

MONITORING PROGRESS IN NATIONAL INITIATIVES ON DIGITISING INDUSTRY

Country report

Netherlands

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Summary

The Netherlands belongs to the cluster of top-performing countries in terms of digitisation according to the Digital Economy and Society Index (DESI). The country ranks 4th among all EU Member States in 2018, the same rank that was already held in 2017. The best results are achieved in the areas Connectivity (1st rank) and Human Capital (2nd rank).

The Netherlands has performed well economically over the last few years, with a GDP growth of 3.1% in 2017. In 2017, the industry accounted for 15% of the Dutch Gross Value added. The Dutch economy is overall highly innovative, with a business expenditure on research development that equals 1.17% of the GDP.

The Netherlands has launched the Smart Industry initiative in 2014 to boost innovation capacity of Dutch businesses, with a total budget (cumulative by 2018, including already confirmed funding for future projects) of EUR 240 million. Overall, at least EUR 83 million have been invested in 2018 across initiatives of the different pillars of the Digitising European Industry (DEI) and EUR 2 million from support mechanisms.

As of 2018, five Digital Innovation Hubs and 39 Fieldlabs have been established under the Smart Industry initiative. Overall, the funding identified for initiatives under Pillars 2 and 3 of the DEI amounts to at least EUR 59 million. The regulatory framework has been updated in 2017 and 2018 with notable modifications of the cybercrime and the data processing legislation (Pillar 4 of the DEI). Nevertheless, further adjustments are needed, in particular in the area of data ownership.

Ensuring the availability of employees with the necessary ICT skills is one of the major challenges for industry digitalisation in the Netherlands. The Dutch government has launched the Technology Pact in 2013 to address the issues. Thousands of individuals and businesses are trained every year under the umbrella of the Technology Pact. The funding identified for initiatives under Pillar 5 of the DEI amounts to at least EUR 13 million.

Table 1 presents an overview of the main initiatives identified that will be further detailed in this report. Table 2 presents a short SWOT analysis of the Netherlands 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	2014	Overall strategy	Sectoral strategy	Industry	All	All	Total: EUR 240 million (cumulative since 2015, including already confirmed funding for future projects), of which EUR 27 million from EU, EUR 65 million from Dutch government, EUR 29 million from regions, EUR 96 million from private funding, EUR 24 from knowledge institutions
Dutch Digitalisation Strategy	2018	Overall strategy	Horizontal strategy	All	All	All	No overall funding
Digital Agenda	2016	Overall strategy	Horizontal strategy	All	All	All	No overall funding
Smart Industry Fieldlabs	2014	Pillar 2	DIHs	All	All	All	EUR 59,000,000 (2018) The budget comes from national, regional, European and private sources
dutch digital delta Knowledge and Innovation Agenda (KIA) ICT	2016	Pillar 3	PPPs (Public Private Partnerships)	All	Big data, blockchain, cybersecurity	All	EUR 10,000,000 (2018)

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
Digital Trust Center	2017	Pillar 3	Platforms	All	Cybersecurity	All	EUR 1,000,000 (2018)
Data Processing and Cybersecurity Notification Obligation Act	2017	Pillar 4	Cybersecurity, data ownership	All	N/A	N/A	N/A
Computer Crime Act III	2018	Pillar 4	Cybersecurity	All	N/A	N/A	N/A
National Cyber Security Centrum		Pillar 4	Central information hub for cyber security	All	N/A	N/A	N/A
Technology Pact	2013	Pillar 5	The Technology Pact itself is a partnership between public and private partners. They have agreed on various actions, varying from training centres, grants, knowledge sharing, co-operation, life-long learning, college tours, etc.	All	All	N/A	EUR 1,000,000 (2018)* The budget comes from national, regional, European and private sources
dutch digital delta Human Capital Agenda ICT	2015	Pillar 5	Knowledge centres, grants, providing of staff, co-operation	All	All	N/A	N/A
Knowledge Net	2015	Pillar 5	Knowledge sharing, providing infrastructure and materials, information management support	All	All	N/A	EUR 12,000,000 (2018)
Knowledge vouchers	2016	Supporting mechanism	Innovation voucher	All	All	SMEs	EUR 2,000,000 (2018)

* It needs to be pointed out that the presented funding for the Technology Pact indicates only the national government's funding of the Pact's national organisation. The Technology Pact is a public-private partnership between many stakeholders and relies on a very broad and complex funding that includes funding from the regions, funding from schools and funding from businesses. Each of these partners contributes to the funding of the Pact. It is, therefore, virtually impossible to determine the precise total amount of funding that is attributed to the Technology Pact.

