MONITORING PROGRESS IN NATIONAL INITIATIVES ON DIGITISING INDUSTRY

Country report

Sweden

July 2019

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Summary

Sweden is part of the group of top performers among EU Member States when it comes to digitalisation. On the Digital Economy and Society Index (DESI), Sweden scores 70.4 in 2018 (67 in 2017) with equally high scores in each of the sub-indicators. Furthermore, Sweden is a strong industrial country with one of the best performing economies in recent years. The yearly GDP growth in the period 2015-2017 has been 4.5%, 2.7% and 2.15% respectively, and in 2017 the percentage of GDP from manufacturing was 18.8. While Sweden is performing well in this field, a continuous effort seems crucial in order for the country to keep its place among the top performers. Indeed, while the country's large industrial companies are strong in digitalisation, small- and medium sized enterprises (SMEs) generally lag behind. Other challenges include a gap concerning ICT skills. Furthermore, there is increasing competition from emerging economies and other countries, and there has been a trend of multinationals moving their head offices abroad with the potential risk that research departments might follow.

In the past few years, Sweden has further emphasised the focus on digitalisation and in particular within the industrial sector. In 2016, the *Smart Industry* was launched - a strategy focusing on the enhancement of Swedish companies' ability to manage the rapid transformation of the industrial sector in Sweden. Subsequently, a national digitalisation strategy was adopted in 2017 with the overall objective for the country to become the world leader in harnessing the opportunities of digital transformation. In addition to these two strategies, a national approach to artificial intelligence (AI) was adopted in May 2017. Overall, it can be said that Sweden has a well-coordinated strategy and management regarding digitalisation.

Regarding Pillar 1 of the DEI, projects of cross-border cooperation take place both at regional level and at national level including cooperation such as the European Blockchain Partnership (EBP) and the Electronic Components and Systems for European Leadership (ECSEL). Under Pillar 2-3, several projects focus on the manufacturing industry with the aim to support companies adapting to new technologies. These include Produktion 2030, PiiA, Digitalisation Pilots, and Kickstart Digitalisation, with a funding of at least EUR 48.2 million for the 2013-2016 period. Kickstart Digitalisation is focused solely on SMEs. Furthermore, a number of initiatives aim to make the regulatory framework fit for the digital age (Pillar 4 of the DEI). Some of these initiatives concern cyber security, e.g. the National strategy for developing and enhancing cyber security in Sweden, and a mission to strengthen the ability of the public and SMEs to prevent IT-incidents. An inquiry into cross-sectoral policy development related to new technologies is also on-going. In addition, a National Agency for Digital Government has been set up. Finally, various initiatives under Pillar 5 aim to prevent shortages of ICT specialists and boost digital skills. Two cooperation programmes set up in 2016 aim for a better competence provision and matching through the connection of companies with schools and universities. Other actions focus on skills development within companies (Digital skills for management teams and boards of SMEs), while others aim to improve the offer within education institutions (e.g. Short, flexible university level courses for specialists in the workforce, and Further education in AI). There are also initiatives with a more general and societal scope such as the DigidelCenters in Swedish municipalities and the national digitalisation strategy for school institutions for learning initiatives in schools and universities. Initiatives under Pillar 5 add up to at least EUR 10.52 million in the period 2016-2019. In addition to the DEI pillars, other support mechanisms are available in the form of procurement measures, tax incentives, digitalisation vouchers, and access to finance, for a total of at least EUR 31.16 million in the period 2017-2020. Finally, EU structural funds for Sweden are estimated to EUR 259.5 million by 2020.

Table 1 presents an overview of the main initiatives identified, including investments and actions per DEI pillar. These initiatives will be further detailed in the present report. Table 2 presents a SWOT analysis of Sweden 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
Smart Industry	2016	Overall strategy	N/A	Industry	All	All	SEK 4 billion (EUR 388 million)[1]
National Digitalisation Strategy	2017	Overall strategy	N/A	All	All	All	SEK 50 million (EUR 4.8 million) allocated yearly
National Approach to Artificial Intelligence	2018	Overall strategy	N/A	All	AI	All	No information
Produktion 2030	2013	Pillar 2-3	Strategic programme	Manufacturing/ industry	Robotics and automation machinery	All	EUR 14.7 million (national, 53% publicly funded)
PiiA	2013	Pillar 2	Strategic programme	Manufacturing/ industry	Robotics and automation machinery	All	EUR 14 million (national, 51% publicly funded)
Digilift / Kickstart Digitlisation	2016 (pilot 2015)	Pillar 2	Competence centre (coaching efforts for SMEs)	Manufacturing/ industry	Social media, Cloud, Mobile services, IoT	SMEs	EUR 8.1 million (national, 100% publicly funded)
Digitalisation Pilots	2016	Pillar 3	PPP	Manufacturing/ industry	Robotics and automation machinery	All	EUR 11.4 million (national, public and private co-funding, 52% publicly funded)
National strategy for developing and enhancing cyber security in Sweden	2017	Pillar 4	IT security regulation / national strategy	Cyber security	N/A	N/A	N/A
Inquiry into cross-sectoral policy development related to the technologies	2018	Pillar 4	Inquiry by commission	Precision medicine, digitalised industry and	N/A	N/A	N/A

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
of the fourth industrial revolution				connected automatic driving			
National Agency for Digital Government	2018	Pillar 4	Agency	Develop, coordinate and support the digitalisation of state authorities, municipalities and county councils.	N/A	N/A	N/A
Mission for the Swedish Civil Contingencies Agency to strengthen the ability of the public and small and - medium enterprises to prevent IT-incidents	To start in 2019	Pillar 4	National information campaign	Awareness and knowledge regarding IT incidents and IT thefts	N/A	N/A	N/A
Cooperation programme between schools and industry	2016	Pillar 5	Collaboration and competence provision	Industry	All	SMEs	EUR 0.86 million (2016-2018)
SME support to develop strategies for competence provision	2016	Pillar 5	Collaboration and competence provision	Industry	All	SMEs	EUR 0.86 million (2016-2018)
National digitalisation strategy for school institutions / Action Plan	2017	Pillar 5	Digital equipment and learning initiatives in schools and universities	Education and social work	N/A	N/A	EUR 0.29 million (national, 100% publicly funded).

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
Funding of DigidelCenters in Swedish municipalities	2018	Pillar 5	Skills development for citizens in digital equipment and IT	Education and social work	N/A	N/A	EUR 1.2 million (national, 80% publicly funded)
Digital skills for management teams and boards of SMEs	2018	Pillar 5	Digital skills development	All	N/A	SMEs	EUR 1.46 million (national, 100% publicly funded)
Short, flexible university level courses for specialists in the workforce	2018	Pillar 5	Digital skills development	Mainly manufacturing industry, but other sectors not excluded	N/A	N/A	EUR 1.95 million (national)
Further education in artificial intelligence	2018	Pillar 5	Skills development AI	No specific limitations as regards sectors, but manufacturing and industry in a broader sense is pointed out and believed to be supported by this.	N/A	N/A	EUR 3.9 million (national, 100% publicly funded)
Procurement measures	-	Support mechanism					EUR 0.38 million in 2017 and 2018
RISE ICT	-	Support mechanism	Research centre	All	N/A	N/A	N/A
Tax incentives	2014	Support mechanism	Partial exemption of social security contributions per employee for companies active in systematic	Research and development			N/A

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
			research and development				
Automation Programme - Robotlift	2018	Support mechanism	Funding – grant or voucher	Manufacturing/ industry	Robotics and automation machinery	SMEs	EUR 10.7 million (national, 100% publicly funded)
Digitalisation vouchers		Support mechanism	Support for small companies that want to take in external competence to develop the company and increase competitiveness – either through a service or by hiring additional staff on a project basis.			SMEs	Agency for Economic and Regional Growth: The voucher can vary from EUR 4,740 – 23,690 per voucher. Yearly budget is SEK 50 million (EUR 4.72 million) implying a total sum of EUR 18.88 million in the period 2016-2019. ALMI innovation voucher: SEK 100,000 (EUR 9, 547) per voucher.
Access to finance		Support mechanism	Promote investment related to smart industry with the aim of stimulating investors in start-ups to place or expand				By 2020, Sweden will spend EUR 1.2 million

