European Commission

Digital Transformation Scoreboard 2018

EU businesses go digital: Opportunities, outcomes and uptake

Internal Market, Industry, Entrepreneurship and SMEs

Digital Transformation Scoreboard 2018:

EU businesses go digital: Opportunities, outcomes and uptake

About the Digital Transformation Monitor

The Digital Transformation Scoreboard is part of the Digital Transformation Monitor (DTM). The DTM aims to foster the knowledge base on the state of play and evolution of digital transformation in Europe. The DTM web platform provides a monitoring mechanism to examine key trends in digital transformation. It offers a unique insight into statistics and initiatives to support digital transformation, as well as reports on key industrial and technological opportunities, challenges and policy initiatives related to digital transformation.

Web page: https://ec.europa.eu/growth/tools-databases/dem/monitor/

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Foreword

Commissioner Elżbieta Bieńkowska

Internal Market, Industry, Entrepreneurship and SMEs (DG GROW)

The future of industry is digital. Progress in technologies such as big data, artificial intelligence and robotics, the Internet of Things and high-performance computing is already transforming the very nature of work and society as a whole.

The Digitising European Industry (DEI) strategy, adopted in April 2016, aims at reinforcing the EU's competitiveness in digital technologies and ensuring that any industry in Europe - big or small, wherever situated and in any sector - can fully benefit from digital innovations. It builds upon ongoing national initiatives for digitisation of industry.

Political and industry leaders have committed to work together on digitising industry within the European Platform of National Initiatives. The Platform plays an essential role in shaping national strategies and in mobilising Member States. Fifteen national initiatives on digitising industry have already been launched, and more are in preparation. This collaboration will strengthen the European economy and society and enable businesses to thrive in a world transformed by digital technologies, share experiences, explore new approaches and, above all, set a common European agenda for investments.

Substantial progress has been made in the twenty months since the Digitising European Industry strategy was launched. The uptake of digital technologies by our companies is increasing in most EU Member States. The Digital Transformation Scoreboard 2018 shows the progress made by Member States in terms of digital technology integration.

Reaping the benefits of digital technologies remains critical to the growth and prosperity of the European economy and society. Industry 4.0 related technologies like big data and data analytics, cloud technology and the Internet of Things show a significant adoption level, but the multi-modal adoption of newer technologies like Artificial Intelligence is still at an early stage.

Artificial Intelligence is opening massive business opportunities and transforming value chains. It is therefore at the core of the renewed EU Industrial Policy, our work on SMEs, and the Digital Single Market strategy.

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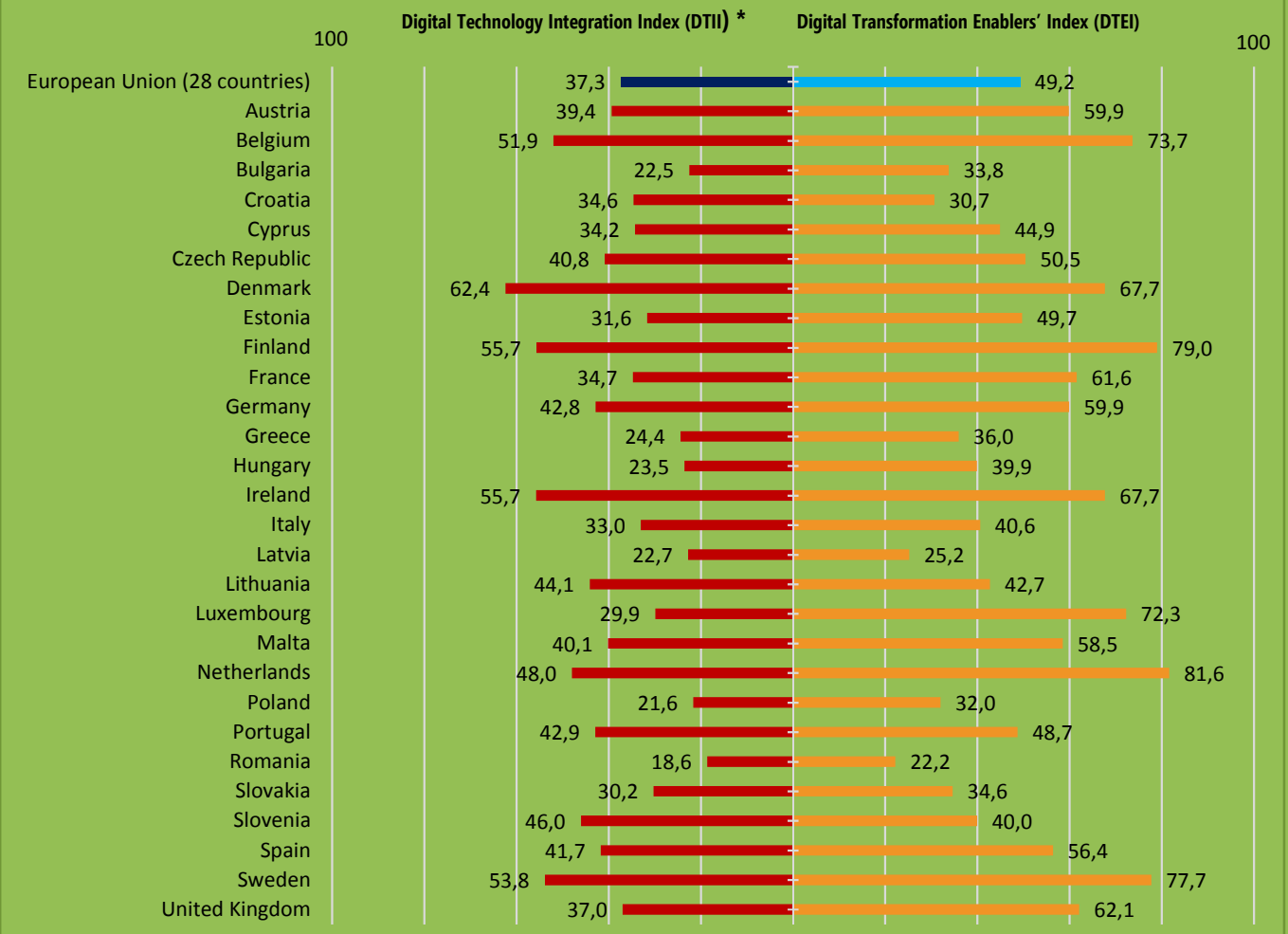
Executive summary

Conditions and outcomes of digital transformation

- With respect to the **national indicators analysis** carried out in the previous Digital Transformation Scoreboard, more Member States perform considerably above the EU-28 average in terms of digital technology integration. Nevertheless, improvements are necessary for eastern and southern Member States, which still lag behind.
- In comparison to 2016, Scandinavian and western European economies still dominate the top positions (DTEI/DTII). Nevertheless, it is encouraging to observe the progress of countries in lower positions.
- The Netherlands, Finland, Sweden, Belgium, and Luxembourg are leading the way in terms of conditions enabling digital transformation (DTEI).
- Significant progress has been made across the EU in entrepreneurial culture, supply and demand of skills and investments and access to finance.
- The comparison between the Digital Technology Integration Index (DTII) scores across Member States shows that the three highest-scoring economies are Denmark, Ireland, and Finland.

Digital Technology Integration Index (DTII) and Digital Transformation Enablers' Index (DTEI) (EU-28 average)



* Integration of Digital Technologies – Based on scores from section 4 of the DESI (Digital Economy and Society Index – 2017) on the Integration of Digital Technology. 2018 DESI will be published in May 2018.

Digital transformation in selected industries

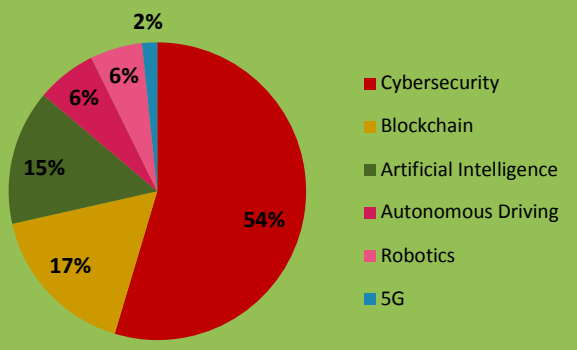
- The **2018 survey** shows that the pace of digital adoption differs significantly across the two industries studied. Both the food and the construction industries have different needs, and digital adoption depends greatly on these needs.
- 57% of the companies surveyed believe that they have the necessary skills to adopt new digital technologies.
- 27% of European businesses in the food industry and 10.7% of those in construction have appointed a Chief Digital Officer.
- More than 70% of the companies surveyed indicate to have invested in digital technologies to improve production processes.

Digital pulse – Using media analytics to assess the uptake of Industry 4.0 technologies

These 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. Quantitative analysis enabled the frequency of mentions and the net sentiment for each of the six technologies to be analysed over the course of 2017, and the results were aggregated by week.

- Cybersecurity, Blockchain technology and artificial intelligence are the three most popular technologies and technological solutions on online media channels in 2017.
- In 2017, the most digitally aware European countries were the UK, Spain, Denmark, and Luxembourg.

Popularity of digital technologies and solutions in online media



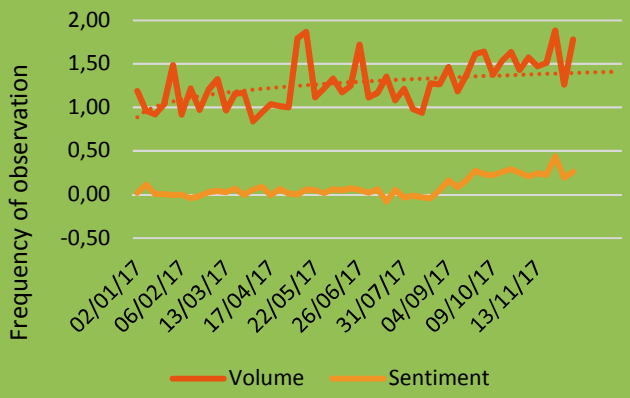
Example: The digital pulse for artificial intelligence

Volume of discussions about AI in 2017 (EU-28):

- The trend in the volume of discussions about AI marginally increased during the period.
- This trend shows three distinguishable peaks that are likely to correspond to the excitement around NASA´s Kepler space telescope, which analysed thousands of exoplanets using machine-learning technologies, and ultimately helped to discover a new exoplanet in December 2017.

Development of AI sentiment in 2017 (EU-28):

- The general perception of artificial intelligence is positive and optimistic, with significant positive growth since September '17.



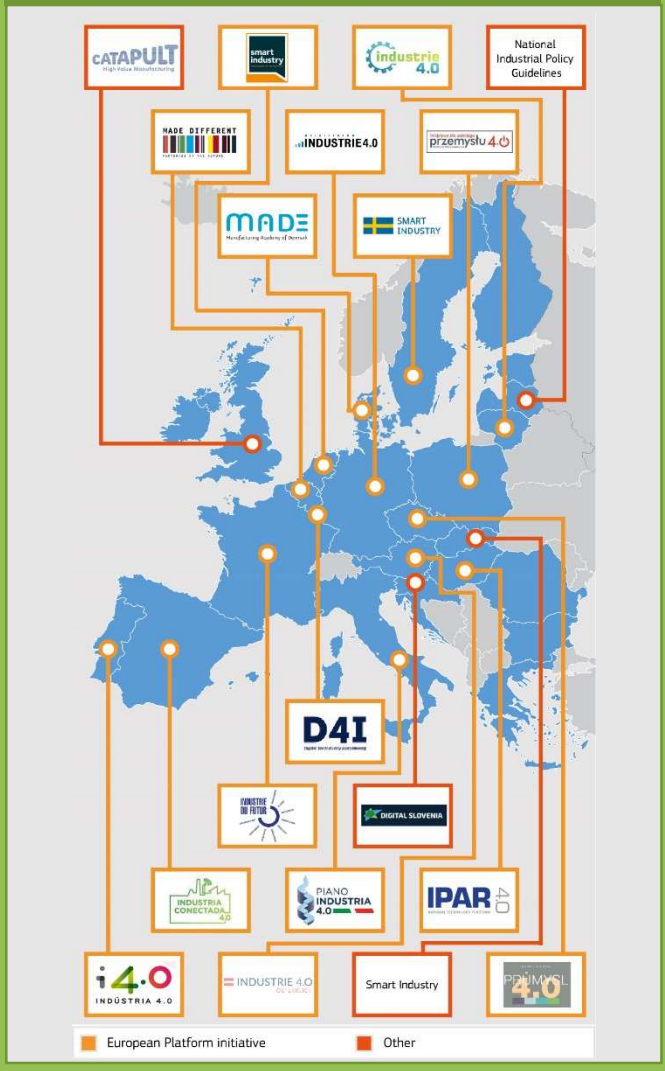
Digital transformation policies

In the policy landscape of European countries, digital transformation policies take different shapes. Next to initiatives directly targeting the digitisation of industry, EU Member States have also set up other types of initiatives, such as strategies for the development of information society and innovation programmes, that are closely intertwined with their national digital growth strategy. The development of national initiatives for digitising industry is an important element of the European Platform of National Initiatives on Digitising Industry which is at the core of the Digitising European Industry strategy, and a forum to identify challenges that need to be addressed at EU level, share experiences and best practices, trigger collaboration, boost co-investments and explore common approaches to regulation, skills and jobs. The platform comprises fifteen national initiatives for digitising industry, with further initiatives under preparation.

On the basis of **desk research and interviews**, the DTM analysed a total of 19 national digital transformation policies and programmes. The main results of the analysis include:

- These policies have common goals but differ in many aspects e.g. policy design, funding approach, financial size and implementation strategies.
- **Stakeholders from industry and research** played an important role.
- These policies focus equally on the development of new technologies and on the deployment and use in industry of existing technologies.

National digital transformation policies and programmes



Objectives and methodology of the scoreboard

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Digital technologies have created new markets and unprecedented business opportunities. They will open new ways for companies to integrate their customers´ needs and preferences into their development and production processes, help them to enhance quality and avoid faults in their production processes and create transparency and flexibility across entire process chains. In Europe, the key challenge is to ensure that such opportunities are fully captured by industry and service companies, leveraging digitization to create growth and new jobs. The aim of the Digital Transformation Scoreboard 2018 is to assess to what extent this is the case and to provide evidence on the extent of digital transformation in Europe. The evidence gathered will help decision-makers at EU and national level to create policies supporting EU companies in the digital transformation processes. It will enable companies to understand why digital technologies are important and how they can create (or reinforce) their own digital strategy.

Introduction to the Digital Transformation Scoreboard (DTS)

The principal objective of the Digital Transformation Scoreboard (DTS) is to **monitor the transformation of existing industry and enterprises**. In particular, the scoreboard adopts national indicators to monitor digital transformation in Europe with a geographic focus and from a macro-perspective. It also uses qualitative and quantitative data to investigate the adoption of digital technologies across two non-ICT sectors (i.e. agri-food and construction) and across Member States. 2017's results are presented in this Digital Transformation Scoreboard.

General approach of the Digital Transformation Scoreboard 2018

The scoreboard is based on four main tools. The qualitative part includes (a) a **survey** gathering information about the uptake of mature and emerging digital technologies by EU companies and its impact on company´s performance and (b) **desk research and interviews** providing a more complete picture of the issue being addressed. The quantitative part includes (c) the use of a **Digital Intelligence Platform** to measure digital pulse as a digital advancement KPI of the interest and acceptance of the technologies in EU Member States (real-time data approach). It also revolves around monitoring digital transformation based on (d) the analysis of national data sourced from **national statistics** offices and international organisations (indicator approach).

Survey

Desk-research and interviews

Real-time data

National indicators

Content of the scoreboard

The scoreboard is divided into the following nine sections:

1) Executive summary;

2) The **objectives and methodology of the Scoreboard** presents in more detail the aim, content approach and scope of the scoreboard, including which industries and which technologies were considered;

3) Section 3, **National digital transformation policies and programmes**, provides an overview of the comparative analysis of digital transformation policies carried out by the Digital Transformation Monitor (DTM);

4) Section 4, **Digital transformation: a source of business opportunities with major societal impact**, uses the survey to explore whether European food and construction companies have adopted digital technologies and how this has impacted their businesses;

5) Section 5, **Digital transformation in selected industries**, provides an overview of the extent to which digital technologies have been adopted in the construction and food industries, by which type of company, whether one technology adoption was coupled with another one, and whether companies saw benefits in this adoption;

6) The overview is completed in section 6, **Uptake of digital technologies in Europe**, by the same exercise carried out for each of the nine technologies identified for the Digital Transformation Scoreboard;

7) In section 7, **Digital pulse: Using media analytics to assess the uptake of Industry 4.0 technologies**, the interest and acceptance of six technologies in EU Member States is estimated using real-time data extracted from open sources on the internet;

8) In section 8, **Digital integration and enabling factors**, the enabling conditions for digital transformation, as well as the outcomes, are identified. Each EU-28 Member State is ranked based on its situation regarding each of the seven identified enabling & outcome conditions;

9) Finally, section 9, **Country profiles**, provides a country-specific description of the enabling conditions, outcomes, strengths, areas for improvement and interesting policy practices for the EU-28 Member States. The analysis of enabling conditions and outcomes was based on national indicators from the EC, Eurostat and World Economic Forum.

Survey

Objectives of the survey

The survey captures the most recent uptake of digital technologies and digital transformation at firm level. It measures the output dimension at firm level, and results are then aggregated and segmented at sectorial levels.

The target audience for the survey was companies in the food and construction sectors across the 28 EU Member States. An online questionnaire was distributed by e-mail to approx. 16,000 companies using the online survey tool Interview™ in 2017. A total of 120 responses from C-level executives were collected and used for the analysis.

2 industries

Construction

The impact of digitisation can be felt across all industries, including construction. Mature and emerging digital technologies will disrupt the entire supply chain and the interactions and exchange of information therein. Examples of this ongoing digital transformation include 3D scanning, Building Information Modelling (BIM) or use of automated equipment. It will also impact the final products of construction, for example smart connected cities and smart homes that adjust their functioning according to the needs of citizens and inhabitants. [1]

More specifically, four key technological trends concern the construction value chain. These include (a) digital data and access, networks and connectivity, automation and robots, and new emerging technologies such as virtual and augmented reality, 3D printing and geo-localisation. [1]

3,3 million enterprises, with 95% of SMEs with fewer than 20 employees [1]

Food

The food industry is Europe´s leading manufacturing sector, with a €1.1 trillion turnover, and a key job provider, with 4.2 million employees.[2] Like for the construction sector, the potential impacts of new digital technologies are wide ranging. Fourth Industrial Revolution technologies have the potential to help transform food systems and radically modify the shape of demand by improving value-chain linkages and creating more effective production systems. Taken together, these technologies will lower cost to scale, accelerate innovation, increase transparency in food systems and enable consumers to make informed choices.[3]

Despite these promises, the food industry has been slow to harness the opportunities offered by these technologies, attracting significantly lower investment and inspiring fewer technology start-ups than other sectors. Nevertheless, a recent acceleration of innovation efforts make the future adoption of technology feasible.[3]

IoT for real-time supply chain traceability could reduce food loss by up to 35 million tonnes by 2030[3]

9 key technologies

Social media

Social media has a wide-ranging impact on digital entrepreneurs, such as providing a better insight into customer behaviour. Recent trends include social media going company-wide beyond marketing and community-building functions, and a decline in email use as instant messaging becomes an office fixture, allowing for real-time communication and information sharing.

