

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

Country report

United Kingdom

July 2019



Table of contents

Summary	3
1 General context	6
1.1 Economic context and status on digitisation	6
1.2 National strategy on digitising industry	8
1.3 EU cooperation in the field of digitising industry initiatives	13
2 Other policy support to digitising industry	13
2.1 Boosting innovation capacity	13
2.2 Regulatory framework for a digital age	19
2.3 Skills development	21
2.4 Support mechanisms	24
3 Conclusions	28
ANNEX 1 List of stakeholders interviewed	31
ENDNOTES	31

Tables

Table 1: Overview of initiatives	4
Table 2: SWOT of the UK on digitalisation	5
Table 3: General economic and digital indicators for the UK	8
Table 4: Overview of national strategies to digitise the industry	9
Table 5: Key policies and achievements of the Industrial Strategy	11
Table 6: Overview of initiatives to boost innovation capacity (Pillars 2 and 3 of the DEI)	14
Table 7: Number of Testbeds linked to the 5G strategy	16
Table 8: Main initiatives under Pillar 4	19
Table 9: UK's main initiatives to develop digital skills	22
Table 10: Main support mechanisms	25
Table 11: Breakdown for the financing of initiatives	28
Table 12: Total output overview	30

Figures

Figure 1: UK's readiness for future of production	8
---	---

Boxes

Box 1: Good practice	29
----------------------------	----

Summary

The United Kingdom (UK) belongs to the high-performing group of EU countries regarding digital transformation. In 2018, the country ranked 7th on the Digital Economy and Society Index (DESI), 8th in the Digital Transformation Enablers' Index (DTEI). It is also one of the leading countries in terms of readiness for the future of production, according to the World Economic Forum.

The UK economy has suffered from a slower growth over the past years. The industrial sector is traditionally strong and innovative and represents about one tenth of the country's Gross Value Added (GVA). The UK's main assets include a good connectivity and performing digital infrastructure, a dynamic start up ecosystem and entrepreneurship culture, world-leading universities, and a high level of support from public authorities. The UK is also among the leading EU Member States for 5G, Artificial Intelligence (AI) and robotics, cybersecurity and autonomous driving and blockchain, according to the Digital Intelligence Platform.¹ On the other hand, important challenges are to ensure the diffusion of innovations to all businesses, especially small and medium-sized enterprises (SMEs), to fill in remaining digital skills gaps, to enhance the use of integrated management software solutions by businesses and to increase high tech patent applications, as highlighted in this report.

The UK government has taken a comprehensive set of initiatives to encourage the digital transformation of the industry, with an overall funding budget of GBP 3.9 billion (EUR 4.6 billion) (see section 0). The UK participates in different European strategies and platforms aimed at strengthening coordination in the digital field (Pillar 1). Within Pillars 2 and 3, the Industrial Strategy launched in November 2017 has triggered measures to boost productivity, create jobs and increase the earning power of UK citizens. The Digital Strategy, set out in March 2017, contains provisions to develop digital skills and set the right conditions for citizens and businesses to seize the benefits brought by the digital economy (Pillar 5). The UK government has also set a digital-friendly regulatory framework with strategic measures on AI and robotics, cybersecurity and data protection (Pillar 4), as well as implemented different types of support for start-ups and innovative businesses through partnerships between public authorities, universities and the industry.

The recent implementation of the initiatives makes it difficult to assess impacts at the moment. However, the combination of these measures has already shown positive results and is expected to further improve the UK's performance in the remaining weaker areas of digitisation. The government is working with industry representatives to implement monitoring and evaluation systems in order to better evaluate future impacts. It should also be noted that these measures are in line with the UK's Smart Specialisation Strategy, which aims to support research and innovation at regional level.

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 UK 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
Industrial Strategy	2018	Strategy	Strategy	All	All	All	No overall funding
Digital Strategy	2018	Strategy	Strategy	All	All	All	No overall funding
Made Smarter Review and Made Smarter Commission	2017 & 2018	Pillar 3	Public-private partnerships	Manufacturing	All	All	GBP 121 (EUR 138) million increase in the 2018 budget (national/public)
Made Smarter North West Pilot	2019	Pillars 2&3	Other (tech adoption support and advisory service)	Manufacturing	All	SMEs	GBP 20 (EUR 23.4) million spent (2018) (national/public)
High Value Manufacturing Catapult (HVMC) and Digital Catapult	2011	Pillar 2	Public-private partnerships, funding, DIH, other (R&D commercialisation support)	Manufacturing (HVMC) and all sectors (Digital Catapult)	All	All	GBP 106.1 (EUR 121) million (HVMC) and GBP 14.3 (EUR 16.3) million spent (DC) (2018) (national/public&private)
5G Testbeds and Trials (5GTT)	2017	Pillars 2&3	Testbeds, competence centre, research & innovation support	Primary digital but ultimately all sectors	5G	All	GBP 223 (EUR 254) million spent (2018) – GBP 1 (EUR 1.14) billion investment for digital infrastructures by 2020-2021 (national/public&private)
AI Review and Sector deal	2017 & 2018	Pillar 4	Other regulatory measures	All	AI	All	GBP 0.95 (EUR 1.1) billion (national/public)
National Cybersecurity strategy	2016	Pillar 4	IT security regulation	All	Cybersecurity	All	GBP 1.9 (EUR 2.1) billion (national/public)
Data Protection Act 2018	2018	Pillar 4	Data ownership/data privacy regulation	All	All	All	No overall funding
Regulatory Sandbox	2016	Pillar 4	Regulatory test bed	Financial	Cryptoassets, blockchain, DLT	All	NA
Digital Skills Partnership	2017	Pillar 5	Training Centres; Counselling Centres; Investment grants; Tax incentives; Providing of training staff	All	All	All	GBP 84 (EUR 96) million (period tbc) (national/public)
National Retraining Scheme	2018	Pillar 5	Training staff	All	All	All	GBP 100 (EUR 114) 20 million (period tbc)

Initiatives	Starting year	Overall strategy/DEI Pillar/support mechanism	Type of initiative	Sectors targeted	Digital technologies targeted	Size of companies targeted	Budget
							(national/public)
Skills Pilot	2018	Pillar 5	Training staff	All	All	All	GBP 20 (EUR 22.8) million (period tbc) (national/public)
Digital Manufacturing Industrial Strategy Challenge Fund Programme	2017	Support mechanism - Pillars 2&3	Research & innovation support competition Funding	Manufacturing	All	All	GBP 3.8 (EUR 4.3) million in 2018 (split tbc) (national/public) – funding has not started yet
Digital Manufacturing Potential	2017	Support mechanism - Pillars 2&3	Research & innovation support competition Funding	Automotive, aerospace, ICT, Chemicals, machining, pharma	All	All	GBP 11.4 (EUR 13) million awarded (2017) (national/public&private)
Innovation Fellowships	2017	Support mechanism - Pillars 2&3	Research & innovation support competition Funding	Sectors of the Industrial Strategy	All	NA	GBP 38.8 (EUR 44.2) million awarded (2017) (national/public)

Note: all conversions from GBP to EUR are done with the average exchange rate of January 2019.

Table 2: SWOT of the UK on digitalisation

<p>Strengths:</p> <ul style="list-style-type: none"> • Good digital infrastructure and connectivity • Dynamic start-up ecosystem and entrepreneurship culture; world-leading universities • Leading position in some key technologies (5G, AI, robotics) 	<p>Weaknesses:</p> <ul style="list-style-type: none"> • Low integration of digital technologies by businesses (especially SMEs) • Digital skills gaps (basic digital skills and ICT specialists) • Improvements in the use of integrated management software solutions and high-tech patent applications
<p>Opportunities:</p> <ul style="list-style-type: none"> • Government initiatives to improve take up of digital technologies by businesses and to fill digital skills gaps • Strong innovation potential of firms • Attractive business environment; high level of government support and numerous public private partnerships 	<p>Threats:</p> <ul style="list-style-type: none"> • Insufficient skills of workers to exploit digital technology • Lack of understanding and awareness of opportunities; digitisation perceived as a threat by SMEs • Confusing business support landscape; lack of coherence and of strong branding/leadership

1 General context

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

The UK has suffered from a slower economic growth over the past years – in 2017, GDP growth was of 1.7% against of 2.3% in 2015, according to Eurostat. This slowdown in growth was driven primarily by the rise in prices and a decline in consumption growth following the 2016 depreciation of sterling in the aftermaths of Brexit.² Despite an increase in net exports, the UK economic growth is expected to remain subdued due to modest consumption growth, weak real wage growth, and diminishing consumer and business confidence.³

The UK economy has a traditionally strong and innovative industrial sector⁴, but its share in the overall economy is rather small compared to other EU countries – about 10.1% of the GVA against 19.6% in the rest of the EU, according to Eurostat. Furthermore, the industry's weight in the economy has sharply declined in recent decades: from over one quarter of the economy in the 1970s, against about one tenth today.⁵ This trend has been accompanied by a loss of manufacturing facilities, capacity, capabilities and jobs, though the UK's manufacturing sector still employs over 2.7 million people and makes up 45% of UK exports today.⁶

The UK already counts highly innovative start-ups and research companies (e.g. Deep Mind, the AI research company). The UK's digital sector is a strong driver of growth, contributing to GBP 118.4 billion (EUR 135 billion) to the UK economy and accounting for over 7% of the UK's GVA in 2015.⁷ Taken together, the UK's digitally-intensive producing and using firms account for 16% of the GVA, 24% of all exports and three million jobs, according to a 2017 report from TechUK.⁸ The Made Smarter Review identified that over 10 years, industrial digitalisation could boost UK manufacturing by GBP 455 billion (EUR 518 billion), increasing sector growth up to 3% per year, and creating a net gain of 175,000 jobs whilst reducing CO2 emissions by 4.5%.⁹

Status on digitisation

The United Kingdom ranks 7th out of the 28 EU Member States in the DESI 2018, the same as in 2017.¹⁰ While its ranking remained unchanged, its score increased due to an improved performance in all DESI domains. UK citizens are well connected, make good use of a variety of









online services (especially for shopping, online entertainment and social networks) and their digital skills are improving. However, some gaps in digital skills remain:

- DESI data shows that one third of citizens do not have basic digital skills and the number of computer science graduates has remained stable, despite growing demand in the labour market.
- There is also a strong and growing gender divide with increasingly fewer women studying ICT careers.
- Use of digital technologies by businesses shows a mixed picture, with high use of social media, cloud and e-commerce, but low use of some integrated management software solutions (electronic information sharing, radio-frequency identification and e-invoices).
- Furthermore, there is a low percentage of high-tech patent applications, according to the government.¹¹

The UK ranks 8th in the DTEI, with high scores in infrastructure, investment and access to finance, entrepreneurial culture and e-leadership. On the other hand, the country ranks lower (15th) in the Digital Technology Integration Index (DTII), which shows lower integration of digital technologies by businesses, as reflected in the DESI.

