/a	All	n/a
Digital skills for All (Technology Pact)	2018	Pillar 5	Educational programme, PPP	All	n/a	All	2018-2022: 24.26 million EUR
Corporate partnership to increase IT security in the Danish business community	2018	Pillar 5	PPP	n/a	ICT security	All	2018-2021: 10 million DKK [1.34 million EUR]
National and international efforts to safeguard data ethics and protection of personal data	2018	Pillar 5	PPP	n/a	n/a	n/a	n/a
SME:Digital	2018	Support mechanism	Innovation vouchers	All	Social Media, mobile services, Cloud, IoT, Cyber Security, Robotics and Automation Machinery, Big Data and Data Analytics, 3D-printing and AI.	SMEs	80 million DKK [10.71 million EUR]
Pilot project on an investment pool	2019	Support mechanism	State finance fund	All	Artificial Intelligence	All	DKK 20 million [2.7 million EUR]
The Danish Industry Foundation	1898	Support mechanism	Private fund	n/a	n/a	n/a	4 billion DKK [536 million EUR]
Danish Growth Fund	1992	Support mechanism	State finance fund	n/a	n/a	SMEs	DKK 17 billion (1992-2018) [2.28 billion EUR].
Innovation Fund Denmark	2014	Support mechanism	Innovation fund	n/a	All	n/a	in 2017, 1.2 billion DKK [160.7 million EUR]

Table 2: SWOT of Denmark on digitalisation

<p>Strengths:</p> <ul style="list-style-type: none"> • Denmark performs very well in connectivity, thanks to the widest 4G coverage in Europe, and the coverage of broadband connections • Almost all Danes are online, and they make good use of a variety of online services • A large number of Danish enterprises have embraced digital technologies: 28 % of SMEs sell online, well above the 17 % EU average. 	<p>Weaknesses:</p> <ul style="list-style-type: none"> • A key priority for Denmark is to create a better match between the digital skills required by companies and the supply of graduates with these skills.
<p>Opportunities:</p> <ul style="list-style-type: none"> • With the newly launched digital strategy for Denmark's Digital Growth, the country has a good foundation to remain at the forefront of the digital development. • A strong federal ministry (The Ministry of Industry, Business and Financial Affairs) is in charge of the development. • Denmark is a frontrunner in the delivery of digital public services among EU countries. 	<p>Threats:</p> <ul style="list-style-type: none"> • The strategy and many of the initiatives have been launched within the last year, and the impact still needs to be seen.

1 General context

The objective of this report is to analyse the current status of national initiatives on digitising industry in Denmark. 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

In general, the economy of Denmark is strong and is on a steady upturn, increasingly supported by private consumption and business investment. The broad-based economy expansion is projected to continue in 2019 and moderate in 2020¹.

Looking at the gross value-added measure (GVA) in Denmark, 21.8 % is from the area “Public administration, defence, education, human health and social work activities”, followed by 20.4 % from “Distributive trades, transport, accommodation and food services, and 17.9 % from “Industry”².

Status on digitisation

Since 2014, Denmark has been the leading country in digital performance across all EU Member States³. This is due to several factors: for example, the Danish Government established the Agency for Digitisation in 2011 with the aim of digitising the public sector. This indicates that digitisation, as well as the implementation of welfare technology, have been a national, political priority for several years. Furthermore, the businesses investments in IT capital (software and information- and communication technology) have, over the last 18 years, contributed to increased labour productivity⁴. All together this indicates how digitisation, during the last couple of years, has been a focus point for both the Danish Government and the Danish business community.

According to the International Digital Economy and Society Index (I-DESI), Denmark has an overall score of 75.9. Denmark scores well in all five dimensions of the index. Within human capital, Denmark performs very well (ranks 6 on this dimension) and are making progress in particular in its percentage of STEM graduates. Furthermore, Denmark is the best performing country on the dimension ‘integration of digital technology (ranks 1st). On the Digital Technology Integration Index (DTII) and Digital Transformation Enablers’ Index (DTEI) Denmark ranks respectively 1st (62.4) and 5th (67.7).

Looking more specifically at the production, World Economic Forum has assessed 100 countries readiness for future production, as production systems stand on the brink of another technological revolution⁵. Herein, Denmark ranks as one of the leading countries (see figure 1). Being placed in this category means that Denmark has a strong current production base, and, that the country is well positioned for the future.

The above assessment is made up of two main components: ‘Structure of production’, which is a country’s current baseline of production, and ‘drivers of production’, which are key enablers that position a country to capitalize on the technological revolution.

Figure 1 shows that Denmark, of the two components, scores the highest on ‘drivers of production’ (7.2). This is in line with the overall assessment from the present report: that Denmark has taken up a lot of new measures (see initiatives below) to meet the technological future and the challenges that this entails.

Figure 1: Denmark readiness for future production

Readiness Overall Assessment			
Drivers of Production			7.2
Driver	Weighting	Rank	Score /10
 Technology & Innovation	20%	12th	6.9
 Human Capital	20%	12th	7.3
 Global Trade & Investment	20%	18th	6.8
 Institutional Framework	20%	4th	8.8
 Sustainable Resources	5%	8th	8.4
 Demand Environment	15%	34th	5.4
Structure of Production			6.3
Structure	Weighting	Rank	Score /10
 Complexity	60%	19th	7.6
 Scale	40%	46th	4.3

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

The table below presents some of the main economic numbers and status on digitisation from Denmark.