Mobile services

Mobile devices are technological advances that are transforming traditional businesses. Monitoring the use of mobile services is a prime indicator of how digital technologies influence the way in which businesses work.

Cloud technologies

The convergence of the cloud is promoting the growth of centrally coordinated applications that can be delivered to any device. Important business data, forms and other documents can now be accessed from virtually anywhere, and cloud computing is making it easier to do business.

Internet of Things

Mobile devices e.g. phones and wearable devices are now part of an expanded computing environment including – among others – consumer electronics and connected screens in the workplace. This network of Internet of Things (IoT) will raise management challenges for IT and manufacturing/logistics organisations as they lose control of user-endpoint devices.

Cybersecurity solutions

Cybersecurity has never been more essential, as companies have more digital valuable assets than ever before. The increasingly used hybrid cloud architecture requires a new approach to cybersecurity. The pervasive use of mobile devices by employees means that corporate IT now has to manage the security of many more devices.

Robotics and automated machinery

Robotics shift the labour/capital mix while managing societal expectations. End-user industries are rapidly adopting robots for industrial purposes to improve the quality of products and reduce manufacturing costs.

Big data and data analytics

Companies are beginning to utilise big data and data analytics to gain business insights. As analytical technologies mature, they will leverage what computers do best, while freeing decision-makers from complex data analysis to deliver "intelligence in the moment".

3D printing

3D printing is poised to transform nearly every industry. Recent developments have transformed the way in which products are designed, developed, manufactured and distributed. Mass production remains the biggest challenge but it is already used to produce parts faster.

Artificial intelligence

AI will change the world and be ubiquitous in tomorrow's economy. AI major gains are likely to focus on productivity, efficiency, automation and costs, enabling consumers and businesses to capitalise on the digital economy.

Desk research and interviews

With the objective of exploring and understanding all facets of digital transformation policies, desk research and interviews with representatives from the implementing authorities were used (section 3).

In the Country Profiles section (section 9), desk research was also conducted to identify the strengths and areas for improvement and good practices in each of the EU Member States.

In addition, in order to complement industry findings retrieved from the survey (section 5), a series of interviews were conducted with C-level executives in food and construction companies and support organisations.

Figure 2.1: Country Profiles

The country profiles section is composed of 28 two-page sheets. A country profile was created for each Member State, providing an overview of the identified key statistics through charts and figures to show strengths and areas of development regarding the enablers and outputs described above. Each sheet includes:

- A **general overview** of how the country supports digital entrepreneurship;
- A highlight of the **country's strengths and areas for improvement**;
- A short assessment of where the country stands **compared to other Member States**;
- A focus on initiative(s) considered **good practices**.

Source: Digital Transformation Scoreboard 2018

Real-time data

Section 7 examines the use of a Digital Intelligence Platform to measure **digital pulse** as a digital advancement KPI of the interest and acceptance of new technologies in EU Member States. The analysis used information (i.e. text corpora and images) collected from open sources available on the Internet.

Quantitative analysis on the results enabled three dimensions (i.e. the frequency of mentions, the importance of the specific topic expressed by volume of reuse of a given observation, and the net sentiment) to be determined in relation to six specific technologies or new physical systems: cybersecurity, autonomous driving, artificial intelligence (including machine learning), robotics, 5G, and blockchain. The time frame set for this analysis was the year 2017 (from 1 January to 15 December) and the results were aggregated by week.

National indicators

The indicators developed under the Digital Transformation Scoreboard have been updated to provide a relevant view of the current state of play of European businesses in the field of digital transformation and digital entrepreneurship.

The statistical analysis of the indicators are aggregated through the Digital Transformation Scoreboard to provide a **comparative assessment of the factors supporting the development of digital transformation in the EU-28 Member States.** The statistics should help Member States assess the areas where they need to concentrate their efforts in order to boost their digital-transformation performance.

This statistical information is presented using a **five-category typology of 'enablers'** that captures the principal aspects of digital transformation in the EU-28 Member States to enable countries to be ranked. The effects of digital transformation, namely the increase in ICT start-ups and the integration of digital technology, are captured through indicators in **two 'output' categories**.

Figures 2.2 and 2.3 provide an overview of the enablers and outputs.

Figure 2.2: Presentation of enablers and outputs

Presentation of the enablers

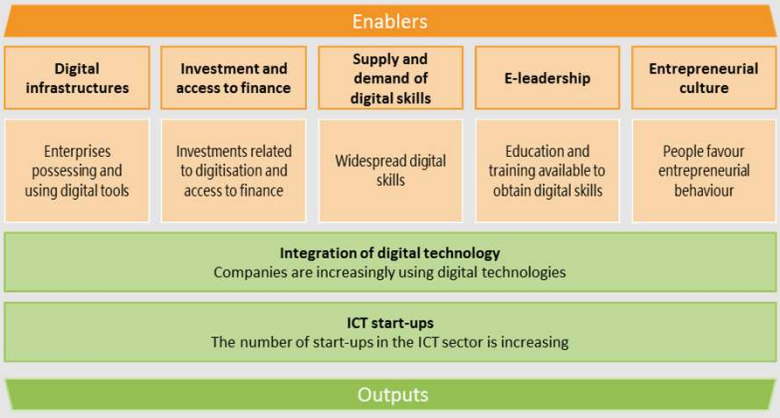
- **Digital infrastructures:** three indicators capturing the availability of digital infrastructures
- **Investment and access to finance: six** indicators capturing investment in activities related to digitalisation and how access to finance for funding them is facilitated.
- **Supply and demand of digital skills:** four indicators capturing the availability of digital skills within the population.
- **E-leadership:** three indicators capturing to what extent education and training are available to facilitate the acquisition of digital skills.
- **Entrepreneurial culture:** three indicators assessing the business-friendliness of the environment and the level of the entrepreneurial culture.

Presentation of the outputs

- **Integration of digital technology** (in line with the scores from section 4 of the DESI on the Integration of Digital Technology measured with 8 indicators)*
- **ICT start-ups** (three indicators)

Source: Digital Transformation Scoreboard 2018

Figure 2.3: Overview of the general approach to the indicator-based monitoring of digital transformation

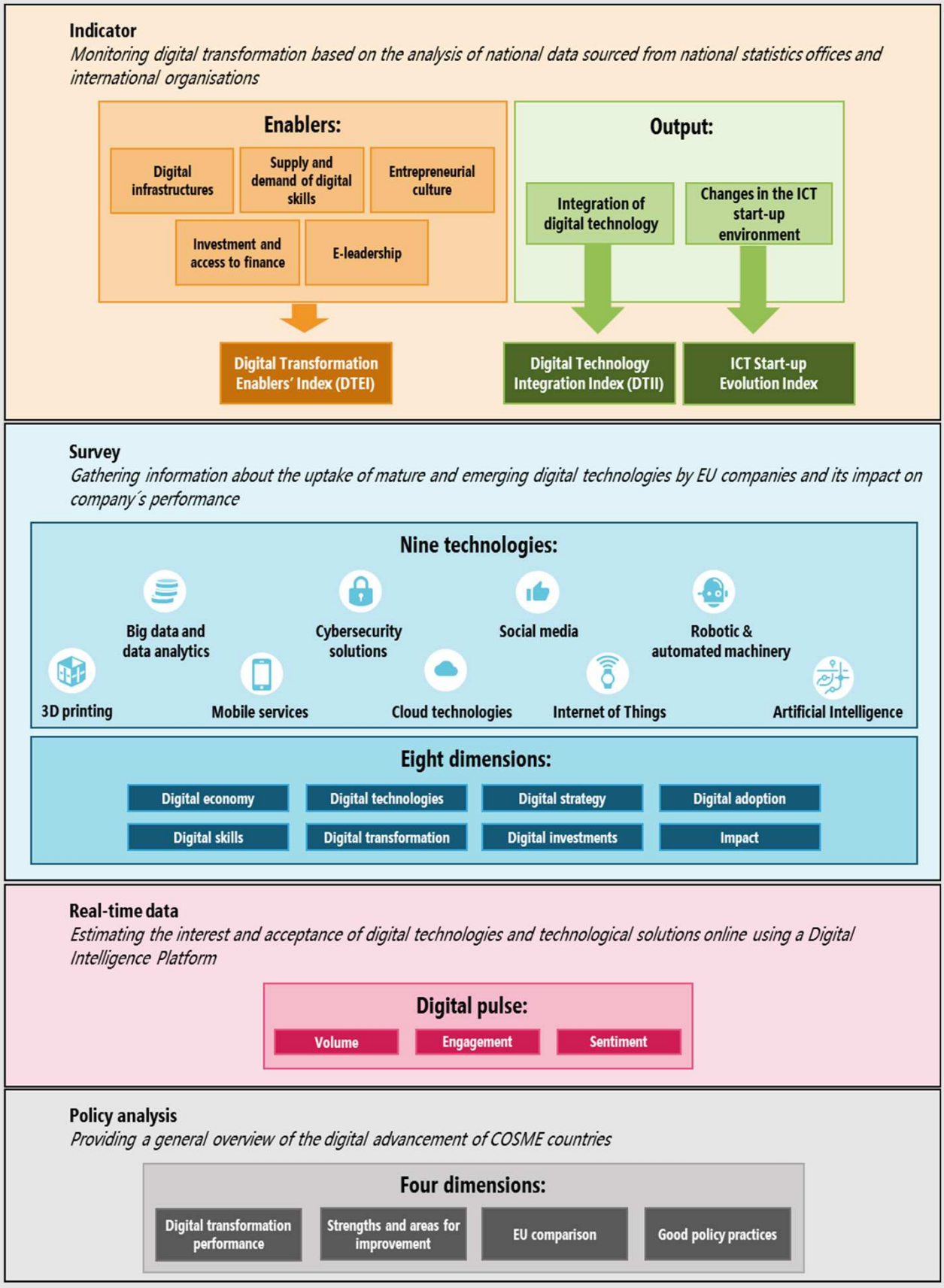


Source: Digital Transformation Scoreboard 2018

*DESI (Digital Economy and Society Index – 2017), available at: https://digital-agenda-data.eu/charts/desi-composite#chart={"indicator":"DESI_SLIDERS","breakdown":{"DESI_1_CONN":0,"DESI_2_HC":0,"DESI_3_UI":0,"DESI_4_IDT":10,"DESI_5_DPS":0},"unit-measure":"pc_DESI_SLIDERS","time-period":"2017"}

Figure 2.4: Framework of the Digital Transformation Scoreboard 2018

The Digital Transformation Scoreboard (DTS) was built around 4 main methodological approaches. The figure below gives more details on each of these approaches, emphasizing the objective pursued, the key elements investigated, and the tools and dimensions used.



Source: Digital Transformation Scoreboard 2018

National digital transformation policies and programmes

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The greatest digital opportunity for Europe lies in the transformation of existing industry and enterprises, and successful start-ups. As a result, almost 2/3 of EU Member States have made the digitisation of their industries a priority, adopting large-scale policies and related initiatives to increase productivity and competitiveness and improve the digital skills of their workforce. Despite many commonalities, findings from analysing national initiatives across Europe reveal how diverse the tools developed and experiences gained really are. This chapter provides an overview of the comparative analysis carried out under the Digital Transformation Monitor (DTM).

3.1 Analysing national digital transformation policies and programmes

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68% of EU Member States have already put in place comprehensive digital transformation policies

Objectives and approach

DTM Digital Transformation Monitor

In the policy landscape of European countries, digital transformation policies take different shapes. Next to initiatives directly targeting the digitisation of industry, EU Member States have also set up other types of initiatives, such as strategies for the development of innovation programmes, that are closely intertwined with their national digital growth strategy.

The Digital Transformation Monitor (DTM)[4] analysed a total of 19 national industry digitisation initiatives and programmes launched in EU Member States between 2011 and 2017. On the basis of desk research and interviews with representatives from the implementing authorities, 19 case-study reports have been developed by the DTM. The reports scrutinise the initiatives' framework conditions, including the design and rollout of industry digitisation policies. Next to key policy trends, the reports examine the underlying processes and strategies, policy lessons learned and their potential for being upscaled and transferred to other countries and regions in Europe.

In addition, DTM also investigated whether national industry digitisation initiatives and programmes have already been launched in COSME countries such as Turkey, Iceland and Serbia (report available at: https://ec.europa.eu/growth/tools-databases/dem/monitor/category/national-initiatives).

European Platform of National Initiatives

The analysis of the national initiatives carried out by the DTM is an important element of the European Platform of National Initiatives on Digitising Industry.[5] The Platform is at the core of the Digitising European Industry strategy, and serves as coordination framework and forum to identify challenges in need of being addressed at EU level. Further goals of the Platform include sharing experiences and best practices, triggering collaboration of EU Member States, boosting co-investments as well as exploring common approaches to regulation, skills and jobs. The platform comprises fifteen national initiatives for digitising industry, with further initiatives under preparation.[6]

With a view to stimulating knowledge sharing and the exchange of good practices, conducting a comparative analysis of industry digitisation policies in Europe is a vital exercise. This chapter is a first step in that direction.

The background of the policies

Given the low adoption rate of digital technologies in EU companies and the vast opportunities offered by them, governments all over Europe have adopted initiatives to support the uptake of digital technologies and strengthen their industries. In response to the European Initiative on digitising industry, EU Member States have even accelerated action by adopting further measures, while deepening their national digitisation strategies.[6] The majority of initiatives aim at strengthening their countries' industrial competitiveness and modernisation to make their economies "fit for the future" or ensure the sustainability of the manufacturing sector.

While these policies have common goals, they differ in many aspects such as policy design, funding approach and implementation strategies. Moreover, the outputs and outcomes produced by the initiatives so far indicate that some policies have achieved greater degrees of success than others. However, almost half of the initiatives have only been adopted since 2016 or later – with some additional countries having initiatives in the making – and have yet to deliver results.

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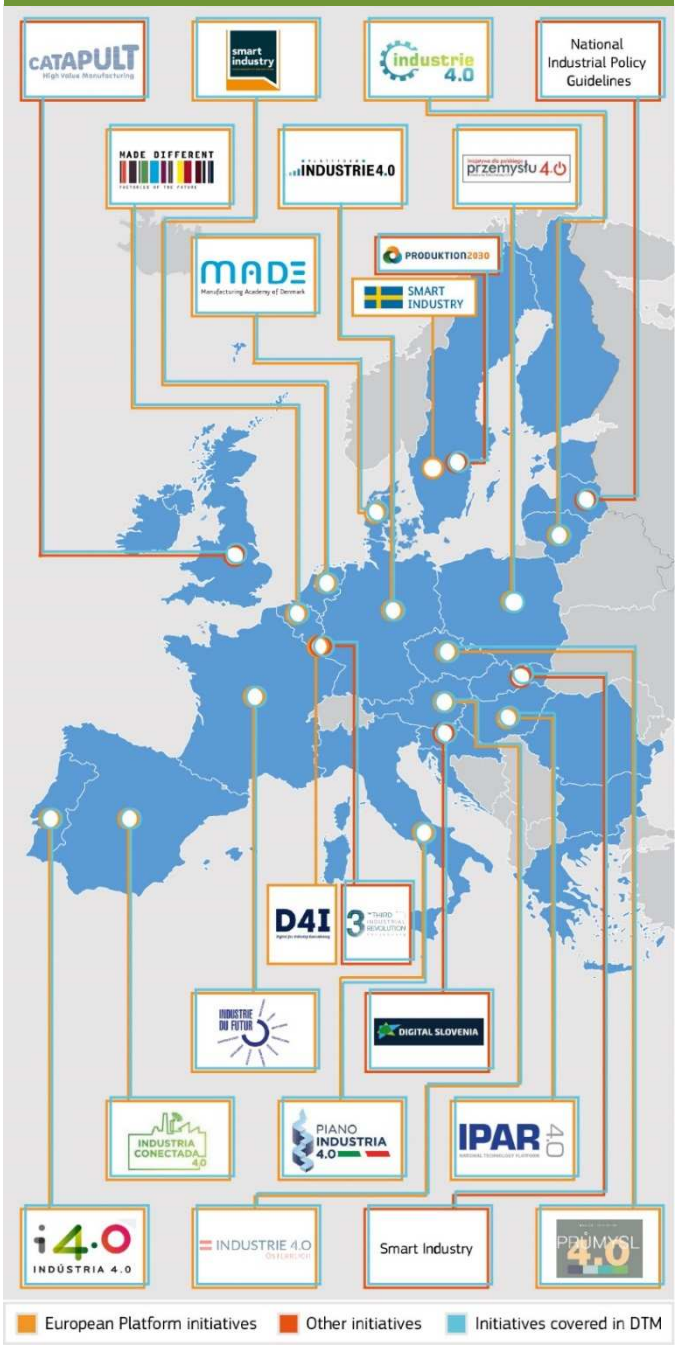
Figure 3.1: Overview of digital transformation policies and programmes



Source: Modified on the basis of https://ec.europa.eu/digital-single-market/en/cordination-european-national-regional-initiatives[5]

3.2 Key characteristics of national policy initiatives

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70% of digitisation initiatives are driven by domestic industry, yet only 15% are majority-financed by industry

Priority challenge

Industry digitisation policies show a strong tendency to focus on infrastructure and technology rather than on the development of skills. While this is the case for 70% of the initiatives, skills are nevertheless an important component of all of the examined initiatives. The analysis of National Initiatives for Digitising Industry equally stated that all 15 policies had a digital skills component.[7] However, only 16% of these initiatives prioritise the development of skills over infrastructure/technology topics.

The policies reviewed exhibit differences in their thematic focus, infrastructure/technology and skills. Each policy follows a distinctive structure regarding activities, thus it is hard to generalise the approaches used. However, there are some commonalities. For example, initiatives focusing on technology/infrastructure tend to be organised into working groups on specific technologies or cross-cutting issues, such as IoT, while skills-centred initiatives tend to take the shape of support programmes, e.g. by involving companies to re-educate or requalify employees (upskilling).

The policies examined do not show a clear pattern regarding particular technological focuses. Overall, the technologies that appear most frequently in the policy documents refer to the IoT, big data and artificial intelligence (AI).

Design and implementation

Stakeholders from industry and research have played an important role in designing and implementing industry digitisation initiatives. As shown in figure 3.2, 3/4 of national Industry 4.0 policies adopted a bottom-up approach to designing, initiating and implementing the initiatives.