The UK is among the leading countries in terms of readiness for the future of production, according to the World Economic Forum.¹² While the UK's "Structure of Production" (measured by complexity and scale indicators) is weaker than other leading countries, the UK performs well across all "Drivers of Production". According to the report, strong technology platforms and ability to innovate has allowed the country to specialise in high tech manufacturing industries, such as aerospace and pharmaceuticals. The UK performs solidly on education outcomes, although it could further develop technical training. It has a strong institutional framework, which reflects the government's commitment to boost digitisation of the industry. The figure below presents the UK's drivers and structure of production's scores.

Figure 1: UK's readiness for future of production
Readiness Overall Assessment

Drivers of Production				7.8
Driver	Weighting	Rank	Score /10	
 Technology & Innovation	20%	2nd	8.0	
 Human Capital	20%	8th	7.5	
 Global Trade & Investment	20%	4th	8.3	
 Institutional Framework	20%	13th	8.2	
 Sustainable Resources	5%	22nd	7.4	
 Demand Environment	15%	6th	7.1	
Structure of Production				7.0
Structure	Weighting	Rank	Score /10	
 Complexity	60%	8th	8.6	
 Scale	40%	37th	4.7	

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

The UK's business environment is perceived as dynamic by the government and industry representatives interviewed for the study. The government highlighted important strengths in some key technologies (5G, AI, Robotics, cybersecurity, autonomous driving and blockchain), and promising initiatives to strengthen digital skills and increase take up of digital innovations by businesses.

Economic and digital indicators for the UK are summarised in the table below.

Table 3: General economic and digital indicators for the UK

	% GDP from manufacturing	% GDP growth	DESI position and change	DESI sub-indicators Human Capital, Use of Internet, Integration of Digital Technology in 2018
UK	10.1 (2017)	1.7 (2016-2017)	7 th (2018), same place as in 2017	<ul style="list-style-type: none"> Human capital: 4th (2018), same as in 2017 Use of Internet Services: 7th (2018), same as in 2017 Integration of Digital Technology: 14th (2018), one place improved compared to 2017

1.2 National strategy on digitising industry

The table below presents an overview of the initiatives to digitise the industry in the UK.

Table 4: Overview of national strategies to digitise the industry

Name	Industrial Strategy ¹³	Digital Strategy ¹⁴	AI Review and Sector deal ¹⁵	5G Strategy ¹⁶
Type	Horizontal initiative	Sectoral initiative (digital)	Sectoral initiative (AI)	Sectoral initiative (5G)
Starting date	November 2017	March 2017	2017 (Review) & 2018 (Sector deal)	March 2017
Objective	A long-term plan to boost productivity by backing businesses to create good jobs and increase the earning power of people throughout the UK, with investment in skills, industries and infrastructure. This is achieved through building on the UK's strengths and embracing new technologies, so that the country can be at the forefront of emerging opportunities and industries in the years ahead.	Applies the principles outlined in the Industrial Strategy to the digital economy. The objective is to build on the UK's success to date to develop a world-leading digital economy that works for everyone.	Make the UK "the best place in the world for businesses developing and deploying AI to start, grow and thrive, to realise all the benefits the technology can offer."	Make the UK a global leader in 5G so that it can take early advantage of its potential and help to create a world-leading digital economy that works for everyone. In particular: <ul style="list-style-type: none"> • Accelerate the deployment of 5G networks; • Maximise the productivity and efficiency benefits to the UK from 5G; Create new opportunities for UK businesses at home and abroad.
Ministry/ministries in charge (website, contact person)	Department for Business, Energy and Industrial Strategy (BEIS)	Department for Digital, Culture, Media & Sport (DCMS)	Office for AI (BEIS & DCMS)	DCMS
Scope of the strategy/action plan	All sectors	All sectors	All sectors	Digital but ultimately all sectors
Measures included in the strategy/action plan	The strategy builds on strategies of the past, outlining five foundations of productivity – Ideas, People, Infrastructure, Business Environment and Places – as the essential attributes of a successful economy. The government is creating new policies and investment in each of these areas. These include: <ul style="list-style-type: none"> • Public investment in research and development, matched by sustained growth in private sector spending; • Upgrades to the infrastructure, with the fastest growth in 	The strategy is composed of seven strands: <ol style="list-style-type: none"> 1. Connectivity – building a world-class digital infrastructure to the UK. Includes measures such as the introduction of universal service obligation, roll out of fibre and 5G, regulation on adverts for broadband, free Wi-Fi in public spaces; 2. Digital skills and inclusion – giving everyone access to the digital skills they need. Includes the Digital Skills Partnership, the support to the National Citizen Service 	The strategy of the UK on AI is composed of: <ul style="list-style-type: none"> • The AI Review, an independent review which makes 18 recommendations to encourage the growth of AI in the UK; • The AI Sector Deal, which sets actions to promote the adoption and use of AI in the UK and delivers on the recommendations of the AI Review. It sets out measures according to the five foundations of the Industrial Strategy: ideas, people, infrastructure, business environment, places. 	The strategy outlines the key themes that will determine our progress towards 5G, which are: <ul style="list-style-type: none"> • building the economic case • fit for purpose regulations • local areas – governance and capability • coverage and capacity – convergence and the road to 5G • ensuring a safe and secure deployment of 5G • spectrum • technology and standards As part of the Strategy, the government has rolled-out the 5G

Name	Industrial Strategy ¹³	Digital Strategy ¹⁴	AI Review and Sector deal ¹⁵	5G Strategy ¹⁶
	<p>infrastructure spending in the G7;</p> <ul style="list-style-type: none"> • Technical education and retraining; • Ten Sector Deals¹⁷, long-term strategic partnerships between government and industry, in the following sectors: life sciences, automotive, creative industries, artificial intelligence (AI), construction, nuclear, aerospace, rail, Life Sciences 2, and Offshore Wind. <p>The five foundations are supported by four Grand Challenges¹⁸, global trends that will shape our economy and position the UK at the forefront of the industries of the future. The challenges are: AI & Data, Clean Growth, Future of Mobility and Ageing Society.</p>	<p>to include digital skills and careers in its programme;</p> <ol style="list-style-type: none"> 3. The digital sectors – making the UK the best place to start and grow a digital business. Includes investment in R&D funding, industry, AI, etc.; 4. The wider economy – helping every British business become a digital business. Includes the creation of a Productivity Council; 5. A safe and secure cyberspace – making the UK the safest place in the world to live and work online. Includes measures to support the National Cyber Security Centre, the introduction of a new approach to Active Cyber Defence, apprenticeship and adult retraining for cyber skills; 6. Digital government – maintaining the UK government as a world leader in serving its citizens online. Includes measures to develop digital government services; 7. Data – unlocking the power of data in the UK economy and improving public confidence in its use. Includes the implementation of the General Data Protection Regulation. 		<p>Testbeds and Trials Programme to help develop innovations in the sector (see section 2.1).</p>
Overall funding	No overall funding	No overall funding	GBP 0.95 billion (EUR 1.1 billion) for the Sector Deal	GBP 223 million (EUR 254.4 million) in 2018

Impacts, challenges and perceptions

Since the publication of the Industrial Strategy in January 2017, GBP 45 billion (EUR 51 billion) have been committed across the UK for its implementation, making of the UK the economy with highest annual growth in investment spending among G7 countries.¹⁹

The following table presents the key policies of the Strategy and the key achievements as of December 2018.

Table 5: Key policies and achievements of the Industrial Strategy²⁰

Foundations	Key policies	Key achievements
Ideas	<ul style="list-style-type: none"> Raise total R&D investment to 2.4% of GDP by 2027 Increase the rate of R&D tax credit to 12% Invest GBP 725 million (EUR 827 million) in new Industrial Strategy Challenge Fund the second wave to capture the value of innovation 	<ul style="list-style-type: none"> Raised R&D tax credit to 12% 602 new research and development projects supported by government funding GBP 2.7 billion (EUR 3.1 billion) addressing R&D challenges through the Industrial Strategy Challenge Fund GBP 110 (EUR 125) million to support international collaboration in science and research
People	<ul style="list-style-type: none"> Establish a technical education system that rivals the best in the world to stand alongside the UK world-class higher education system Invest an additional GBP 406 million (EUR 463 million) in maths, digital and technical education, helping to address the shortage of science, technology, engineering and maths (STEM) skills Create a new National Retraining Scheme that supports people to re-skill, beginning with a GBP 64 million (EUR 73 million) investment for digital and construction training (initial funding has now increased to GBP 100 million – EUR 117 million) 	<ul style="list-style-type: none"> 1.4 million apprenticeship starts since 2015 including 12.5% increase of higher-level apprenticeships Institute for Apprenticeships launched T-Levels consultation response published The Advanced Maths Premium and Institute of Coding launched GBP 1,200 (EUR 1,369) paid to schools and colleges for each additional pupil taking Maths A level 25% increase in A level computer science entries since 2017 47,000 people started higher-level apprenticeships A new industrial Master's programme for AI will see the Government work in partnership with universities and major corporations.
Infrastructure	<ul style="list-style-type: none"> Increase the National Productivity Investment Fund to GBP 31 billion (EUR 35 billion), supporting investments in transport, housing and digital infrastructure Support electric vehicles through GBP 400 million (EUR 456 million) charging infrastructure investment and an extra GBP 100 million (EUR 114 million) to extend the plug-in car grant Boost digital infrastructure with over GBP 1 billion (EUR 1.15 billion) of public investment, including GBP 176 million (EUR 201 million) for 5G and GBP 200 million (EUR 228 million) for local areas to encourage roll out of full-fibre networks 	<ul style="list-style-type: none"> Bidding round closed for the GBP 840 million (EUR 959 million) Transforming Cities Fund, with announcements due in late 2018 Announced the successful bidders for the initial phase of the 5G Testbeds and Trials Programme (5GTT), including areas in the Midlands, West and Northern England, Wales and Scotland Road to Zero Strategy launched GBP 37 billion (42.12) for productivity investment, including better transport and digital connections 200 trains fitted with the latest digital signalling technology by the end of 2018 650,000 new homes created through the Housing Infrastructure Fund
Business environment	<ul style="list-style-type: none"> Launch and roll out Sector Deals – partnerships between government and industry aiming to increase sector productivity. The first Sector Deals are in life sciences, construction, artificial intelligence and the automotive sector Drive over GBP 20 billion (EUR 22.8) of investment in innovative and high potential businesses, including through establishing a new GBP 2.5 billion (EUR 2.8 billion) 	<ul style="list-style-type: none"> GBP 2.5 billion (EUR 2.85 billion) British Patient Capital programme launched to enable long-term investment in innovative companies across the UK Published an Export Strategy to support British businesses looking to export to the global market Completed the call for evidence for the Business Productivity Review