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
			production, research, development, industrial services and testing				
Structural funds		Support mechanism					EUR 259.5 million

Table 2: SWOT of Sweden on digitalisation

Strengths: • Strong industrial foundation with a strong science base; • Digitalisation is high among large industrial companies and multinationals; • Sweden is strong in sustainable production; • Openness towards the rest of the world and the global market.	**Weaknesses**: • Skills shortage - demand exceeds supply regarding ICT skilled workers (the supply of skills to the industrial sector must be improved); • Decreasing number of STEM graduates; • Regulatory framework perceived as cumbersome; • Digitalisation and innovation mostly within multinational industrial companies, less in SMEs.
Opportunities: • Mobility and collaboration between academia and industry; • Research exchanges and mobility of researchers between countries and sectors; • Suitable research infrastructure, making Sweden an attractive place to work in compared to other countries; • Further investment in women in ICT.	**Threats**: • Multinationals that are strong in digitalisation moving their research to other countries; • Increasing competition from emerging economies and other countries; • SMEs continue to lag behind due to external factors such as lack of resources.

1 General context

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

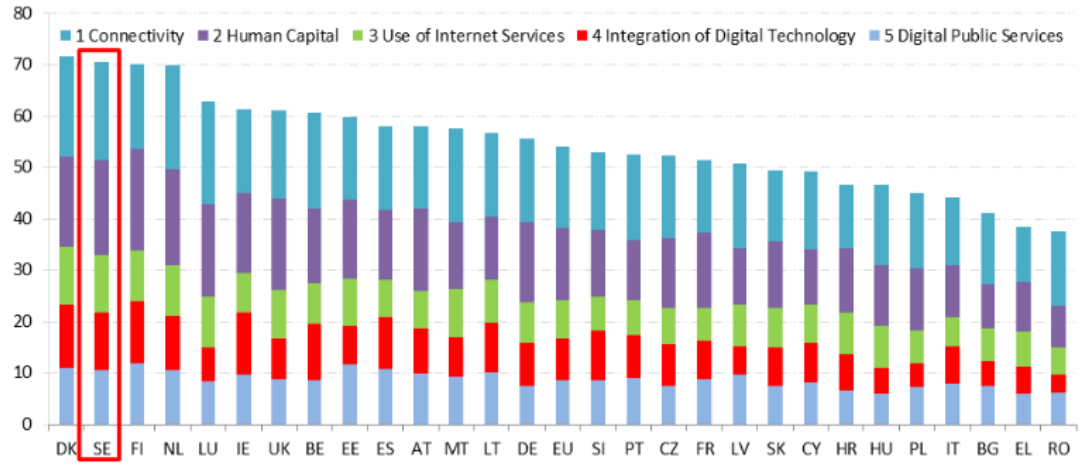
Sweden is a strong industrial country and has been one of the best performing economies in recent years. The GDP per capita has grown faster than in most OECD countries, despite a population increase that is mainly due to immigration. Furthermore, the unemployment rate which peaked in 2010 (8.9%) is now just below 7%. In addition, the business environment in Sweden is positive, ranking 10th among 190 economies in the World Bank's "Ease of Doing Business" index (World Bank 2018), and 2nd among 127 countries in the Global Innovation Index (GII 2017). Sweden is well above the EU, G7 and OECD averages in both measures[23].

The industrial sector is an important driver of growth and job creation in Sweden, and essential both for the country's wealth and the collective welfare system. The industrial sector and the industrial services sector are present throughout the country and are together responsible for a fifth of the country's GDP, 77% of the total value of Swedish exports and create about a million of jobs. Finally, Sweden's openness towards the rest of the world has been positive as it has enabled access to a large market, while forcing the industrial sector to constantly renew and transform to cope with global competition[4].

Status on digitisation

Sweden is one of the leading countries in Europe regarding innovation. The country has a strong science base, a qualified workforce and internationally competitive and innovative large companies, in the manufacturing as well as in the services sector. In the Digital Economy and Society Index (DESI) 2018, Sweden ranks second with a score of 70.4 compared to the EU average of 54. The overall progress is in line with the EU average as well, as with the countries in the high-performance cluster. For example, Sweden is ranked 3rd in Human Capital, 2nd in Use of Internet, and 4th in Integration of Digital Technology. (See figure 1 below).

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



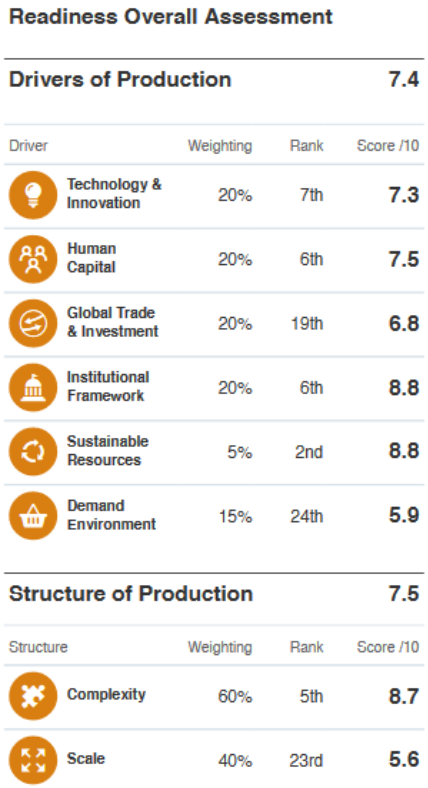
Source: DESI 2018 Country report - Sweden

Traditionally, Sweden's innovation model has relied particularly on large multinational enterprises. However, the internationalisation of such companies has in some cases resulted in headquarters moving abroad, and there is now a potential risk that also research and innovation activities could partially follow. Therefore, it is crucial that conditions in Sweden remain attractive through continued investment, stable framework conditions and a broader innovation base.

Other opportunities include further focus on SMEs as the economy has not currently fully exploited the potential of innovative SMEs and start-ups. Furthermore, a closer cooperation between academia and business would be beneficial as knowledge exchange and joint projects among firms and universities can be beneficial, raising business awareness of upcoming scientific developments. Also, ensuring the supply of highly skilled workers is vital for innovation and business investments. There has been a gradual decline of the number of new graduates over the past years in Sweden, particularly in science and engineering. While having the second highest number of ICT specialists in the workforce according to DESI, demand exceeds supply, and the number of STEM graduates is not expected to increase in the coming years.

In 2018, the World Economic Forum published the Readiness for the Future of Production Report, in which 100 countries are assessed regarding drivers of production and structure of production. Based on a number of key economic indicators and key production indicators, countries are positioned within four different archetypes. Sweden is placed in the archetype of leading economies with high scores throughout the assessment, as shown by the below figure[5].

Figure 2: Readiness for the Future of Production – Sweden



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

The below table presents some of the key indicators related to the economic context and status of digitalisation and innovation in Sweden.

Table 3: Key indicators for economic context and status of digitalisation

	% GDP from manufacturing	% of GDP growth	DESI position – and change	DESI sub-indicators Human Capital, Use of Internet, Integration of Digital Technology in 2018
Sweden	18.8 (Eurostat)	GDP growth per year 2015-2017: 4.5%, 2.7%, and 2.1% (Eurostat)	2nd in 2018, 3rd in 2017.	• Human capital: 3rd (5th in 2017) • Use of Internet Services: 2nd (same place as 2017) • Integration of Digital Technology: 4th (same place as 2017).