Table 2: SWOT of the Netherlands on digitalisation

<p>Strengths:</p> <ul style="list-style-type: none"> • The Netherlands follows a distinct and tailored approach to industry digitalisation that includes public-private partnerships and a triple helix of government-industry-science relationships. • The infrastructure required for digitalisation (broadband penetration etc.) in the Netherlands is excellent. • The entrepreneurial culture in the Netherlands is strong. • The Netherlands achieves very high results in terms of quality of digital skills. 	<p>Weaknesses:</p> <ul style="list-style-type: none"> • While the quality of ICT skills that are available in the Netherlands is very high (2nd rank in the DESI Human Capital dimension), there is a very high demand and an overall shortage of people with these skills.
<p>Opportunities:</p> <ul style="list-style-type: none"> • Major opportunities lie in innovation and application of data science, AI and blockchain. Respective public-private partnerships have already been established or are in the process of being established. • The Smart Industry initiative is successful and has already led to the creation of five Smart Industry Hubs and 39 Fieldlabs, so there is potential in further increasing the number of Fieldlabs. 	<p>Threats:</p> <ul style="list-style-type: none"> • The regulatory framework in the Netherlands has undergone some relevant changes but there are still relevant developments (such as data ownership) which are not yet adequately reflected in the legislation. • The global competition for ICT talent is a major threat to industry digitalisation in the Netherlands, as recruitment of Dutch ICT specialists from other countries could increase the shortage of ICT specialists in the Netherlands.

1 General context

The objective of this report is to analyse the current status of national initiatives on digitising industry in the Netherlands. 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 that presents the overall methodological approach applied in all country cases.

1.1 Economic context and status on digitisation

General economic context

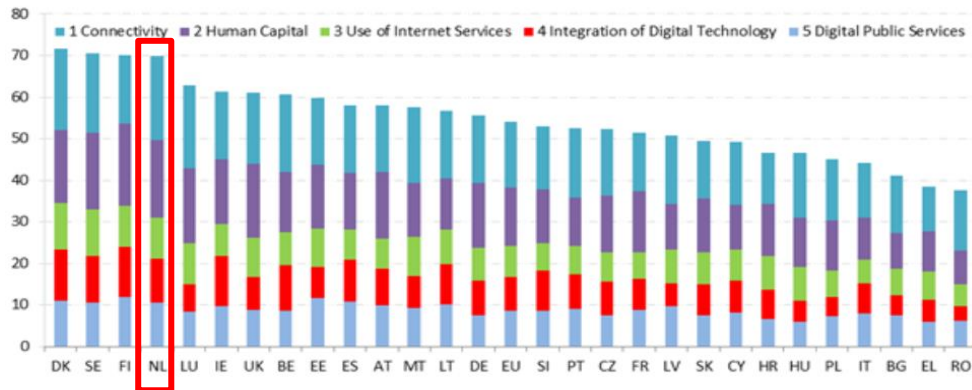
Generally, the Netherlands has performed well economically over the last few years. Since 2009, the GDP has constantly increased by about 2-3% per year, and with 3.1% in 2017, economic growth reached the highest value of the decade. The investment rate has developed stably and in line with GDP growth, and private consumption is one of the main drivers for growth. Unemployment (including long-term unemployment) has been decreasing and is notably below the EU average. The Netherlands have increased their exports in 2017 thanks to positive trends in neighbouring countries and in world trade, but high domestic demand has also driven up imports. The economic outlook for 2019 is positive, with an expected GDP growth of 2.5%.¹

In 2017, the industry accounted for 15% of the Dutch Gross Value added. The Dutch economy is overall highly innovative, with a business expenditure on research development that equals 1.17% of the GDP. This places the Netherlands in the upper quarter of EU Member States in terms of expenditure in R&D.

Status of digitisation

As shown in Figure 1, the Netherlands ranks 4th in the Digital Economy and Society Index (DESI), unchanged from the year before (and only 0.02 score points from ranking 2nd):

Figure 1: 2018 Digital Economy and Society Index



Source: Digital Economy and Society Index (DESI) 2018 Country report – The Netherlands

With this rank, the Netherlands is in the high-performing cluster of countries. Compared to 2017, the Netherlands progressed roughly in line with both the EU average and the high-performing cluster average. The country achieves high results in all the five DESI areas (notably 1st rank in Connectivity and 2nd rank in Human Capital). Regarding the percentage of individuals that use the internet and have at least basic digital skills, the Netherlands ranks 2nd and 4th respectively, whereas it is only on the 18th place regarding the usage of social networks. When it comes to the integration of digital technology, the Netherlands scores overall above the EU-average but performs comparatively poorly regarding the percentage of SMEs selling online (18th) and the percentage of SME turnover from e-commerce (15th).² Table 3 summarises these main economic and digital indicators:

Table 3: General economic and digital indicators for the Netherlands

	% GVA (gross value added) from industry	% GDP growth	DESI position – and change	DESI sub-indicators Human Capital, Use of Internet, Integration of Digital Technology in 2018
Netherlands	15.0 (2017)	2.4 (2015-2017)	4 th (2018), same place as in 2017	<ul style="list-style-type: none"> Human Capital: 2nd (3rd in 2017) Use of Internet Services: 3rd (no change compared to 2017) Integration of Digital Technology: 6th (no change compared to 2017)

A huge challenge for businesses in the Netherlands is the low number of Science, Technology, Engineering and Maths (STEM) graduates, which is one of the lowest in the EU (in relation to the population). Shortages of ICT specialists are a huge obstacle for the development of the digital economy and the digital society as a whole and therefore also for the digitalisation of the industry, and the situation is expected to aggravate in the future.³ This challenge has also been pointed out by most of the industry stakeholders interviewed for this report. The Dutch government has

set up the Technology Pact and the Human Capital Agenda ICT initiative to address the growing demand for ICT specialists.