The methods and tools employed by the initiatives to involve stakeholders are diverse. A recurring tool used for stakeholder involvement included in-depth consultations in order to define policy priorities in line with the needs of domestic industries. As pointed out by the analysis carried out by DG CONNECT on national initiatives for digitising industry[6], the degree of public intervention in the initiative's platform varies. While developments in some initiatives are driven by the state, in others industry and academia tend to have a strong role[7], often making up the majority of members in governance structures, e.g. in steering committees. The eight members of the Board of Directors of the Manufacturing Academy of Denmark (MADE), for example, include five members from industry and three members from academia.

In the cases of Austria and Denmark, a separate legal entity was created in order to coordinate the implementation of the initiatives. These are Association Industry 4.0 Austria – the Platform for Smart Production, whose mission is to foster collaboration among all stakeholders; and MADE, whose mission is to apply research, drive innovation and strengthen education in manufacturing. The advantages reported include the setting up of a dedicated team working full-time on the activities, and a greater degree of neutrality from political parties.

Good practice example: Smart Industry's field labs

The Dutch *Smart Industry (SI)* initiative, places an emphasis on deploying digital technology and improving ICT conditions by taking advantage of existing strengths in the Dutch ICT infrastructure. A total of 10 field labs were set up, with multi-stakeholder practical environments for designing, testing, experimenting with and deploying technological solutions. The labs engage in multiple try-out innovation projects, including training within projects. In addition, companies are provided with technological and market understanding, including training and specific tools.

Good practice example: Produktion2030's PhD school

The starting point of Sweden's *Produktion2030 (P2030)* was based on six areas of strength in which Sweden is generally competitive, but in which continuous efforts are needed to maintain the market position and address skills gaps. One of P2030's main activities was to set up a PhD school in production developing courses at master's level and for continuous education. The PhD school also seeks to promote university networking and the interchange of researchers.

Figure 3.2: Overview of main policy dimensions [R4]

Good practice example: Bottom-up implementation in Indústria 4.0

Portugal's Indústria 4.0 adopted a bottom-up approach in the design and implementation of its flagship Industry 4.0 initiative. Designing the strategy relied on the comprehensive engagement of industry, academia and education stakeholders in order to determine the needs and potential of domestic industry. Meanwhile, the management of the platform and the monitoring of its 62 public and private measures is led by the private association COTEC. Furthermore, a strategic committee made up of multinational companies and relevant stakeholders guides and advises the government board on the development of the strategy's content.

Good practice example: From state to industry-driven Industrie 4.0

Launched in 2011 as the first initiative of its kind, *Germany's Industrie 4.0* was initially designed and implemented by the German Government in collaboration with industry. The policy design was led by the German Ministry of Education and Research and the German Ministry of Economy through strategy development and funding, while the practical implementation was driven by industry players which have recently taken full control of the platform's operations. The platform is chaired by the ministers involved, as well as by industry, scientific and trade-union directors. While the industry-driven Steering Board has the responsibility for strategy development, a Scientific Advisory Committee advises on scientific and programme-related matters.

Sources of funding

As shown in figure 3.3, the majority of industry digitisation initiatives are primarily financed through public means; nevertheless, private-sector co-financing has either already been provided or future plans are in place in almost all initiatives. While public funding dominates in 42% of the initiatives examined, the same percentage of policies is supported by public and industry funding in equal amounts. Meanwhile, industry funds exceed public funds in only 16% of the initiatives.

Furthermore, it is difficult to compare the financing obtained from industry for the examined cases, as industry financing frequently relies on contributions in kind, which are not publicly disclosed.

Alongside industry co-financing, a number of initiatives have introduced membership fees as an additional source of income. This is the case for the Austrian *Plattform Industrie 4.0* and the *Manufacturing Academy of Denmark*, with additional initiatives considering introducing a membership fee, such as Hungary's *IPAR 4.0.*

The authorities implementing these initiatives have introduced fees in order to become more independent of government funds, thereby ensuring a more sustainable funding model in the long term. In some initiatives, e.g. Austria, a multi-tier fee was introduced depending on the type of member organisation. While membership fees certainly generate additional income, coordinators of the initiatives emphasise that their introduction also triggers increased demands from members to ensure that the fees are used efficiently.

Figure 3.3: Overview of budget and strategic focus of national initiatives

	Budget	Strategic focus
PLATTFORM INDUSTRIE 4.0	2011-today **€200 million** (excl. financial in-kind contributions from industry)	Deployment
INDUSTRIE 4.0 ÖSTERREICH	**€500,000** annually (for platform only)	Mixed
PRODUKTION2030	2013-2018 **Approx. €50 million** (incl. industry contributions)	Deployment
CATAPULT High Value Manufacturing	2012-2018 **€164 million** (incl. commercial income and collaborative R&D)	Deployment
MADE DIFFERENT	2016-2019 **€170,000** (Wallonia)	Deployment
PRŮMYSL 4.0	Not yet defined	Mixed
MADE Manufacturing Academy of Denmark	2014-2019 **€50 million** (incl. industry & RTO contributions)	Mixed
IPAR 4.0	Not yet defined	Mixed
PIANO INDUSTRIA 4.0	2017-2020 **Approx. €18 billion** (incl. tax incentives)	Deployment
i4.0 INDÚSTRIA 4.0	2017-2020 **Approx. €4.5 billion** (total investment incl. industry contributions)	Deployment

	Budget	Strategic focus
INDUSTRIA CONECTADA 4.0	2016 **€97.5 million**	Mixed
INDUSTRIE DU FUTUR	2014-2020 **Approx. €10 billion** (incl. loans & tax cuts)	Deployment
smart industry	2014-2017 **€25 million** (excl. industry co-financing)	Deployment
industrie 4.0	2017-2020 **€79.8 million** (foreseen budget)	R&D
Inicjatywa dla polskiego przemysłu 4.0	2016-2040 **€235 billion** (based on Morawiecki Plan incl. EU funds)	Mixed
National Industrial Policy Guidelines	2014-2020 **€6 billion** (incl. EU funds)	R&D
Smart Industry	Not yet defined	R&D
DIGITAL SLOVENIA	Not yet defined	R&D
THIRD INDUSTRIAL REVOLUTION	Not yet defined	Mixed

Scale of the initiatives

As shown in figure 3.3, the initiatives examined do vary not only in terms of their source of funding, but also in terms of their overall financial scale. Interestingly, the rule that larger countries with larger industries and higher state budgets provide higher funding does not appear to apply at first sight. While the German Government has to date invested €200 million in its platform, the Italian *Industria 4.0* and the French *Alliance industrie du futur* have invested €18 billion and €10 billion respectively.

There are various factors limiting the comparability of the initiatives' budgets. First, the sheer size of the programme is not always indicative of fresh programme funds. Moreover, some initiatives e.g. Italy and France also include tax incentives and additional fiscal measures in their budgets encouraging private investments, which is not the case in Germany and some other countries. It is equally important to remember that funds contributed from the private sector are at times future obligations that have yet to be invested.

Strategic approach

National digitisation initiatives in Europe focus equally on supporting the development of new technologies (R&D dimension) and supporting the deployment and use of existing technologies in industry (deployment dimension), with some initiatives providing a mixed strategic focus. R&D encompasses research projects on new technologies and/or products, while deployment serves to support businesses and/or research organisations in deploying existing technological solutions or creating efficient skills training, such as support actions helping businesses deploy technologies.

Good practice example: IdF's extensive private-sector financing

The French *Alliance industrie du futur (IdF)* relies heavily on private investment, which are the key funding source behind the programme. All of IdF's public financing tools depend on private financing and are deployed to encourage private investment in production lines, R&D etc.

Out of a total investment of 10 billion, the €100 million and €550 million budgets for technological support co-finance up to 50% of private project costs. This also applies to the tax assistance that provides private investment incentives. The public funding spent on tax assistance is expected to induce private investment in an amount seven times higher. In terms of the leverage effect, NFI, the predecessor to IdF, achieved a private financing leverage effect of about 5 overall. IdF is expecting a leverage effect at least as high as NFI's.

Good Practice example: HVMC's one third funding model

The British *High Value Manufacturing Catapult (HVMC)* relies on a tripartite funding model. One third of the budget for the HVMC centres is obtained through core public funding to support investments in capabilities, know-how, expertise and skills, and long-term capital assets.

For the 2015/2016 financial year, €61.3 million in public funding went to HVMC centres, making up 30% of the total budget. In addition, the financing model provides that one third of the budget is sourced from collaborative R&D projects funded jointly by the public and private sector, as a result of UK and EU calls for tenders. Thanks to its balanced funding model, the HVMC is very sustainable. In order to ensure continuous private investment, the HVMC equally developed an in-depth strategy.

Good Practice: The R&D focus of Austria's Plattform Industrie 4.0

The *Industrie 4.0 Österreich platform (PI4.0)* provides ample activities focusing on conducting research in strategic I4.0-related areas. Thematically, the platform is currently organised into six working groups. The working groups bring together members of the association and top-tier experts, e.g. from ministries, funding agencies, standards organisations, etc.).

In addition to research on current and urgent I4.0 topics, the platform's activities involve experimental actions for members, as well as disseminating case studies and best practices. As a one-off, the Working Group on Pilot Factories was set up in order to advise the Austrian Government on the contents of a future project call.

Good Practice: The deployment focus of Belgium's Made Different

The Belgian *Made Different* focuses on deploying technological solutions in local companies. It supports and steers businesses during their transformation into Factories of the Future (FoF). The detailed concept defines seven key areas covering technological, production, sustainability and human-centred aspects.

All these pillars are interlinked and companies must adopt an all-encompassing transformation strategy in order to successfully qualify as an FoF. Around 265 Belgian manufacturing companies are actively participating and have implemented or started to implement one of the seven key transformations.

Good Practice: The mixed strategic approach of Denmark's MADE

The *Manufacturing Academy of Denmark (MADE)* focuses on both R&D and deployment activities to similar extents. Besides its diverse industrial research activities, MADE provides access to state-of-the-art knowledge and hands-on practical experience for manufacturing companies that are not directly involved in the research projects, e.g. through innovation conferences, workshops, R&D laboratory and industrial visits.

The Open Laboratory visits allow companies and academic researchers to gain insights into state-of-the-art technologies in a specific area. Typically, an Open Laboratory involves short presentations, case studies and technology demonstrations.

3.3 Outcomes of policy initiatives

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Most digital transformation initiatives lack clear targets, effective monitoring tools and KPIs

Monitoring tools and KPIs

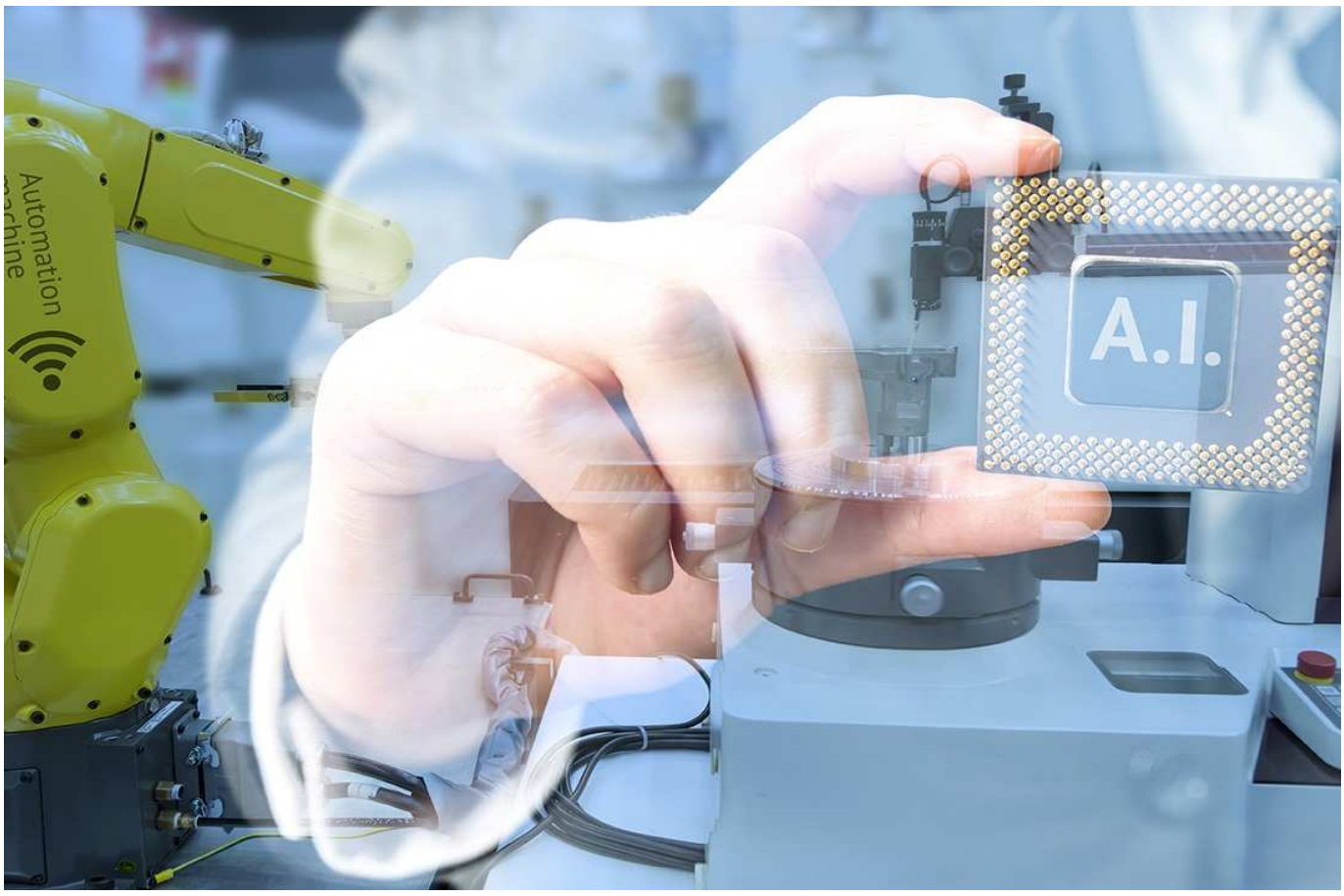
Although the national initiatives are often the result of complex, multi-stakeholder design processes, most of the initiatives are missing an evaluation framework with clear targets and KPIs to measure the success of their initiatives from the very start. In particular, comprehensive evaluation studies assessing whether the initiatives have achieved the results initially targeted are almost non-existent. On the positive side, a number of initiatives are carefully monitoring the outputs obtained by their activities.

The *British High Value Manufacturing Catapult (HVMC)* stands out among all initiatives. Being a Research & Innovation programme by nature, it is perhaps less surprising that HVMC has established clear targets and monitoring and evaluation cycles. The results of the comprehensive evaluation study show that the value of innovation work represented 123% of the original target set in 2013-2015. This indicates that demand for services and support far exceeds initial expectations.

Achieved impacts

Since many of the initiatives were only launched in the last two years, the results and impacts are not equally available for all policies. However, at least one third of examined initiatives can be said to have produced tangible impacts, i.e. the creation of new infrastructures, while almost all policies have led to some form of intangible impacts, i.e. fostering collaboration, increasing digital skills, etc.

For the moment, tangible quantitative results and outcomes are provided by the French, Dutch and Swedish initiatives. For example, the French IdF granted more than 800 loans to companies, while carrying out 3,400 company assessments for modernising production. Meanwhile, the Netherlands set up 30 field labs by the end of 2017, each creating a turnover of between €250,000 and €4 million annually. Last but not least, the Swedish P2030 funded 30 projects, involved over 150 businesses and set up a PhD school.



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Digital transformation: a source of business opportunities with major societal impact

4

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Digital transformation is progressing exponentially thanks to technological advancements influencing our everyday lives in all aspects through newly emerging economic models (circular economy, experience economy, sharing economy, etc.), business models and value chains. It brings many new opportunities to businesses as the DTS survey results show. Nevertheless, it also includes challenges. Business leaders are still struggling to implement effective strategies to use the digital world as a source of innovation for their customers or users. In addition, the need for up/reskilling is widely recognised at all levels. If companies want to fully exploit the tremendous opportunities brought by digital technologies, they must start setting up new forward-looking training programmes in order to create the digital savvy workforce they need. In addition, policy makers at all levels (EU, national and regional) should continue putting in place bold policy initiatives aiming at establishing the right framework conditions for raising the next-generation sector-specific workforce.

4.1 A first pack of digital technologies has already been adopted by EU firms, but the multi-modal adoption of newer technologies is still at an early stage

More opportunities to be exploited

Nearly 9 out of 10 European companies consider digital technologies an opportunity. According to the DTS survey results, European firms (i.e. doing business in the **construction and agri-food sectors**) seem to understand the opportunities being brought about by digital transformation, by adopting different digital technologies into their business models. These technologies are increasingly adopted mainly to better understand the needs of their customers by providing customised innovative solutions, and to stay competitive by increasing revenues and profitability while cutting operational costs. In fact, more opportunities are waiting to be exploited not only for economic benefits, but also to simultaneously tackle **societal challenges** through the **multi-model adoption** of new-generation digital technologies in particular thematic topics. For instance, in the thematic topic of '**sustainable production and consumption**', which covers the agri-food industry, different technologies can be adopted simultaneously to exploit further opportunities, as shown by PwC's analysis below[8]

Multi-modal integration of digital technologies must have a purpose

Essentially, the nine technologies being assessed under the DTS should be considered under different categories of purpose such as input, processing and output. For instance, big data, IoT and social media are mainly inputs; AI, blockchain, big data analytics and cloud are for processing; 3D printing and mobile services can be considered outputs; while robotics and cybersecurity may fall under all three areas. Thus, complementarities should be sought between different technologies before adopting an individual one.

Figure 4.1: Overview of technologies used in sustainable production and consumption[8]

Further efforts are needed to unlock the full potential of the opportunities offered by digital technologies

Even though the opportunities offered by the digital economy are widely recognised, only a few of the European companies surveyed are taking full advantage of them.

An increasing yet slow adoption rate of new digital technologies

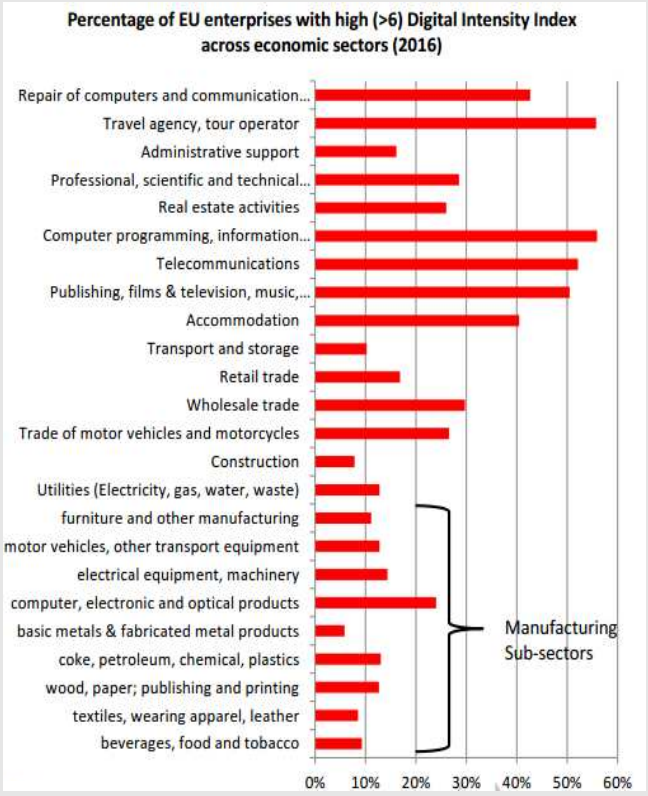
67% of respondents to the 2018 DTS **have adopted at least one technology,** while **35% have adopted more than two**. This observation shows a slight increase over last year (from 62% adopting a single technology). This can be interpreted as increased leverage on digital technology adoption. However, the multimodal adoption is progressing at a slow pace.