1.2 National strategy on digitising industry

In the past few years, there have been some important policy developments in the area of digitalisation and industrial digitalisation in Sweden. Some of the key elements are presented in the below sections.

Smart industry

With the aim of strengthening the industrial sector's competitiveness and reinforcing Sweden's position as an attractive location for industrial production, the Swedish Government launched a strategy for new industrialisation – Smart Industry – in January 2016[6].

The strategy focuses on enhancing companies' ability to manage the rapid transformation of the industrial sector in Sweden. The strategy is supported by an action plan which will be updated continuously. Thus far, the action plan has been updated once, presenting concrete measures and actions to strengthen the industry in the context of increasing competition and digitalisation[7]. Four focus areas have been identified, as outlined below.

- **Industry 4.0** – with the aim of ensuring Swedish companies in the industrial sector lead the digital transformation and exploit the potential of digitalisation. Within this focus area, the following actions are included:
    - Stimulate the development and use of digital technology with the potential to lead industry's transformation;
    - Use the opportunities of digitalisation broadly independently of the sector, size of company or geographical location;
    - Adapt framework conditions and infrastructure for the digital era.

- **Sustainable production -** intends to increase resource efficiency, environmental considerations and more sustainable production, consequently contributing to value creation in the industrial sector, job creation and competitiveness throughout the country. Within this focus area, the following actions are included:
    - Effective regulatory frameworks facilitating change;
    - More focus on the work to reduce greenhouse gas emissions;
    - Better conditions for a circular economy;
    - Promote environmental and climate technology;
    - More focus on the work to reduce impact of hazardous chemicals and the phasing out of particularly hazardous substances.

- **Industrial skills boost** has the purpose of meeting the industrial sector's needs and promoting long-term development through a system for supply of skills at local, regional and national level. Within this focus area, the following actions are included:
    - Increased number of education places responding to the needs of the industry;
    - Increase the interest in industry relevant education and trainings;
    - An educational system providing the students with the right knowledge and competence;
    - International competence to be made accessible in Sweden;
    - Strengthening the work of the industry with strategic competence supply;
    - Better conditions for life-long learning

- **Testbed Sweden** - aims to ensure that Sweden is at the forefront of research contributing to the strengthening of the country's industrial production. Within this focus area, the following actions are included:
    - Direct investments in research and innovation towards areas that have particularly great potential to contribute to new industrialisation and long-term competitiveness;

- Opening up the public sector as a way to provide the industrial sector with a test bed for solving societal challenges in close cooperation with local and regional actors;
- Increasing the use of innovation-friendly procurement practices;
- Promoting research collaboration between academia and the industrial sector, as well as developing the institute sector;
- Making Sweden a more attractive place for researchers to work in;
- Making Sweden a more attractive place for companies to invest in and carry out R&D activities.

In addition to the four focus areas presented above, the action plan outlines some horizontal measures:

- Promote new industrialisation at the regional level;
- Streamline and simplify for SMEs;
- Highlight good examples of companies at the forefront;
- Actively work together with and within the EU;
- Finally, an international conference regarding the transition towards the new strategy was organised in Stockholm in November 2016 with the participation of 27 countries.

The focus areas of Smart Specialisation in Sweden[8] are very much in line with the Smart Industry strategy, and include the following:

- Manufacturing and industry;
- Key enabling technologies;
- Information and communication technologies;
- Sustainable innovation; and
- Energy production and distribution.

Digitalisation strategy

In May 2017, the Swedish government adopted a digitalisation strategy with the overall objective for Sweden to become the world leader in harnessing the opportunities of digital transformation[9]. In contrast to Smart Industry, this strategy focuses on the society as a whole. The strategy concentrates on the following five areas:

- **Digital skills**, implying that everyone should be familiar with digital tools and services and have the ability to participate in the digital transformation based on their own situation;

- **Digital security**, entailing people, companies and organisations having confidence in the use of digital services as the digital transformation changes society in several important ways;

- **Digital innovation**, involving the existence of competitive conditions for the creation of spread of new products and services of value to society, companies, the environment and people;

- **Digital leadership**, entailing activities being improved, developed and enhanced through governance, measurement and follow-up. Furthermore, the access to public sector activities for companies, organisations and people should be facilitated;

- **Digital infrastructure**, implying an improvement and reinforcement of infrastructure for electronic communications needed for the transmission of data.

To support the implementation of this strategy, a Digital Council has been set up, consisting of 10 advisors, led by the Minister of Digitalisation[10].

National Approach to Artificial Intelligence

In addition to the strategies mentioned above, the national approach to artificial intelligence (AI) should be highlighted. AI is an area that is evolving rapidly and includes various technologies, such as machine learning and deep learning. Based on this, and the potential opportunity of further emphasising activities in this field, the Swedish Government developed a national approach to AI that was launched in May 2018. The purpose of this approach is to identify an overall direction for AI-related work and lay the foundation for future priorities[11]. Some of the points highlighted in the approach include the improvement of digital infrastructure to leverage opportunities in the field, to increase access to data, and also to actively participate in the EU's digitalisation efforts. Furthermore, the development of standards and principles for safe, sustainable and ethical AI is highlighted.

The table below presents an overview of the national strategy on digitising industry – Smart Industry, as well as the Digitalisation Strategy and the National Approach to Artificial Intelligence.

Table 4: Overview of national strategies regarding digitalisation and industry

Name	Smart Industry	Digitalisation strategy	AI Strategy
Type	National Strategy – Smart Industry	Digitalisation Strategy	National Approach to Artificial Intelligence
Starting date	January 2016	June 2017	May 2018
Objective	Strengthen the industrial sector's competitiveness and reinforce Sweden's position as an attractive location for industrial production.	For Sweden to become the world leader in harnessing the opportunities of digitalisation.	To identify an overall direction for AI-related work and lay the foundation for future priorities
Ministry/ministries in charge (website, contact person)	Ministry of Enterprise and Innovation, https://www.regeringen.se/regeringens-politik/smartindustri/	Ministry of Infrastructure, https://www.regeringen.se/informationsmaterial/2017/05/for-ett-hallbart-digitaliserat-sverige---en-digitaliseringsstrategi/	Ministry of Enterprise and Innovation: https://www.regeringen.se/4aa638/contentassets/a6488ccebc6f418e9ada18bae40bb71f/national-approach-to-artificial-intelligence.pdf
Scope of the strategy/action plan	Sustainable production, industrial skills boost, test bed Sweden, "industry 4.0" – companies in Sweden to be leaders of the digital transformation and in exploiting the potential of digitalisation.	Digital skills, digital security, digital innovation, digital leadership, digital infrastructure	Education and training, research, innovation and use, framework and infrastructure.
Measures included in	Laws and regulations, investments in	Laws and regulations, investments in enterprise,	The improvement of digital infrastructure to leverage

Name	Smart Industry	Digitalisation strategy	AI Strategy
the strategy/action plan	enterprise, education and innovation, public procurement and opening up to the public sector, providing testbeds and open data.	education and innovation, etc.	opportunities in the field, to increase access to data, and also to actively participate in the EU's digitalisation efforts. Also, the development of standards and principles for safe, sustainable and ethical AI is highlighted.
Overall funding and distribution by volume and source of funding (public/private, EU/national)	The yearly budget for promoting business, entrepreneurship and innovation is approx. SEK 4 billion (EUR 388 million). A large portion of this budget supports the digitalisation of industry. In addition, budgets for regional development, promotion of energy efficiency etc, contribute to the digitalisation of industry. However, these budgets also finance other initiatives focussing on other issues.	As regards the digitalisation strategy, there is SEK 50 million (EUR 4.8 million) allocated yearly in government funding for different initiatives, including initiatives linked to digital competence and innovation. In total, there have been more than 200 government initiatives linked to the strategy since its adoption (with different and additional sources of funding).	No information

Impacts, challenges and perceptions

Following the launch of the national strategy - Smart Industry, in January 2016, an action plan was published in June the same year outlining 45 concrete measures[12]. As mentioned, the action plan of the strategy is set to be updated along the way and a second version of the action plan was published in December 2017 with an additional 37 measures, building on the measures, pilots and initiatives performed under the first plan, with the aim of scaling up those that had particularly good results. Regarding the national digitalisation strategy, about 200 initiatives have been launched since the strategy was adopted in May 2017, including e.g. further budget allocated to this area, missions for the authorities and suggestions or decisions about developments in the regulatory area.