Foundations	Key policies	Key achievements
	Investment Fund, incubated in the British Business Bank <ul style="list-style-type: none"> Launch a review of the actions that could be most effective in improving the productivity and growth of small and medium-sized businesses, including how to address what has been called the 'long tail' of lower productivity firms 	<ul style="list-style-type: none"> No.1 destination for venture capital in Europe¹⁵ 375,000 businesses supported by Growth Hubs in local areas across England 78,000 SMEs supported by the British Business Bank
Places	<ul style="list-style-type: none"> Agree Local Industrial Strategies that build on local strengths and deliver on economic opportunities Create a new Transforming Cities fund that will provide GBP 1.7 billion (EUR 1.9 billion) for intra-city transport. This will fund projects that drive productivity by improving connections within city regions Provide GBP 42 million (EUR 48 billion) to pilot a Teacher Development Premium. 	<ul style="list-style-type: none"> Cultural development fund Expression Of Interest stage attracted a high level of interest Published the Strengthening Local Economic Partnerships paper First phase of Skills Advisory Panels piloted in seven areas GBP 675 million (EUR 770 million) for local plans to make high streets and town centres fit for the future 18 cities benefiting from GBP 2.5 billion (EUR 2.85 billion) to improve intra-city transport GBP 120 million (EUR 137 million) to fund local innovation through the Strength in Places Fund

Source: UK Government.

The UK government has also delivered on the Digital Strategy:²¹

- Invested GBP 21 million (EUR 24 million) in the Tech Nation programme to establish regional hubs throughout the country, widening access to Tech City UK's training, mentoring and development programmes;
- Announced a plan to unlock over GBP 20 billion (EUR 22.8 billion) of capital investment in innovative firms by doubling the annual allowance of the Enterprise Investment Scheme and the Venture Capital Trust scheme;
- Supported and funded the Tech Talent Charter, an industry-led initiative committing over 170 industry signatories to diversity in tech;
- Supported the creation of a favourable business environment for early stage tech businesses. There are more than 200 incubators and 160 accelerator programmes located across the UK offering a mix of funding, mentoring and training;
- Delivered 2.5 million free digital skills trainings with the industry as part of the Digital Skills Partnership and announced GBP 84 million (EUR 96 million) to boost the skills of computer science teachers (see section 2.3).

The Ofcom 2018 Connected Nations Report²² finds that superfast broadband coverage has increased to 94% of homes and businesses, from 91% in 2017 and 89% in 2016, which delivers on the Digital Strategy's ambitions.²³ 1.8 million premises can get full fibre services compared to 840,000 in 2017 and 498,000 in 2016. 91% of the UK has now access to 4G mobile coverage from at least one operator.

As part of both the Industrial and Digital Strategies, two sectoral strategies have been framed for AI and 5G. The **AI Review** is an independent review, carried out by Dame Wendy Hall FRS FREng and Jérôme Pesenti, on how the AI industry can be grown in the UK and focuses on skills, data and leadership. The Sector Deal was subsequently published, responding to the AI Review and announcing a number of initiatives, including the creation of a favourable regulatory framework for the development of AI (see section 2.2). The **5G Strategy** has the objective of making the UK a global leader in 5G through the deployment of 5G networks, the maximisation of the productivity and efficiency to the UK from 5G and the creation of business opportunities in the UK and abroad. As part of the Strategy, the government has rolled-out the 5G Testbeds and Trials Programme to help develop innovations in the sector (see section 2.1).

An independent **Industrial Strategy Council** has been set up to assess progress and make recommendations to government on how to monitor and implement the Industrial Strategy.²⁴ As part of the Digital Strategy, a forum bringing together the government and the tech community has also been created to support the growth of the UK digital economy. The forum focuses on supporting tech sectors and innovation, as well as the adoption of digital in the wider economy.²⁵

Both the Industrial and the Digital Strategies are perceived as very useful by the industry representatives interviewed for the study. According to the Confederation of Business Industry (CBI), the provision of forward-looking plans to enhance the UK competitiveness, identify the strengths and the limits of the UK industry and support the digital sector in the UK is very appreciated by the business community. The government has made great progress in supporting digital transformation of businesses and there is a better coordination among different departments. Among the weaknesses identified by the interviewees, the lack of a comprehensive set of targets for monitoring and the lack of clear vision on the means chosen to improve digital structures prevent the more efficient roll-out of the strategies.²⁶ CBI is currently working with the industry in order to better define such targets and improve the monitoring system.²⁷

1.3 EU cooperation in the field of digitising industry initiatives

The UK is part of a **joint research and investment project to support innovation in microelectronics** with France, Germany and Italy. The four countries have committed to provide up to EUR 1.75 billion in funding with the aim to unlock EUR 6 billion in private investment. The project has been approved by the European Commission in December 2018 and should be completed by 2024.²⁸

The UK takes also part in the **European Coordinated Plan on AI**.²⁹ The coordinated plan builds on a declaration of cooperation signed by all EU Member States and Norway in April 2018, where countries expressed their willingness to cooperate more closely on AI. By mid-2019 the signatories are encouraged to implement or to take into account the Plan in their national strategies on AI. The UK initiatives on AI are further detailed in section 2.2.

Apart from the Coordinated Plan on AI, the UK is part of other wide cooperation initiatives such as the **European Blockchain Partnership** and the **ECSEL Joint Undertaking** – the Public-Private Partnership for Electronic Components and Systems.

UK businesses also participate in **Horizon 2020 projects**, whose national contact points are hosted by the funding agency UK Research and Innovation (UKRI).

2 Other policy support to digitising industry

2.1 Boosting innovation capacity

Boosting innovation capacity of businesses (DEI Pillars 2&3) is addressed under the UK's Industrial Strategy and the fourth pillar of the Digital Strategy (see section 1.2). The table below presents an overview of relevant initiatives.

Table 6: Overview of initiatives to boost innovation capacity (Pillars 2 and 3 of the DEI)

Name	5G Testbeds and Trials (5GTT) Programme	Made Smarter Review and Made Smarter Commission	Made Smarter North West Pilot	High Value Manufacturing Catapult (HVMC) and Digital Catapult
Type	Testbeds, competence centre, research & innovation support	Public-private partnerships	Other (tech adoption support and advisory service)	Public-private partnerships, fFunding, DIH, other (R&D commercialisation support), testbed
Starting date	2017	October 2017 (Review) and September 2018 (Commission)	January 2019	2010
Objective	<p>Make the UK a global leader in 5G so that it can take early advantage of its potential and help to create a world-leading digital economy that works for everyone.</p> <p>In particular:</p> <ul style="list-style-type: none"> Accelerate the deployment of 5G networks; Maximise the productivity and efficiency benefits to the UK from 5G; <p>Create new opportunities for UK businesses at home and abroad.</p>	<p>Increase awareness of opportunities and how to exploit them amongst manufacturers; strengthen the business support landscape; create more focused, ambitious leadership; increase the adoption of digital technology through a strong industry and government partnership.</p>	<p>Increase engagement of SMEs; Increase the number of manufacturing SMEs accessing research, innovation and catapult centres; Increase collaboration between university students and SMEs; Enhance manufacturing supply chain competitiveness through the application of digital technology and Increase the number of new start-up companies.</p>	<p>Drive the growth of the manufacturing sector by helping bridge the gap between emerging innovation and industrial-scale manufacturing. The Digital Catapult has a specific focus on utilising digital technology as part of this process.</p>
Relevant for DEI Pillar	Pillar 2&3	Pillar 3	Pillars 2&3	Pillar 2
Short description	<p>The 5GTT Programme is part of the 5G Strategy and aims to ensure a safe and secure deployment of 5G by helping business to embrace and develop this technology.</p> <p>Six pilots have been awarded in March 2018, which will test 5G across a range of applications including increasing manufacturing productivity.</p>	<p>The Made Smarter Review is an industry-led review exploring how UK manufacturing can maximise benefits from increasing adoption of digital technology through a strong industry and government partnership.</p> <p>The Made Smarter Commission is a national industry-government council created as a result of the Review. It is tasked with developing the vision for the future of UK manufacturing and driving the digitalisation of the sector. It consists of senior representatives from leading businesses (including SMEs), trade bodies and academia.</p>	<p>The pilot will test new approaches to supporting manufacturing SMEs with the adoption of digital technologies that will transform their business performance and improve productivity.</p> <p>The pilot will have three main activities: promotion of the support available to increase awareness of the opportunity from the adoption of digital technology and facilitate engagement; delivery of intensive advice and support; developing an evidence base.</p>	<p>The HVMC helps manufacturers of all sizes to incubate and develop new innovations which require new processes to become a commercial reality. The centres provide support via access to production-scale, world class equipment and to the skills to develop innovative processes.</p> <p>The Digital Catapult is a digital technology specialist innovation centre that provides physical and digital facilities for experimentation and testing that would otherwise not be accessible for smaller companies.</p>
Granting organisation	DCMS	BEIS	BEIS	BEIS (delivered by UKRI)

Name	5G Testbeds and Trials (5GTT) Programme	Made Smarter Review and Made Smarter Commission	Made Smarter North West Pilot	High Value Manufacturing Catapult (HVMC) and Digital Catapult
Participating organisations	Industry, local government, ALBs including regulators	Industry, trade bodies, academia	Industry, trade bodies, academia, Local Enterprise Partnerships	Research councils, industry
Sectors targeted	Primary digital but ultimately all sectors	Manufacturing	Manufacturing	Manufacturing
Technologies targeted	5G	All	All	All
Funding (split by private/public and national/EU), state period/annual funding	GBP 223 million (EUR 254.4 million) in 2018 (Public)	GBP 121 million (EUR 139 million) budget increase announced in the Autumn 2018 budget (Public)	GBP 20 million (EUR 23.4 million) in 2019 (Public)	In 2018: GBP 106.1 million (EUR 121 million) (HVMC); GBP 14.3 million (EUR 16.3 million) (DC) <ul style="list-style-type: none"> • 33% Core public funding from UK Government; • 33% Business Funded R&D Contracts; 33% Competitively won Collaborative R&D Projects, which tend to be funded from a mix of public and private sources
Current status of initiatives	GBP 200 million (EUR 228.1 million) has been allocated to the programme to date.	First meeting of the Commission took place in September 2018.	Launched at the end of 2018.	In 2018 the HVMC has supported 1,500 projects, the DC has supported 25 projects; 3,700 businesses have benefitted from the HVMC in 2018, 3,387 in 2017; 638 businesses have benefitted from the DC in 2017.