This year, **social media, big data and analytics**, and **cloud** technologies are the most commonly adopted digital technologies among the nine technologies assessed by the survey participants, with 31%, 24%, and 23% adoption rates respectively, as illustrated in figure 4.2. In last year's DTS, focused on the automotive, healthcare and mechanical engineering industries, the top technology being adopted was **mobile services**, with **cloud and social media** in second place, closely followed by **robotics** in third. The differences between the findings of two consecutive survey results, taking into account the different focus industries, can be explained by the fact that the digitisation of economic sectors is progressing at different rates, each with different starting points, specific needs and technological preferences. The difference in the integration of digital technology by different sectors can also been seen in figure 4.3, which contains data taken from Europe's Digital Progress Report.[9] Among the sectors listed with a Digital Intensity Index greater than 6, construction and food manufacturing are low down (below 10%), meaning that they have a slow absorption rate of digital technologies.

Social media taking the lead is a clear indication of increased focus on customer experience through social listening in order to gain deeper insights into consumer behaviour and preferences. The high adoption of **cloud services** in both years can be interpreted as the widespread deployment of **service-based business models such as SaaS, PaaS and IaaS** being offered by cloud technologies in addition to the flexibility, elasticity, security, pay-as-you-go service opportunities, and cost-cutting features in hardware. Cloud computing supports big-data processing, which demands enormous computer resources for relatively short durations, so it is not surprising to see these two technologies among the top 3.

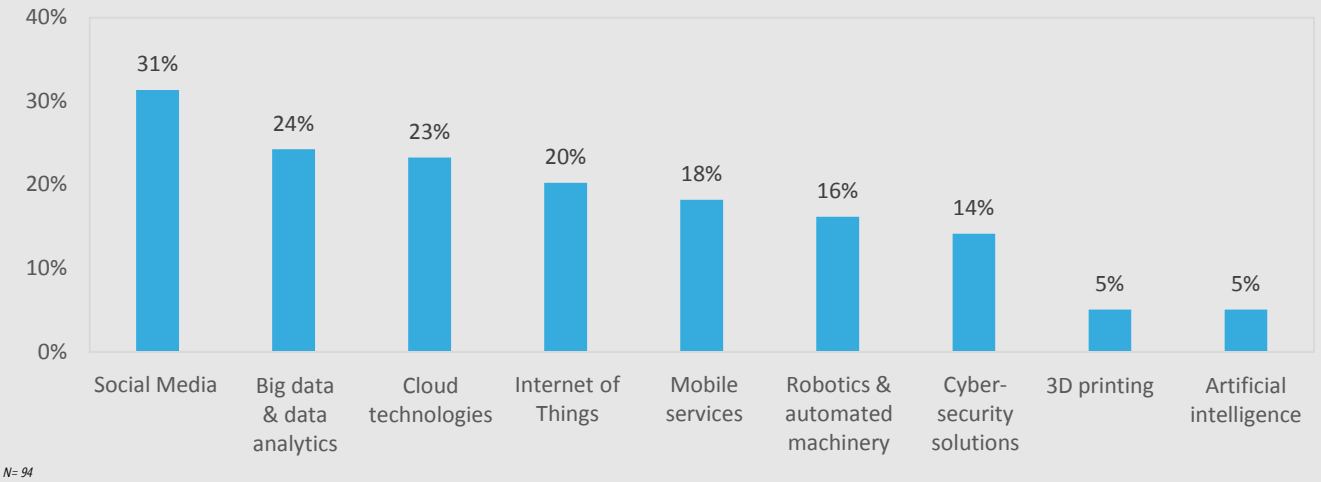
35% of respondents have adopted at least two of the nine key digital technologies

Figure 4.3: Integration of digital technology by different sectors[9]



With cyberthreats ranked among the top 10 threats by CEOs, as shown by PwC's 21st CEO Survey[10], the relatively low adoption rate of **cybersecurity** solutions is astonishing and can only be explained by sectoral characteristics.

Figure 4.2: Level of technology adoption among all survey participants



N= 94
Source: Digital Transformation Scoreboard 2018

4.2 Economic impacts observed from digital transformation

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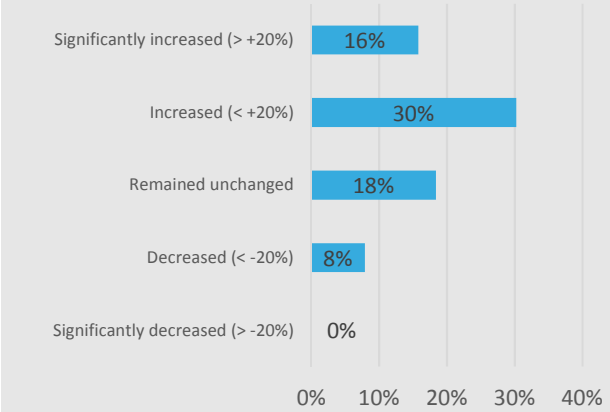
The DTS demonstrates that the companies surveyed which are investing in digital technologies have already seen positive impacts on economic performance in the form of higher annual turnover and lower operational costs.

Technology adoption leads to positive results in annual turnover

46% of DTS participants report a medium to large increase in their annual turnover over the last three years following the adoption of technology, while for 18% have not yet seen any positive impacts, as shown in figure 4.4.

Figure 4.4: Impact of technology adoption on annual turnover (last 3 years)



N= 76
Source: Digital Transformation Scoreboard 2018

In essence, many of the European firms that achieve digital transformation have seen, in general, a positive or at least stable pattern on their turnover (about 65%) which can be linked to gains in labour productivity. Additionally, the integration of new digital technologies such as social media, big data and analytics, and cloud technologies enables digital adopters to act more quickly on business opportunities and to increase and maintain the customer base, which can ultimately translate into turnover growth as well.

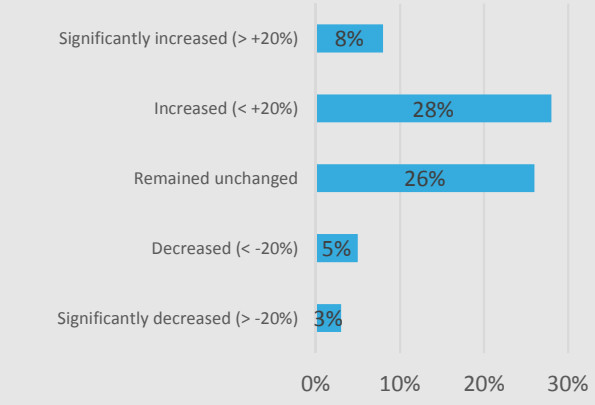
46% of companies investing in digital technologies have seen an increase in their annual turnover

8% of companies investing in digital technologies have seen a decrease in their operational costs

Impact on operational costs

Among DTS respondents, **only 8% of technology adopters have seen a decrease in their operational costs**, while **36% reported an increase** (figure 4.5). This increase can be explained by potential investment in skills development, training and process adjustments. It may also be too early to see long-term cost-reduction benefits. In theory, by exploiting digital tools (e.g. big data and analytics for predictive maintenance), businesses are expected to reduce operational costs by increasing flexibility and reducing uncertainty. Digitally enabled businesses can also create value whilst helping reshape internal processes, enabling companies to transform into lean and efficient organisations.

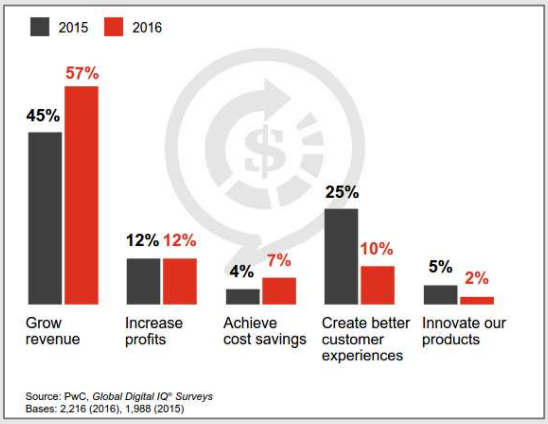
Figure 4.5: Impact of technology adoption on operational costs (last 3 years)



N=76
Source: Digital Transformation Scoreboard 2018

Essentially, as shown by the **PwC Digital IQ survey** results[11], **growth in revenue** is the most dominant expected value among CEOs investing in digital technologies, as seen below. Nearly three quarters cited **revenue growth as a top benefit** of their digital initiatives, followed by **increased profits** (47%) and **reduced costs** (40%). Disruption is seen as a lower priority at the moment.

Figure 4.6: Benefits of digital initiatives[11]



Business functions being improved by digital adoption

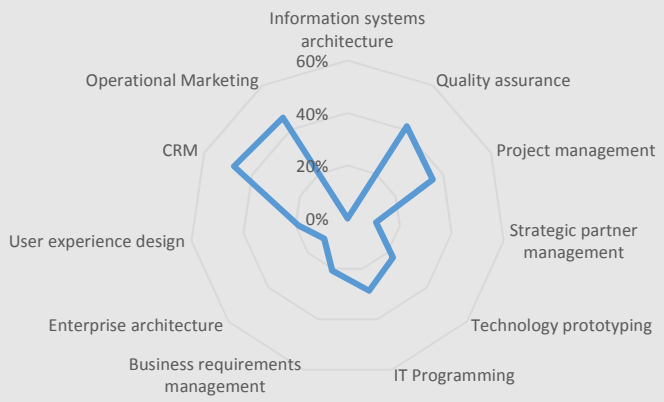
The DTS aims to provide insights on different business functions aiming to be improved by the adoption of diverse digital technologies. It also sheds light on the drivers behind digital adoption in EU businesses.

EU companies are adopting some of the digital technologies mainly to improve their business functions, rather than transforming

As seen in figure 4.7, the main reasons for companies surveyed adopting digital technologies were twofold:

1. To improve their **external business functions**: **customer relationship management (CRM)** system or strategies enabling client interactions to be better managed, dealing with future and current customers, optimising and systemising relationships, and **operational marketing** aiming to improve sales volumes by better understanding and attracting customers;
2. To improve their **internal functions**: **quality assurance** and **project management**.. The former explains the wide adoption of **social media**, while the latter explains the widespread adoption of **big data and analytics** combined with **cloud** technologies to improve internal functions. Compared to last year's findings, this year's survey indicated a shift in focus from internal towards customer-centric external functions.

Figure 4.7: Business functions improved by technology adoption



N=101
Source: Digital Transformation Scoreboard 2018

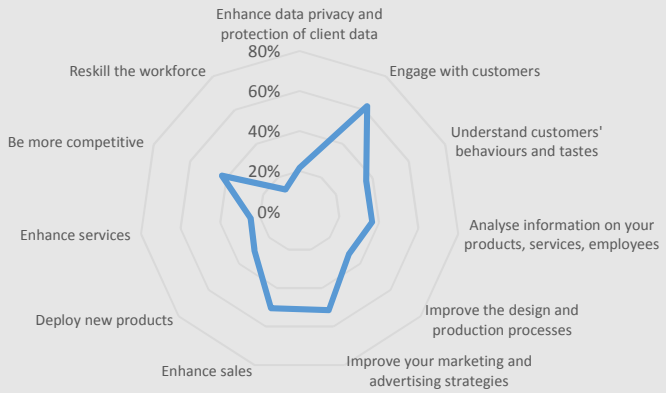
48% of respondents invest in digital technologies to improve their CRM operations

Drivers of digital adoption

Main rationale: increase sales by improving marketing strategies through better engagement with customers

The main driver for the industry – putting more leverage on **social media, big data analytics and cloud** – is based on the well understood importance of **better engaging with customers** through social listening to be able to adapt quickly according to their fast-changing behaviours and preferences (see figure 4.8).

Figure 4.8: Objectives of digital adoption



N= 101
Source: Digital Transformation Scoreboard 2018

As indicated by the **2017 PwC Digital IQ Survey**[11], **customer-centric** businesses that focus on creating better customer experience report better digital strategies and stronger financial performance. Thus, company leaders expecting to unlock value from digital investments are strongly recommended to put **more focus on human experience**, including employee-customer interactions, at every step of the business process.

20% of respondents have appointed a Chief Digital Officer (CDO)

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The survey results confirm the rise of the appointment of a Chief Digital Officer (CDO) from 12% to 20% over two years, yet the pace has slowed, contrary to the will of businesses to transform themselves. 79% have included the adoption of digital technologies in their innovation strategies. The **2017 PwC Digital IQ Survey**[11] results are in line with this finding, whereby only 7% of all organisations had a leader with the title of CDO. Currently, CEO and CIO remain the digital leaders of their organisations, with near-sole control over digital strategy, investment and innovation. CIOs are taking increasing responsibility over digital activities. Considering the importance of consumer experience, the emergence of Chief Experience Officers (CXOs) in the C-suite is also expected.

4.3 Digital up/reskilling: recent narrative for European governments and businesses

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57% of survey respondents believe they have gained the necessary skills over the last 3 years to adopt new digital technologies

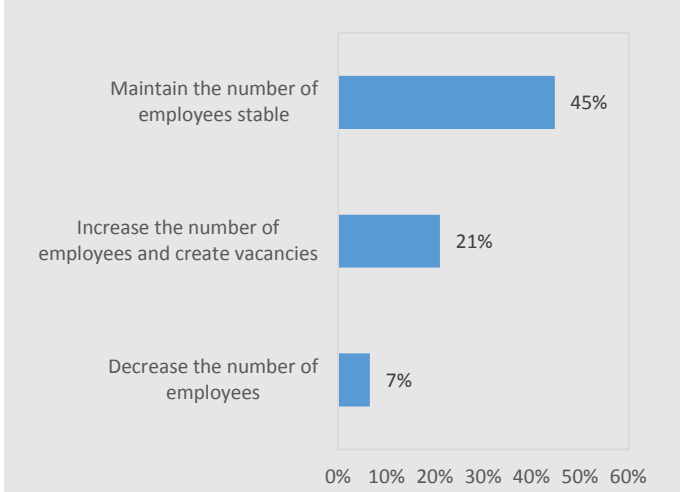
Job demographics: creation outpacing destruction

Job destruction vs creation is still an ongoing debate with different perspectives and projections [12], [13], [14]. This is due to the merging of the digital, physical and biological realms at a time when we are experiencing the Fourth Industrial Revolution thanks to the emergence of more advanced technologies and the multimodal adoption of existing ones, which is causing societal shifts by having an effect on economics, values, identities and possibilities for future generations.

Job creation continues to increase

The DTS findings demonstrate that the adoption of digital technologies is not necessarily leading to job destruction – at least so far. On the contrary, **integrating digital solutions has mostly enabled technology adopters to either keep their employee numbers stable or increase them**. Overall, the job creation rate rose from 10% last year to 21%, while the rate of employee numbers remaining stable or increasing rose from 54% to 66%. This should lessen the fear of jobs being lost through digital transformation. Essentially, the shift in existing job definitions and the emergence of new skill sets require **continuous up/reskilling** to meet the needs of evolving digital economy.

Figure 4.9: Impact of digital adoption on employee numbers



N= 113
Source: Digital Transformation Scoreboard 2018

66% of technology adopters have maintained or increased their employee numbers

Up/reskilling the workforce to be able to fulfil newly emerging job opportunities and ensure lifelong employability

According to DTS findings, **57%** of the companies surveyed **believe that they have the necessary skills to adopt new digital technologies**, while the remaining **43% are either unaware or lacking the necessary skill set** for digital transformation.

Digital skills (gap) in the EU

Even though the survey results are not overly pessimistic, the lack of digital skills ('skills gap') across both the general EU population and the labour force specifically is well documented. The populations of almost half the EU Member States fall below the EU average in terms of Digital Competence while the other half sit above it.[9]

The figures below[15] illustrate the significance of the situation and highlight the need for up/reskilling the workforce to be able to fulfil newly emerging job opportunities and ensure lifelong employability, both of which are key narratives of the EU.

17% of Europeans had never used the internet in 2017

35% of the labour force in Europe lacked adequate digital skills in 2017

Source: http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database

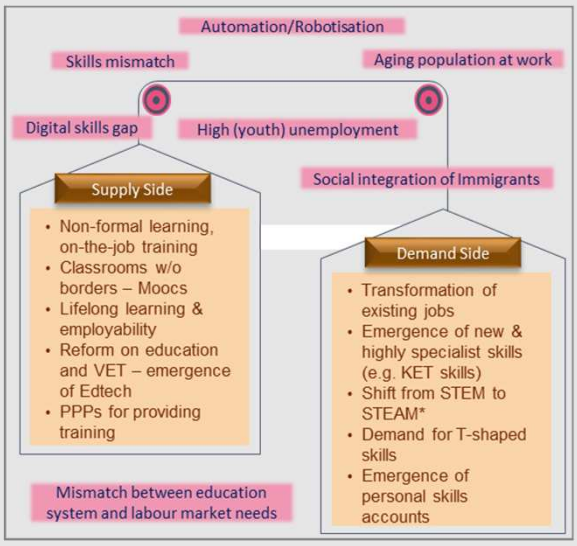
As underlined under the renewed EU Industrial Policy, a prosperous Europe needs a successful industry with a strong manufacturing base, which requires modernisation embracing digitisation and technological change, integrated products and services, development of less polluting and less energy-intensive technologies, reduction of waste and so investments in a workforce with the right skills.

Individuals must therefore engage in life-long learning not only to remain employable but also to achieve fulfilling and rewarding careers. Likewise, employers should not solely rely on new workers with the right ready-made skills but invest on workforce up/re-skilling as a beneficial investment even in the absence of skills-shortages. For policy makers, fostering continuous reskilling and lifelong learning across the economy is quite critical in order to maintain a labour force equipped with the right skills needed to boost sustainable, smart and inclusive economic growth.

Emerging trends in skills, education and VET

The figure below illustrates emerging trends as regards supply and demand for skills and the key challenges associated with it.