In a recent study from OECD, it is mentioned that Sweden performs well in the digital transformation and has high ambitions. However, it is highlighted that this implies that the country needs to have high ambitions regarding the continuous work in the area. For example, efforts are needed to ensure further connectivity, increased use of opportunities related to digitalisation, strengthened digital competence and digital innovations, strengthened ability of the labour market to handle the transformation, improvement of the focus on economic aspects of digital security, and overall to ensure that strategy becomes concrete actions[13].

1.3 EU cooperation in the field of digitising industry initiatives

Since the launch of Smart Industry in 2016, the Swedish Government has participated in cross-border collaboration with other EU countries and in relevant European initiatives. Sweden is part of the EU coordinated plan on artificial intelligence with the aim of maximising the impact of

investment at EU and national level, collaborating through the creation of synergies and exchange of best practice, and defining collectively the way forward in this area to make sure that the EU can compete globally as a whole. Actions of this plan are to start in 2019 or 2020[14]. Furthermore, Sweden signed in 2018 the Declaration creating the European Blockchain Partnership (EBP), and thus agreed to cooperate with the other signatory countries in the establishment of a European Blockchain Services Infrastructure (EBSI). The objective of this cooperation is to support the delivery of cross-border digital public services, with the highest standards of security and privacy[15]. Sweden is also one of 30 participating states in the Electronic Components and Systems for European Leadership (ECSEL) Joint Undertaking, a PPP co-financed by the EU and the participating states with the aim of together funding research, development and innovation projects to ensure Europe's competitive leadership in the digital area.

Regarding bilateral collaboration, France and Germany have been important collaboration partners for Sweden and two bilateral innovation partnerships were highlighted by the Swedish Government representatives consulted.

The cooperation with Germany was initiated in January 2017 and has the aim of establishing a partnership on exchange of experience regarding digitalisation of SMEs in particular[16]. In the context of this collaboration, the countries will establish a partnership and launch a knowledge exchange to explore ways of boosting the digitalisation processes of SMEs within industrial and service sectors. The partnership brings together existing national policy measures while combining those with a new bilateral dimension. Through the Swedish Government's Smart Industry strategy and the German strategies Industrie 4.0 and Mittelstand-Digital, both countries have launched policies in this spirit. Areas of focus for this cooperation includes mobility, test beds, SME digitalisation and eHealth.

The cooperation with France was initiated in November 2017[17]. The focus of the partnership is to create exchanges on artificial intelligence and knowledge exchanges on digital transformation in strategic partnership for innovation and green solutions. This is done by exploring ways to support digital transformation processes in SMEs in all economic sectors and bringing together existing policy measures. The partnership aims to address social challenges, create new jobs and maintain social cohesion.

Sweden is 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.

2 Other policy support to digitising industry

2.1 Boosting innovation capacity

The table below presents an overview of the main initiatives to boost innovation capacity (pillars 2 and 3 of the DEI).

Table 5: Overview of initiatives within Boosting innovation capacity (Pillar 2-3)

Name	Produktion 2030	Process Industrial IT and Innovation (PiiA)	Digilift/Kickstart Digitalisation and Coaching projects	Digitalisation Pilots
Type	PPP, testbeds, research and innovation support through networks and collaboration	Competence centre, innovation platforms, innovation hubs	Competence centre and innovation cluster	PPP
Starting date	2013	2013	2016 (pilot 2015)	2016
Objective	By 2030, Sweden will be one of the world's leading countries in sustainable manufacturing, and the first choice for the development and production of advanced goods and services.	Ensure that the process industry has the advanced IT and automation solutions that are required in order to reap the benefits of digitalisation more effectively than its competitors on the global market.	Works for more small- and medium-sized enterprises to seize digitalisation opportunities	Funding a small number of state-of-the-art digital demonstrators that can serve as examples of what is possible in the area of Industry 4.0, and also serve as testbeds for others.
Relevant for Pillar 2[18] or Pillar 3[19] or both	Pillar 2-3	Pillar 2	Pillar 2	Pillar 3
Short description	Translating industry challenges into relevant and innovative solutions for manufacturing; by building up and strengthening networks and collaborations, both within Sweden and internationally; and by bringing together ideas, players and funding opportunities in order to create valuable solutions for the manufacturing industry of the future. Produktion 2030 is a public-private partnership and brings together industry, academia and research associations. In 2017, Produktion 2030 launched a call for testbed projects to test new production methods and technologies or	Strengthening collaboration between the various process-industry sectors, their suppliers, and researchers. PiiA coordinates funding applications for innovation projects, supports research, analyses industry needs, brings together researchers, and helps industry players to access the training and talent that they need.	Coaching efforts for small and medium-sized companies in the industrial sector and building networks. Providing companies with the opportunity to • learn from each other and gain a better insight into the challenges and possibilities of digitalisation; • receive advice and coaching to increase their use of digital technology; • Increase their knowledge on digitalisation and digital tools and technologies.	Public-private joint funding of selected key pilot projects to speed up the digitization of industrial processes.

Name	Produktion 2030	Process Industrial IT and Innovation (PiiA)	Digilift/Kickstart Digitalisation and Coaching projects	Digitalisation Pilots
	systems in the manufacturing industry.			
Granting organisation	Vinnova, Swedish Energy Agency, Formas	Vinnova, Swedish Energy Agency, Formas	Agency for Economic and Regional Growth	Vinnova
Participating organisations	Association of Swedish Engineering Industries, as well as a number of companies and universities	RISE SICS Vasteras	Association of Swedish Engineering Industries, IF Metall and RISE and IUC Sweden (Industrial Development Centres), and other local and regional partners.	A number of Swedish industrial enterprises and research institutions
Sectors targeted	Manufacturing/Industry	Manufacturing/Industry (Process industry)	Industry	Manufacturing industry
Technologies targeted	Robotics and automation machinery	Robotics and automation machinery, IoT	Social Media, Mobile Services, Cloud, IoT	Robotics and automation machinery
Funding (split by private/public and national/EU), state period/annual funding	EUR 14.7 million (national, 53% publicly funded)	EUR 14 million (national, 51% publicly funded)	EUR 8.1 million (national, 100% publicly funded)	EUR 11.4 million (national, public and private co-funding, 52% publicly funded)
Current status of initiatives	Project on-going. A positive evaluation was conducted in 2016, based on the first three years of the initiative.	Project on-going. Funding is expected until 2023.	Project on-going 2016-2019	Project on-going 2015-2018

Impacts, challenges and perception

All the initiatives included in the table above are national programmes. Digilift/Kickstart Digitalisation in particular stems from the Smart industry strategy. This initiative is the only one out of the four which is focused on SMEs in particular. As mentioned previously, this is an important area due to the fact that smaller companies have been slower in the uptake of digital technologies. The initiative Digilift includes awareness raising workshops, exchange and networking between companies, as well as individual coaching for smaller companies. Following the pilot of this initiative, 58% of companies started a digitalisation project, and a further 32% said they were going to in the coming months[20]. Almost all industry associations consulted were aware of Digilift, while awareness regarding the other initiatives was low. However, the perception of usefulness of the known initiatives was high (4.5 in a 1-5 scale), and the perception of uptake of digital technologies due to the initiatives was fairly high (3.5 in a 1-5 scale). It should also be mentioned that about 150 testbeds result from these initiatives, as well as 60 test- and demo sites for production technology, and 14 marker spaces. Finally, about 80 "blue sky prizes" were supported by Sweden's innovation agency Vinnova.