The assessment of countries' readiness for future production carried out by the World Economic Forum in 2018⁴ places the Netherlands at minimum in the top 15% regarding drivers of production. A breakdown of drivers is provided in Table 4 below. For structure of production, the Netherlands ranks 22nd in complexity and 37th in scale.

Table 4: The Netherlands' readiness for future production

Drivers of Production	Rank /100	Score /10
Technology & Innovation	4	7.7
Human Capital	13	7.1
Global Trade & Investment	3	8.4
Institutional Framework	8	8.7
Sustainable Resources	15	7.7
Demand Environment	9	6.6
Structure of Production	Rank /100	Score /10
Complexity	22	7.4
Scale	37	4.6

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

1.2 National strategy on digitising industry

Impacts, challenges and perceptions

The Smart Industry strategy, developed by the Ministry of Economic Affairs and Climate Policy together with TNO (Netherlands Organisation for Applied Scientific Research), FME (Technical Industry Employers' Organisation), KMU (Royal Metal Union) and KVK (Chamber of Commerce), is the Dutch targeted approach to industry digitalisation. Digitalisation remains a major challenge particularly for SMEs, and Smart Industry addresses this challenge and aims at speeding up the digitalisation of Dutch businesses. The current implementation agenda focuses on five action lines: getting businesses started; Fieldlabs; knowledge; skills; digital environment. Since 2015, EUR 240 million have been invested in Smart Industry Fieldlabs. The strategy is implemented in concrete initiatives to create DIHs and Fieldlabs. The impact, challenges and perceptions of these initiatives are presented in more detail in Section 2.1.

The Smart Industry strategy is embedded in the broader context of the Digital Agenda and the Dutch Digitalisation Strategy. The Dutch Digital Agenda was adopted in 2016 and set out several short-term activities for the period 2016-2017. Its goal was to make better use of technological opportunities to ensure that the Netherlands remains a top competitor in terms of digital industry. The agenda follows five action lines: education, knowledge and innovation (covering, among others, the Human Capital Agenda ICT, see Section 2.3); open and high-speed infrastructure;

security and trust; more scope for entrepreneurs (which includes the Commit2Data initiative of the dutch digital delta, see Section 2.1); and digitisation of sectors (under which falls the Smart Industry initiative).⁵

In 2018, the Ministry of Economic Affairs and Climate Policy adopted the Dutch Digitalisation Strategy with the objective to make the Netherlands the digital leader of Europe. The strategy follows two complementary tracks. The first track focuses on accelerating economic and social opportunities in seven economic and social policy areas: SMEs, industry, energy, mobility, health, agriculture and government. Most relevant for industry digitalisation are the SMEs strand (which includes the SME Action Plan that starts in 2019) and the industry strand (which includes the Smart Industry initiative). The second track centres on developing the basic conditions for digitalisation. Five major themes are outlined in the digitalisation strategy: ground-breaking research and innovation; changes in work, new skills and lifelong learning (including the Human Capital Agenda ICT and the Technology Pact, see Section 2.3); dynamic digital economy (focusing on trust, data economy and infrastructure); strengthening the resilience of citizens and organisations (including the Digital Trust Center, see Section 2.1); and fundamental rights and ethics in the digital age.⁶

The table below summarises the national strategies on digitising industry:

Table 5: National strategies on digitising industry

Name	Smart Industry	Dutch Digitalisation Strategy	Digital Agenda
Type	Sectoral initiative	Horizontal initiative	Horizontal initiative
Starting date	2014	2018	2016
Objective	To speed up digitisation of Dutch businesses	Making use of digital technologies to ensure the Netherlands' competitiveness	Making the Netherlands the digital leader of Europe
Ministry/ministries in charge (website, contact person)	Ministry of Economic Affairs and Climate Policy, Department of Top Sectors and Industrial Policy	The Ministry of Economic Affairs and Climate Policy https://www.government.nl/topics/ict	The Ministry of Economic Affairs and Climate Policy, Regulatory Reform and ICT Policy Department
Scope of the strategy/action plan	The Smart Industry strategy should lead to new exportable business propositions. By focusing on the development of an ambitious, internationally leading programme, the Ministry builds on the integrated Dutch ecosystem within which businesses, knowledge institutions and the government work together closely on implementation and breakthrough innovations.	Accelerating economic and social opportunities track with seven policy areas: <ul style="list-style-type: none"> • SMEs • Industry • Energy • Mobility • Health • Agriculture • Government Developing basic conditions track with five themes: <ul style="list-style-type: none"> • ground-breaking research and innovation • changes in work, new skills and lifelong learning • dynamic digital economy • strengthening the resilience of citizens and organisations fundamental rights and ethics in the digital age	Five action lines: <ul style="list-style-type: none"> • education, knowledge and innovation • open and high-speed infrastructure • security and trust • more scope for entrepreneurs digitisation of sectors
Measures included in the strategy/action plan	Several examples of KPI's: <ul style="list-style-type: none"> • Establishment of five regional Smart Industry Hubs 	Smart Industry Human Capital Agenda ICT Digital Trust Center	Smart Industry Human Capital Agenda ICT dutch digital delta