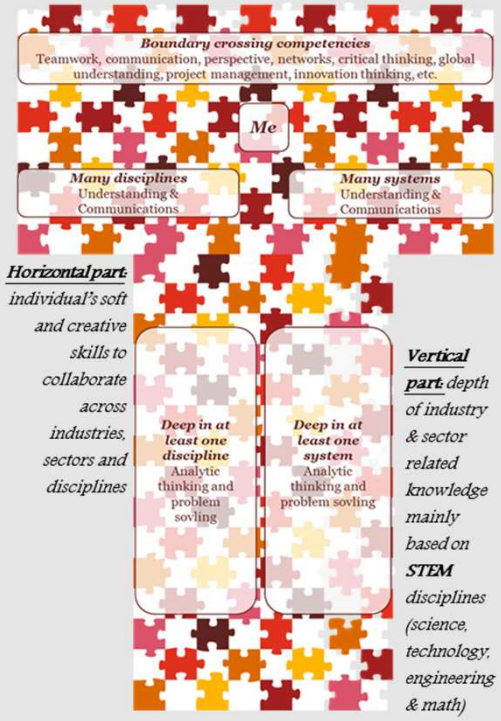
Figure 4.10: Supply and demand trends for skills[16]



*STEAM: *Science, Technology, Engineering, Arts and Mathematics*

In order to adapt to the change caused by digital transformation, the worker of tomorrow must have leadership and entrepreneurship skills combined with research and innovation skills. This will encompass a range of skills, from technical, academic, sectoral and digital skills to softer skills like problem-solving, creative and design thinking, communication, emotional intelligence, multicultural openness, leadership, managerial and interaction skills.[17] This new concept is defined as **T-shaped skills**, as illustrated below.

Figure 4.11: T-shaped skills



EU Policy Framework

'A New Skills Agenda for Europe: Working together to strengthen human capital, employability and competitiveness' [18]

The New Skills Agenda launched by the EC in 2016, which aims to strengthen HC and competitiveness is centred around three key work strands:

1. Improving the quality and relevance of skills training
2. Making skills and qualifications more visible and comparable
3. Improving skills intelligence and information for better career choices.

Progress continues under **10 Flagship Initiatives**.[19] Among these, the EC will support MSs implementing **upskilling pathways** for up/reskilling **adults with low skills levels** (e.g. without upper secondary education and ineligible for youth guarantee support), whether they are employed, unemployed or economically inactive.

The Commission is working with EU MSs and other interested parties to revise **EQF** so as to achieve a better understanding of **qualifications** and make better use of all available skills in the European labour market.

The **Digital Skills and Jobs Coalition** aims to: train 1 million young unemployed people for vacant digital jobs through internships/traineeships; support the upskilling and retraining of the workforce; modernise education and training to give all students and teachers the opportunity to use digital tools and materials in their teaching and learning activities; reorient and make use of available funding to support digital skills and raise awareness of the importance of digital skills. The '**Digital Opportunity Scheme**' has recently been developed and will be effective from June 2018; it will enable industry to provide on-the-job training for digital skills to young people supported under the Erasmus + Programme.

The **Blueprint for Sectoral Cooperation** aims to improve skills intelligence and address skills shortages in specific economic sectors – automotive; maritime technology; space/geoinformation; textiles, leather clothing and footwear; and tourism. It was launched in 2017 and in 2018 will continue focusing on additive manufacturing, construction, maritime shipping, the paper-based value chain, renewable energy and green technologies, defence, and the steel industry.

Under **Key Competences for Lifelong Learning**, the EC recommends that MSs enable teaching and learning of 8 key competences (communication in a mother tongue and in a foreign language; mathematical, scientific and technological; digital; learn to learn; social and civic; entrepreneurship; and cultural awareness) as part of their lifelong learning strategies, which are fundamental for each individual in a knowledge-based society.

The **Digital Education Action Plan**[20] sets out how education and training systems can make better use of innovation and digital technology and support the development of the digital competences needed for life and work. The Action Plan has a specific focus on initial education and training systems and covers schools, vocational education and training (VET) and higher education, with the following priorities for action:

1. Making better use of digital technology for teaching and learning
2. Developing relevant digital competences and skills
3. Improving education through better data analysis and foresight.

The way forward

The EU-level actions summarised above do not suffice alone. Success depends on the commitment, collaboration and expertise of many players, such as national governments, regions, local authorities, industry, academia, foundations, professional bodies, workers and civil society, and people themselves, seizing opportunities to make the best of their talents. Thus, collaborative efforts between the aforementioned stakeholder groups in the form of PPPs is needed, accompanied with public-private funding. In these efforts to design, implement and upscale education and training programmes across all age groups for up/reskilling, sustainability, social inclusion and integration should be kept in mind for achieving smart, sustainable and inclusive growth in the EU.

Digital transformation in selected industries

5

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The 2018 Digital Transformation Scoreboard survey focused on two industries – food and construction – that are essential to Europe's economy and in which SMEs constitute a large share of added value and employment at EU level. Yet, and as illustrated by the survey´s results, these two industries are still lagging behind in terms of digital transformation. Efforts still need to be made regarding the widespread deployment of digital tools and platforms and management capabilities in these industries. This is especially critical in light of the profound impact that the advent of digital technologies has already in these industries, which will only increase with the penetration of new and disruptive technologies. This chapter presents key insights into the impact of new digital technologies on these two industries and the directions needed to be taken to shape their different stakeholders' response to emerging digital challenges and opportunities faced by their leaders.

5.1 Awareness of the digital economy

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91.3% of respondents in the construction sector believe there are business opportunities in the digital economy

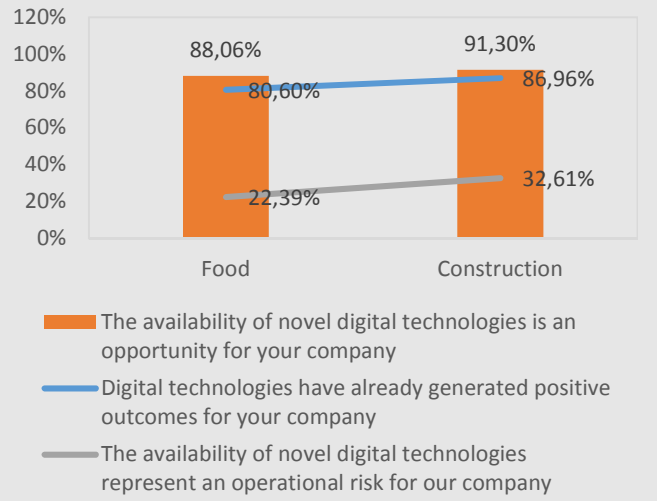
The omnipresence of digital technologies: an opportunity for EU companies

The digital age and the omnipresence of digital interactions and connectedness open doors to a multitude of business opportunities for European companies. According to the results of the survey, **89.3% of companies state that they are fully aware of the new prospects brought about by the digital revolution**. A **further breakdown of this result by industry** reveals that 91.3% of business leaders in the construction industry say they are aware of the potential of digital technologies, while in the food industry the awareness rate is slightly lower at 88%, indicating that the construction industry is more ready to engage in its digital transformation.

EU companies perceive new digital technologies as an opportunity and not a threat

Digital transformation does not happen on its own. Being aware of the benefits of digital technologies is not enough and cannot serve as an indication of a firm's ability to transform digital opportunities into concrete results. The survey results show that **87% of companies in the construction industry state that they have already seen positive outcomes through digital technologies**, while the share is slightly lower in the food industry (81%). Although it is impossible to determine whether these positive outcomes were generated by adopting one or more of the nine key technologies discussed in Chapter 6 of this report or by adopting other technologies, this observation provides evidence as to the ability of European businesses in these two industries to take full advantage of the opportunities offered by digital technologies by translating them into tangible results.

Figure 5.1: Share of businesses that consider the digital economy an opportunity (by industry)



N=113
Source: Digital Transformation Scoreboard 2018

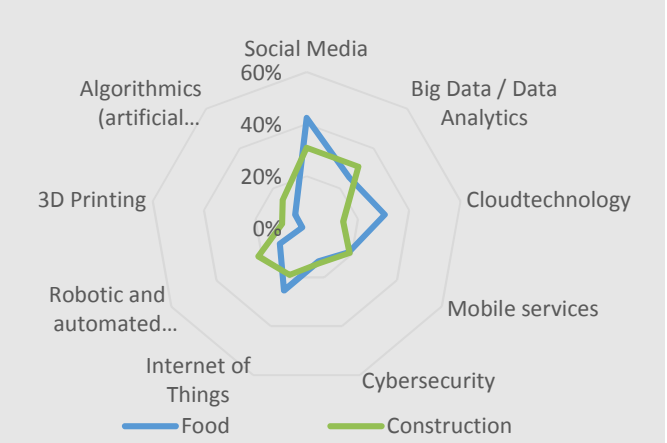
"We were the first olive oil company to establish an online traceability system from tree to bottle. It was – and it still is – a strong marketing tool for us. It has really helped us gain a better position than our competitors"

Emmanouil Karpadakis, Marketing Manager at Terra Creta (olive oil producing company, Greece)

A slow digital adoption pace

The results of the 2018 survey show that the pace of digital adoption processes differs significantly across the two industries studied. In the food and construction industries, European businesses aware of the importance of the digital economy have integrated specific digital technologies at different and variable rates, ranging from 1.7% in 3D printing to 42.4% in social media for the food industry, and from 9.5% in 3D printing to 31% in big data and analytics in the construction industry.

Figure 5.2: Use of digital technologies by industry



N= 101
Source: Digital Transformation Scoreboard 2018

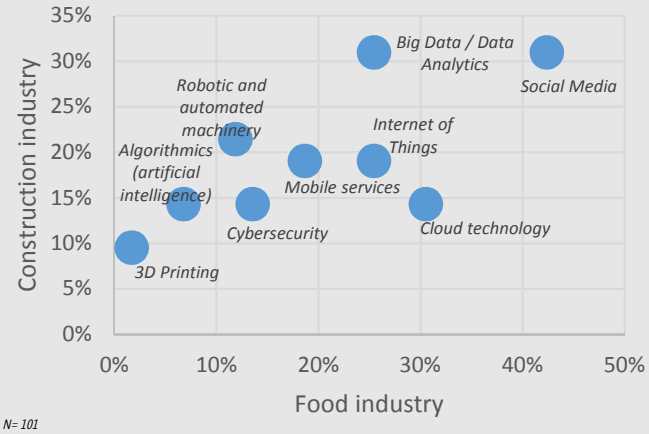
Different industries have different needs for digital technologies

Both the food and the construction industries have different needs in terms of key digital technologies, and the level of digital adoption depends greatly on these needs. The adoption of social media, cloud technologies, big data and analytics and the Internet of things is progressing rapidly, with between 25% and 45% of companies in the construction industry adopting these technologies, while in the case of the food industry, the key digital technologies adopted by more than 20% of the companies are social media, big data and analytics, and robotic and automated machinery.

These differences in the adoption of key digital technologies indicate that different needs are prioritised in each industry. For instance, the need for robotic and automated machinery is higher in the food sector than in the construction sector due to the nature of the production processes in this industry. Interestingly, both industries adopt social media technologies at a high rate, which may imply that there is a greater need to engage with customers than to improve production processes; while on the contrary, in both industries, 3D printing technology is only adopted by a low percentage of firms in each industry, with a slight larger share in the construction industry.

32.6% of respondents in the construction industry think that the availability of novel technologies poses an operational risk for their company

Figure 5.3: Differences in the use of digital technologies by industry



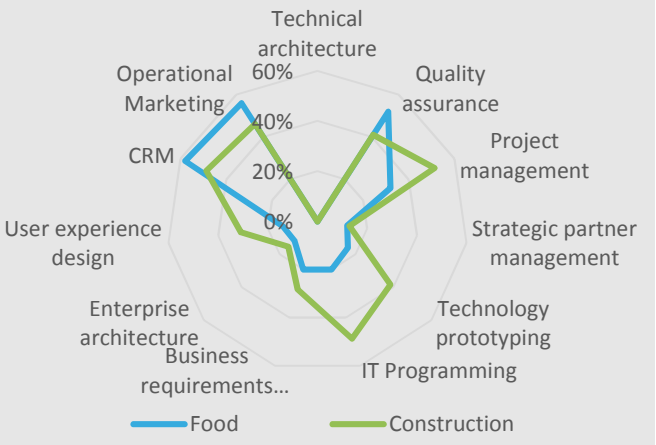
N= 101
Source: Digital Transformation Scoreboard 2018

Digital transformation affects different functions in different industries

The adoption of digital technologies affects different business functions within companies. In general, CRM, operational marketing, and quality assurance are the most affected functions in the food industry, while in the construction industry these functions are mainly project management, IT programming, CRM, and operational marketing.

These functions are not only oriented towards manufacturing and supply within businesses, but also towards their marketing strategies. Therefore, the digital transformation of businesses in these two industries affects not only key functions related to the demand side of the industry (e.g. CRM, operational marketing), but also key functions related to the supply side (e.g. IT programming and project management).

Figure 5.4: Functions affected by digital adoption by industry

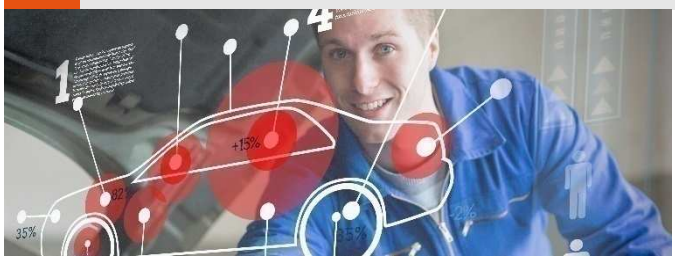


N= 89
Source: Digital Transformation Scoreboard 2018

"Our company has already started to adopt digital technologies such as social media, mobile services, and Internet of things. We are now trying to improve our use of big data and analytics."

Francesco Panzera, Export Account Manager at Caffè Morettino
(artisanal slow coffee producing company, Italy)

5.2 Skills to harness the potential of digital technologies



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Availability of digital skills

The lack of digital skills in the job market across Europe no longer seems to be an insurmountable obstacle to the uptake of digital technologies by the industry. It is common to see that even though only a fraction of companies have access to the right skills needed to engage in digital transformation, they can often outsource their digital work (e.g. produce a digital strategy and ensure its implementation), and therefore still access the appropriate skills required by the digital economy.

"It is not difficult to find people who have the digital profile we need. In addition, if some applications require more advanced digital skills, we can outsource them".

Emmanouil Karpadakis, Marketing Manager at Terra Creta (olive oil producing company, Greece)

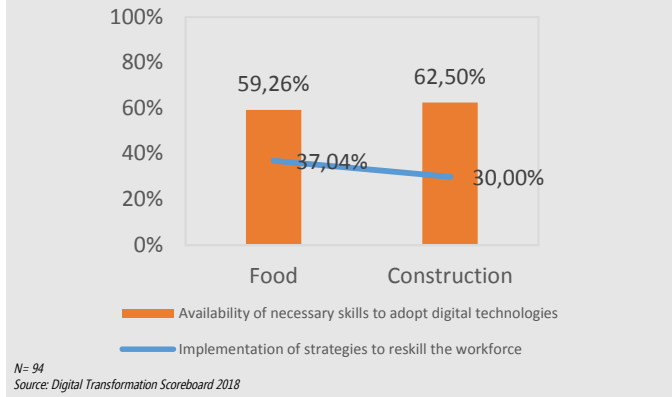
Digital skills are currently often perceived as assets with increased specific characteristics, and access is usually granted through outsourcing processes. As the digital transformation of the European industry advances over time, we can expect to observe insourcing trends, provided that the EU continues its efforts to implement policies and initiatives aiming at making it easier to upskill, reskill and train the population.

Defining upskilling and reskilling strategies to accelerate digital transformation processes

Digital transformation relies heavily on the ability of businesses to obtain and develop the right talent with the required skill set to fully participate in the digital economy. Consequently, combined efforts from both public and industry players are necessary to upskill the working population.

The DTS survey reveals that **59.2% of companies in the food industry and 62.5% in the construction industry state that they have the necessary skills to harness a digital transformation**. This observation shows that more than one in three companies in these two industries in Europe struggle to find the human resources needed to exploit the opportunities offered by the digital economy. Such a digital skills shortage is likely to reduce the competitiveness of European business.

Figure 5.5: Availability of digital skills by industry



N= 94
Source: Digital Transformation Scoreboard 2018

59.2% of respondents in the food sector state that the necessary skills to engage in digital transformation are available

The quest for digital talent ready to hit the ground running

Digital transformation requires not only digital expertise, but also strategic experience and deep knowledge of the industry. These qualities are necessary for businesses to succeed in their transformation. In many cases, businesses already have skilled employees in-house, thanks to whom they can reap the benefits offered by digital technologies once these employees are digitally up/reskilled. Nevertheless, the DTS survey shows that **less than a third of European businesses in the food (37%) and construction (30%) industries have implemented strategies to reskill their workforce.**

"We are currently thinking about developing a digital strategy for our company. We are now looking to hire somebody who would lead us in our digital transformation, but we haven´t found this person yet as he/she should have not only expertise in digital technologies and strategies but also deep knowledge of our industry."

Dimitar Grigorov, Sales Director at EME AD (electric fitting elements and tool equipment producing company, Bulgaria)

Getting investments in upskilling strategies right

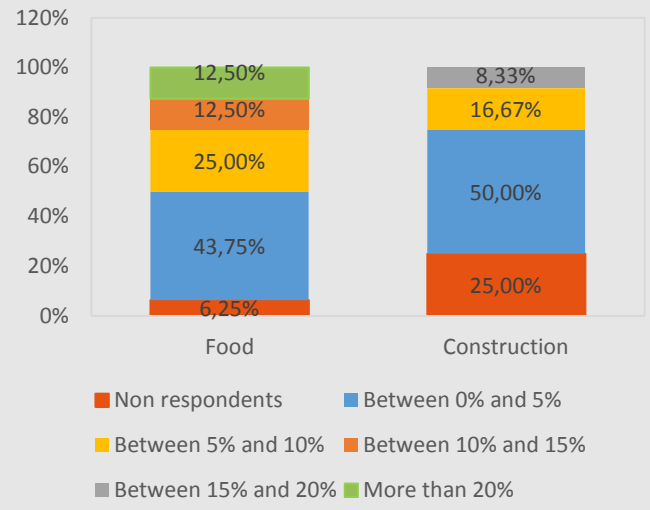
This skills gap urges European companies to review all training and upskilling strategies. Nowadays, employers have to navigate through the complexities of the digital economy where rapid technological advances call for lifelong learning and continuous improvement of employees' skills, keeping in line with the digital economic paradigm. The deployment of reskilling strategies is a key solution to enable employees to carry their companies forward into the digital future. Upskilling strategies are therefore critical investments for any business willing to transform the way in which it operates in a digital economy.

Low investment levels in upskilling strategies

Investing in retraining employees is also a key factor in determining the digital transformation strategy. DTS survey results indicate that the majority of businesses deploying reskilling strategies only spend a small share (of up to 5%) of their annual revenues for this purpose: 43.8% of companies in the food industry and 50% in the construction industry state that they spend between 0% and 5% of their annual revenues in reskilling, while 25% in the food industry and 16.7% in the construction industry report investments of up to 10% of annual revenues. Interestingly, it is in the food sector where a non-null share of businesses (12,5%) state that they invest more than 20% of annual revenues in reskilling and training schemes.