5G Testbeds and Trials (5GTT) Programme

In Autumn 2016, the government announced its intention to invest in a nationally coordinated programme of 5G testbed facilities and trials, as part of over GBP 1 billion (EUR 1.14 billion) of funding announced to boost the UK's digital infrastructure.³⁰

The **5G Testbeds and Trials (5GTT) Programme**³¹ was set up by the DCMS as a centre of excellence in 2017 to press forward the work in this area. The Programme encourages and funds the creation of a series of Testbeds and Trials in a range of geographic and vertical market segments. It will explore the benefits and challenges of deploying 5G technologies.

GBP 200 million (EUR 228 million) has been allocated to the Programme to date, and early projects that have been successfully delivered include:

- A 5G mapping project developed in co-ordination with Ordnance Survey;
- A GBP 16 million (EUR 18 million) investment in creating the 5GUK Test Network;
- The establishment of UK5G, the national innovation network for the sector and advisory board for the 5GTT programme.

In March 2018, the six winners of the first Phase of the 5G Testbeds and Trials competition were announced. These six projects, led by SMEs universities and local authorities, will test 5G across a range of applications including increasing manufacturing productivity (see the table below).³²

Table 7: Number of Testbeds linked to the 5G strategy

Name	Lead organisation	Amount of grant	Description
5G RuralFirst: Rural Coverage and Dynamic Spectrum Access Testbed and Trial	Cisco	GBP 4.3 million (EUR 4.9 million)	5G RuralFirst aims to create a complete end-to-end rural 5G testbed system for trials of new wireless and networking technologies, spectrum sharing, and new applications and services. The project, led by Cisco, is being delivered by a network of 32 organisations, including principal partner the University of Strathclyde, and will focus on testing innovative approaches and stimulating new business models for ensuring 5G connectivity is accessible and affordable in hard-to-reach rural areas.
5G Smart Tourism	West of England Combined Authority	GBP 5 million (EUR 5.7 million)	This testbed will focus on delivering enhanced experiences for tourists using Augmented Reality (AR) and Virtual Reality (VR), 3d motion tracking, and 4k 360° content streaming technology, in major attractions in Bath and Bristol, including the Roman Baths and Millennium Square.
Worcestershire 5G Consortium - Testbed and Trials	Worcestershire Local Enterprise Partnership	GBP 4.8 million (EUR 5.5 million)	This project is exploring ways to increase productivity by using robotics, big data analytics and augmented reality with 5G.
Liverpool 5G Testbed	Sensor City	GBP 3.5 million (EUR 4 million)	Sensor City will lead a consortium made up of Liverpool university researchers, the NHS and social care organisations, local tech SMEs and UK 5G tech company, Blu Wireless. Funded for one year in the first instance, the project will see high value technologies including low-cost open source 5G networks, artificial intelligence, virtual reality and IoT deployed across deprived communities in the Liverpool city region testbed.
AutoAir: 5G Testbed for Connected and	Airspan Communications Ltd	GBP 4.1 million (EUR 4.7 million)	AutoAir aims to make 5G technologies available for the validation and development of Connected and Autonomous Vehicles at the UK's premiere vehicle proving ground at Millbrook. Fast travel speeds

Name	Lead organisation	Amount of grant	Description
Autonomous Vehicles			complicate cell-tower handoff, and autonomous vehicles will require more network bandwidth than is available currently. It will also investigate how these 5G connectivity solutions could be transferable to both road and rail transportation.
5G Rural Integrated Testbed (5GRIT)	Quickline Communications	GBP 2.1 million (EUR 2.4 million)	5GRIT will be trialling innovative use of 5G technology across a range of rural applications, such as smart agriculture, tourism and connecting poorly-served communities, using shared spectrum in the TV bands and a mix of local ISPs and self-provision.

Each testbed will receive between GBP 2 million and GBP 5 million (EUR 2.3 million and EUR 5.7 million) in government grants, as part of a total investment of GBP 41 million (EUR 47 million) from private sector and other public sector funding. The projects will run from 2018 to 2019. Additional projects are expected to start on roads, rail and cybersecurity.³³

Made Smarter Review and Made Smarter Commission

The **Made Smarter Review**³⁴ is a Government and Industry partnership approach to increasing manufacturing productivity using industrial digital technology. Set out in the Industrial Strategy as an initiative that will increase UK industrial digital capability, it aims to harness existing programmes and policy to support the development and adoption of digital technology. The **Made Smarter Commission**³⁵ has been designed to oversee and take forward a plan for the sector, including how manufacturing will help meet the “Grand Challenges” outlined in the government’s Industrial Strategy (see section 1.2). A GBP 121 million (EUR 139 million) budget increase for Made Smarter has been announced in the Autumn 2018 budget to support the transformation of manufacturing through digitally-enabled technologies, such as the Internet of Things (IoT) and virtual reality.³⁶

As part of Made Smarter, a **GBP 20 million (EUR 23 million) pilot project in the North West of England** has been announced in September 2018 and started in January 2019. It focuses on adoption of digital technology by manufacturers, especially SMEs, as the diffusion of innovations to SMEs has been identified as one weakness of the UK’s industry ecosystem. The aim is to engage with 3,000 SMEs in the region.

High Value Manufacturing Catapult (HVMC) and Digital Catapult

The Catapult Programme was announced by the UK government in October 2010 to improve the diffusion of research and innovation to businesses. The **HVMC**³⁷, focused on manufacturing, comprises seven Technology and Innovation centres which work with companies of all sizes to bridge the gap in – and accelerate the activity between – technology concept and commercialisation. These centres offer access to leading edge equipment, expertise and an environment of company collaboration.

According to the Manufacturing Technology Centre, one of the seven centres affiliated to the HVMC, the three assets of the programme are: the provision of infrastructure to test products; the in-house expertise of 3,000 engineers (which represent the great majority of digital engineers in the UK); an ecosystem of researchers, public and private organisations, and national and EU institutions.³⁸ In 2017, the HVMC has supported 3,387 businesses, among which 1,383 SMEs.³⁹ In 2018, this figure amounts to 3,700, according to government sources.⁴⁰ According to the impact report, the HVMC generates GBP 16 (EUR 18) for one pound invested.⁴¹

The **Digital Catapult**⁴², on the other hand, is focused on digital technology. Four innovation centres (three regional, one national based in London) provide physical and digital facilities for experimentation and testing that would otherwise not be accessible for smaller companies. The Digital Catapult focuses on the two industry sectors where the increase of use of digital technology is expected to have the most impact – manufacturing and the creative industries.

In 2017, the Digital Catapult has had 638 engagements with start-ups and scale-ups, 42 new industrial collaborations and 31 new academic engagements to drive innovation and adoption of advanced digital technologies. The three core technologies programmes are AI and machine learning, 5G and powered wide areas networks, and immersive contents and applications.⁴³

This goal to make linkages between research and innovation and business growth is not new in the UK's industrial policy. The **Knowledge Transfer Partnerships**⁴⁴ scheme, also delivered by UKRI, have been established since 2003 to place graduates and academics with relevant skills into firms to translate their research insights into business growth. The government has announced further investment up to GBP 25 million (EUR 29 million) for the Knowledge Transfer Partnerships in order to place over 200 additional graduates.⁴⁵ The willingness to link academia and the business environment with public funding is one originality of the UK system, as will be developed further in section 2.4.

On national level, the UK has **14 Digital Innovation Hubs** – eight fully operational and six with a preparation status. They cover various market domains: agriculture, fishing, construction, manufacturing (food products, textiles, chemicals, basic and fabricated metal products, electrical and optical equipment, machinery, electrical equipment), transport, electricity, public administration, education and health, through a large spectrum of technology areas.

On a regional level, each hub's activities are aligned with the Smart Specialisation (RIS3) strategy of the UK, which focuses on a series of key technologies: aerospace, automotive, life sciences, offshore wind, oil & gas, nuclear, information economy, agri-tech, professional business services, construction.⁴⁶

Impacts, challenges and perceptions

According to representatives of the industry, a strong government leadership and the broad scope of the initiatives for boosting innovation capacity have been key in delivering the objectives of the Strategies.⁴⁷

The initiatives described directly address one important weakness of the UK industry ecosystem, which is the slow diffusion of innovation to businesses (see section 0) by allowing the businesses to test recent innovations in real world. The industry representatives interviewed considered the initiatives useful (4.75 on a scale from 1 until 5). These programmes also contribute to create linkages between the academia and the industry and in turn facilitate the more rapid commercialisation of innovations, according to the CBI.⁴⁸

The lack of SME reach, another important challenge, is addressed by these initiatives and has brought positive results: according to the Manufacturing Technology Centre, an increasing number of SMEs participate in the HVMC programme for instance.⁴⁹ According to the CBI, the level of take-up of digital technologies by companies, and especially small ones, is already good (4 on a scale from 1 until 5) and increasing: the majority (55%) of their member companies have now a digital strategy.⁵⁰ This suggests that digital innovations are slowly being embraced by the entire business community.

Another challenge raised by the MTC, which concerns measures in both the Industrial and the Digital strategy, is the need to deliver results within a short timeframe (four to five years). This

raises concerns for participating authorities and stakeholders, especially when it comes to providing testbeds and innovation centres with the right equipment, which is costly and takes time.⁵¹

Although it is too early to assess thoroughly the impacts of these initiatives, the measures implemented as part of Pillars 2 and 3 seem to go in the right direction to overcome the UK's main challenges.

2.2 Regulatory framework for a digital age

The UK has taken a comprehensive set of measures in order to set a framework for a digital age. The table below presents the main initiatives under Pillar 4 of the DEI.