Respondents to the industry survey conducted in the context of this study mentioned that existing government initiatives are crucial, both in terms of dialogue regarding possibilities and challenges, as well as of the provision of means to implement activities. It was said that the initiatives are needed for the digital transformation, in particular for those who are falling behind and need an extra push. The concept of meeting industrial challenges in close partnership between academia, RTOs and public authorities was seen as the main strength of Produkt 2030 and PiiA. Finally, the fairly long timeframe of investment was also highlighted as important.

The indicators available show progress in recent years with regard to digitalisation among Swedish companies. Between 2015 and 2017, the number of Swedish enterprises that use two or more types of social media, sell online, and generate at least 1% of their turnover via these sales, has increased. While it is difficult to establish a link to the specific initiatives, these indicators demonstrate an increased awareness regarding digitalisation in the past few years.

Figures also indicate that Sweden is actively funding digital transformation. In 2015, the Swedish ICT spending (as percentage of GDP) was at 3.4%, compared to the OECD average of 2.3% (OECD 2017). According to the industry survey, the perception of the level of innovation in digital industries remains somewhat elevated in case of non-ICT sectors (3.75 in a 1-5 scale). Furthermore, the take-up of digital technologies in non-ICT industries is perceived as elevated by the industries (3.75 in a 1-5 scale) and the government (4 in a 1-5 scale), indicating that while there is progress, continuous support is needed. Finally, the usefulness of government support for digital transformation is considered positive (3.5 in a 1-5 scale).

Respondents to the industry survey said regarding the level of innovation in digital industries, that Sweden is one of the leading countries both in Europe, but also globally. Furthermore, it was also mentioned that small enterprises that have adapted to the digitalisation have well advanced digital business models, services and innovation strategies. Also, the respondents from the Swedish Government said that there is a good infrastructure and general digital awareness in Sweden, and thus a great potential to reach out to those companies that are lagging behind.

Regarding the take-up of digital technologies by non-ICT companies, respondents from the engineering industry mentioned that larger companies in their sector are generally well advanced, while SMEs need to increase their take-up of digital technologies, and perhaps also change their mind-set and business logics to adapt to future opportunities and challenges. Another respondent highlighted the wide gap between those companies that are digital and those that are not. It was said that, in general, this is due to financial resources, as well as the lack of qualified personnel. However, there is a consensus that Sweden is well advanced and that the take-up of digital

technologies overall is higher than in most countries. Indeed, Sweden is ranked number 4 in the Integration of digital technology (DTII) and number 3 in the Digital Transformation Enablers' Index (DTEI)[21].

In the context of the Swedish digitalisation strategy, and the focus area of digital leadership, two additional initiatives were mentioned by the survey respondents from the Swedish Government. Due to their more regional nature they are included here rather than in the table above:

- Increasing the **digital skills of the leadership of municipalities and regions**. This is an agreement with the Swedish Association of Local Authorities and Regions (SKL) to increase digital competence within local authorities and regions.
- Establishing **regional coordinators for digitalisation.** This implies the opportunity for local authorities and regions to establish digitalisation coordinators, and for the Agency for Economic and Regional Growth to establish a national secretariat to support the regional coordinators.

2.2 Regulatory framework for digital age

The table below presents the main initiatives related to a digital regulatory framework (Pillar 4).

Table 6: Overview of initiatives under Pillar 4

Name	National strategy for developing and enhancing cybersecurity in Sweden	Mission for the Swedish Civil Contingencies Agency to strengthen the ability of the public and small and -medium enterprises to prevent IT-incidents	Inquiry into cross-sectoral policy development related to the technologies of the fourth industrial revolution	Agency for Digital Government
Type	IT security regulation / national strategy	National information campaign	Inquiry by committee	Agency
Starting date	2017	March 2018. Mission presented 31 January 2019[xxii]	Committee appointed August 16, 2018.	2018
Aims and objectives	Aims to create long-term conditions for all stakeholders in society to work effectively on cybersecurity and raise the level of awareness and knowledge throughout society.	Increase the target group's (SMEs) and the public knowledge regarding basic security measures enabling a better protection against IT-incidents and ID thefts.	Improve conditions in Sweden for increased competitiveness and inclusive, safe, secure and effective use of new solutions, applications and services in society.	Agency working to develop, coordinate and support the digitalisation of state authorities, municipalities and county councils.
Short description	The strategy sets out objectives within six priority areas: Securing a systematic and comprehensive approach in cyber security efforts; Enhancing network, product and system security; Enhancing capability to prevent, detect and manage cyberattacks and other IT incidents; increase possibility of preventing and combating cybercrime; Increasing knowledge and promoting expertise; Enhancing international collaboration.	The Swedish Civil Contingencies Agency will collaborate with the Police authority, as well as the Agency for Economic and Regional Growth, the tax authorities, the Swedish Companies Registration Office, and where needed also with industry associations. Activities and information campaign will be carried out to increase awareness and knowledge regarding IT-incidents and ID thefts.	The committee shall until December 31, 2021, assist the government in identifying policy challenges and accelerating policy development related to technologies of the fourth industrial revolution, for example in the areas of precision medicine, digitalised industry and connected and automatic driving. It shall investigate policies and regulations and suggest improvements. The committee shall collaborate with e.g. EU institutions, OECD, and World Economic Forum.	The Agency will develop national digital infrastructure such as data management standards, eID and digital post, as well as promote open data and data-driven innovation. There is ongoing preparatory work to grant the Agency the right to issue regulations, and to instruct several agencies with promoting both supply of and demand for open government data.
Sectors targeted	All	All (focus on SMEs)	Industry and manufacturing, pharma	All

Impacts, challenges and perception

Regarding the regulatory context, the Agency for Digital Government was set up in Sweden in 2018 to develop, coordinate and support the digitalisation of state authorities, municipalities and county councils. It will also develop national digital infrastructure such as data management standards, eID and digital post, as well as promote open data and data-driven innovation – an area where Sweden has been performing relatively weakly[23]. Furthermore, the government representatives consulted mentioned that there is ongoing preparatory work to grant the Agency the right to issue regulations, and to instruct several agencies with promoting both supply of and demand for open government data. The initiatives included in the above table are all national initiatives.

In June 2017, a cybersecurity strategy was adopted, setting out the following six priorities[24]:

- Securing a systematic approach in cybersecurity efforts;
- Enhancing network, product and system security;
- Improving the capability to prevent, detect and manage cyberattacks and other IT incidents;
- Increasing the possibility to prevent and combat cybercrime;
- Increasing knowledge about vulnerabilities and needs; and
- Enhancing international cooperation.

Furthermore, IT incident reporting for all government agencies was introduced in 2017. However, according to the DESI country report (2018) a challenge to further development regarding digital public services is the decentralised public administration hampering the organisation of such actions, in particular regarding the exchange of patient information in health care[25]. The Mission for the Swedish Civil Contingencies Agency to strengthen the ability of the public and small and -medium enterprises to prevent IT-incidents presented its results in early 2019. The information campaign had a significant reach through social media, radio, TV and newspapers. It was concluded that the campaign had resulted in an increased awareness and knowledge regarding risks in the digital society among the general public and SMEs[26].

The respondents to the industry survey perceived the existing regulatory framework not to be fully fit for the digital age (2.6 in a 1-5 scale). It was said that while there are improvements, in particular for individuals, the regulatory framework is not always favourable for companies. One of the industry associations said that the overarching regulatory barrier is the lack of knowledge/understanding of digital technologies among the political parties/law makers/governmental agencies, and their potential to address societal needs and challenges. Due to the lack of understanding of digitalisation and its potential, the regulations are too detailed and burdensome. Another respondent mentioned that there is an insecurity about the enforcement of the regulations in the digital field. The survey respondents from the Swedish Government mentioned the lack of reliable information as a regulatory barrier. According to the government respondents, the on-going inquiry into cross-sectoral policy development related to the technologies of the fourth industrial revolution is expected to contribute to a better understanding. However, as all measures are rather recent, it is difficult to say anything about the effects at this point. Furthermore, efforts regarding Better Regulation at EU level and through the Agency for Economic and Regional Growth were mentioned as measures to improve the regulatory framework. Finally, the Swedish Agency for Digital Government was highlighted as a good practice example by the government respondents.