60% More than 60% of respondents have invested less than 10% of their annual turnover in upskilling strategies

Figure 5.6: Percentage of annual turnover invested in upskilling strategies by industry



N= 28
Source: Digital Transformation Scoreboard 2018

Digital technologies: a threat or an opportunity for job creation?

The digital transformation of the European industry is currently giving rise to questions about employability. As widely asserted in economic literature, technological change has always stirred up fear about mass unemployment; these fears still arise today, even when empirical observations show that technological progress has enabled society to achieve greater well-being and be better off. A longer life expectancy, fewer working hours and better health conditions provide factual arguments in favour of the positive impact that technological progress has on society.

There is no doubt about the existence of other additional issues, such as the unequal distribution of created value and the concentration of wealth amongst smaller shares of the population; yet what we are interested in is the opportunities brought about by the digitisation of the European industry. As stated by the International Labour Organization (see the ILO portal on the Future of Work), "the ability of the world economy to create enough jobs will ultimately depend on the policy response brought to global challenges such as the introduction of new technologies, growing inequalities or aggregate demand shortages."

"Digitalisation also entail risks. If everything is automated, what will happen to 2.5 billion low-skilled workers? What will they do?"

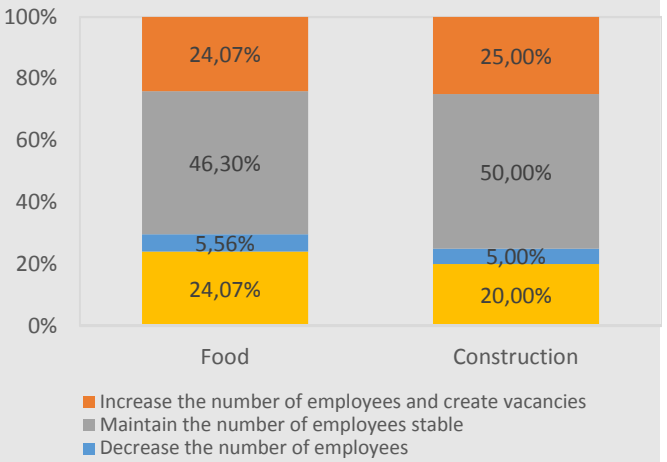
Dimitar Grigorov, Sales Director at EME AD
(electric fitting elements and tool equipment producing company, Bulgaria)

According to the latest survey results, the majority of companies stating that digital technologies have generated positive outcomes also report having **kept their employee numbers stable in recent years**; these companies represent 46.6% of those survey in the food industry and 50% in the construction industry.

Furthermore, 24% of these businesses in the food industry and 25% in the construction industry reported **an increase in their employee numbers**. Either by conjuncture or by actual causality from digital technologies, **this observation helps demystify the correlation between digital technologies and jobs in the digital economy**. On the other hand, a very small share of these companies (5.5% in the food industry and 5% in the construction industry) have decreased their employee numbers, which would indicate job losses. Since the **cumulative share of businesses in the two sectors has a positive relationship with the job market**, these results show that adopting digital technologies has a generally positive impact on jobs.

70% More than 70% of respondents who have seen concrete results from the adoption of digital technologies have at least maintained their employee numbers, or created job vacancies.

Figure 5.7: Impact of digital adoption on employee numbers by industry



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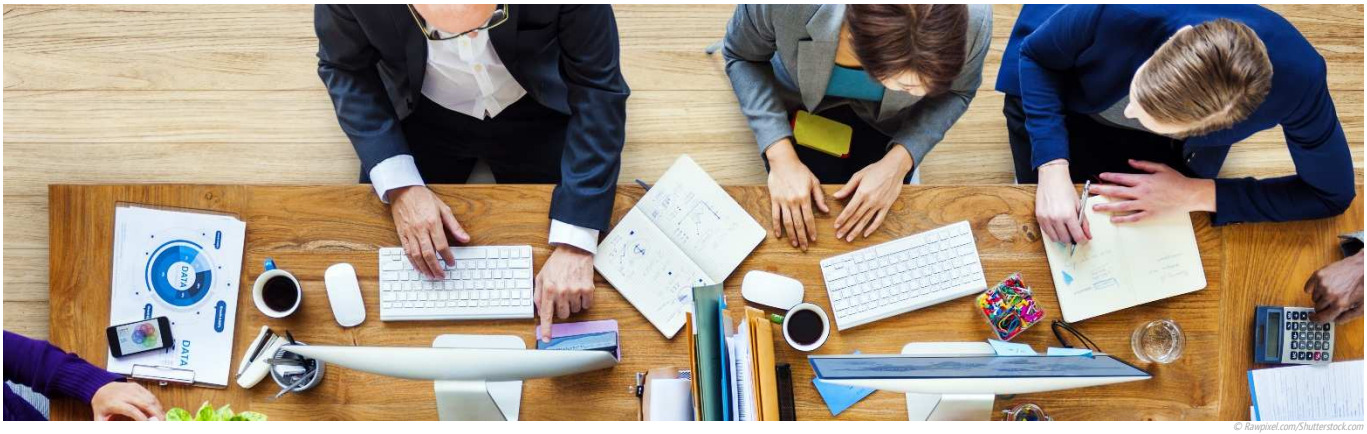
Source: Digital Transformation Scoreboard 2018



5.3 Investment in the take-up of digital technologies

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Investing in the integration of digital technologies

The integration of digital technologies within a businesses production process requires significant investment, which is characterised by:

- strong uncertainty in the short-term and long-term outcome,
- high irreversible costs, associated not only with purchasing technology, but also the associated learning and time to complete operability; and
- low flexibility in terms of future adjustments required if the expected benefits are not felt.

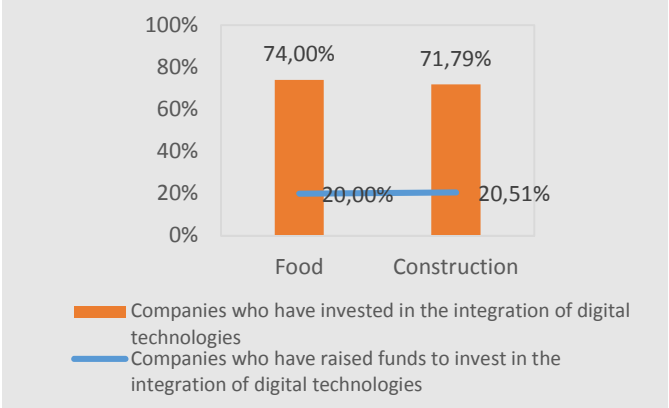
This explains why not all businesses surveyed say they have invested in the adoption of a new digital technology (only 70% in both industries). In addition, there are differences between companies that have actually raised money to invest in digital technologies (only about 20% of companies).

Finally, investing in the integration of digital technologies involves not only taking into account the benefits they bring to an individual business, but also the base of businesses using the technology and the capacity of the technology to generate benefits for any user. For instance, if the scale of a business does not meet the threshold beyond which benefits can be generated, then the adoption process itself slows down across the industry.

"I was once in contact with a company specialising in extracting value from data trafficking on e-shops, but it is not really an option for us. In order to get something out of it, you really need to have access to massive amount of data. Our e-shop does not generate so much data as we are a very small food company – 25 employees – that sells a limited number of different products"

Magdalena Szafarz, Project Manager at diet-food
(superfood producing company, Poland)

Figure 5.8: Investment in digital technologies and funding raised for digital investments by industry



N= 89
Source: Digital Transformation Scoreboard 2018

70% More than 70% of respondents indicate to have invested in digital technologies to improve production processes

Main objectives behind investment in digital technologies

Businesses are investing in the integration of digital technologies to ensure success in their digital transformation. In general, businesses in the food and construction sectors have made investments to adapt their infrastructure, organisation and governance approaches.

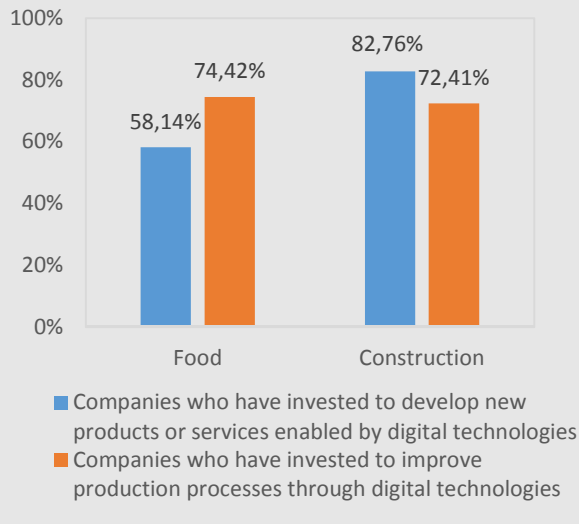
Their objectives are **to develop new products or services** (54.8% in the food industry and 82.7% in the construction industry) enabled by novel digital technologies, and **to improve their production processes** (74.4% in the food industry and 72.4% in the construction industry) through technology use.

However, improving business processes or developing new products requires several functions to be consolidated at firm level. For example, automating an industry brings significant challenges. Installation a fully automated assembly line requires ensuring that all parts to be assembled are of top quality and correspond to the parameters defined for assembly. If these conditions are not met, the benefits brought by automated lines will quickly become problems. This quality problem is even more acute if production parts are bought from several external providers.

"If we want to transform digitally all of our processes, it will be very expensive. What we do is to automate the production line for one product at a time. The problem with this approach, is that we cannot adapt the line easily if the product changes, for example due to a new customer requirement. We then risk having invested in automation for nothing."

Dimitar Grigorov, Sales Director at EME AD
(electric fitting elements and tool equipment producing company, Bulgaria)

Figure 5.9: Purposes of investment in digital technologies by industry



N= 72
Source: Digital Transformation Scoreboard 2018

Focus on the nature of invested funds

The capacity of European businesses in the two industries to raise funds for implementing their digital transformation strategies is quite limited, as previously described. Nevertheless, there is an interest **in understanding the nature of funds invested** to ensure success in the digital transformation process.

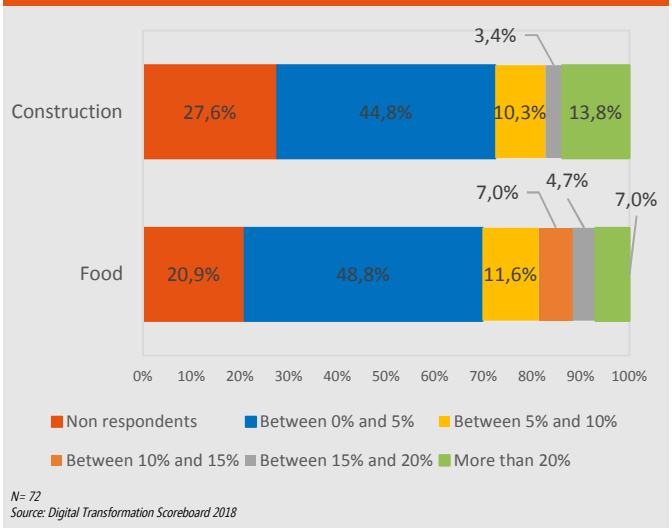
Distributing the use of private funding in order to integrate digital technologies shows that the vast majority of companies in both industries have a low intensity of private funding (less than 5%) in terms of percentage of annual revenues (48.8% of companies in the food industry and 44.8% in the construction industry) for digital transformation purposes.

The picture is slightly different in the case of public funding, where only a proportion share of companies stated that they have used public funding. We also see a low intensity of public funding, where 32.2% of businesses in the food industry and 10.3% in the construction industry (representing nearly half of respondents using public funding) reported an intensity of less than 5% of annual revenues from public funding used for digital transformation.

"We rely on different types of investments to finance our digital transformation such as self-financing, European funds and public funding programmes for digital transformation."

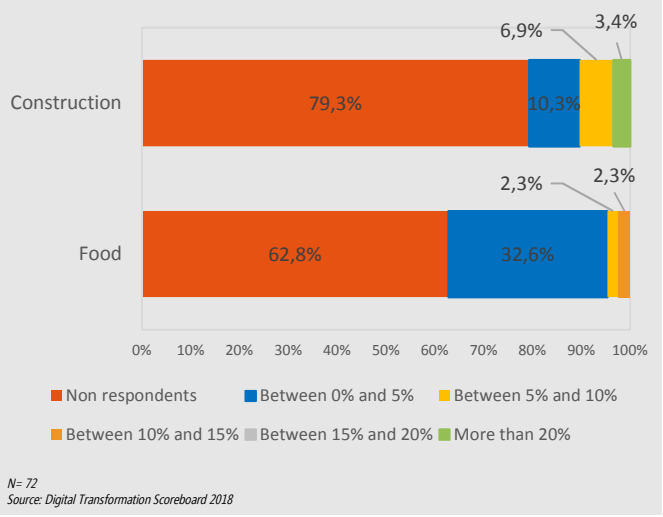
Francesco Panzera, Export Account Manager at Caffè Morettino
(artisanal slow coffee producing company, Italy)

Figure 5.10: Use of private investment for integrating digital technologies by industry



N= 72
Source: Digital Transformation Scoreboard 2018

Figure 5.11: Use of public funding for integrating digital technologies by industry



N= 72
Source: Digital Transformation Scoreboard 2018

"We function on a self-funding basis when we have to invest in digital technologies in our company. We want to stay independent and we therefore do not seek financial support from public bodies or private investors."

Dimitar Grigorov, Sales Director at EME AD
(electric fitting elements and tool equipment producing company, Bulgaria)

"We organise workshops on cybersecurity and social media for family business owners. These two technologies are very important for them, but they often do not understand what they entail and how they can benefit from them."

Kasia Gierczak-Grupińska, President of Fundacja Firmy Rodzinne
(family business support organization, Poland)

5.4 Integrating digital technologies into a firm's long-term strategy

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85% of respondents in the construction sector have integrated digital technologies into their innovation strategy

General strategies

Today, most businesses understand that digital technologies present significant opportunities to improve efficiency, identify new product and management options, and expand their customer base. Nevertheless, they must redefine both capabilities and organisational structures in order to benefit and grow from digital as it evolves. Having a cohesive and long-term digital strategy is therefore key to ensuring future growth and facing competitiveness threats.

Adopting this perspective, **more and more companies will need a leader with a title of CDO**, who would own and drive digital strategy across the entire organisation and help it extract value for the business. In addition, as the digital economy relies on information with the characteristics of a public good (a non-depletable and non-excludable resource), **digital leaders will need to rely on collaborative processes** enabling flow and be seized upon to review and validate their strategic vision.

"We cannot say we have a digital strategy. We have a strong vision and we know where we want to go. We are just using the tools that are available to reach our objectives".

Emmanouil Karpadakis, Marketing Manager at Terra Creta (olive oil producing company, Greece)

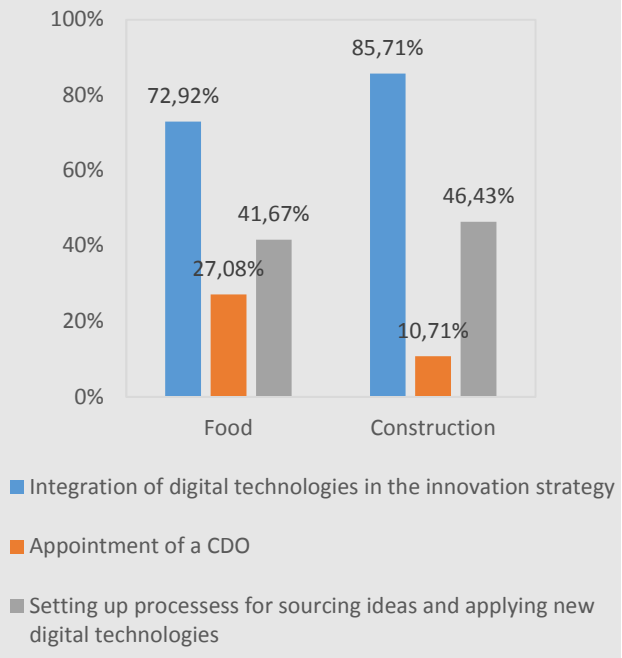
Chief Digital Officers are still not perceived as critical for digital transformation

Results from the survey indicate that digital strategies within businesses do integrate the concept of digital technology adoption, although the implementation of their digital transformation does not seem to follow a top-down strategic perspective in the construction industry, where **only a small proportion of businesses (10.7%) have appointed a digital leader**, such as a Chief Digital Officer. This observation contrasts with the situation in the food sector, which is more likely to have integrated a top-down approach and for which 27.1% of companies have appointed a CDO.

Nevertheless, **businesses do seem to recognise the importance of establishing new processes for sourcing ideas and applying new digital technologies to solve business problems**. A significant proportion of businesses that have adopted digital technologies have integrated the adoption into their innovation strategy, while a smaller yet still sizeable amount have set up collaborative processes to source ideas and apply these technologies (41.7% of businesses adopting digital technologies in the food industry, and 46.4% in the construction industry).

This observation highlights the importance of digital strategies that not only integrate adoption processes, but also recognise the importance of collaborative processes to harness the potential and opportunities brought about by digital transformation.

Figure 5.12: Digital strategies by industry



N= 76
Source: Digital Transformation Scoreboard 2018

27% of respondents in the food sector have appointed a Chief Digital Officer

Digital platforms: threat or opportunity?

Digital platforms e.g. market places, infrastructure platforms are nowadays essential to every business value chain: they offer new value propositions and create new business opportunities by increasing efficiency through data exchange. However, they can be controversial, as they are often perceived as dominant players at risk of abusing their preferential position in B2B relationships. They often attract criticism due to the increasing amounts of value they capture and the lack of transparency regarding the ways in which they collect and exploit data.

"We have adopted cloud technology to a certain level, but we could do more, especially when it comes to exchanging information with our distributors across the globe. Exchanging data and information through the cloud is reliable and fast. Adopting the technology could therefore help us increase our efficiency."