Table 8: Main initiatives under Pillar 4

Name	AI Review and Sector Deal	National Cyber Security Strategy 2016 to 2021	Data Protection Act 2018	Regulatory sandbox
Type	Industrial strategy/National policies	IT security regulation	Data ownership/data privacy regulation	Regulatory test bed
Starting date	2017 (Review) & 2018 (Sector deal)	2016	2018	2016
Objective	Make the UK “the best place in the world for businesses developing and deploying AI to start, grow and thrive, to realise all the benefits the technology can offer.”	Make the UK one of the most secure places in the world to do business in cyberspace.	Update the UK’s data protection laws for the digital age.	Allow companies to test innovative products and services in a live environment.
Short description	The AI Review is an independent review which makes 18 recommendations to encourage the growth of AI in the UK; The AI Sector Deal sets actions to promote the adoption and use of AI in the UK and delivers on the recommendations of the AI Review. It sets out measures according to the five foundations of the Industrial Strategy: ideas, people, infrastructure, business environment, places.	Sets out the government’s approach to tackling and managing cyber threats in the UK. The strategy plans to invest GBP 1.9 billion in defending systems and infrastructure, deterring adversaries and developing a whole-society capability. It also includes measures to strengthen cyber skills and sets out a National Cyber Security Centre to provide expertise for businesses and individuals as well as rapid response to major accidents.	The Act sets rules in order to adapt to the important amount of data that is being processed; empowers people to take control of their data; supports UK businesses and organisations through the change; ensures that the UK is prepared for the future after leaving the EU.	Tool developed by the Financial Conduct Authority to allow companies to test their products in a live environment with regulatory oversight. Since 2016, 89 companies have benefitted from the sandbox to test innovative technologies in the field of finance, such as include cryptoassets, blockchain technology, DLT, regtech solutions, etc.
Sectors targeted	All	All	All	Financial

AI Review and AI Sector Deal

The **AI Review**⁵² is an independent review published in October 2017 and carried out by Professor Dame Wendy Hall (University of Southampton) and Jérôme Pesenti (CEO and AI expert). The Review reports on how the Artificial Intelligence industry can be grown in the UK. The review makes 18 recommendations to improve access to data, supply of skills, maximise AI research, and support uptake of AI.

In parallel of the AI Review, recommendations on the robotics industry have been made in the Robotics Review RAS 2020⁵³ and in the Made Smarter Review (see the section above).

The **AI Sector Deal**⁵⁴ draws on the government's Industrial Strategy and Digital Strategy to promote the adoption and use of AI in the UK. It is led by the Office for AI, a joint partnership between BEIS and DCMS, and delivers on the recommendations of the AI Review.

The Sector Deal outlines a package of up to GBP 0.95 billion (EUR 1.1 billion) of support. This includes government, industry and academic contributions up to GBP 603 million (EUR 687 million) in newly allocated funding, and up to GBP 342 million (GBP 390 million) from within existing budgets, alongside GBP 250 million (EUR 285 million) for Connected and Autonomous Vehicles.

This support complements and leverages some of the GBP 1.7 billion (EUR 1.9 billion) that has been announced under the cross-sectoral Industrial Strategy Challenge Fund so far, with five challenges having AI components that AI businesses will be able to bid for through future competitions.

Complementary to this support, new AI fellowships and funding for 450 PhD researchers to secure the UK's leading position in the global AI market (see section 2.3).

National Cybersecurity Strategy

The **National Cybersecurity Strategy (2016-2021)** sets out the UK government's approach to tackling and managing cyber threats in the UK. The strategy plans to invest GBP 1.9 billion (EUR 2.1 billion) in defending systems and infrastructure, deterring adversaries and developing a whole-society capability, which includes measures to strengthen cyber skills. It also established the National Cyber Security Centre which provides expertise for businesses and individuals as well as rapid response to major accidents.⁵⁵

Data Protection Act 2018

Finally, the UK Data Protection Act 2018 reinforces the provisions of the EU General Data Protection Regulation (GDPR) to provide a comprehensive data protection framework. The Act sets rules in order to adapt to the important amount of data that is being processed; empowers people to take control of their data; supports UK businesses and organisations through the change; ensures that the UK is prepared for the future after leaving the EU.⁵⁶

Regulatory sandbox

In 2016 the Financial Conduct Authority (FCA) has launched a regulatory sandbox that allows companies to test their products in a live environment with regulatory oversight.⁵⁷ As of 2018, 89 companies have been accepted to test their products and services. Propositions being tested include cryptoassets, blockchain, DLT, regtech solutions, etc. According to a report by Deloitte and Innovative Finance⁵⁸, the sandbox has three main benefits:

- Give opportunity to test products in a live environment;

- Increase visibility with investors and customers;
- Help identify flaws early and fine tune offerings*

According to the same report, companies that have benefited from the sandbox believed it has delivered real value. One of the main flaws identified is that the authorisation process can be challenging, especially for small firms, without prior knowledge of financial regulations.

Impacts, challenges and perceptions

Similar to the measures under Pillars 2 and 3, measures under Pillar 4 seem to go in the right direction to help the UK industry face the challenges identified.

The AI Sector Deal, in particular, has been praised by the stakeholders interviewed as comprehensive and forward-looking, with a rating of 5 on a scale from 1 to 5.⁵⁹ The amount invested for AI by the UK government is the highest in Europe, and this seems to bear fruit. The UK came first in the rankings of the Oxford Insights Global Government AI Readiness Index 2017, which reflects its world-leading centres for AI research and strong technology industry.⁶⁰ Furthermore, the UK has the strongest AI and machine learning market in Europe with over 200 SMEs working in the sector (compared to 81 in Germany and 50 in both the Nordic countries and France), as well as very innovative AI firms in its territory.⁶¹ For instance, Deep Mind, the AI research company, was formed in the UK and Google's decision to keep the expertise in London is a testament to the strength of the UK's R&D base and computing expertise, according to the government representatives interviewed.⁶²

On the other hand, according to interviewees, the UK government strategy on robotics is less comprehensive, and the use of robots is still rare among UK companies. On cybersecurity finally, the business community feels that there could be more emphasis on adopting concrete measures stemming from the strategy, according to the CBI.⁶³

2.3 Skills development

Digital skills development is addressed under one pillar of the Digital Strategy. The table below presents the main initiatives on digital skills (Pillar 5 of the DEI).

Table 9: UK's main initiatives to develop digital skills

Name	Digital Skills Partnership	National Retraining Scheme	Skills Pilot
Type	Training Centres; Counselling Centres; Investment grants; Tax incentives; Providing of training staff	Training staff	Training staff
Starting date	2017	2018	2018
Objective	<ul style="list-style-type: none"> • Increase the national coherence of digital skills provision; • Support the development of Local Digital Skills Partnerships in English regions that can help to deliver targeted digital skills training for local communities and economies with local and national partners; • Increase digital enterprise by helping small businesses and charities upskill their employees and increase their digital capabilities; • Support computing in school. 	Improve job-specific retraining.	Help employers in Greater Manchester and surrounding areas to address local digital skills gaps through short training courses.
Short description	It is a multi-stakeholder and cross-sectoral partnership on digital skills addressing all levels of digital skills. The partnership is supported by a Board and four Delivery Groups.	The first phase of the scheme will include a new guidance service with expert advice to help people identify work opportunities in their area, and state-of-the-art courses combining online learning with traditional classroom teaching to develop key transferable skills	Training courses on digital skills. The first pilot is given in the Manchester area, to be expanded to other regions.
Granting organisation	DCMS, Department for Education	Department for Education	Department for Education
Participating organisations	Training centres, Public institutes (Institute for Coding, National Innovation Centre for Data)	Confederation of British Industry, Trade Union Congress	NA
Sectors targeted	All	All	All
Funding (split by private/public and national/EU), state period/annual funding	GBP 84 million (EUR 96 million) to train up to an additional 8,000 computer science teachers and open a National Centre for Computing; GBP 30 million (EUR 34 million) in England to test the use of AI and innovative EdTech in online digital skills courses.	GBP 100 million (EUR 114 million) for the first phase of the scheme.	GBP 20 million (EUR 22.8 million) of Skills pilots, including GBP 3 million (EUR 3.4 million) pilot to help employers in Greater Manchester and surrounding areas to address local digital skills gaps through short training courses.
Current status of initiatives	The first three Local Digital Skills Partnerships pilots have been established in Lancashire, Heart of the South West and the West Midlands. In the frame of the partnership, a consultation was launched on updating Basic Digital Skills framework created in 2015. In addition, the DCMS has established a research programme to understand the UK's current and future advanced digital skills needs.	The first phase of the scheme includes a new guidance service with expert advice to help people identify work opportunities in their area, and state-of-the-art courses combining online learning with traditional classroom teaching to develop key transferable skills.	NA

Digital Skills Partnership

The Digital Skills Partnership⁶⁴ has been established as part of the Digital Strategy. It is a multi-stakeholder and cross-sectoral partnership on digital skills addressing all levels of digital skills. In November 2017 the partnership established a Board⁶⁵ and four Delivery Groups⁶⁶ to tackle four priorities:

- Increase the national coherence of digital skills provision;
- Support the development of Local Digital Skills Partnerships in English regions that can help to deliver targeted digital skills training for local communities and economies with local and national partners;
- Increase digital enterprise by helping small businesses and charities upskill their employees and increase their digital capabilities;
- Support computing in school.

The first three Local Digital Skills Partnerships pilots have been established in Lancashire, Heart of the South West and the West Midlands.⁶⁷

In the frame of the partnership, a consultation was launched on updating Basic Digital Skills framework created in 2015.⁶⁸

In addition, the DCMS has established a research programme to understand the UK's current and future advanced digital skills needs.⁶⁹ This work collects data from employers via an online survey. This is supported through the Institute of Coding and the National Innovation Centre for Data.

The UK is one of the few EU countries to have introduced a comprehensive computing curriculum throughout its compulsory education system (since September 2014). To ensure successful delivery, there has been some budget increase for digital skills of GBP 84 million (EUR 96 million) to train up to an additional 8,000 computer science teachers and open a National Centre for Computing; GBP 30 million (EUR 34 million) in England to test the use of AI and innovative EdTech in online digital skills courses; GBP 400 million (EUR 456 million) towards maths, digital and technical education. The UK government confirmed that full funding for basic digital skills courses will be introduced from 2020.

According to the CBI, this initiative is useful makes connections between the government and stakeholders to identify skill gaps, which makes it very promising.⁷⁰

National Retraining Scheme

The National Retraining Scheme has been established in partnership between the government, the CBI and the Trades Union Congress. It focuses on job-specific retraining. The Autumn 2018 budget has announced the allocation of GBP 100 million (EUR 114 million) for the first phase of the scheme, which will include a new guidance service with expert advice to help people identify work opportunities in their area, and state-of-the-art courses combining online learning with traditional classroom teaching to develop key transferable skills.⁷¹

Skills pilots

The 2018 Autumn budget has announced that the government will fund GBP 20 million (EUR 22.8 million) of Skills pilots. This will include a new GBP 3 million (EUR 3.4 million) pilot to help employers in Greater Manchester and surrounding areas to address local digital skills gaps through short training courses.

Other upcoming initiative

In addition to the above, the introduction of new qualifications for technical and vocational training (**T levels**)⁷² are to be introduced in 2020. These two-year courses have been developed in collaboration with employers and businesses so that the content meets the needs of industry and prepares students for work.