Table 3: General economic and digital indicators for Denmark

	% GDP from manufacturing (2017)	% increase GDP growth	DESI position – and change	DESI sub-indicators Human Capital, Use of Internet, Integration of Digital Technology in 2018
Denmark	12.8 % ⁶	2017: 2.3 % changes	Denmark ranks 1 st in 2017 and 2018	<ul style="list-style-type: none"> • Human Capital: 6th (same rank in 2017) • Use of Internet Services: 1st (same rank in 2017) • Integration of Digital Technology: 1st (same rank in 2017)

1.2 National strategy on digitising industry

This table below presents the main national strategies on digitising the industry and the economy: Strategy for Denmark’s Digital Growth, Danish Cyber and Information Security Strategy, Digital Strategy 2016-2020, Digital Health Strategy and the National Strategy for Artificial Intelligence.

Table 4: Overview of national strategies on digitising industry

Name	Strategy for Denmark's Digital Growth	Danish Cyber and Information Security Strategy	Digital Strategy 2016-2020	Digital Health Strategy	National Strategy for Artificial Intelligence
Type	General strategy	General strategy	General strategy	Health strategy	General strategy
Starting date	2018	2018	2016-2020	2018	2019-2027
Objective	<p>For Denmark to be a digital frontrunner with three underlying objectives:</p> <ol style="list-style-type: none"> 1. Trade and industry must tap into the potential for growth inherent to digitalisation 2. The best conditions for digital transformation of business 3. Everyone should be equipped to operate in the digital transformation 	<p>Citizens, businesses and authorities must be familiar with and be able to manage digital risks, such that Denmark can continue to use digital solutions to support the development of the society.</p>	<p>The Digital Strategy 2016-2020 sets the course for Danish public sector digitisation efforts and their interaction with businesses and industry.</p> <p>The second goal of the strategy (Public sector digitisation must provide good conditions for growth) contains initiatives that are targeted at businesses.</p>	<p>To ensure that patients experience the health system as a coherent and trustworthy health network for all that is both inherently digital and inherently personal.</p>	<p>The government sets four objectives in this National Strategy for Artificial Intelligence for how Denmark can be a front-runner in responsible development and use of artificial intelligence.</p> <ol style="list-style-type: none"> 1. Denmark should have a common ethical and human centred basis for artificial intelligence 2. Danish researchers should research and develop artificial intelligence 3. Danish businesses should achieve growth through developing and using artificial intelligence 4. The public sector should use artificial intelligence to offer world-class services
Ministry/ ministries in charge (website, contact person)	<p>Ministry of Industry, Business and Financial Affairs Website: https://www.regeringen.dk/nyheder/strategi-for-danmarks-digitale-vaekst/</p>	<p>Ministry of Finance Website: https://uk.fm.dk/publications/2018/danish-cyber-and-information-security-strategy</p>	<p>Agency for Digitisation (Ministry of Finance) The government Digital Strategies concern the authorities at all levels of government, from state, to regions to municipalities.</p>	<p>Ministry of Health Website: https://www.sum.dk/Aktuel/Publikationer/~media/Filer%20-%20Publikationer_i_pdf/English/2018/A-coherent-and-trustworthy-health-</p>	<p>Ministry of Finance and Ministry of Industry, Business and Financial Affairs Website: https://eng.em.dk/publications/2019/marts/national-</p>

Name	Strategy for Denmark's Digital Growth	Danish Cyber and Information Security Strategy	Digital Strategy 2016-2020	Digital Health Strategy	National Strategy for Artificial Intelligence
			Website: https://en.digst.dk/policy-and-strategy/digital-strategy/	network-for-all-jan-2108/A-coherent-and-trustworthy-health-network-jan-2018.pdf	strategy-for-artificial-intelligence/
Scope of the strategy/action plan	National, businesses on all levels	Public authorities, businesses and citizens	Public authorities, businesses and citizens	Public health authorities, health sector businesses and citizens	Public authorities, researchers, businesses and citizens
Measures included in the strategy/action plan	This strategy covers 38 concrete initiatives regarding Denmark's digital growth, including regulation, support-schemes, network organizations / HUBs, public data sandboxes, guidelines etc.	With the Danish Cyber and Information Security Strategy 2018-2021, the Danish government is taking the next step towards a more secure digital Denmark. The strategy focuses on three areas: technological preparedness; raised awareness of cyber and information security among citizens, businesses and authorities; improved cooperation and coordination between responsible authorities. Moreover, sub-strategies for cyber and information security in the most critical sectors will ensure that the individual sectors take action where it is most needed.	The second goal of the strategy contains three focus areas that each contain initiatives related to digitisation of business: 1. Better framework for the business community 2. Public sector data as a growth driver 3. An efficient utilities sector	The strategy sets out a goal of long-term change for a number of areas for putting patient needs first and making workflows easier for healthcare professionals as well as a number of specific large-scale and small-scale efforts. At the same time the strategy puts focus on development of new solutions and technologies and new models for collaboration between the health system, learning environments and private suppliers. The strategy therefore encourages close cooperation between the health care system and private companies and	The strategy contains 24 initiatives. The government will implement targeted efforts within four focus areas: 1. A responsible foundation for artificial intelligence 2. More and better data 3. Strong competences and new knowledge 4. Increased investment In order to ensure that specific experience from relevant areas of society is gathered immediately, the government will set goals for work on artificial intelligence within specific priority areas. These areas are: <ul style="list-style-type: none"> • Healthcare • Energy and utilities • Agriculture