Emmanouil Karpadakis, Marketing Manager at Terra Creta (olive oil producing company, Greece)

European businesses are mostly positively disposed towards digital platforms

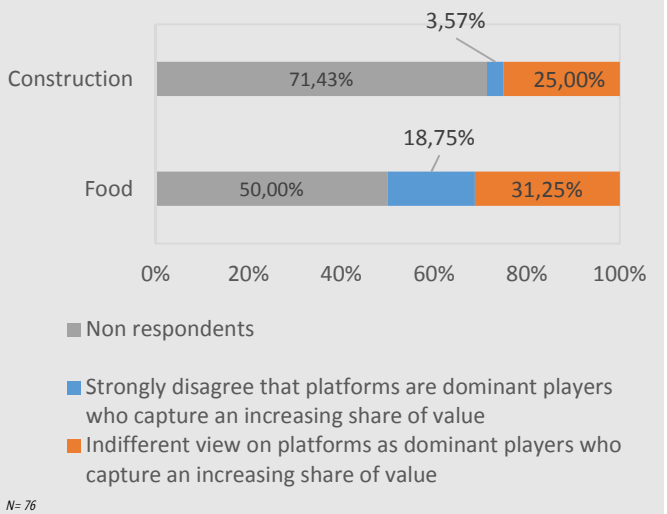
DTS survey results show that the respondents do not consider digital platforms a threat. A large proportion of businesses that have adopted digital technologies state that they are indifferent to views on the dominant and non-transparent character of digital platforms (25% of companies in the construction industry adopting technologies and 31.3% in the food industry neither agree nor disagree). A smaller proportion of companies disagree with this notion (3.6% in construction and 18.8% in food).

anyguide

"We use the services of the digital platform AnyGuide in order to manage the seminars and tours we organise for tourists in our premises. The platform provides us with a tour operator management solution, which is easy to use. We will soon have another similar partnership in order to further promote our brand."

Emmanouil Karpadakis, Marketing Manager at Terra Creta (olive oil producing company, Greece)

Figure 5.13: Opinions about digital platforms by industry



N= 76
Source: Digital Transformation Scoreboard 2018

5.5 Impact on company performance

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48% of respondents in the food sector that have adopted digital technologies have experienced up to 20% increases in productivity gains over the last three years

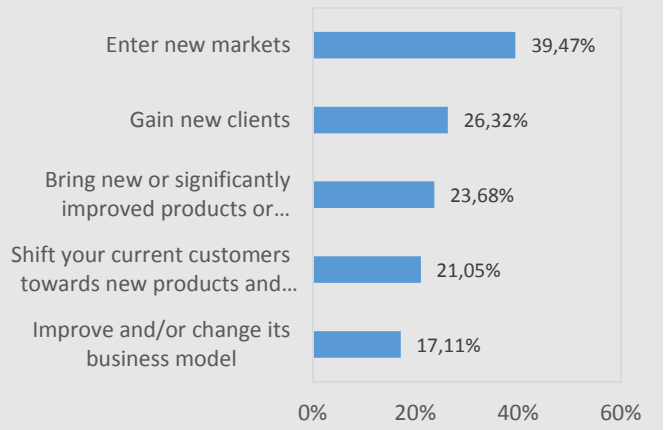
Strategic impact of digital adoption

The adoption of digital technologies can help businesses generate growth by developing and commercialising new or improved products and services, winning new clients and markets, and converting existing clients towards new products and services with higher added value. The survey results show that **39.5% of businesses across the two industries report having benefitted from strategic impact in terms of growth through entry into new markets**. Other strategic benefits were felt in the form of attracting new clients (26.3% of companies) and introducing significantly improved products or services to the market (23.7% of companies). However, the adoption of digital technologies seems to be taking place at a slow pace due to the costs faced by businesses at the moment of adoption. Some technologies, such as 3D printing, are associated with significant uncertainty and high irreversible costs, resulting in a slower decision-making process with regard to adoption.

"We bought a 3D printer 6 years ago. We use it especially for prototyping. We now also work with a 3D printing service provider based in Germany when designing more complex, technical parts. If the technology gets faster and cheaper, it might be used by the industry in production, but now it is not an option, it is simply too slow and expensive."

Dimitar Grigorov, Sales Director at EME AD
(electric fitting elements and tool equipment producing company, Bulgaria)

Figure 5.14: Impact of digital adoption by industry



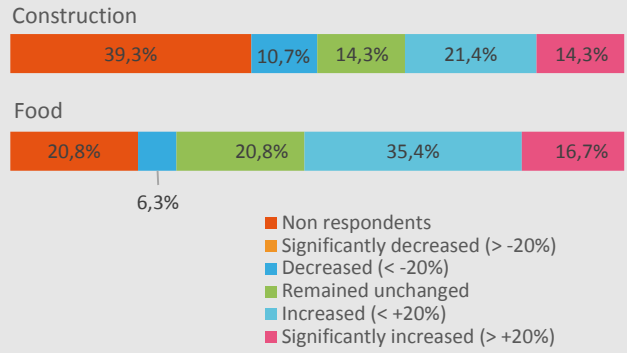
N= 76
Source: Digital Transformation Scoreboard 2018

Digital transformation has as positive impact on annual turnover and productivity

Survey results indicate that a large proportion of businesses that have adopted digital technologies reporting positive changes in their annual turnover. **Most of these technology-adopting businesses (35.7% in the construction industry, and 52% in the food industry**) highlight that their annual turnover grew by up to 20% and more during the last three years, while a smaller share 14,2% and 20,8% of these businesses respectively, indicate that their annual turnover during the last three years remained unchanged.

Regarding changes in resource efficiency measured by productivity gains, the perception is the same, with a large proportion of businesses adopting technologies, ranging from 35.7% in the construction industry to 47.8% in the food industry **reporting having experienced 20% or greater efficiency and productivity** in the last three years, while a smaller proportion (17.8% and 29.7% respectively) state that their productivity in the last three years has remained unchanged.

Figure 5.15: Productivity impact of digital transformation on annual turnover by industry



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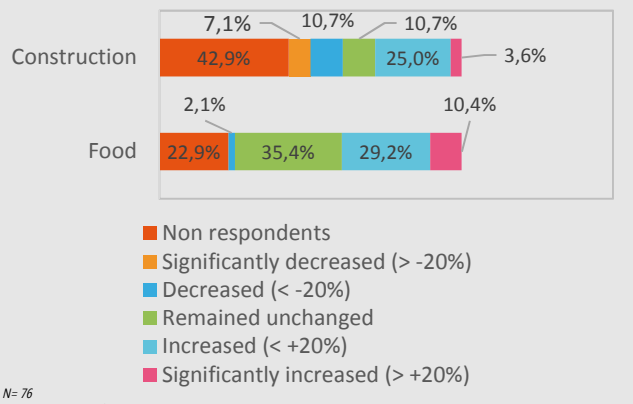
Source: Digital Transformation Scoreboard 2018

Higher operational costs as a result of technology adoption

Changes in the operational costs of technology-adopting businesses reflect the costs tat these companies incur not only by adopting novel digital technologies, but also by ensuring that their organisation, infrastructure, and operational processes are aligned with the new organisational requirements resulting from digital transformation. The survey results show that the **operational costs** of technology adopters across the two industries (28.6% in the construction industry and 39.6% in the food industry) **have increased by 20% or more.** It remained unchanged for a smaller yet not insignificant proportion of businesses (10.7% in construction and 35.4% in food).

Figure 5.16: Productivity impact of digital transformation on operational costs by industry



N= 76
Source: Digital Transformation Scoreboard 2018

Adoption of digital technologies in Europe

6

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This section describes the results obtained from the perception survey carried out on a sample of 120 European companies, which were surveyed about their use of key digital technologies in their production processes and service provision[a]. The survey focused on the strategies of new technology adoption, the objectives pursued by adopting these technologies, the business functions affected by technology adoption, and the associated impact in terms of turnover, productivity, job creation and cost reduction. The following nine key digital technologies were included in the survey: social media; big data and data analytics; cloud technology; the Internet of things (IoT); mobile services; robotics and automated machinery; cybersecurity; 3D printing; and artificial intelligence. These technologies were chosen because they are currently the most prominent new digital technologies enabling the rapid transformation of industries and the way in which businesses operate in the digital paradigm.

6.1 Overview of technologies being adopted

General technology adoption

Technology adoption amongst the sample of surveyed firms shows some interesting patterns. In addition to mature technologies, such as the use of social media, industry 4.0-related technologies show a significant adoption level. More specifically, **social media technologies come out on top**, being adopted by more than 30% of the sample firms surveyed. It is a pleasant surprise to learn that big data and data analytics, cloud technology and the Internet of things are adopted by at least 20% of the sample firms. **Artificial intelligence and 3D printing** are the two technologies with the **lowest adaptation level**, measured at 5% in this survey.

In comparison with the previous Digital Transformation Scoreboard, **cybersecurity solutions are still ones of the less-adopted technologies**, with only 14% of companies in the sample claiming to have adopted it, despite the fact that it is one of the most critical technologies for adoption by any company given the current business environment, in which cyberattacks have increased in frequency, harming the European economy.

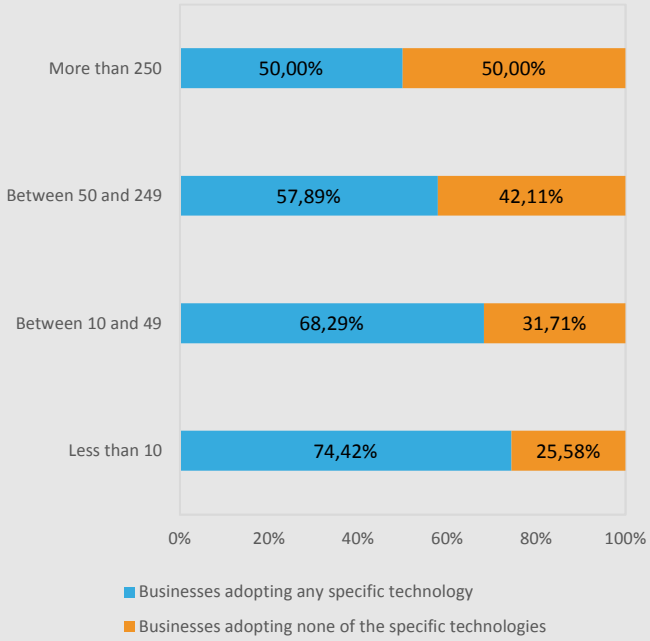
Technology adoption by firm characteristics

The level of adoption of existing and new digital technologies by the European industry differs across the firms included in the survey sample. There are clear differences in technology adoption when firms are divided into groups of key characteristics such as firm size, firm age, and stage of development.

Across business size classes

Dividing technology distribution into firm size shows that **smaller firms in the sample are more likely to adopt digital technologies** than larger firms. As shown in figure 6.1, almost 75% of very small firms (fewer than 10 employees) state that they have adopted at least one digital technology for business purposes, while this share decreases for bigger firms. 68% of firms with between 10 and 50 employees, 58% of firms with between 50 and 240 employees, and 50% of large firms – with more than 250 employees – state that they have adopted a digital technology for business purposes.

Figure 6.1: Technology adoption by business size



N= 113
Source: Digital Transformation Scoreboard 2018

Across business age classes

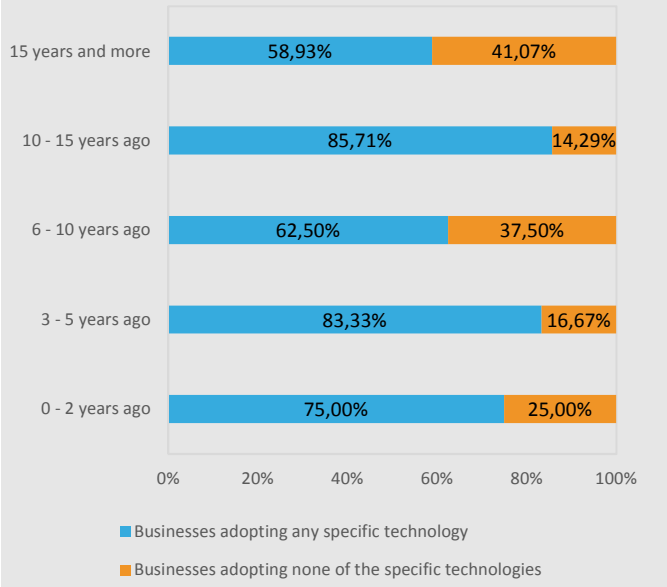
Splitting firms' technology adoption levels by the age of the firm shows that young firms (under 5 years old) and mid-aged firms (between 10 and 15 years old) have the highest degree of technology adoption amongst the sample. At least two thirds of the latter companies adopted at least one of the nine technologies surveyed. On the other hand, firms aged between 6 and 10 years and over 15 years have the lowest share of adoption, at around 60%.

This observation does allow any relationship between firm age and technology adoption to be generalised, although it hints at the possibility that

[a] For more information on the methodology, see section 2, page 7

young firms are "born digital".

Figure 6.2: Technology adoption by company age

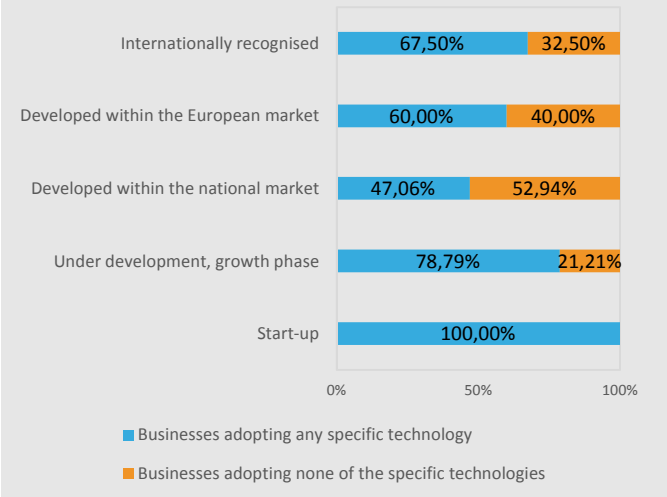


N= 112
Source: Digital Transformation Scoreboard 2018

Technology adoption by stage of development

Finally, an assessment of technology adoption by stage of development reveals that **all start-ups and companies under development have the highest share of adoption**, over 78%, while firms developed in the national market present the lowest share at 47%. This finding is expected, as most start-ups are digital technology-oriented. Interestingly, firms developed in the European and global markets also present a higher share of adoption, between 60% and 68%. This observation points to a **"shallow spot" of technology adoption among established firms** in national markets with respect to more dynamic "in-growth" and internationally recognised firms.

Figure 6.3: Technology adoption by company development stage



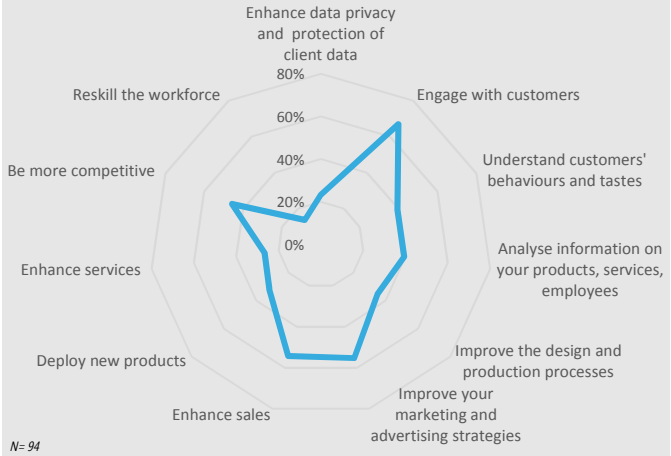
N= 109
Source: Digital Transformation Scoreboard 2018

Purpose and impact of adoption

Firms decide to adopt digital technologies with an objective in mind.

Respondents were provided with a list of principal adoption objectives, and were asked to express their views on the characteristics driving their adoption of digital technologies for business purposes. In general, the sample of firms indicated that **technologies were mainly adopted to improve engagement with customers** (67% of respondents), improve marketing and advertising strategies (55%), enhance sales (54%), and increase competitiveness (46%). To a lesser extent, companies cited the purposes of analysing information on products, improving design, deploying new products, and enhancing service as drivers of technology adoption. Figure 6.4 below shows the purposes of technology adoption amongst the sample of firms.

Figure 6.4: Purpose of digital technology adoption

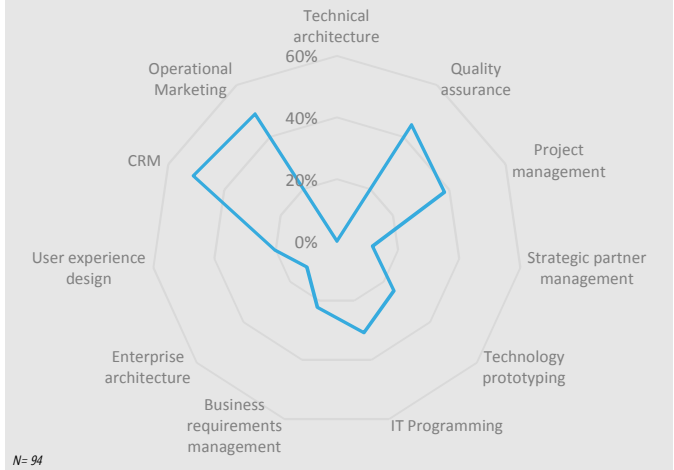


N= 94
Source: Digital Transformation Scoreboard 2018

General impact of key technology adoption

The impact that this adoption pattern has on the firms is reflected by the business function that respondents claimed to have been affected by the use of digital technologies. According to the sample of firms surveyed, the most affected business functions were operational marketing and CRM, quality assurance, project management, and IT programming, ranging from 31% to 51% of respondents. On the other hand, the least-affected business functions were prototyping, enterprise architecture, user-experience design, and strategic partner management. Figure 6.5 illustrates the main business functions affected amongst the sample of firms.

Figure 6.5: Business functions affected by digital technology adoption



N= 94
Source: Digital Transformation Scoreboard 2018

6.2 Social media

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82% of respondents who have adopted social media consider digital technologies to have generated positive outcomes

Figure 6.6: Profile of survey respondents who have adopted social media

50% are companies with more than 250 employees

25% are start-ups, formed from another company

37% use social media to gain new clients

37% are between 3 and 5 years old

46% are under development/growth phase

76% adopted social media to improve their marketing and advertising

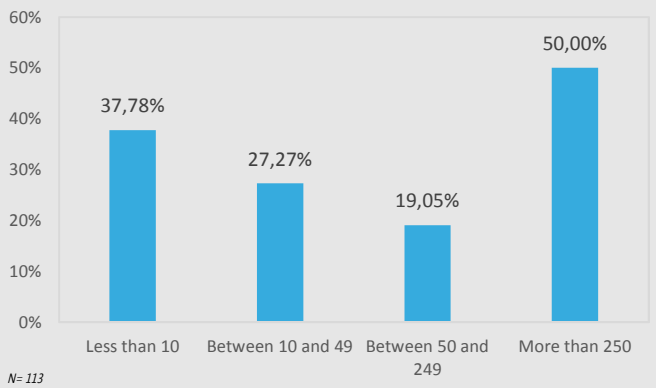
Source: Digital Transformation Scoreboard 2018

Business characteristics

According to the sample of companies surveyed, social media are more frequently adopted by either very small firms of fewer than 10 employees, or large firms of more than 250 employees, as can be seen in figure 6.7. The share of adoption **reflects a U-shaped relationship with firm size, highlighting the existence of underlying factors driving social media adoption**. As a hypothesis, these factors may be the firm's reputation and visibility on the market, which may be more sought more keenly by small firms in the search for growth, and by large firms seeking to maintain their position on the market.