According to the Institute for Apprenticeship, the introduction of T levels is expected to streamline the currently perceived complicated technical qualifications system. The aim is to offer greater consistency and quality to college-based technical study programmes, by backing courses by rigorous teaching and respected qualification, and by offering an extended work placement to gain valuable industry skills. They will be available alongside apprenticeships as one half of a high-quality, employer-led technical and professional education offer.⁷³

In the 2018 Autumn budget, the government has announced that it will provide GBP 38 million (EUR 43 million) of capital funding to support the implementation of the first three T levels in 2020 across 52 providers.⁷⁴ The Industrial Strategy aims at reforming apprenticeship overall with the goal is to invest GBP 2.5 billion (EUR 2.9 billion) per year starting from 2018.⁷⁵

Impacts, challenges and perceptions

Since the framing of the Digital Strategy, the government has delivered more than 2.5 million free digital skills training opportunities with industry as part of the Digital Skills Partnership, with almost half a million new pledges made.⁷⁶

The commitment of the UK government to improve digital skills seems to bear fruit. The UK has already a high percentage of individuals with basic digital skills (71% according to the DESI 2018), ICT specialists (5.1% in the UK against 3.7% in the rest of the EU) and Science, Technology, Engineering and Mathematics Graduates (22.1% against 19.1% in the rest of the EU). The UK's score in the supply and demand for digital skills indicator of the Digital Transformation Scoreboard has much improved since 2017.⁷⁷

This upward trend is confirmed by national sources. The Lloyds Bank Consumer Digital Index 2017 indicates that over the past year, 1.1 million more UK adults have gained Basic Digital Skills.⁷⁸ According to the Nominet Digital Futures Index 42% of adults are classed as digitally savvy and there are 58,945 tech businesses with employees in the UK in 2017.⁷⁹

According to the CBI, due to all these initiatives, the required digital skills and resources are expected to further increase in the next five years. The CBI has also indicated its project to launch a survey on their member companies on the number of companies who took steps to improve digital skills of their employees in order to measure impacts.⁸⁰

It should be noted however that little has been done in order to solve the gender divide noted in the DESI (see section 0).

2.4 Support mechanisms

The different initiatives described in the previous sections are completed by financial support mechanisms.

UK Research and Innovation (UKRI)⁸¹ is the funding agency of the UK government, partially funded by the BEIS. It brings together seven sectoral Research Councils, Research England and Innovate UK. The two agencies relevant for digitising are the **Engineering and Physical Sciences Research Council (EPSRC)** – the funding agency for engineering and physical

sciences research) and **Innovate UK** (the funding agency for science and technology innovations). The two agencies work together on projects for digitising the industry, bringing together research organisations and businesses.

The table below summarises the main support mechanisms available in the UK.

Table 10: Main support mechanisms

Name	Digital Manufacturing Industrial Strategy Challenge Fund Programme	Digital Manufacturing Potential	Innovation Fellowships
Type	Research & innovation support competition Funding	Research & innovation support competition Funding	Research & innovation support competition Funding
Starting date	May 2017	October 2017	November 2017
Objective	Boost innovation and commercialisation/scale-up of industrial digitalisation technology related R&D.	Working with a wide range of industrial partners, the projects will tackle different challenges in this space, including the improvement of processes in the chemical and pharmaceutical industries; developing methods to capture and predict impact from the introduction of digital technologies for improved manufacturing performance; the integration of revision control in digital-physical models; the improvement of modelling for analysis of dynamic loading in engineering and manufacturing; and the development of low-cost digital tools for SMEs.	Support research fellows (junior academic post or researchers within industry who wish to transition into academia) whose research can help achieve the aims of the Industrial Strategy and will lead to short or long-term economic benefit for the UK.
Relevance for pillars	Pillars 2&3	Pillars 2&3	Pillars 2&3
Short description	A R&D and innovation competition to support the transformation of cross-sector manufacturing with digital technologies, such as the IoT and immersive technologies.	EPSRC awarded GBP 11.4 million (EUR 13 million) to seven projects which aim to create novel digital tools, techniques and processes that will support the translation of digital capabilities into the manufacturing sector. This investment marks the continuation of EPSRC's longstanding commitment to foster inter and multi-disciplinary collaboration and support business innovation via digital transformation. It arose out of work conducted by the Connected Everything Network Plus, which was established to create a multidisciplinary community focused on industrial systems in the digital age.	Three-year research fellowship programme supported by the National Productivity Investment Fund (NPIF). The programme helps early career researchers to build the pipeline of talents entering both industry and the research base. The priority areas are the following: robotics and artificial intelligence systems; high productivity services through specialised artificial intelligence; development and manufacture of batteries for the electrification of vehicles; digital manufacturing; quantum technologies; cheap and clean energy technology; integrated and sustainable cities, including low energy buildings; new approaches to data science.
Granting organisation	BEIS (delivered by UKRI)	BEIS (delivered by EPSRC)	BEIS (delivered by EPSRC)

Name	Digital Manufacturing Industrial Strategy Challenge Fund Programme	Digital Manufacturing Potential	Innovation Fellowships
Participating organisations	Research councils, industry	Various universities and businesses. ⁸²	Universities.
Sectors targeted	Manufacturing	Automotive, aerospace, ICT, Chemicals, machining, pharma	Sectors of the Industrial Strategy
Technologies targeted	All	All	All
Funding (split by private/public and national/EU), state period/annual funding	GBP 3.8 million (EUR 4.3 million) in 2018 (split tbc) (Part of the government's GBP 4.7 billion (EUR 5.4 billion) increase in R&D over four years – GBP 1.1 billion (EUR 1.25 billion) increase has been announced in the Autumn 2018 budget)	GBP 11.4 million (EUR 13 million) awarded. Funding is received via BEIS, with some contribution from the industry.	Up to GBP 38.9 million (EUR 44.4 million) available from EPSRC (received via BEIS). Additional funding from other Research Councils: up to GBP 1.6 million (EUR 1.8) from AHRC, GBP 1 million (EUR 1.14 million) from BBSRC, up to GBP 0.4 million (EUR 0.46 million) from ESRC. GBP 38.8 million awarded.

Industrial Strategy Challenge Fund

The **Industrial Strategy Challenge Fund**⁸³ has been established to strengthen UK science and business innovation. The fund aims to bring together UK research with business to meet industrial and societal challenges. It is part of the government's GBP 4.7 billion (EUR 5.4 billion) investment in R&D over four years, as part of the GBP 23 billion (EUR 26 billion) National Productivity Investment Fund announced in Autumn 2016.⁸⁴

A GBP 1.1 billion (EUR 1.25 billion) increase has been announced in the Autumn 2018 budget, which includes the GBP 121 million (EUR 138 million) increase for Made Smarter as well as other challenges for innovation in electric motor technology, quantum technologies, etc.⁸⁵

Since its launch in 2017, the Fund has supported the following challenges: audience of the future; faraday battery; data to early diagnosis and precision medicine, healthy ageing, leading-edge healthcare, next-generation services, prospering from the energy revolution; quantum technologies; robots for a safer world; transforming construction; transforming food production; creative industries clusters; driverless cars; manufacturing and future materials; national satellite test facility.

Digital Manufacturing Potential

The **Digital Manufacturing Potential**⁸⁶ is an EPSRC-funded research programme issued in July 2017. It aims to create novel digital tools, techniques and processes that will support the translation of digital capabilities into the manufacturing sector. According to an EPSRC representative interviewed, this investment marks the continuation of EPSRC's longstanding commitment to foster inter and multi-disciplinary collaboration and support business innovation via digital transformation. The EPSRC awarded GBP 11.4 million (EUR 13 million) to seven projects, which started in July 2018.

The Digital Manufacturing Potential programme arose out of work conducted by the **Connected Everything Network Plus**⁸⁷, which was established to create a multidisciplinary community focused on industrial systems in the digital age. Connected Everything is an EPSRC-funded research network for the Digital Manufacturing community which addresses the question of how

to support the future of manufacturing in the UK. Its outputs help direct the strategic choices to be made with respect to future UK research funding in this area. Amount of funding was GBP 82,958 (EUR 94,617) in 2016, GBP 332,505 (EUR 332,505) in 2017 and GBP 335,198 (EUR 382,293) in 2018.

Innovation Fellowships

The **Innovation Fellowships**⁸⁸ is an EPSRC programme supported by the NPIF (see the paragraph of the Industrial Strategy Challenge Fund above). It aims to support research fellows whose research can help achieve the aims of the Industrial Strategy. The priority areas are the following: robotics and artificial intelligence systems; high productivity services through specialised artificial intelligence; development and manufacture of batteries for the electrification of vehicles; digital manufacturing; quantum technologies; cheap and clean energy technology; integrated and sustainable cities, including low energy buildings; new approaches to data science.

Up to GBP 38.9 million (EUR 44.4 million) has been made available from EPSRC, which are expected to fund between 65 and 85 research projects. Additional funding from other UK Research Councils comprised: up to GBP 1.6 million (EUR 1.8 million) from AHRC, GBP 1 million (EUR 1.14 million) from BBSRC, up to GBP 0.4 million (EUR 0.46 million) from ESRC.

In total, GBP 38.8 million (EUR 44.2 million) were awarded to support 74 Fellowships. The Fellows are based in 37 different UK universities, who will be working with 177 individual companies, 36 partner universities and 17 other partners such as government agencies and Catapults.⁸⁹

According to the representatives of UKRI interviewed, the UK funding system makes strong linkages between universities and the business environment.⁹⁰ This should contribute to solving the challenge of applying the research and innovation as quickly as possible in the industry, as outlined by the UKRI.