Name	Strategy for Denmark's Digital Growth	Danish Cyber and Information Security Strategy	Digital Strategy 2016-2020	Digital Health Strategy	National Strategy for Artificial Intelligence
				external learning environments behind the technologies to understand and exploit the potential for the benefit of patients and staff.	<ul style="list-style-type: none"> • Transport
Overall funding and distribution by volume and source of funding (public/private, EU/national)	The strategy will be supported by 125 million DKK [16.74 million EUR] annually towards 2025 as well as 75 million DKK [10.04 million EUR] permanently to implementation of the strategy's initiatives. Public funding of 1 billion DKK [133.92 million EUR], private funding specified for each initiative described in other sections below (Digital Hub Denmark, SMV: Digital, Strengthened cyber security in companies, Data as driver of growth and Digital Skills for All (Technology Pact)).	Public funding of 100 million DKK [13.4 million EUR]; Private funding: N/A	Approx. 370 million DKK [approx.. 50 million EUR] (This is not a consolidated number)	Public funding: 47 million DKK [6.3 million EUR] (some initiatives in the strategy will, however, receive funding from other sources).	<p>The government has earmarked DKK 60 million (EUR 9.2 million) for 2019-2027. This is a supplement to the DKK 295 million (EUR 45.4 million) allocated in the Finance Act 2019 from the research reserve for research into new technological possibilities and digital technologies and for a national centre for research into digital technologies.</p> <p>The government has also proposed a new investment fund to expedite the dissemination of digital welfare solutions.</p> <p>Together with initiatives already launched, the investment fund will have a total investment budget of DKK 410 million (EUR 63.1 million) for 2018-2022.</p>

All of the above strategies are quite new, and it has therefore not been possible to collect data on the implementation status and likely challenges facing the initiatives.

The Danish smart specialisation strategy of 2014 focuses on the following five priority areas⁷:

1. Manufacturing & Industry
2. Energy production & distribution
3. Sustainable innovation
4. Human health & social work activities
5. Agriculture, forestry & fishing

Since the Danish Cyber and Information Security Strategy and the Strategy for Denmark's Digital Growth are targeted at all sectors and digital technologies, they are not aligned specific with one of the priority areas of the smart specialisation strategy. However, the Digital Health Strategy is targeted the health sector and is therefore aligned with the priority area on human health and social work activities.

1.3 EU cooperation in the field of digitising industry initiatives

Denmark takes part in the coordinated Plan on Artificial Intelligence and the European Blockchain Partnership at EU level. Furthermore, Denmark participates in the ECSEL Joint Undertaking. This is a programme funding research, development and innovation projects for world-class expertise in key enabling technologies essential for Europe's competitive leadership in the area of the digital economy.

Aalborg University (as a full partner) and the Danish ICT Industry association ITBD (as associated partner) are also involved in 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.

At this moment (primo 2019) the Ministry of Industry, Business and Financial Affairs does not have further information regarding EU cooperation activities. However, the Ministry of Industry, Business and Financial Affairs indicated that there is ongoing collaboration within Horizon 2020.

2 Other policy support to digitising industry

2.1 Boosting innovation capacity

This section describes four initiatives supporting the digitising industry in Denmark. It is important to note that the perception of the initiatives below are based on an interview with one industry association. Therefore, the answers are not representative for the entire industry. Moreover, this is also the case throughout the rest of the report since it was only possible to collect interview data from one industry association.

The table on the next page presents an overview of the main initiatives to boost innovation capacity (pillars 2 and 3 of the DEI). Digital Hub Denmark is funded as part of the Strategy for Denmark's Digital Growth.

Table 5: Overview of initiatives to boost innovation capacity

Name	MADE	Digital Hub Denmark	RoboCluster	InfinIT
Type	DIH, PPP	DIH, PPP	Innovation Network	Innovation Network
Starting date	2014	2018	2014	2014
Objective	The vision is to make Denmark the world's leading manufacturing nation through research, innovation and education.	The goal of Digital Hub Denmark is to support and strengthen the digital growth environment in Denmark and to strengthen collaboration across private companies, researchers, and tech-entrepreneurs.	RoboCluster's vision is to make Denmark a leader in the development and innovative application of robotics and automation in areas where it creates maximum value for Danish society and individual companies.	The goal is to convert the infinite possibilities that technology offers into concrete collaborations between research and industry.
Relevant for Pillar 2 ⁸ or Pillar 3 ⁹ or both	Pillars 2&3	Pillars 2&3	Pillars 2&3	Pillars 2&3
Short description	MADE – Manufacturing Academy of Denmark was launched in 2014 to strengthen the Danish manufacturing ecosystem through applied research, development and innovation. MADE unites manufacturing companies, universities and Research and Technology Organisations (RTOs) in an innovative collaboration that exploits and enhances the strongholds for which Denmark is world renowned.	Digital Hub Denmark is a public private partnership between the Danish Government, the Confederation of Danish Industry, the Danish Chamber of Commerce and Finance Denmark.	The Innovation Networks have a multitude of skills and activities which include: <ul style="list-style-type: none"> •Matchmaking and creating collaboration between companies, researchers, the public sector, technological service providers and other partners. •Innovation •Network RoboCluster has a focus on Robotics, Automation and Drones. 	InfinIT is a Danish network for innovative use of IT.
Granting organisation	Private companies Innovation Fund Denmark Universities and Research and Technology Organisations (RTOs), Private funds and associations	Ministry of Industry, Business and Financial Affairs Ministry of Higher Education and Science Ministry of Foreign Affairs	Danish Agency for Institutions and Educational Grants	Danish Agency for Institutions and Educational Grants