2.3 Skills development

The table below outlines the main initiatives to develop digital skills (Pillar 5 of the DEI).

Table 7: Overview of initiatives under Pillar 5

Name	Cooperation programme between schools and industry	SME support to develop strategies for competence provision	National digitalisation strategy for school institutions / Action Plan	Funding of DigidelCenters in Swedish municipalities	Digital skills for management teams and boards of SMEs	Short, flexible university level courses for specialists in the workforce	Further education in artificial intelligence
Type	Support structures for collaboration	Competence provision-strategies of companies	Provision of training, digital equipment in schools and universities	Digital inclusion centres	Training	Provision of training in university colleges and universities	Provision of training in universities (seven in total, coordinated by Chalmers University of Technology)
Starting date	March 2016	March 2016	2017	2018	2018	2018	2018
Objective	Creating a support structure for school students to get in contact with employers in occupational categories with labour shortage.	Stimulating and strengthening the strategic work of small and medium sized companies to ensure their supply of skills.	Digital competency for everyone within school institutions; - Equal access and use; - Research and follow up regarding the possibilities of digitalisation	To strengthen and increase digital competencies among inhabitants in the municipalities, and to assist them with digital services and technique.	The programme shall increase the businesses ability to use digitalisation for profits and their ability to assess and handle risks from a digitalisation perspective	To retain and develop the competitiveness of Swedish industry by increasing the opportunities to absorb new technology in fields where the development is rapid and upskilling throughout the working life is needed.	Contribute to meeting the needs of the labour market for transition and deepened knowledge in AI. The purpose is to tap the potential of the new technology and thus increase Swedish competitiveness as well as handling societal challenges.
Short description	Pilot project to improve cooperation between industry, industrial	Mapping of competence needs and creation of action plans to address these needs.	The work on an action plan regarding the digitalisation of the school system is on-	Funding has been provided to the Internet Foundation in Sweden in order to establish 5-10	The Agency shall develop and implement a programme aimed at increasing the	Vinnova was commissioned to strengthen lifelong learning through the funding of pilots	Seven universities (headed by Chalmers University of Technology)

Name	Cooperation programme between schools and industry	SME support to develop strategies for competence provision	National digitalisation strategy for school institutions / Action Plan	Funding of DigidelCenters in Swedish municipalities	Digital skills for management teams and boards of SMEs	Short, flexible university level courses for specialists in the workforce	Further education in artificial intelligence
	services companies, and schools.	Through this process companies will become more mature in their way of thinking around skills needs, better at highlighting this to education providers, and better at making their own decisions regarding e.g. investment in competence development.	going. Several actors from within the school system are involved, as well as SKL (Swedish Association of Local Authorities and Regions). A report will be presented to the government in March 2019, mapping needs and on-going initiatives and activities, as well as suggestions for new activities.	new DigidelCenters – training centres available to anyone that might need assistance in using or starting to use digital solutions. The centres will be established in several municipalities. The Internet Foundation has added funding (2.4 MSEK), resulting in total 15 centres opening in 2019.	awareness of the leaderships and boards of SMEs on how the businesses can make use of the benefits offered by digitalisation.	to produce short flexible advanced level university courses within fields of high relevance to the fourth industrial revolution, directed towards specialists in the workforce.	have been commissioned to increase the possibilities for lifelong learning in the field of AI. The task is twofold: -Establishing a common platform of knowledge for AI - Arranging competence development in AI in the form of further education for people in the workforce, preferably as short flexible courses.
Granting organisation	National government	National government	Swedish Government	Swedish Government, Internet Foundation	National Agency for Economic and Regional Growth	National Innovation Agency (Vinnova)	Swedish Government
Participating organisations	Agency for Economic and Regional Growth	Agency for Economic and Regional Growth	Swedish national agency for education and other actors within the school institutions	The Internet Foundation in Sweden, various municipalities	-	University colleges and universities	Universities (seven in total, coordinated by Chalmers University of Technology)

Name	Cooperation programme between schools and industry	SME support to develop strategies for competence provision	National digitalisation strategy for school institutions / Action Plan	Funding of DigidelCenters in Swedish municipalities	Digital skills for management teams and boards of SMEs	Short, flexible university level courses for specialists in the workforce	Further education in artificial intelligence
Sectors targeted	Industry	Industry	Education and social work	Education and social work	All	Mainly manufacturing industry, but other sectors not excluded	No specific limitations as regards sectors, but manufacturing and industry in a broader sense is pointed out and believed to be supported by this.
Funding (split by private/public and national/EU), state period/annual funding	EUR 0.86 million 2016-2018	EUR 0.86 million 2016-2018	EUR 0.29 million (national, 100% publicly funded)	EUR 1.2 million (national, 80% publicly funded)	EUR 1.5 million (national, 100% publicly funded)	EUR 1.95 million (national)	EUR 3.9 million (national, 100% publicly funded)
Current status of initiatives	Finishing phase (to be concluded end of March 2019)	The initiative has been extended for another year and will run until 2020. Additional funding of SEK 10 million (EUR 0.95 million) was allocated.	A report will be presented to the government in March 2019	Having started out with 5-10 centres being started, 15 centres are to be functional in 2019.	Currently a new call open for projects for a period of 20 months, starting February/March 2019.	Nine projects are currently running. Final report is due in March 2020.	On-going 2018-2019

It should be noted that funding stated here is the funding granted from the government. Co-financing schemes are possible, thus total amount of investment could be larger. Co-financing could come from other public sources or from the private sector to varying degree.

Other initiatives relevant for Pillar 5

While some initiatives are meant to specifically address digital skills of the industry, it should be mentioned that the national Digitalisation Strategy also has a priority for digital skills, targeting the whole of society, resulting in several initiatives[27]. Focus areas include the education system, the possibility for everyone to contribute, and take part in the digital society, skills matching, and public administration. Another project to highlight is "Civil engineer 4.0", set up in the context of previously mentioned Produktion 2030 (see section 3.1). It aims to update the civil engineering education in pace with the technology changes, by introducing short modules concerning new technology in existing courses. These modules offer great flexibility and can be used also in other parts of the education system[28].

Impacts, challenges and perception

The initiatives included in the table above are all national initiatives. While most of the industry associations surveyed in the context of this study were aware of the national digitalisation strategy for school institutions, awareness regarding the other initiatives was limited. The use of digital skills training initiatives among member companies was indicated to be low by survey respondents. Also, the usefulness of skills initiatives was perceived as low. When the survey respondents were asked about whether digital skills of the workforce had improved since 2015, only a small improvement was suggested (2 on a scale of 5). However, it should be noted that the initiative included under Pillar 2-3, called Digilift/Kickstart Digitalisation which also has a learning and skills development component, has had a positive impact (see section 2.1).

The Swedish Agency for Economic and Regional Growth has recently started a work to predict the digital skills gap, according to the survey respondents from the Swedish Government. Indeed, this is a crucial area as the demand for ICT skilled workers exceeds supply, despite the fact that Sweden continues to have the second highest number of ICT specialists[29]. According to the Swedish IT and Telecom Industries, a shortage of 70,000 ICT specialists by 2022 is estimated (DESI 2018).

2.4 Support mechanisms

Public expenditures in innovation and SMEs

The number of funding agencies and programme supporting companies and digitalisation, and the varying forms of funding, objectives, and target groups of such programmes make it difficult to provide an overview and to estimate the total cost for these supports.