Name	Smart Industry	Dutch Digitalisation Strategy	Digital Agenda
	<ul style="list-style-type: none"> • Assessment that is performed by 1000 entrepreneurs • 1000 skilled workers should have followed courses at Fieldlabs • Five best practices (demonstrators) on human-oriented technology 		
Overall funding and distribution by volume and source of funding (public/private, EU/national)	<p>Sources of funding in EUR millions (rounded values, cumulative 2015-2018, including already confirmed funding for future projects):</p> <ul style="list-style-type: none"> • EU: 27 • Dutch government: 65 • Regions: 29 • Private: 96 • Knowledge institutions: 24 <p>Total: 240</p>	No overall funding	No overall funding

1.3 EU cooperation in the field of digitising industry initiatives

Part of the European Commission's Digitising European Industry (DEI) initiative is the co-ordination of national and regional initiatives to ensure coherence and share experience between Member States. In this context, the Netherlands maintains an international co-operation between the Smart Industry strategy and the German *Industrie 4.0 Plattform*. This co-operation was established in October 2018 to exchange best practices, notably in the fields of skills, standardisation, cybersecurity, research & development, legal framework conditions, and digital business models. The overarching goal behind this co-operation is promoting, supporting and implementing sustainable joint industry initiatives that build on the innovative strength of both countries.

The Netherlands is part of the EU Coordinated Plan on Artificial Intelligence and participates in the Joint Undertaking for Electronic Components and Systems for European Leadership (ECSEL) that aims to foster the competitiveness of the electronics components and systems sector in Europe by supporting research, development and innovation projects.

2 Other policy support to digitising industry

This chapter provides an overview of the Netherlands' main initiatives for industry digitalisation, grouping the initiatives according to the structure of the DEI. Section 2.1 presents the initiatives to boost innovation capacity (DEI Pillars 2 and 3), Section 2.2 the initiatives related to the digital regulatory framework (DEI Pillar 4), and Section 2.3 the initiatives for digital skills development (DEI Pillar 5)

2.1 Boosting innovation capacity

Pillar 2 and Pillar 3 of the DEI promote measures to boost the industry's innovation capacity. Pillar 2 covers the establishment of Digital Innovation Hubs (DIHs) as one-stop-shops where businesses can get help to improve their production processes, products and services by means of digital technology. Pillar 3 promotes the support for partnerships and industrial platforms in the form of digital industrial platforms or large-scale piloting and Public-Private Partnerships (PPPs). The table below presents an overview of the Netherlands' main initiatives in these domains:

Table 6: National initiatives to boost innovation capacity

Name	Smart Industry Fieldlabs	dutch digital delta Knowledge and Innovation Agenda (KIA) ICT	Digital Trust Center
Type	DIHs	PPPs	Platforms
Starting date	2014	2016	2017
Objective	To speed up digitisation within Dutch businesses, resulting in: 1. Greater economic growth due to increased productivity 2. Growth in employment and attractive jobs 3. Solutions to societal problems, e.g. due to lower consumption of raw materials and energy	To identify instances of high-potential ICT innovation in the top sectors and to provide an agenda for public-private partnerships in the 2016-2019 period	To increase the resilience of businesses to cyber threats
Relevant for Pillar 2 ⁷ or Pillar 3 ⁸ or both	Pillar 2	Pillar 3	Pillar 3
Short description	The Smart Industry initiative describes the actions needed to ensure digitalisation in the Netherlands. The agenda has been drawn up by a broad coalition of businesses, knowledge institutions and government authorities. The Implementation Agenda is firmly embedded within the top sectors high-tech systems and materials (HTSM) and ICT and also has links to other top sectors, including chemicals, agri & food and horticulture & starting materials. To speed up industrial transformations, nine major projects have been defined, together with specific objectives and activities until 2021.	This KIA ICT contains the ICT challenges and themes of various (top)sectors as well as cross-cutting ICT themes that unite the different sector challenges. Investing in public-private partnerships originating from this KIA ICT gives a high return on investment, since each action line is relevant for more than one sector. This KIA ICT also identifies long-term ICT subjects that most likely end up in the National Research Agenda.	At the end of 2017, the Ministry of Economic Affairs and Climate Policy and the Ministry of Justice and Security jointly launched the 'Digital Trust Center' (DTC) programme. Its first task is to provide businesses with reliable and independent information on digital vulnerabilities and concrete advice on the action they should take. A digital platform and other facilities will be used for this purpose. Its second task is to foster cyber security alliances between businesses. Both tasks aim to help businesses improve their cyber security arrangements and to increase their resilience to cyber threats.
Granting organisation	Ministry of Economic Affairs and Climate Policy	Ministry of Economic Affairs and Climate Policy	Ministry of Economic Affairs and Climate Policy