Name	MADE	Digital Hub Denmark	RoboCluster	InfinIT
		Danish Chamber of Commerce Confederation of Danish Industry Finance Denmark		
Participating organisations	Private companies (approx. 150) Educational institutions and GTS-institutions Other organisations	Ministry of Industry, Business and Financial Affairs Ministry of Higher Education and Science Ministry of Foreign Affairs Danish Chamber of Commerce Confederation of Danish Industry Finance Denmark	Knowledge institutions, cluster organisations and companies, as well as business associations etc.	Knowledge institutions, cluster organisations and companies, as well as business associations etc.
Sectors targeted	Not sector specific	Not sector specific	This is a generic robotics network covering a wide range of sectors/industries.	This is a generic IT network covering a wide range of sectors/industries.
Technologies targeted	Cloud, IoT, Cyber Security, Robotics and Automation Machinery, Big Data and Data Analytics, 3D-printing and AI.	IoT, Big Data and Data Analytics and AI.	Cloud, IoT, Robotics and automation machinery, 3D-printing and AI.	Mobile services, Cloud, IoT, Cyber security, Big Data and Data Analytics and AI.
Funding (split by private/public and national/EU), state period/annual funding	Funding from national government, private funds and associations, Industry and EU. Total amount of funding p.a.: 2015: EUR 3.4 million 2016: EUR 3.4 million 2017: EUR 5.8 million 2018: EUR 7.6 million The numbers shown do not include in-kind funding in the form of industrial hours, equipment or software used to co-finance the work. This accounts for 2/3 of the total funding which means the total value is three times the cash amount listed here.	Government funding (110 million DKK from 2018-2022) [14.73 million EUR] + Private funding (12 million DKK from 2018-2022) [1.61 million EUR]	Primarily national, secondarily regional funding. Total amount of funding p.a. (Basic grant from Ministry): Mid 2014-End 2018: 14.8 million DKK [2 million EUR]. 2019-2020: 12 million DKK [1.6 million EUR].	Total amount of funding p.a. (Basic grant from Ministry): Mid 2014-End 2018: 19.9 million DKK [2.6million EUR]. 2019-2020: 14 million DKK [1.8 million EUR].
Current status of initiatives	From the 1 st of December 2018 until the end of 2020, MADE have been chosen to manage 'Innovationsnetværket for	The initiative is funded until 2022.	The initiative is funded until 2020.	n/a

Name	MADE	Digital Hub Denmark	RoboCluster	InfinIT
	Fremtidens Produktion' by the Danish Agency for Institutions and Educational Grants.			

MADE

The industry association interviewed for the report (1 industry representative) perceives MADE as a very useful initiative (5 in a scale from 1 – 5 ranging from low to high usefulness). The association points at strengths of the initiative such as having a strong connection with researchers and businesses. Regarding the uptake of digital technologies due to the initiative, the industry association also ranks MADE high on the scale (4 on the same scale as above).

Looking at the number of businesses benefitting from the initiative, the industry association noted that among 1 – 5000 businesses are benefitting from the initiative.

Digital Hub Denmark

The industry association consulted places Digital Hub Denmark in the middle of the scale indicating that the initiative neither is useful nor not-useful (3 in a 1-5 scale). When asked about the uptake of digital technologies due to the initiative, the industry association ranks the initiative at 3 indicating that the uptake is neither high nor low. This might be due to the fact that the initiative is still to be developed. One of the perceived challenges of the initiative is that it will embrace too many activities.

RoboCluster

The industry association interviewed perceives this initiative as moderately useful (3 in a 1-5 scale). The association's perception of uptake of digital technologies due to this initiative is ranked at 5 indicating a very high uptake of technologies. One of the perceived strengths of the initiative is that it is useful in promoting the Danish Robot Cluster.

The number of businesses benefitting from the initiative is considered to be 50 between 2015 – 2018. These are primarily SME's.

InfinIT

The industry association marks the initiative InfinIT as little useful (2 in a 1-5 scale) However, looking at the industry association's perception of the initiatives ability to uptake digital technologies, the answer is 3 (in a 1-5 scale) indicating that the initiative, according to the industry association, is having a moderate impact on the uptake of digital technologies.

A challenge of the initiative is, according to the industry association, that it has problems with visibility and impact.

Impacts, challenges and perceptions

As most of the initiatives were launched in 2018, and the data on the initiatives has been quite limited, it is difficult to comment on the usage of the initiatives. However, according to the Smart Specialisation Platform it appears that Denmark has seven DIH of which five are fully operational and three are in preparation to be implemented.

Furthermore, the industry association in general perceives the level of innovation in digital industries (ICT, digital platforms) as well as the take-up of digital technologies in Denmark as very high (ranking both 5 on a 1 – 5 scale). The industry association also notices that the Governments' support is very useful (4 on the same scale as above), but assesses that there is room for improving the coordination of such initiatives.