A report from the Swedish National Audit Office from 2014 makes an attempt to provide an overview of financial support for SMEs and innovation, suggesting that SEK 27 billion (EUR 2.58 billion) are spent on companies, while about SEK 35 billion (EUR 3.34 billion) are spent on research and innovation, however not limited to companies. Vinnova, the Energy Agency, and the Agency for Economic and Regional Growth are the national authorities providing most of the support for this target group[30].

RISE ICT – Sweden's Research Institute and Innovation Partner

RISE is a publicly owned research centre performing applied research, knowledge creation and innovation. RISE was originally founded in 1997 by the Swedish Ministry of Enterprise, Energy and Communications, and the government agency the Knowledge Foundation. They became fully owned by the government in 2007 and got an extended mandate and increased resources in 2009. However, despite the funding by the government, RISE decides on budget and mandate. Various projects with different focus are set up by RISE within e.g. digital learning, sustainable

mobility, data science and AI, automation and industrial processes. Through its activities, RISE acts as a link between academia, industry, public organisations and user groups.

Procurement measures

The Swedish procurement authority is involved in the context of Smart Industry. Procurement may have a great potential as a tool for promoting innovation, and the procurement authority has therefore been tasked to provide support to order groups of contracting authorities, with a total investment of SEK 4 million (0.38 million) in 2017 and 2018[31]. It should also be noted that this is in line with smart specialisation strategies.

Structural Funds – ESIF ICT investments

According to the ICT Monitoring Tool[32], Sweden is planning the following ICT Investments under ESIF with relevance to smart manufacturing research and dissemination, amounting to a total of EUR 259.5 million:

- EAFRD - ICT in rural funds: EUR 158 M
- 047 - ICT: Very high-speed broadband network (access/local loop; >/= 100 Mbps): EUR 71 M
- 082 - ICT Services and applications for SMEs (including e-Commerce, e-Business and networked business processes), living labs, web entrepreneurs and ICT start-ups): 16 M
- 044 - Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring, control and information systems): EUR 12 M
- 015 - Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems): EUR 2 M
- 046 - ICT: High-Speed broadband network (access/local loop; >/= 30 Mbps): EUR 0.5 M

Tax incentives

Swedish governments have avoided tax credit schemes, with an exception in 2014 when a limited tax incentive scheme was set up for small businesses hiring R&D staff. However, another scheme in place since 2014 consists in a partial exemption of social security contributions per employee for companies active in systematic research and development[33].

Automation vouchers

The Automation programme / Robotlift results from the Smart Industry strategy and was initiated in 2018. It is planned to go on until 2021 with a total budget of EUR 10.7 million (100% publicly funded), managed by the Agency for Economic and Regional Growth. It is focused on SMEs and provides grants or vouchers for automation/robotization of manufacturing industry. The main objective is to reach large numbers of industrial companies and to help them accelerate their work within automation, thereby improving their competitiveness and long-term growth. The programme provides support, means and tools directly and indirectly for small manufacturing companies to start or speed up their work within automation and robotization of their manufacturing processes, including also skills and knowledge development.

Digitalisation vouchers

The Agency for Economic and Regional Growth supports small companies that want to take in external competence to develop the company and increase competitiveness – either through a service or by hiring additional staff on a project basis. The voucher can vary from SEK 50,000-250,000 (EUR 4, 740 – 23, 690), and should not cover more than half of the costs. The remaining

part should be paid by the company[34]. The scheme has been in place since 2016 with a yearly budget of SEK 50 million (EUR 4.72 million). 96.8% of the voucher users (200-300 per year) find that the voucher has helped to increase the company's competitiveness, and 94% consider that the company's digital maturity has increased thanks to the scheme. 18 out of 21 Swedish regions apply the scheme[35].

Facilitate access to finance

Regarding start-ups, Sweden has a venture capital strategy and infrastructure apt to fund young companies and high-risk projects. By 2020, Sweden will spend EUR 1.2 million to promote investment related to smart industry with the aim of stimulating investors in start-ups to place or expand production, research, development, industrial services and testing[36].

ALMI företagspartner is one important state player enabling SME's access to finance. It offers credit (micro-credit, business credit), venture capital, advisory services and incubation services to SMEs. Almi Företagspartner AB is owned by the Swedish government and is the parent company of a group consisting of 16 regional subsidiaries. In addition to the above-mentioned services, they provide innovation vouchers for established SMEs with the aim of offering new products or services to their clients. Vouchers can be used to purchase external services or expertise and amount to SEK 100,000 (EUR 9,547)[37].

Industrifonden is another venture capital firm supporting growth companies in the sectors of technology and life sciences.

3 Conclusions

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

In an attempt to provide an overview of the funding of digitising industry, the budgets of the initiatives presented in the context of this study have been added together resulting in the sum of about EUR 349.38 million (2013-2021), including also the support mechanisms and thus the EU structural funds representing a major part of the total sum (EUR 259.5 million). However, it should be noted that this sum is not complete: e.g. the funding put down by RISE could not be identified, neither the budgets of the coming years of certain projects under Pillar 2-3.

Table 8: Overview of funding for digitalisation 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)**
Kickstart Digitalisation	EUR 8.1 million			
PiiA	EUR 14 million			
Produktion 2030	EUR 14.7 million			
Digitalisation Pilots		EUR 11.4 million		
National strategy for cybersecurity			N/A	
Swedish Civil Contingencies Agency to strengthen the ability of the public and SMEs to prevent IT-incidents			N/A	
Inquiry into cross-sectoral policy development related to the technologies of the fourth industrial revolution			N/A	
National Agency for Digital Government			N/A	
Digitalisation strategy for school institutions				EUR 0.29 million
Digidel centres in SE municipalities				EUR 1.2 million
Digital skills for management teams and boards of SMEs				EUR 1.46 million
Short, flexible university level courses for specialists in the workforce				EUR 1.95 million
Further education in artificial intelligence				EUR 3.9 million
Cooperation programme between schools and industry				EUR 0.86 million
SME support to develop strategies for competence provision				EUR 0.86 million
RISE ICT	N/A			
Procurement measures	EUR 0.38 million (2017-2018)			
Tax incentives	(no budget identified)			
Robotlift/Automation vouchers	EUR 10.7 million			
Digitalisation vouchers/Innovation vouchers	ALMI innovation vouchers for SMEs: EUR 9,547 per voucher (not included in the total sum below) Agency for Economic and Regional Growth digitalisation vouchers: EUR 4,740 – 23,690 per voucher (not included in total sum below). Yearly budget is SEK 50 million (EUR 4.72 million) implying a total sum of EUR 18.88 million in the period 2016-2019.			
Access to finance	EUR 1.2 million by 2020			
ESIF ICT investments	EUR 259.5 million			
Total spending	Ca EUR 349.38 million in the period 2013-2021 (under the pillars: EUR 58.72 million, under support mechanisms: EUR 290.66 million)			

As indicated by the DESI index, Sweden is one of the best performing European countries with regard to digitalisation with high scores for all sub-indicators. Some good examples include the use of internet services (score 73.4) and human capital (score 74.2). However, also in the remaining sub-categories, Sweden is well performing with the scores ranging from 56.4 to 76. While Sweden has a solid industrial base with several large companies that are strong in digitalisation, SMEs have been slower to adapt to the opportunities of digitalisation. Other challenges include increasing competition from emerging economies as well as the potential risk of multinationals and large industrial companies moving their research departments to other countries. Finally, while Sweden has the second highest number of ICT specialists in Europe, demand exceeds supply. This skills gap needs to be addressed, in particular as the number of STEM graduates lags behind many other European countries.