Name	Smart Industry Fieldlabs	dutch digital delta Knowledge and Innovation Agenda (KIA) ICT	Digital Trust Center
Participating organisations	TNO, FME, KMU, KVK	NWO, TNO, ECP	Ministry of Justice and Security
Sectors targeted	All	All	All
Technologies targeted	All	Big data, blockchain, cyber security	Cyber security
Funding (split by private/public and national/EU), state period/annual funding	EUR 59,000,000 (2018) The budget comes from national, regional, European and private sources	EUR 10,000,000 (2018)	EUR 1,000,000 (2018)
Current status of initiatives	The current Smart Industry Implementation Agenda outlines the concrete steps for the period 2018-2021.	The current KIA ICT covers the period 2016-2019.	The Digital Trust Center was launched in June 2018.

Impacts, challenges and perceptions

The Smart Industry initiative is the Netherland's main programme for the digitalisation of the industry and has been running since 2014. As of 2018, five Smart Industry Hubs have been created as central contact points for companies and to co-ordinate the co-operation between the regions. The Hubs also work closely together with the steering office of the Smart Industry initiative. Under the Smart Industry initiative, 39 thematic Fieldlabs where companies can develop and test new solutions have also been established. As the initiative is still ongoing, more Fieldlabs are expected to open in the future. The share of the initiative's funding from public sources (national and regional) is almost 40%.

The four industry stakeholders interviewed for this report perceive the Smart Industry initiative and the other initiatives presented in Table 6 overall as very useful (4.5 in a 1-5 scale where 1 is low and 5 is high). The initiatives' strengths are seen in their ability to accelerate innovation, and in the fact that they have a broad scope and strong backing from the government. In terms of uptake of new technologies, the initiatives' impact is regarded as moderate (2.8 in a 1-5 scale). A major challenge is to ensure that the initiatives lead to innovation that is implemented into new products and services which can actually be successful on the market. While the total amount of funding available is appreciated, the funding could be more focused on producing concrete results according to stakeholders.

In addition to the initiatives outlined in Table 6, the Dutch government is in the process of launching a new national programme for Artificial Intelligence under the European Commission's co-ordinated action plan on the development of AI in the EU. The objective of the programme is to develop and share knowledge about AI technology and potential applications, as well as about questions related to ethics and interactions between AI and humans. The programme will involve partners from regional hotspots in Amsterdam, Delft, Utrecht, Nijmegen, Groningen and Eindhoven.⁹

The industry stakeholders interviewed for this report see huge opportunities in the use of new technologies, first and foremost in data science and artificial intelligence, and to some extent (and in connection with the formerly mentioned technologies) also blockchain. The starting position of Dutch businesses is overall considered being very good, with high innovation capacities and excellent broadband penetration and other relevant infrastructure. On the other hand, access to data is seen as a major challenge. In many sectors, most data are held by few dominant large companies. This often goes together with using proprietary data protocols and standards that further inhibit data sharing. Access to and sharing of data is however a key factor for businesses to use relevant new technologies. Another major challenge for the uptake of new technologies is the scarcity of skilled employees and the resulting war for talent.

2.2 Regulatory framework for digital age

Pillar 4 of the DEI promotes the development of a digital-friendly regulatory framework to foster digitalisation (including regulations on cybersecurity and free flow of data). The table below presents the Netherlands' main initiatives related to this pillar:

Table 7: Main initiative under Pillar 4

Name	Data Processing and Cyber security Notification Obligation Act	Computer Crime Act III	National Cyber Security Centrum
Type	IT security & data ownership regulation	IT security regulation	Central information hub for cyber security
Starting date	2017	2018	N/A
Objective	To update the legislation on data processing and ownership.	To update the cyber-crime legislation.	To enhance the resilience of the Dutch society in the digital domain.
Short description	This act introduces a duty to report a breach of security or a loss of integrity of electronic information systems, also known as serious ICT infringements. This duty to report only applies to providers of products or services whose availability or reliability is of vital importance to Dutch society. The proposal also contains rules on the processing of data for the Minister of Security and Justice's tasks in the field of cyber security.	This act strengthens the detection and prosecution of computer crime in the Criminal Code and the Criminal Procedure Code. This adapts the legislation to the technological developments on the internet and the use of computers for communication and the processing and storage of data.	The National Cyber Security Centre (NCSC) is the central information hub and centre of expertise for cyber security in the Netherlands. NCSC's mission is to contribute to the enhancement of the resilience of Dutch society in the digital domain, and thus to create a secure, open and stable information society. On an international level the NCSC is the Dutch point of contact in the field of ICT threats and cyber security incidents. The NCSC is also a key figure in the operational coordination at a major ICT crisis and the Computer Emergency Response Team (CERT) for the Dutch central government.
Sectors targeted	Not sector-specific	Not sector-specific	Drinking water Energy Nuclear Financial sector Electronic communication networks and services/ICT Mainport Rotterdam Mainport Schiphol

Impacts, challenges and perceptions

Overall, the regulatory framework is perceived by the industry stakeholders interviewed for this report as somewhat fit for the technical age (3 in a 1-5 scale). The recent legal updates, notably the Data Processing and Cyber security Notification Obligation Act, are regarded as useful (4 in a 1-5 scale) but at the same time as simply necessary. While it is acknowledged that the regulatory framework is improving, it is also noted that the framework tends to lag behind technological developments (which is, to some extent, inevitable). In addition, effective enforcement of the regulatory framework needs to be guaranteed.