Finally, it should be noted that in 2019 InfinIT, as well as Robocluster, have strengthened ties to relevant business cluster organizations in order to further increase outreach and involvement of SMEs.

2.2 Regulatory framework for digital age

This section describes the national regulatory framework in Denmark. In 2018, the Danish Government decided that regulation was needed to support the businesses opportunities for testing, developing and applying new digital technologies and business models. This resulted in the initiative “Agil Erhvervsrettet Regulering”. Two other initiatives are also relevant here, namely “Data as driver of growth” and “Strengthened cyber security in companies” which are funded as part of the Strategy for Denmark’s Digital Growth.

All three initiatives are listed in the table below (Pillar 4 of the DEI).

Table 6: Main initiatives to adapt the regulatory framework to the digital age

Name	Agile Business regulation "Agil Erhvervsrettet regulering"	Data as driver of growth	Strengthened cyber security in companies
Type	Business regulation	Rules on data use	Cybersecurity portal
Starting date	2018	2018	2018
Objective	To ensure that Denmark’s regulation is modernized so that the country can attract and retain innovative companies that want to develop or apply new technologies and digital business models. This also supports effective competition, which will benefit consumers	To support the use of data in Danish businesses, so that data may be utilized to improve productivity and business development.	To strengthen cyber security and information security in small and medium-sized enterprises.
Short description	The initiative has established six principles for agile regulation of trade, industry and the public sector as well as a single point of entry for new business models, perform a digital check-up as to whether existing commercial regulation is up-to-date and improve opportunities for testing in fields with particular potential for digital growth. The initiative also puts forward a proposed consumer policy, that will work to ensure that the information companies provide to consumers digitally has actual value for the consumer. Furthermore, it will make it easier for consumers to use own data	This initiative includes a broad range of measures focused at supporting the use of data in Danish businesses, including: <ul style="list-style-type: none"> • Creating clear guidelines for companies’ use of data, developing ethical recommendations for data, • Establishing a blockchain solution for the Register of Shipping and certificates, • Developing digital export certificates, supporting a trial put & take database for tourism data • Free access to Danish Meteorological Institute’s weather, climate and maritime data • Digital physical planning and planning data • Trial computer space for sharing data between 	Single point of entry for security incidents, the Government has supported IT security in Danish business by making it easier to report IT security incidents via a single digital point of entry for reporting (across 10 authorities and 7 legislative acts), and by providing specific tools for companies to better equip them to handle the rising threat scenario. Establishing a coordinated information portal to provide better access to knowledge, specific tools and guidance on IT security (www.sikkerdigital.dk). Business Council for IT security Committee, which will support the dialogue with the business

Name	Agile Business regulation "Agil Erhvervsrettet regulering"	Data as driver of growth	Strengthened cyber security in companies
	from public registers to obtain quotes from companies, make condition and electrical installation reports more user-friendly and improve opportunities to develop new innovative solutions that can make it easier for consumers to scan the market for mortgages.	companies and the authorities <ul style="list-style-type: none"> Undertake analysis and testing of the commercial potential of selected public data. <p>Most recently in the National Strategy for Artificial Intelligence, the government will in collaboration with the business community and research communities, identify five public-sector datasets during 2020 and 2021, which can be made accessible for businesses, researchers and public authorities as non-personal data.</p>	community and identify additional measures to strengthen the IT security of SMEs.
Sectors targeted	All	All sectors, but especially the maritime and tourism sector	SMEs across sectors

Impacts, challenges and perceptions

The Government has taken steps and made plans to transform IT security rules to support the digitisation of industry. This has been done through the National Strategy for Cyber and Information Security¹⁰ (see Section 1.2) and establishing a coordinated information portal to provide better access to knowledge, specific tools and guidance on IT security (initiative "strengthened cyber security in companies" presented above). Furthermore, the Government has established guidelines for the use of data, which they consider to be best practice. In relation to the latter, the industry association consulted points out how the Government has founded an expert panel on data ethics in order to sustain trust in the use of data both in private companies and in the public sector. The industry association and the Danish Government believe that digital responsibility can become a competitive advantage for Danish companies. Thirdly, the Danish Government has taken steps to change accounting treatment to enable digital investments to be recorded as capex. These steps include overhauling the rules for depreciation of IT and telecommunications, which is currently being done (primo 2019).

Even though the Agile Business Regulation is quite new, the effects from the measures taken in this field can already be seen. As an example, the Government has formulated a new specification in the Act for Food as a result of a request from a start-up working on a new business model for distributing surplus food. However, the industry association consulted does not perceive yet any significant impact of the Agile Business Regulation, ranking its usefulness at 2 in a scale of 1-5 where 1 is low and 5 is high. When asked about their perception of the uptake of digital technologies due to the measure, they rank it at 2 on the same scale as the one mentioned above. However, the industry association points out that one of the strengths of the initiative is the fact that it gives companies an opportunity to overcome regulatory barriers to business development and new business model. On the other hand, they point out that one of the weaknesses is the difficulty for companies in knowing which authority to contact. However, as the initiative

establishes a single point of entry for new business models, the initiative is addressing this challenge. Its recent establishment (summer of 2018) might explain why the industry is not fully aware of it yet.