3 Conclusions

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

Table 11: Breakdown for the financing of initiatives

	Pillar 2	Pillar 3	Pillar 4	Pillar 5
	Digital Innovation for all	Partnerships and industrial platforms	Regulatory framework for digital age	Preparing for digital future (skills)
Made Smarter Review and Made Smarter Commission	GBP 121 million (EUR 138 million)			
Made Smarter North West Pilot	GBP 20 million (EUR 23.4 million)			
High Value Manufacturing Catapult (HVMC) and Digital Catapult	GBP 106.1 million (EUR 120.9) (HVMC) and GBP 14.3 million (EUR 16.7 million) (DC)			
5GTT	GBP 223 million (EUR 254.4 million)			
AI Review and Sector deal			GBP 0.95 billion (EUR 1.1 billion)	
National Cybersecurity strategy			GBP 1.7 billion (EUR 1.9 billion)	
Data Protection Act 2018			No overall funding	
Regulatory Sandbox			NA	
Digital Skills Partnership				GBP 84 million (EUR 96 million); GBP 30 million (EUR 34 million)
National Retraining Scheme				GBP 100 million (EUR 114 million)
Skills Pilot				GBP 20 million (EUR 22.8 million)
Digital Manufacturing Industrial Strategy Challenge Fund Programme	GBP 3.8 million (EUR 4.3 million) in 2018, GBP 1.1 billion (EUR 1.25 billion) increase announced in 2018			
Digital Manufacturing Potential	GBP 11.4 million (EUR 1.3 million)			
Innovation Fellowships	GBP 38.8 million (EUR 44.2 million)			
Total spending	GBP 3.9 billion (EUR 4.6 billion) made available between 2016-2021			

Although most of the measures available in the UK are still recent, they already seem to have an important impact. The framing of four key strategies (Industrial Strategy, Digital Strategy, 5G and AI) has been followed by policy measures covering all pillars of the DEI: DIHs and testbeds for key technologies as part of Pillars 2&3, regulations on AI, cybersecurity and data protection as part of Pillar 4, and several initiatives addressing digital skills gaps as part of Pillar 5.

These measures, along with a strong support from the UK government, have allowed the UK to secure a strong position in the field of digitisation. For instance, both Catapult programmes have

engaged with about 4,400 businesses and universities, with very high returns on investment. The UK has a high number of testbeds, with 14 DIHs and 6 testbeds for 5G. In the area of digital skills, the different programmes allow to raise money to train 8,000 additional computer science teachers (Digital Skills Partnership) and to place over 200 additional graduates into businesses (Knowledge Transfer Partnership).

Most indicators are not yet available for 2018, but the interviews have expressed confidence in the encouraging trends to continue in the next years. Indicators such as capex spending and number of start-ups have increased between 2015 and 2017 (see the table below), and most figures on digital skills for the UK are above the EU average (see the table below and section 2.3).

It should be noted that some ICT indicators have remained stable or have slightly decreased between 2015 and 2017 (ICT spending as % of GDP, use of internet services, integration of digital technologies by businesses) but this does not reflect the outcome of the policies presented in this report, which are mostly from 2017 onwards.

The AI Sector Deal has been highlighted as a good example of a government's plan to further develop in the sector by the stakeholders interviewed. It is presented in the box below.

Box 1: Good practice

The **AI Sector Deal** is part of the AI Strategy led by the UK Office for AI, a joint partnership between BEIS and DCMS. The **Sector Deal** outlines a package of up to GBP 0.95 billion (EUR 1.1 billion) of support including government, industry and academic contributions up to GBP 603 million (EUR 687 million) in newly allocated funding, and up to GBP 342 million (EUR 390 million) from within existing budgets, alongside GBP 250 million (EUR 285 million) for Connected and Autonomous Vehicles.

In addition, the Industrial Strategy Challenge Fund unlocks GBP 1.7 billion (EUR 1.9 billion) for AI, with **five challenges having AI components** that AI businesses will be able to bid into through future competitions.

Finally, new **AI fellowships and funding** are made available for 450 PhD researchers.

This makes of the UK the government with the highest investment in AI in Europe, which seem to have a positive impact. The UK is the leading European country in AI with a number of highly innovative firms and over 200 SMEs working in the sector (compared to 81 in Germany and 50 in both the Nordic countries and France) (see section 2.2).

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

Table 12: Total output overview

		Pillar 2	Pillar 3	Pillar 4	Pillar 5
		Digital Innovation for all	Partnerships and industrial platforms	Regulatory framework for digital age	Preparing for digital future (skills)
Application	Name of key initiatives (start dates in brackets)	Made Smarter Review and Made Smarter Commission (2017 & 2018), Made Smarter North West Pilot (2019), HVMC and Digital Catapult (2010), 5GTT (2017)		AI Review and Sector Deal (2017 & 2018), National Cyber Security Strategy (2016), Data Protection Act (2018), Regulatory Sandbox (2016)	Digital Skills Partnership (2017), National Retraining Scheme (2018), Skills Pilot (2018)
	Funding (total amount and period)	GBP 486.6 million (EUR 555.3 million) between 2015-2018			GBP 234 million (EUR 266.8 million) between 2018-2020
	Industries addressed	All		All	All
	EU programme involved	Horizon 2020		NA	NA
Usage	Perception of initiative	Government support is considered as very useful for digital transformation (4.75/5)		NA	NA
	Take-up	14 DIHs	6 5G testbeds		NA
Outcomes	Perception of outcomes	The level of take-up of digital technologies is perceived as high (4/5)	The level of innovation in digital industries is perceived as high (4/5)	NA	NA
	Outcome metrics	7 th in DESI in 2017 and 2018 ICT spending: 2.3% of GDP in 2015		Total capex spending has increased by 7% between 2015-2017 and the number of start-ups by 9% in the same period (approx. 660,000 start-ups in 2017) No data available for 2018	Number of people employed with ICT specialist skills has increased by 5% between 2015-2017. Share of enterprises providing training to develop ICT skills has remained stable (26% in 2017 against 27% in 2015) ⁹¹ No data available for 2018
	Change in outcomes	ICT spending as % of GDP remained stable since 2015, 7 th in use of internet services indicator in DESI (same as in 2017), 14 th in integration of digital technologies in DESI (13 th in 2017)			
End-goal	Productivity growth	Continuous growth of labour productivity since 2010 (corresponding to the crisis recovery), 0.8% in 2017 (highest growth rate since 2011)			
Summary		The UK has launched a comprehensive set of measures addressing all the Pillars of the DEI, with a particular focus on the areas of weaknesses. As most initiatives have been implemented in 2018, it is yet too early to assess the impacts of the initiatives. The stakeholders interviewed in the government and the industry alike are confident that the measures go in the right direction.			

ANNEX 1 List of stakeholders interviewed

Type of stakeholder	Name of organisation
National authority	Department for Business, Energy & Industrial Strategy (BEIS)
National funding agency	UK Research and Innovation
Innovation centre	Manufacturing Technology Centre
Industry association	Confederation of British Industry

ENDNOTES

-
- ¹ Results are based on a Digital Intelligence Platform which measures the “digital pulse: of the interest and acceptance levels of the technologies in EU Member States. Source: UK Department for Business, Energy & Industrial Strategy (BEIS).
- ² European Commission (2018). Country Report United Kingdom 2018. Available at: <https://ec.europa.eu/info/sites/info/files/2018-european-semester-country-report-united-kingdom-en.pdf>
- ³ Ibid.
- ⁴ World Economic Forum (2018). Readiness for the Future of Production report. Available at: http://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf
- ⁵ Ibid.
- ⁶ The Manufacturer (2017). UK Manufacturing Statistics. Available at: <https://www.themanufacturer.com/uk-manufacturing-statistics/>
- ⁷ UK Parliament (2017). Technology (ICT) Sector Report. Available at: <https://www.parliament.uk/documents/commons-committees/Exiting-the-European-Union/17-19/Sectoral%20Analyses/36-Technology-ICT-Report%20FINAL.pdf>
- ⁸ TechUK (2017). The UK Digital Sectors After Brexit. Available at: <https://www.techuk.org/insights/news/item/10086-the-uk-digital-sectors-after-brexite>
- ¹⁰ European Commission (2018). Digital Economy and Society Index 2018, Country Report UK. Available at: http://ec.europa.eu/information_society/newsroom/image/document/2018-20/uk-desi_2018-country-profile_eng_B4415D06-056C-DDB7-6B695AFEDFB5F952_52236.pdf
- ¹¹ Interview with BEIS on 27/11/2018 and written feedback received on 14/01/2019.
- ¹² World Economic Forum (2018). Readiness for the Future of Production report. Available at: http://www3.weforum.org/docs/FOP_Readiness_Report_2018.pdf
- ¹³ UK Government (2017). Building our Industrial Strategy. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/611705/building-our-industrial-strategy-green-paper.pdf
- ¹⁴ UK Government (2017). UK Digital Strategy. Available at: <https://www.gov.uk/government/publications/uk-digital-strategy>
- ¹⁵ UK Government (2018). Introduction to Sector Deals. Available at: <https://www.gov.uk/government/publications/industrial-strategy-sector-deals/introduction-to-sector-deals>
- ¹⁶ UK Government (2017). Next Generation Mobile Technologies: A 5G strategy for the UK. Available at: <https://www.gov.uk/government/publications/next-generation-mobile-technologies-a-5g-strategy-for-the-uk>
- ¹⁷ UK Government (2018). Introduction to Sector Deals. Available at: <https://www.gov.uk/government/publications/industrial-strategy-sector-deals/introduction-to-sector-deals>
- ¹⁸ UK Government (2018). The Grand Challenges. Available at: <https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/industrial-strategy-the-grand-challenges>
- ¹⁹ Financial Times (2018). “UK investment spending leaves G7 rivals trailing”. Available at: <https://www.ft.com/content/90d47ddc-3337-11e8-ac48-10c6fde22f03>
- ²⁰ UK Government (2017). Industrial Strategy: the 5 foundations. Available at: <https://www.gov.uk/government/publications/industrial-strategy-the-foundations/industrial-strategy-the-5-foundations>; UK Government (2018). Forging our future: Industrial Strategy – the story so far. Available at: <https://www.gov.uk/government/publications/forging-our-future-industrial-strategy-the-story-so-far/forging-our-future-industrial-strategy-the-story-so-far>
- ²¹ UK Government (2018). GBP 25 million for 5G projects on the anniversary of the UK’s Digital Strategy. Available at: <https://www.gov.uk/government/news/25m-for-5g-projects-on-the-anniversary-of-the-uks-digital-strategy>
- ²² Ofcom (2018). Connected Nations 2018. Available at: https://www.ofcom.org.uk/data/assets/pdf_file/0020/130736/Connected-Nations-2018-main-report.pdf
- ²³ UK Government (2018). Superfast broadband now available to more than 19 out of 20 UK homes and businesses. Available at: <https://www.gov.uk/government/news/superfast-broadband-now-available-to-more-than-19-out-of-20-uk-homes-and-businesses>
- ²⁴ UK Government (2018). New Industrial Strategy Council meets as membership is involved. Available at: <https://www.gov.uk/government/news/new-industrial-strategy-council-meets-as-membership-announced>
- ²⁵ UK Government (2017) Digital Strategy: Summary and Annexes. Available at: <https://www.gov.uk/government/publications/uk-digital-strategy/summary-and-annex>
- ²⁶ Interview with the Confederation of British Industry (CBI) on 18/12/2018.
- ²⁷ Ibid.
- ²⁸ European Commission (2018). State aid: Commission approves plan by France, Germany, Italy and the UK to give €1.75 billion public support to joint research and innovation project in microelectronics. Available at: http://europa.eu/rapid/press-release_IP-18-6862_en.htm
- ²⁹ European Commission (2018). Coordinated Plan on Artificial Intelligence. Available at: <https://ec.europa.eu/digital-single-market/en/news/coordinated-plan-artificial-intelligence>
- ³⁰ UK Government (2016). Autumn Statement. Available at: <https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016#digital-communications>
- ³¹ UK Government (2018). 5G Testbeds and Trials Programme. Available at: <https://www.gov.uk/government/collections/5g-testbeds-and-trials-programme>