Effects of the legal framework on the uptake of technology are not immediate, but there can be indirect effects. For instance, the implementation of the GDPR and the public debate surrounding it has significantly increased awareness of businesses about data use not only in terms of how to protect data, but also how to integrate it into business models.

The industry stakeholders interviewed have identified several areas where the regulatory framework needs to develop in the near future. Cyber security is a topic that is already in focus, but where more needs to be done. Data ownership and intellectual property of software were pointed out as additional pressing issues, as they are key elements for sharing knowledge and data.

2.3 Skills development

Pillar 5 of the DEI aims to adapt the workforce, education and learning systems to make the citizens fit for industry digitalisation. The table below presents an overview of the Netherlands' main measures for digital skills development:

Table 8: Main initiatives to develop digital skills

Name	Technology Pact	dutch digital delta Human Capital Agenda ICT	Knowledge Net (<i>Kennisnet</i>)
Type	Training centres, grants, knowledge sharing, co-operation, life-long learning, college tours, and others	Knowledges centres, training, information, student grants	Knowledge sharing, providing infrastructure and materials, information management support
Starting date	2013	2015	2015
Objective	To develop a structural approach to ensure a well-trained workforce with enough smart and capable technicians for the jobs of today and tomorrow. The definition of technicians is broad and includes IT.	Promoting regional cooperation Inspire and inform students Promoting the availability of sufficient ICT teachers Lifelong Development in the digitalising society	To contribute to good education by making the professional use of ICT possible
Short description	The Technology Pact is an effort to structurally improve alignment between education and the technology job market and reduce the shortage of technically trained staff. Since the official signing of the Technology Pact (May 2013), all the involved partners have made concerted and dedicated efforts to implement the necessary measures on the basis of an integrated approach entitled 'Choosing, learning and working in technology'. The Technology Pact is characterised by a regional approach with a national support infrastructure. The Technology Pact was updated three years after its original signing in order to evolve in pace with the inevitable social changes as a result of ongoing technological developments and the formation of a new government.	The Human Capital Agenda ICT was launched in November 2015 with the aim of meeting the growing demand for ICT professionals in the labour market. The agenda, drawn up by Team ICT, focuses on what knowledge and skills are needed among the labour force, where there are gaps and especially with which actions this can be improved.	Kennisnet is the public organisation for Education & ICT. It provides a national ICT-infrastructure, advises the sector councils and shares knowledge with the primary education, secondary education and vocational education and training. Together with the sector counsels, Kennisnet enables the educational sector to implement their ambitions with ICT.
Granting organisation	Ministry of Economic Affairs and Climate Policy, Ministry of Education, Culture and Science, Ministry of Social Affairs	Ministry of Economic Affairs and Climate Policy	Ministry of Education, Culture and Science

Name	Technology Pact	dutch digital delta Human Capital Agenda ICT	Knowledge Net (<i>Kennisnet</i>)
Participating organisations	More than 60 organisations have signed the National Technology Pact in 2013. Examples are employers, employees, educational institutions, top sectors, regions and students. Due to the way the Technology Pact is organised regionally more parties are involved – there is a national pact, but via regional execution even more organisations are involved.	ECP, Nederland ICT, NOW, Centric, CIO Platform Nederland, TNO	
Sectors targeted	The focus is on technical and technological jobs. More and more of these kinds of jobs are located outside of the 'traditional' technical sectors, for instance also in health.	Not sector-specific	Not sector-specific
Funding (split by private/public and national/EU), state period/annual funding	EUR 1,000,000 (2018)*	N/A	EUR 12,000,000 (2018)
Current status of initiatives	The current Technology Pact covers the period until 2020.	For 2018, the initiative targeted 6,000 students and 150 speakers as beneficiaries.	The latest course of action covers the period 2019-2022.

**It needs to be pointed out that the presented funding for the Technology Pact indicates only the national government's funding of the Pact's national organisation. The Technology Pact is a public-private partnership between many stakeholders and relies on a very broad and complex funding that includes funding from the regions, funding from schools and funding from businesses. Each of these partners contributes to the funding of the Pact. It is therefore virtually impossible to determine the precise total amount of funding that contributes to the Technology Pact.*

Impacts, challenges and perceptions

Investing in digital literacy and developing ICT skills of people, be it in schools or at the workplace, is regarded as the foundation of digitalisation of the industry and the society as a whole. The initiatives outlined above are well known among the industry stakeholders interviewed and are used extensively. The share of enterprises that provide ICT skills trainings to their employees has constantly increased and there is a significant and prolonged increase in the number of students in higher education who are enrolled in STEM studies.