Regarding the two other initiatives, we do not have data on the industry's perception of their usefulness as well as their perception of the update of digital technologies.

Despite the above-mentioned progress, the field is limited by regulatory barriers at EU and at the national level impeding digital transformation. According to our respondents, it is not systematically considered at the EU level whether regulation is digitally proof and there are still regulatory proposals that are not suited to the current digital reality of businesses or are difficult to digitalise and automatize by public authorities. This places unnecessary burdens on businesses and citizens and can challenge well-functioning national and European digital public services.

The industry association furthermore points out that barriers at national level also exist, related to a lack of regulatory foresight. The industry association consulted suggested that the government should have an annual tech forecast.

The Governments' plan to improve the regulatory climate to support digital transformation is to continuously have a focus on agile regulation. The principles for new regulation cover all new industry-related legislation, meaning that new legislation must make sure that it does not stand unnecessary in the way of new ways of doing business.

2.3 Skills development

The table below presents an overview of the main measures for digital skills development (Pillar 5 of the DEI). Digital Skills for All (Technology Pact) is funded as part of the Strategy for Denmark's Digital Growth.

Table 7: Overview of initiatives to boost digital skills

Name	Digital Skills for All (Technology Pact)	Corporate partnership to increase ICT security in the Danish business community	National and international efforts to safeguard data ethics and protection of personal data
Type	New educational programmes, training centres, testbed of programmes for increasing understanding of technology in primary schools.	Public-private partnership	Public-private partnerships, diplomacy, guidelines
Starting date	2018	2018	2018
Objective	<p>More people to be interested in STEM subjects:</p> <ul style="list-style-type: none"> • 150,000 people participate in the Technology Pact's initiatives in 2020 • 250 companies engage in the Technology Pact's initiatives in 2020. <p>More people to become educated in STEM subjects:</p> <ul style="list-style-type: none"> • 20% more Danes will complete non-dimensioned higher education STEM education in ten years • 20% more will complete a STEM vocational education in ten years <p>More people to use STEM subjects in their jobs:</p> <ul style="list-style-type: none"> • The STEM skills of the workforce are among the best in Europe • Denmark will be at level with the Nordic countries in regard to problem-solving with ICT • Trade and industry will not experience extensive recruitment challenges regarding STEM skills in ten years. 	Increase the competences to better prevent security incidents	Safeguard data ethics and protection of personal data and make it easy for businesses to do so.
Short description	The initiative will establish a Technology Pact, addressing the required skills for a technological and digital future. Also, a test program to improve technological understanding in primary and lower secondary education will be initiated. In general, there will be an increased focus on digital skills in final examinations for vocational education, accompanied by a centre for the Application of IT in teaching. Lastly, a digital strategy for further education will be developed and implemented – the strategy is accompanied by an action plan for getting more graduates from STEM educations and a greater use of satellite-based data in higher education.	The Danish government wishes to improve ICT security and responsible handling of data in the Danish business community, and to help ICT security become one of Denmark's strengths. In order to achieve this, it will be necessary to work together across the public and private sectors. Moreover, this requires close dialogue and exchange of knowledge between the various players, who each in their way can support businesses' work on ICT security and responsible handling	The Danish government will consolidate its efforts relating to data ethics at national level with respect to data processing by Danish businesses as well as at international level. At national level, business-oriented information and guidance material will be prepared on the rules governing responsibility, ownership and rights in connection with the use of data. Furthermore, an expert group has been set up which includes representatives from the Danish

Name	Digital Skills for All (Technology Pact)	Corporate partnership to increase ICT security in the Danish business community	National and international efforts to safeguard data ethics and protection of personal data
		of data. Accordingly, the Danish government will take the initiative to establish cooperation between the public sector and the private sector via a corporate partnership on increased ICT security and responsible handling of data.	business community and which has been tasked with preparing general recommendations for data ethics. The government will also launch a separate strategy concerning protection of Danish citizens' personal data. At the international level, the government will identify data ethics and data protection as key focus areas for the Danish tech ambassador in Silicon Valley as a step towards improving its dialogue with major multinational tech companies.
Granting organisation	The Government, EFRU	Ministry of Industry, Business and Financial Affairs	Ministry of Industry, Business and Financial Affairs Ministry of Finance
Participating organisations	Ministry of Industry, Business and Financial Affairs Ministry of Higher Education Ministry of Education and Science Ministry of Employment	Ministry of Industry, Business and Financial Affairs Danish Chamber of Commerce Confederation of Danish Industry Finance Denmark SMEdenmark	Ministry of Foreign Affairs
Sectors targeted	Cuts across sectors	N/A	N/A
Funding (split by private/public and national/EU), state period/annual funding	Government (24.26 million EUR from 2018-2022).	Government funding (10 million DKK from 2018-2021) [1.34 million EUR]	N/A
Current status of initiatives	The initiative is funded from 2018 – 2022. The Government will in 2021/22 decide on additional funding. Funds for digital initiatives are reserved in the state budget.	The initiative is funded from 2018 – 2021.	N/A

Impacts, challenges and perceptions

The initiatives presented above have all been launched very recently (2018). Nevertheless, the industry association consulted perceives the Technology pact as a good initiative (rating it 3 on a scale 1-5 on both usefulness and uptake of digital skills due to the initiative). This is due to the fact that it highlights the need for digital skills and collaboration between private and public partners. However, the respondent from the industry noted that the success of the initiative is dependent on the involvement of companies.