-
- ³² UK Government (2018). GBP 25 million for 5G projects on the anniversary of the UK's Digital Strategy. Available at: <https://www.gov.uk/government/news/25m-for-5g-projects-on-the-anniversary-of-the-uks-digital-strategy>
- ³³ Ibid.
- ³⁴ UK Government (2017). Made Smarter Review. Available at: <https://www.gov.uk/government/publications/made-smarter-review>
- ³⁵ UK Government (2018). Leading business leaders and academics join forces with government to make manufacturing smarter. Available at: <https://www.gov.uk/government/news/leading-business-leaders-and-academics-join-forces-with-government-to-make-manufacturing-smarter>
- ³⁶ UK Government (2018). Budget 2018. Available at: <https://www.gov.uk/government/publications/budget-2018-documents/budget-2018>
- ³⁷ High Value Manufacturing Catapult. Available at: <https://hvm.catapult.org.uk/>
- ³⁸ Interview with the Manufacturing Technology Centre (MTC) on 29/11/2018.
- ³⁹ HVMC Results. Available at: <https://hvm.catapult.org.uk/impact/results/>
- ⁴⁰ Interview with BEIS on 27/11/2018 and written feedback received on 14/01/2019.
- ⁴¹ HVMC Results. Available at: <https://hvm.catapult.org.uk/impact/results/>
- ⁴² Digital Catapult. Available at: <https://www.digicatapult.org.uk/>
- ⁴³ Digital Catapult. Our story. Available at: <https://www.digicatapult.org.uk/our-story/>
- ⁴⁴ Knowledge Transfer Partnerships. Available at: <http://ktp.innovateuk.org/>
- ⁴⁵ UK Government (2018). Budget 2018. Available at: <https://www.gov.uk/government/publications/budget-2018-documents/budget-2018>
- ⁴⁶ UK Government (2015). Smart Specialisation in England. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/436242/bis-15-310-smart-specialisation-in-england-submission-to-european-commission.pdf
- ⁴⁷ Interview with the MTC on 29/11/2018.
- ⁴⁸ Ibid.
- ⁴⁹ Ibid.
- ⁵⁰ Interview with the CBI on 18/12/2018.
- ⁵¹ Interview with the MTC on 29/11/2018.
- ⁵² Professor Dame Wendy Hall and Jérôme Pesenti (2017). Growing the Artificial Intelligence Industry in the UK. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/652097/Growing_the_artificial_intelligence_industry_in_the_UK.pdf
- ⁵³ RAS Strategy. Available at: <https://connect.innovateuk.org/documents/2903012/16074728/RAS%20UK%20Strategy?version=1.0>
- ⁵⁴ UK government (2018). AI Sector Deal. Available at: <https://www.gov.uk/government/publications/artificial-intelligence-sector-deal/ai-sector-deal#executive-summary>
- ⁵⁵ UK Government (2016). Cybersecurity Strategy. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/567242/national_cyber_security_strategy_2016.pdf
- ⁵⁶ UK Government (2018) Data Protection Act. Available at: <https://www.gov.uk/government/collections/data-protection-act-2018>
- ⁵⁷ Financial Conduct Authority (2016). Regulatory Sandbox. Available at: <https://www.fca.org.uk/firms/regulatory-sandbox>
- ⁵⁸ Deloitte, Innovate Finance (2018). A journey through the FCA regulatory sandbox. Available at: <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/financial-services/deloitte-uk-fca-regulatory-sandbox-project-innovate-finance-journey.pdf>
- ⁵⁹ Interview with the CBI on 18/12/2018.
- ⁶⁰ Oxford Insights (2018). Government AI Readiness Index. Available at: <https://www.oxfordinsights.com/government-ai-readiness-index/>
- ⁶¹ Interview with BEIS on 27/11/2018 and written feedback received on 14/01/2019.
- ⁶² Idem.
- ⁶³ Interview with the CBI on 18/12/2018.
- ⁶⁴ UK Government (2017) "Kicking off the Digital Skills Partnership." Available at: <https://digitalinclusion.blog.gov.uk/2017/07/20/kicking-off-the-digital-skills-partnership/>
- ⁶⁵ UK Government (2017). The Digital Skills Partnership Board members and terms of reference. Available at: <https://www.gov.uk/government/publications/the-digital-skills-partnership/the-digital-skills-partnership-board-board-members-and-terms-of-reference>
- ⁶⁶ UK Government (2018). Introducing the DSP Delivery Groups. Available at: <https://digitalskillspartnership.blog.gov.uk/2018/01/26/introducing-the-dsp-delivery-groups/>
- ⁶⁷ UK Government (2018). Guidance: Digital Skills Partnership. Available at: <https://www.gov.uk/guidance/digital-skills-partnership>
- ⁶⁸ UK Government (2018). "The Basic Digital Skills Framework is being updated". Available at: <https://digitalinclusion.blog.gov.uk/2018/01/23/the-basic-digital-skills-framework-is-being-updated-nows-your-chance-to-have-a-say-and-shape-its-future/>
- ⁶⁹ Pye Tait Consulting, DCMS. "Review of Advanced and Specialist Digital Skills Shortages." Available at: <https://www.pyetait.com/digitalskills/>
- ⁷⁰ Interview with the CBI on 18/12/2018.
- ⁷¹ UK Government (2018). Budget 2018. Available at: <https://www.gov.uk/government/publications/budget-2018-documents/budget-2018>

-
- ⁷² UK government (2019). T-levels: what they are. Available at: <https://www.gov.uk/government/publications/introduction-of-t-levels/introduction-of-t-levels>
- ⁷³ UK Government – Institute for Apprenticeships (2017). The Industrial Strategy – good jobs and greater earning power. Available at: <https://apprenticeships.blog.gov.uk/2017/12/18/the-industrial-strategy-good-jobs-and-greater-earning-power/>
- ⁷⁴ UK Government (2018). Budget 2018. Available at: <https://www.gov.uk/government/publications/budget-2018-documents/budget-2018> \
- ⁷⁵ UK Government (2018). Forging our future: Industrial Strategy – the story so far. Available at: <https://www.gov.uk/government/publications/forging-our-future-industrial-strategy-the-story-so-far/forging-our-future-industrial-strategy-the-story-so-far>
- ⁷⁶ <https://www.gov.uk/government/news/25m-for-5g-projects-on-the-anniversary-of-the-uks-digital-strategy>
- ⁷⁷ Digital Transformation Scoreboard 2018.
- ⁷⁸ Available at : https://www.thetechpartnership.com/globalassets/pdfs/basic-digital-skills-standards/basicdigitalskills2016_findingssummary.pdf
- ⁷⁹ Available at: <https://www.nominet.uk/DigitalFuturesIndex/#!dfi4>
- ⁸⁰ Interview with the CBI on 18/12/2018.
- ⁸¹ UK Research and Innovation. Available at: <https://www.ukri.org/>
- ⁸² University of Leeds, University College London, University of Nottingham, University of Bristol, AstraZeneca, IBM, Promethean Particles Ltd, Swagelok Manchester, Altuity Solutions Ltd, Amalgam, Autodesk, Designability, Renishaw, The Moulton Bicycle Company, Loughborough University, Cranfield University, University of the West of England, Babcock International Group Plc (UK), BAE Systems, High Value Manufacturing (HVM) Catapult, Jaguar Land Rover, University of Strathclyde, Glasgow School of Art, Booth Welsh, Cambridge Crystallographic Data Centre, DAQRI, Perceptive Engineering Ltd, Siemens plc (UK), University of Sheffield, University of Derby, Imperial College London, Carter Manufacturing Limited, MS Research Treatment and Education, MSC Software Ltd, Rolls-Royce Plc, Thomas Swan, TISICS Ltd, Wilson Benesch Ltd, University of Cambridge, Atos Origin IT Services UK, Ltd, British Standards Institution BSI, BTL Precision, EEF, Greater Manchester Chamber of Commerce, Manufacturing Technologies Association, Nottinghamshire Manufacturing Network, P A International Consulting Group Ltd, Precise Component , Raspberry Pi Foundation, Warren Services, Airbus Group Limited, Cisco, Ellen Macarthur Foundation, Manufacturing Technology Centre, Riversimple Movement Ltd.
- ⁸³ Industrial Strategy Challenge Fund: for research and innovation. Available at: <https://www.gov.uk/government/collections/industrial-strategy-challenge-fund-joint-research-and-innovation>
- ⁸⁴ The National Productivity Investment Fund (NPIF) is cornerstone of the government’s plan to support productivity and boost growth. It has been established in 2016 to provide additional capital investment in areas critical to productivity – housing, transport, digital infrastructure, and R&D. Sources: UK Government (2017). Business Secretary announces Industrial Strategy Challenge Fund investments. Available at: <https://www.gov.uk/government/news/business-secretary-announces-industrial-strategy-challenge-fund-investments>; UK Government (2018). Budget 2018. Available at: <https://www.gov.uk/government/publications/budget-2018-documents/budget-2018>
- ⁸⁵ UK Government (2018). Budget 2018. Available at: <https://www.gov.uk/government/publications/budget-2018-documents/budget-2018>
- ⁸⁶ Digital Manufacturing Potential. Available at: <https://epsrc.ukri.org/newsevents/news/ukdigitalmanufacturing/>
- ⁸⁷ Connected Everything Network Plus. Available at: <https://connectedeverything.ac.uk/>
- ⁸⁸ Innovation Fellowships. Available at: <https://epsrc.ukri.org/funding/calls/epsrcukriinnovationfellowships/>
- ⁸⁹ EPSRC (2018). EPSRC – UK Research and Innovation Fellowships provide springboard for future success. Available at: <https://epsrc.ukri.org/newsevents/news/epsrc-uk-research-and-innovation-fellowships-provide-springboard-for-future-success/>
- ⁹⁰ Interview with UK Research and Innovation on 11/01/2019.
- ⁹¹ The CBI is expected to launch a survey on their member companies on the matter, which is expected to bring more up-to-date results (see section 2.3).