The present report has aimed to analyse the current status of national initiatives on digitising industry in Sweden, with the background of the Digitising European Industry (DEI). Recent years have seen an important development in Sweden in this policy area, with the Smart Industry digitalisation strategy launched in 2016, focusing on the industrial sector, a national digitalisation strategy in 2017, addressing the society as a whole, as well as the national approach on artificial intelligence that was launched in 2018. A number of initiatives with the aim of ensuring Sweden's high performance in this area stem from these strategies, covering the different pillars of the DEI.

Regarding the boosting of innovation capacity through DIHs, partnerships and industrial platforms (pillar 2 and 3), four initiatives were examined more into detail out of which one had a specific focus on SMEs. Through Kickstart Digitalisation, SMEs are supported through coaching efforts, exchange of practices and networking in the industrial sector. Produktion 2030 has been in place since 2013 and is a public-private partnership that brings together industry, academia and research association with the aim of ensuring Sweden is the first choice for the development and production of advanced goods and services, and also one of the world's leading countries in sustainable manufacturing.

In terms of regulatory initiatives (pillar 4), a national strategy for developing and enhancing cybersecurity in Sweden for all stakeholders in society should be mentioned. Furthermore, in the same area and with a specific focus on SMEs is the mission for the Swedish Civil Contingencies Agency to strengthen the ability to prevent IT-incidents. Finally, various initiatives within skills development (pillar 5) have been launched both in the context of Smart Industry as well as in the context of the national strategy on digitalisation. Some of these initiatives target the society as a whole, while others focus on skills development within SMEs, or the provision of short courses as a way of continuous development for specialists in the workforce.

European cooperation (pillar 1) is another component of the policy development in Sweden. Partnerships with France on sustainable production, and with Germany on innovation, were particularly highlighted by the Swedish Government. Furthermore, involvement with the EU and EU MS is highlighted in national strategies as a way of moving forward in this area.

The variety of initiatives stemming from the national strategies on digitalisation, as well as previous policy actions, cover the five pillars of the DEI. Indicators show that digitalisation in Sweden in recent years is increasing. For example, the amount of companies using social media and selling online has increased in the period of 2015-2017, and the percentage of companies providing ICT training to their staff is well above the EU average.

One successful example that was launched as a pilot project in 2015 is Kickstart Digitalisation. This project is further outlined in the box below.

Box 1: Good practices

Kickstart Digitalisation / Digilyftet

This initiative aims to support SMEs in seizing digital opportunities. It provides small and medium-sized companies in the industrial sector with the opportunity to learn from each other, receive advice and coaching, and increase their knowledge on digitalisation. The Agency for Economic and Regional Growth is in charge and several associations, as well as local and regional partners are involved.

This is a crucial area of development due to the fact that smaller companies have been slower in the up-take of digital technologies. While this initiative (covering pillar 2) was launched in 2016, a pilot was conducted in 2015. Therefore, some impact and effects can be considered at this point. An evaluation was performed in December 2018 of about 100 participating companies demonstrating the following results[38]:

- Companies reported to be overall satisfied with the quality of the activities;
- 95% of participating companies said that Kickstart has given them better insights into the importance and opportunities of digitalisation, and new ideas on how to reap such opportunities;
- 60% of participating companies have started digitalisation projects, while 35% said that the initiative has helped them to speed up processes and their work within on-going digitalisation projects;
- Lack of time, resources, and knowledge were mentioned as obstacles to take forward digitalisation projects;
- In December 2018, 250 companies had participated in the initiative.

To conclude, the table below (table 9) provides a general overview of the main digitalisation initiatives implemented in Sweden and the overall progress Sweden has made so far with regard to digitalisation. As presented in this report, a number of initiatives are in place to support digitalisation in Sweden. Some of them focus solely on manufacturing, while others focus on all sectors. While most of the projects are fairly recent, making it difficult to evaluate any potential impacts, some initiatives in Pillar 2-3 (boosting innovation capacity) started in 2013. Under Pillar 5 (skills development) and Pillar 4 (regulatory framework), all initiatives were launched in 2017 or 2018. Sweden performs very well in the area of digitalisation and is highly ranked in international and European indexes, however, based on the surveys conducted in the context of this project, it seems like there is room for improvement. Particularly, in regard to skills development and regulatory framework. In a global context of increased competition from emerging economies and other countries, it is crucial that Sweden continues to prioritise this policy area in order to remain among the top performers.

Table 9: National initiatives – inputs and outputs

		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)	PiiA (2013) Kickstart Digitalisation (2016)	Produktion 2030 (2013) PiiA (2013) Digitalisation pilots (2016)	National Strategy for Cybersecurity (2017); Mission for the Swedish Civil Contingencies Agency to strengthen the ability of the public and SMEs to prevent IT-incidents (on-going); Inquiry into cross-sectoral policy development related to the technologies of the fourth industrial revolution (2018), National Agency for Digital Governance (2018)	Collaboration programme schools and industry (2016) SME support to develop strategies for competence provision (2016) National digitalisation strategy for school institutions (2017); Short, flexible university level courses for specialists in the workforce (2018); Digital skills for management teams and boards of SMEs (2018); Further education in artificial intelligence (2018); Funding of DigidelCenters in Swedish municipalities (2018)
	Funding (total amount and period)	EUR 36.8 million (2013-2018)	EUR 26.1 million (2013-2018)		EUR 10.52 million (2017-2018)
	Industries addressed	Manufacturing/Industry	Manufacturing/Industry	All	All
	EU programme involved	No	No	No	No
Usage	Perception of initiative	Government support for digital transformation is considered rather useful (3.5/5).		The regulatory framework is considered to be better, in particular for individuals.	Government initiatives on digital skills are considered to be somewhat useful (2/5).
	Take-up	360 businesses benefitted from Kickstart Digitalisation, 60 test and demo sites for production technology and 14 marker spaces stem from the mentioned projects.	150 testbeds and about 80 innovation competitions: “blue sky prizes” supported by Vinnova, stem from the mentioned projects.		N/A
Outcomes	Perception of outcomes	The level of take-up of digital technologies is perceived as moderate (3/5).	The level of innovation in digital industries is perceived as relatively high (3.75/5)	The regulatory framework is perceived to be moderately fit for	It is considered that the required skills and labour resources to

		Pillar 2	Pillar 3	Pillar 4	Pillar 5
				the digital age (2.6/5).	enable digitalization are available to some extent (2.75/5).
	Outcome metrics	DESI ranking: 2nd (2018) and 3rd in 2017. ICT spending is 3.4% of GDP (2017).		Between 2015-2017, the total capex spending increased by 13.4%. In the same period, the number of new start-ups decreased from 68793 to 68713.	The number of persons with specialist skills has increased by 13.3 % in 2015-2017, while the amount of enterprises providing training to develop ICT skills has increased from 26-28%.
	Change in outcomes	In 2018, Sweden remained ranked number 4 in the DESI ranking on integration of Digital Technology, while the score increased from 53.8-56.4.			
End-goal	Productivity growth	Between 2010 and 2017, the real labour productivity per person employed in Sweden increased by 4.5%, with the highest increase in 2015 (2.9%)[39].			
Summary		Various initiatives have been launched in recent years. While it is still early to analyse the effects of each specific initiative, it can be concluded that, together with the recent Smart Industry strategy, the national digitalization strategy and the national approach to artificial intelligence, they strongly indicate this policy area as a priority for the Swedish Government.			

ANNEX 1 List of stakeholders interviewed

Type of stakeholder	Name of organisation
National government	Ministry for Enterprise and Innovation
Industry Association	Association of Swedish Engineering Industries
Industry Association	Swedish Federation of Business Owners
Industry Association	Swedish Construction Federation
Industry Association	Swedish IT and Telecom Industries

ENDNOTES

[1] The yearly budget for promoting business, entrepreneurship and innovation is approx. SEK 4 billion (EUR 388 million). A large portion of this budget supports the digitalisation of industry. In addition, budgets for regional development, promotion of energy efficiency etc, contribute to the digitalisation of industry. However, these budgets also finance other initiatives focussing on other issues.

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