Regarding digital skills, Denmark is performing well and making progress in particular in its percentage of STEM graduates. Furthermore, in 2017, the share of Danes reporting at least basic digital skills was well above the EU average, including the share of Danes between 55 and 74 years old who are digitally skilled. A key priority for Denmark is thus to create a better match between the digital skills required by companies and the supply of graduates with these skills. The Technology Pact is one of the initiatives to address this issue.

2.4 Support mechanisms

SME: Digital

SME: Digital is a one-stop-shop where SMEs can be granted a voucher for private counselling and guidance to boost their digital transformation and to boost their online sales through the eCommerce centre. In 2018, there was a total of 2.6 million DKK [3.48 thousand EUR] allocated to private counselling. This support mechanism launched in 2018 and is, at this date (primo March 2019), financed until 2021 by the Danish Government and the European structural and investment funds.

The Danish Growth Fund

The Growth Fund is the State Finance Fund, with an independent act and board. The Growth Fund Act states that the Fund is to promote growth and renewal in small and medium-sized enterprises in order to achieve greater socio-economic returns. In cooperation with private investors, the fund has co-financed growth in over 6,000 companies since 1992 for a total commitment of more than DKK 17 billion [2.28 billion EUR].

As an initiative in the National Strategy for Artificial Intelligence, the Danish Growth Fund will manage from 2019 a pilot project in the form of an investment pool of DKK 20 million (EUR 2.7 million) over four years, and this will be targeted at enterprises with a business model based on artificial intelligence. The pool will be implemented as loans or equity, depending on the specific need of the individual business. Given the requirement for private co-financing, the initiative will have a leverage effect, as private capital is also invested in the businesses.

Innovation Fund Denmark

The Innovation Fund invests in the development of new knowledge and better market positions for the country's companies. The Fund allocates funding for activities in strategic research, technology development and innovation. The Innovation Fund was established on April 1, 2014 and allocates funding (in 2017, 1.2 billion DKK [160.7 million EUR]) for activities in strategic research, technology development and innovation. The Innovation Fund has three main inputs of Grand Solutions, InnoBooster and Talents. The Innovation Fund is a collection of support instruments previously used by the Strategic Research Council, Technology and Innovation Council and the High Technology Foundation.

The Danish Industry Foundation

The Danish Industry Foundation is a private and independent foundation. It develops and supports innovative, inspirational and economically sustainable projects and initiatives that strengthen the competitiveness of the Danish industry. Each year, the Foundation aims at funding projects for up to approximately 30 million euros. The foundation was established in 1898 and reports its annual accounts to the Danish Business Authority.

3 Conclusions

The report shows that Denmark has initiated and implemented a wide range of national initiatives that are aligned with the DEI strategy. Furthermore, the Danish Government has recently implemented several strategies on digitising industry: a strategy for Denmark's Digital Growth that emphasises Industry 4.0., a strategy on Danish Cyber and Information Security Strategy that focuses on a more secure digital Denmark. These are complemented by a Digital Strategy 2016-2020 setting the course for Danish public sector digitisation efforts, a Digital Health Strategy focusing on developing new technological solutions and models for collaboration between the health system, learning environments and private suppliers, and finally a National Strategy for Artificial Intelligence to make Denmark a front-runner in responsible development and use of artificial intelligence.

At EU level, Denmark participates in the coordinated Plan on Artificial Intelligence, the European Blockchain Partnership and the ECSEL joint undertaking. Pillars 2 and 3 are well covered with a total of four national initiatives that support the digitising industry in Denmark. Some of the initiatives have been running since 2014 or before such as MADE with up to 5,000 businesses already benefiting from it, RoboCluster with about 50 companies involved, and InfinIT, while other initiatives have been launched in 2018 in connection to the new strategy for Denmark's Digital Growth (Digital Hub Denmark). In relation to Pillar 4, the Government launched three initiatives in 2018 with different principles for agile regulation of trade, industry and the public sector, as well as rules for data use and a central portal on cybersecurity. Finally, three national initiatives under Pillar 5 focus on getting more people to be interested in STEM subjects and increasing the competences in data security. These initiatives are in line with the new strategies on digitising industry.

The following table provides an overview of how the different digitalisation initiatives implemented in Denmark have been funded.

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)
MADE	EUR 7.6 million (2018)			
Digital Hub Denmark	Government funding DKK 110 million (2018-2022) [14.73 million EUR], private funding DKK 12 million (2018-2022) [1.61 million EUR]			
RoboCluster	DKK 41 million (14.8 million DKK from funding p.a) (2014-2018) [5.5 million EUR] DKK 28 million (12 million DKK from funding p.a) (2019-2020) [3.8 million EUR]			
InfinIT	DKK 48.3 million (19.9 million DKK from funding p.a) (2014-2018) [6.5 million EUR] DKK 28 million (14 million DKK from funding p.a) (2019-2020) [3.7 million EUR]			
Strengthened cyber security in companies			DKK 35 million (2018-2022) [4.69 million EUR]	
Data as a driver of growth			DKK 88 million (2018-2022) [11.78 million EUR]	
Agil Erhvervsrettet regulering			n/a	
Technology Pact				EUR 24.26 million (2018-2022)
Corporate partnership to increase ICT security in the Danish business community				DKK 10 million (2018-2021) [1.34 million EUR]
National and international efforts to safeguard data ethics and protection of personal data				n/a
SME: Digital	DKK 80 million (2018-2021) [10.71 million EUR]			
The Danish Industry Foundation	DKK 4 billion [536 million EUR]			
Danish Growth Fund	DKK 17 billion (1992-2018) [2.28 billion EUR].			
Pilot project on an investment pool for artificial intelligence	DKK 20 million (2019-2022) [EUR 2.7 million]			
Innovation Fund Denmark	DKK 1.2 billion (2017) [160.7 million EUR]			
Total spending	At least approx. 3.07 billion EUR (85.51 million EUR across DEI Pillars and 2,990 million EUR from support mechanisms)			