Attribution of results to individual initiatives is difficult due to the complexity of the landscape of funding programmes. Nevertheless, the Netherlands performs very high in terms of development of digital skills and digitalisation of human capital. In the Digital Transformation Monitor, the Netherlands ranks second in the category digital skills.

The industry stakeholders interviewed reported that finding people with the necessary ICT skills is a major challenge and threat to the digitalisation of the industry. Those ICT specialists that are trained and available in the Netherlands are usually very well suited to fulfil the requirements of businesses, but there are simply not enough specialists. It is therefore not a matter of quality, but of quantity. This is not an issue only in the Netherlands but has a much wider scope, as ICT specialists are looked for in and recruited from all over Europe and non-European countries.

2.4 Support mechanisms

The initiatives outlined above are flanked by supporting mechanisms. One of these mechanisms are the knowledge vouchers (*kennisvouchers*). SMEs can apply for a voucher with a value of up to EUR 3,750 which they can use to acquire knowledge and know-how from research institutions or universities. The vouchers, issued by the Netherlands Enterprise Agency (*Rijksdienst voor Ondernemend Nederland – RVO*), shall help SMEs to access research knowledge and initiate partnerships with research institutions. The annual budget for the knowledge vouchers is EUR 2 million.¹⁰

In 2018, the Ministry of Economic Affairs and Climate policy has launched the SME Idea initiative, a new pilot initiative under the flag of the Technology Pact. SME Idea invites entrepreneurs in the field of technology to develop and suggest solutions for any barriers that prevent them from investing in human capital. Out of 129 ideas submitted, a committee has selected 14 ideas which will receive funding to be implemented. The ideas will be monitored and evaluated by a scientific committee with the ultimate goal to share successful ideas with other businesses.

3 Conclusions

The different DESI sub-indices show that the Netherlands performs overall very high and significantly above EU average with regard to digitalisation, particularly in the areas Connectivity and Human Capital where the country ranks 1st and 2nd respectively. The Netherlands is thus part of the cluster of high-performing countries in terms of digitisation.

Under Pillar 1, the Netherlands has recently launched an EU co-operation for industry digitalisation. The co-operation takes place between the Dutch Smart Industry initiative and the German Industrie 4.0 initiative and focuses on skills, standardisation, cybersecurity, research & development, legal framework conditions, and digital business models.

The Smart Industry initiative is the main targeted initiative for industry digitalisation of the Dutch government and runs measures under Pillar 2. The Smart Industry initiative is the umbrella programme for the establishment of Digital Innovation Hubs, of which five have already been created. In addition, there are 39 thematic Fieldlabs operating under the Smart Industry initiative. Smart Industry is open to all sectors and to all technologies.

Box 1: Good practice

Smart Industry Fieldlabs

Fieldlabs are one of the main pillars of the government's Smart Industry strategy. Smart Industry Fieldlabs offer a space where companies and knowledge institutions can develop, test and implement technological ideas and applications that are related to Smart Industry. Every Fieldlab is started by a consortium that can comprise companies and research institutions, but also public entities. Thirty-nine Fieldlabs have been created to this day, and the total funding by 2018 was EUR 240 million (of which almost 40% coming from national or regional public sources). By the end of 2018, the Fieldlabs together created 753 partnerships (of which three quarters with companies), 275 projects, and 433 direct jobs (for instance by companies employing new people to implement a Fieldlab project).¹¹

In addition, the Dutch government has launched several initiatives to boost innovation capacity under Pillar 3, for instance the Dutch digital delta Knowledge and Innovation Agenda (KIA) ICT 2016-2019. The KIA ICT enables the establishment of public-private partnerships (PPPs) to address specific key technologies. Some of the PPPs that have been created focus for example on data science and blockchain. A new PPP about artificial intelligence is currently in the process of being established.

The regulatory framework for industry digitalisation (Pillar 4) has also undergone recent changes, with several new laws or major modifications of existing laws. The most important update is the introduction of the Data Processing and Cybersecurity Notification Obligation Act. Industry stakeholders see nevertheless more urge to adapt the legal framework, particularly in the area of data ownership.

Shortage of skilled workers was identified as a major challenge by industry stakeholders. The Dutch government is therefore very actively promoting and supporting skills development under Pillar 5. In particular, the Technology Pact can be regarded as a good practice.

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

Table 9: Breakdown for the financing of the 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)
Smart Industry fieldlabs	EUR 59,000,000 (2018)			
dutch digital delta Knowledge and Innovation Agenda (KIA) ICT 2016-2019		EUR 10,000,000 (2018)		
Digital Trust Center		EUR 1,000,000 (2018)		
Data Processing and Cybersecurity Notification Obligation Act			N/A	
Computer Crime Act III			N/A	
National Cyber Security Centrum			N/A	
Technology Pact				EUR 1,000,000 (2018)
Knowledge Net				EUR 12,000,000 (2018)
Knowledge vouchers (support mechanism)	EUR 2,000,000 (2018)			
Total spending	Ca. EUR 85,000,000*			