The table below presents a good practice initiative.

Box 1: Good practice

MADE

The national initiative MADE (Manufacturing Academy Denmark), started in 2014 as a bottom-up initiative. The initiative is gaining a strong role in aligning public and private research and innovation strategies for digitising industry. Today it has more than 100 members (companies, universities, GTS-institutes, private funds and associations). The initiative is characterised as a strong bottom-up governance. Many companies in Denmark are amongst the best in the world in their niche. MADE Digital builds on these strengths and combines precisely this diversity because these companies are not competitors, enabling them to share knowledge when collaborating with the best research teams in the country and machine builders to develop new robotic solutions.

To conclude, the table below provides a general overview of the main digitalisation initiatives implemented in Denmark, the level of take-up and perception of their impacts and the overall progress Denmark has made so far regarding digitalisation.

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)	MADE (2014), Robocluster (2014), InfinIT (2014), Digital Hub Denmark (2018),		Agil Erhvervsrettet regulering, Data as a driver of growth, Strengthened cyber security in companies (2018)	Technology Pact, Corporate partnership to increase ICT security, National and international efforts to safeguard data ethics and protection of personal data (2018)
	Funding (total amount and period)	EUR 43.44 million (2014-2022)		EUR 16.47 million	EUR 25.6 million (2018-2022)
	Industries addressed	All		All	All
	EU programme involved	No		No	No
Usage	Perception of initiative	Government support for digital transformation is considered useful (4/5)		There is low perception of improvements in the regulatory framework (2/5)	There is low perception of usefulness of government initiatives on digital skills (3/5)
	Take-up	n/a		/	n/a
Outcomes	Perception of outcomes	The level of take-up of digital technologies is perceived as moderate (3/5)		The regulatory framework is perceived as rather fit for the digital age (4/5)	The required skills and labour resources are considered to be more or less available to enable digitisation (3/5)
	Outcome metrics	DESI overall rank: 1st in 2017 and 2018		Between 2015 and 2017, total capex spending in Denmark increased by 13,1%.	The number of people employed with ICT specialist skills increased by 15,13% between 2015 and 2017. In the same period, the share of enterprises providing training to develop ICT skills fell from 29% (2015) to 27% (2017)
	Change in outcomes	Denmark ranked 1 st in terms of integration of digital technology (DESI) in 2017 and 2018.			
End-goal	Productivity growth	Looking at GDP per hour worked as a measure of labour productivity (OECD) has the number increased from 2010 to 2017 (2010 = 100, 2017 = 108) ¹¹			
Summary		Denmark has a huge focus on digitising industry. Firstly, this shows in the external rankings of Denmark (for example the DESI indicator), where Denmark has been ranked in the top 3 several times. Indicators from the World Economic Forum also shows how the Danish production is well positioned for the technological future. Secondly, looking at the country's internal actions, a lot of new initiatives have been launched in 2018. These cover all four pillars indicating that Denmark takes on a broad perspective when looking to digitize the industry (improving both the national agenda, business community and individual citizens competencies).			

ANNEX 1 List of stakeholders interviewed

Type of stakeholder	Name of organisation
Government representative	Ministry of Industry, Business and Financial Affairs
Government representative	Ministry of Higher Education and Science
Industry association	Confederation of Danish Industry
Other stakeholders	MADE – Manufacturing Academy of Denmark
Other stakeholders	RoboCluster
Other stakeholders	Danish AM Hub

ENDNOTES

¹ OECD Economic Outlook (2018), Denmark – Economic forecast summary (November 2018)

² Eurostat, Gross value added at basic prices, 2017 (from the Statistical folder in Sharepoint)

³ DESI (2018), Country Report Denmark

⁴ Dansk Industri: Hvad ved vi om digitalisering af Danmark?, <https://di.dk/SiteCollectionDocuments/Digitaliseringsindsatsen/Hvad%20ved%20vi%20om%20digitaliseringen%20af%20Danmark.pdf>

⁵ World Economic Forum (2018): Readiness for the future of production. www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf

⁶ The World Bank Data (2018), Manufacturing, value added (% of GDP), <https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=DK>

⁷ Smart Specialisation – Strengthening Innovation in Denmark

⁸ Measures facilitating the adoption of new technologies by industry

⁹ Measures to develop technology building blocks

¹⁰ The Danish Government (2018) Danish Cyber and Information Security Strategy, Ministry of Finance

¹¹ OECD Data (2018), GDP per hour worked, <https://data.oecd.org/lprdy/gdp-per-hour-worked.htm>