**It needs to be pointed out that the presented funding for the Technology Pact indicates only the national government's funding of the Pact's national organisation. The Technology Pact is a public-private partnership between many stakeholders and relies on a very broad and complex funding that includes funding from the regions, funding from schools and funding from businesses. Each of these partners contributes to the funding of the Pact. It is therefore virtually impossible to determine the precise total amount of funding that contributes to the Technology Pact.*

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

Table 10: 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)	Smart Industry fieldlabs (2014)	dutch digital delta Knowledge and Innovation Agenda (KIA) ICT 2016-2019 (2016); Digital Trust Center (2017)	Data Processing and Cybersecurity Notification Obligation Act (2017); Computer Crime Act III (2018); National Cyber Security Centrum	Technology Pact (2013); dutch digital delta Human Capital Agenda ICT (2015); Knowledge Net (2015)
	Funding (total amount and period)	EUR 59,000,000 (2018)	EUR 11,000,000 (2018)		EUR 13,000,000 (2018)
	Industries addressed	All	All	All	All
	EU programme involved	Yes	No	No	No
Usage	Perception of initiative	Government support is considered as very useful (5 in a 1-5 scale) for digital transformation		The regulatory framework is perceived to have slightly improved	The government initiatives on digital skills are perceived as rather useful (4 in a 1-5 scale)
	Take-up	5 DIH 39 Fieldlabs	N/A		4,000 (Technology Pact)
Outcomes	Perception of outcomes	The level of take-up of digital technologies is perceived as elevated (3.5 in a 1-5 scale)	The level of innovation in digital industries is perceived as high (4.5 in a 1-5 scale)	The regulatory framework is perceived to be relatively fit for the digital age (3 in a 1-5 scale)	The required skills and labour resources are considered to be somewhat available to enable digitisation (2.5 in a 1-5 scale)
	Outcome metrics	DESI overall ranking: 4 th in 2017 and 2018		Between 2015 and 2017, total capex spending in the Netherlands decreased by 1%. Between 2015 and 2016, the number of start-ups increased from 64,516 to 67,127.	The number of companies employing ICT specialists decreased by 1.3 percentage points between 2015 and 2017. In the same period, the share of enterprises providing training to develop ICT skills increased from 18% (2015) to 24% (2017).
	Change in outcomes	From 2017 to 2018, the Netherlands improved from 3 rd to 2 nd rank in the DESI ranking on Integration of Digital Technology.			
End-goal	Productivity growth	Between 2010 and 2017, the real labour productivity per person employed in the Netherlands increased by 7.3%, with the highest increase in 2014 (1.5%).			
Summary		The Netherlands has been running the industry digitalisation programme Smart Industry for several years. A major focus of the country's digitalisation strategy lies on human skilled workforce to address the challenge of skills shortages. To this end, the country has launched (among other initiatives) the Technology Pact.			

ANNEX 1 List of stakeholders interviewed

Type of stakeholder	Name of organisation
Government representative	Ministry of Economic Affairs and Climate Policy, Directorate for Topsectors and Industrial Policy
Industry association	JoinData
Industry association	Dutch Association for Transport and Logistics (TLN)
Industry association	Association of the Dutch Chemical Industry (VNCI)
Industry association	Interactive Advertising Bureau (IAB Europe)

Endnotes

¹ European Commission (2018). Country Report Netherlands 2018. Available at: <https://ec.europa.eu/info/sites/info/files/2018-european-semester-country-report-netherlands-en.pdf>

² European Commission (2018). Digital Economy and Society Index 2018, Country Report Netherlands. Available at: http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=52234

³ European Commission (2018). Country Report Netherlands 2018. Available at: <https://ec.europa.eu/info/sites/info/files/2018-european-semester-country-report-netherlands-en.pdf>

⁴ World Economic Forum (2018). Readiness for the Future of Production. Available at: http://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf

⁵ Dutch Ministry of Economic Affairs and Climate Policy (2016). Digital Agenda. Available at: <https://www.government.nl/topics/ict/documents/reports/2017/04/11/digital-agenda-for-the-netherlands-innovation-trust-acceleration>

⁶ Dutch Ministry of Economic Affairs and Climate Policy (2018). Dutch Digitalisation Strategy. Available at: <https://www.government.nl/topics/ict/documents/reports/2018/06/01/dutch-digitalisation-strategy>

⁷ Measures facilitating the adoption of new technologies by industry

⁸ Measures to develop technology building blocks

⁹ Dutch Ministry of Economic Affairs and Climate Policy (2018). Dutch Digitalisation Strategy. Available at: <https://www.government.nl/topics/ict/documents/reports/2018/06/01/dutch-digitalisation-strategy>

¹⁰ Netherlands Enterprise Agency. Kennisvouchers voor MIT. Available at: <https://www.rvo.nl/subsidies-regelingen/kennisvouchers-voor-mkb-mit>.

¹¹ Smart Industry Programme Office (2019). Fieldlabs 2018 – Resultaten en impact van 35 innovatieversnellers. Available at: <https://www.smartindustry.nl/wp-content/uploads/2019/03/Smart-Industry-Fieldlabs-2018-printversie.pdf>