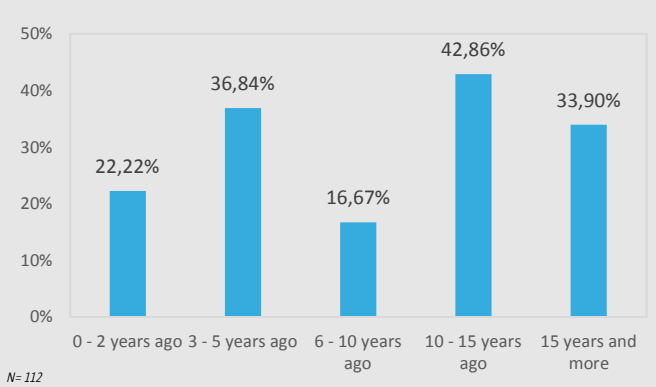
Further to these observations, the adoption of social media mainly takes place in firms under five years old, with at least 59% of such firms having adopted the technology, and in firms over ten years old, with at least 76% adopting. **A "shallow spot" is observed amongst the firms between 6 and 10 years old**, of which only 16.7% say they have adopted social media.

Figure 6.7: Adoption of social media by company size



N= 113
Source: Digital Transformation Scoreboard 2018

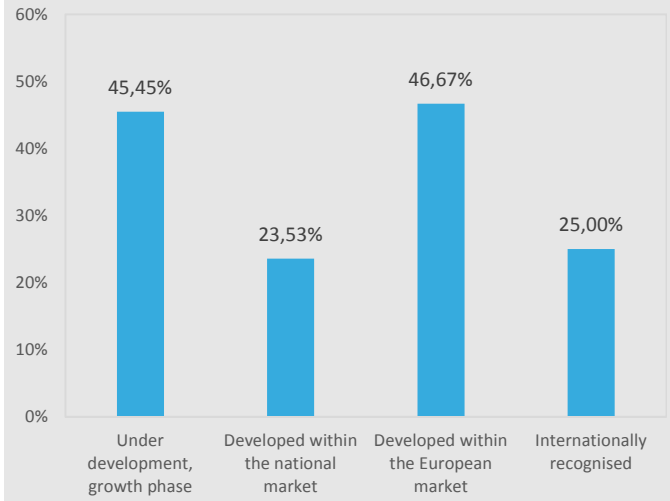
Figure 6.8: Adoption of social media by company age



N= 112
Source: Digital Transformation Scoreboard 2018

Companies adopting social media are also characterised by either a growing phase of development or a scaled-up stage of development in European markets (45.5% and 46.7% of respondents respectively). This observation points at slow dynamics in the adoption of social media by established companies that perhaps do not feel concerned about expanding or communicating to a boundless digital market.

Figure 6.9: Adoption of social media by stage of development

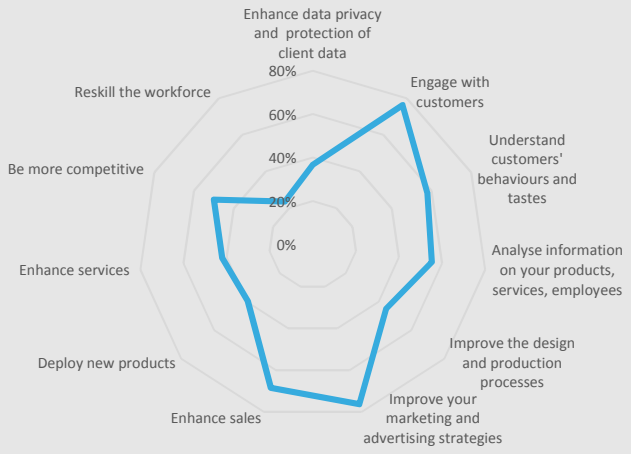


N= 109
Source: Digital Transformation Scoreboard 2018

Purpose

The main aim of companies that adopt social media is to engage with their customers. Thus, the hypothesis that **reputation and brands can be strengthened through extensive use of social media technology to reach a critical mass of customers** is still valid. With Facebook having more than two billion active users and millennials constantly being connected to it on their smartphones, it makes perfect sense for companies to invest in social media. These companies also use social media technologies to improve their marketing and advertisement strategies, and thus to enhance sales.

Figure 6.10: Purpose of social media adoption

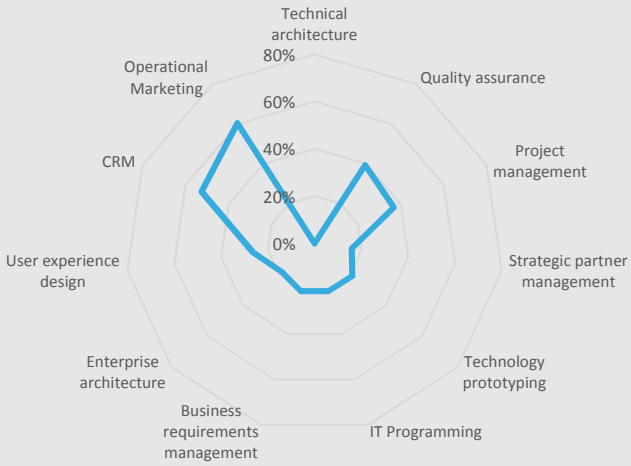


N= 38
Source: Digital Transformation Scoreboard 2018

Impact

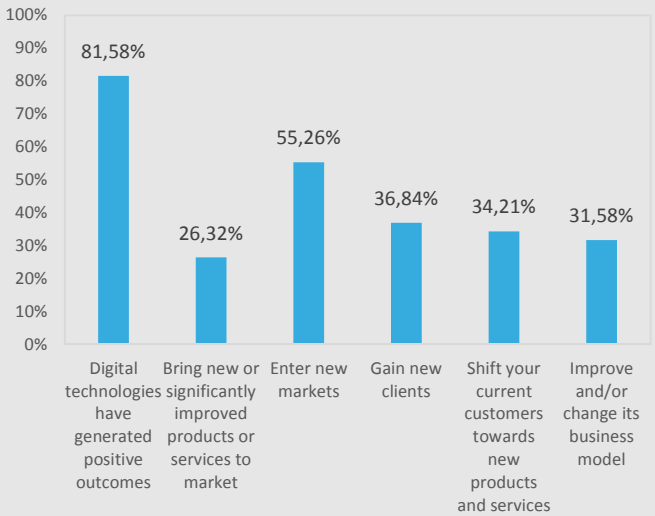
In general, **most of the businesses adopting social media report positive impacts from digital technology adoption** (81% say they having experienced positive outcomes). Specifically, the adoption of social media has enabled firms in the sample to enter new markets and gain new clients. These companies also claim to have undergone changes in their business functions relating to operational marketing, CRM, and quality assurance.

Figure 6.11: Business functions affected by social media adoption



N= 38
Source: Digital Transformation Scoreboard 2018

Figure 6.12: Outcomes of social media adoption

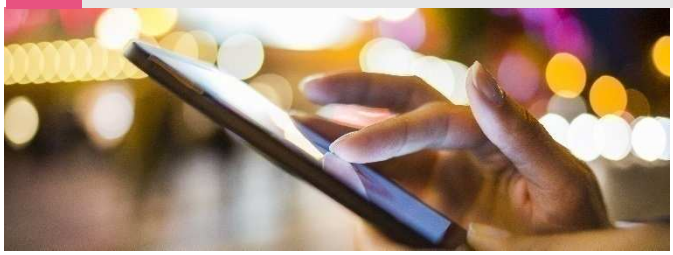


N= 38
Source: Digital Transformation Scoreboard 2018

Conclusions

It is widely recognised that social media enables firms to know their clients better, engage with them and communicate instantly with them. Thus, developing and assessing a social media strategy with the help of data science and analytics is key to a firm's marketing plan. Therefore, social media is recognised as one of the key technologies that need to be adopted during a company's digital transformation. The industry confirms these findings, as well as the positive impact that social media technologies have on business development.

6.3 Mobile services



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50% of respondents who have adopted mobile services use the technology to gain new clients

Figure 6.13: Profile of survey respondents who have adopted mobile services

30% are companies with more than 250 employees

65% use mobile services for project management

60% are public-private entities

11% are companies under 2 years old

19% are companies developed in the EU market

90% report positive outcomes from the adoption

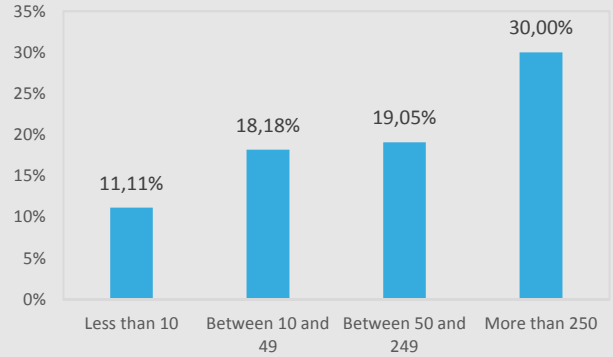
Source: Digital Transformation Scoreboard 2018

Business characteristics

A significant share (30%) of large businesses of more than 250 employees have adopted mobile services. The share of small and medium-sized companies that have adopted this technology is less than 20% of companies within their categories, which is surprising given the increasing use of mobile devices.

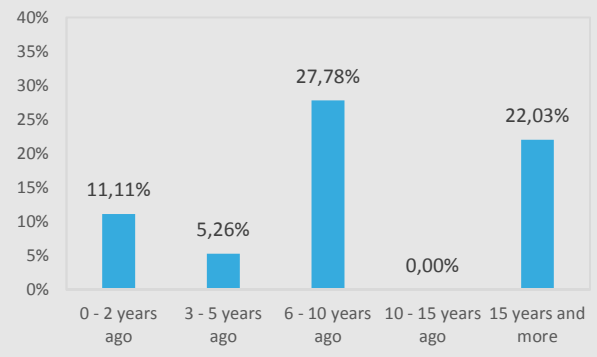
The most commonly used smart mobile devices are smartphone, tablets, laptops, smart watches and other wearables that can connect to the internet. It is estimated that there were 2,32 billion smartphone users worldwide in 2017[21]. In terms of adaptation level of mobile services by company age, this is high for businesses between 6 and 10 years old, and those more than 15 years old, with 28% and 22% of companies in each respective category. Adaptation levels are very low for newly establish companies and those between 10 and 15 years old. This finding is perhaps due to the small sample size.

Figure 6.14: Adoption of mobile services by company size



N= 113
Source: Digital Transformation Scoreboard 2018

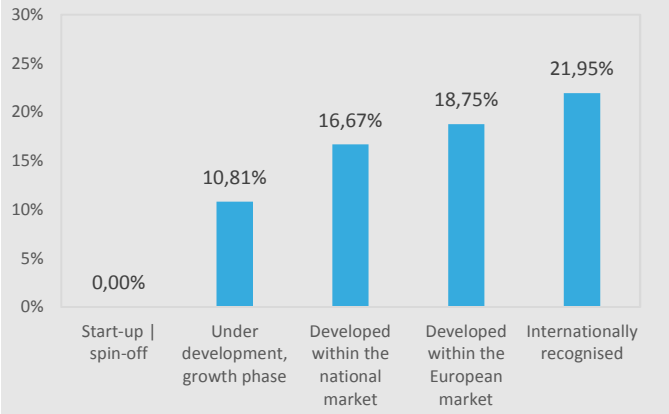
Figure 6.15: Adoption of mobile services by business age



N= 112
Source: Digital Transformation Scoreboard 2018

In addition, this technology is progressively adopted by businesses as their stage of development advances: the more developed the companies in sample are, the higher the share of adoption of mobile services. It is interesting to note the absence of the technology among start-ups and spin-off companies. This might be due to the specificities of the sectors under scrutiny.

Figure 6.16: Adoption of mobile services by development stage

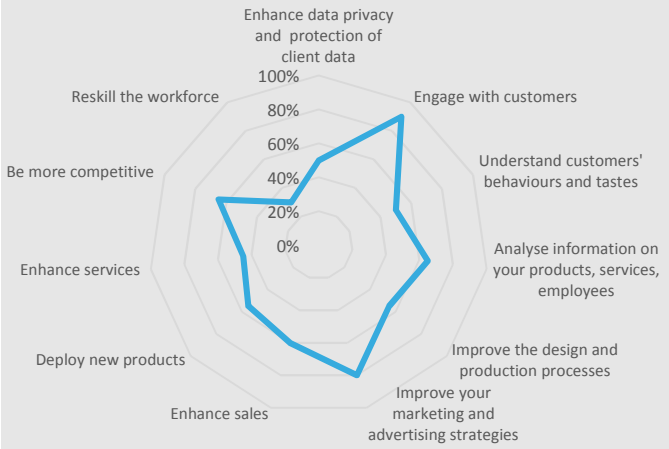


N= 109
Source: Digital Transformation Scoreboard 2017

Purpose

Further observations indicate that businesses adopt mobile services mainly with the purpose of engaging with customers (90%), improving marketing strategies (80%), and increasing competitiveness (65%), highlighting how important the technology is for reaching a customer base for whom mobile technologies are the preferred method of accessing information.

Figure 6.17: Purpose of mobile service adoption

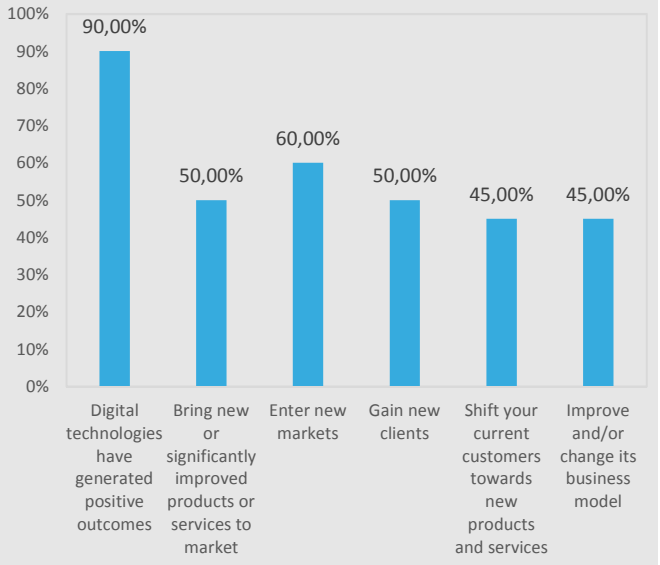


N= 19
Source: Digital Transformation Scoreboard 2018

Impact

In general, positive impacts from digital technology adoption are reported by most of the businesses adopting mobile service technologies for business purposes (90% say they have experienced positive outcomes). More specific impacts have also been felt, with 60% of these businesses having entered new markets, 50% having introduced significantly improved products and services to the market, and 50% having gained new clients.

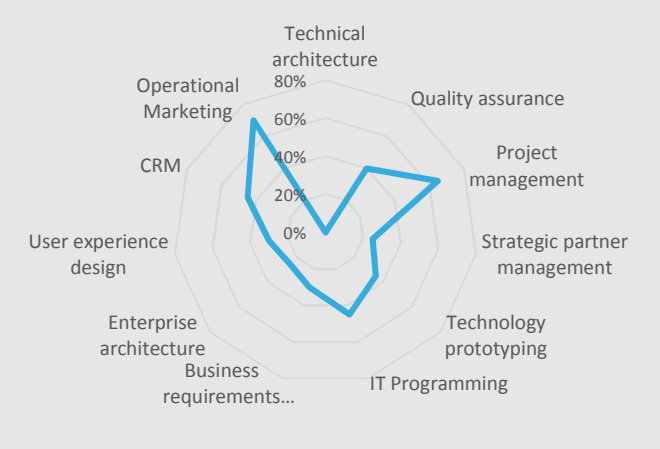
Figure 6.18: Outcomes of mobile service adoption



N= 19
Source: Digital Transformation Scoreboard 2018

Additional conclusions about the usefulness of mobile services can be derived by the analysis of business functions under transformation. Businesses adopting mobile services also state that key digital technologies mainly affect their operational marketing function (70%), followed by project management (65%) and IT programming functions (45%). These observations confirm changes that businesses have made in adopting key digital technologies, in particular mobile services: digital transformation is not only changing the way in which projects are managed, but also the way in which products and services are marketed.

Figure 6.19: Business functions affected by mobile service adoption



N= 19
Source: Digital Transformation Scoreboard 2018

70% of respondents who have adopted mobile services state that the technology has mainly affected their operational marketing function

6.4 Cloud technologies

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35% of respondents who have adopted cloud technology use it to bring new or significantly improved products or services to market

Figure 6.20: Profile of survey respondents who have adopted cloud technology

10% are companies with more than 250 employees

46% use cloud technology for CRM

25% are family or privately owned businesses

11% are businesses aged between 0 and 2 years

21% are companies under development

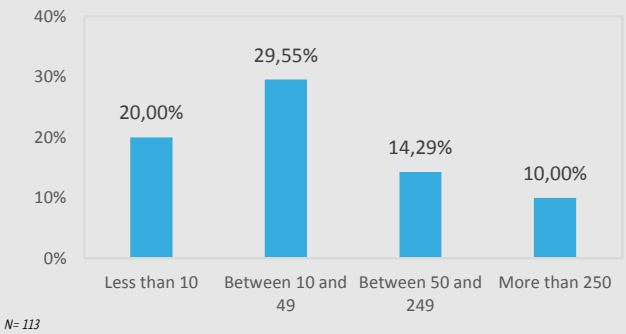
89% had positive outcomes from the adoption

Source: Digital Transformation Scoreboard 2018

Business characteristics

Amongst the companies surveyed, the cloud was mainly adopted by small businesses with between 10 and 49 employees (nearly 30% of them), followed by very small SMEs (20%). Only one in seven larger SMEs (50-249 employees) and one in ten larger companies adopted cloud computing technologies. This finding suggests a negative correlation between company size in terms of personnel and cloud technology adoption.

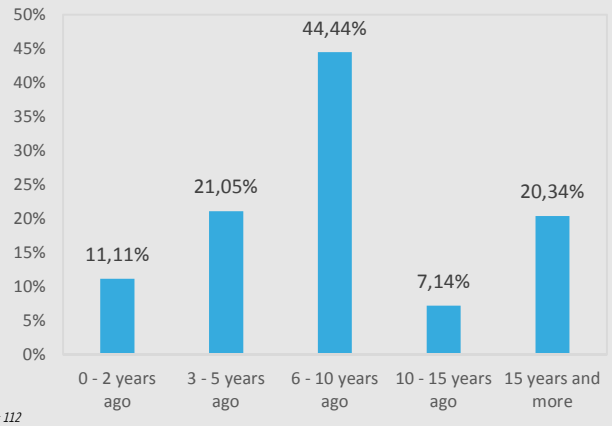
Figure 6.21: Adoption of cloud technology by company size



N= 113
Source: Digital Transformation Scoreboard 2018

Businesses in operation for between 6 and 10 years exhibit the highest share of cloud technology adoption (44%). They are probably mature enough to invest in technologies that will ensure future profitability. Surprisingly, newly founded companies do not seem to invest in cloud technologies. This observation may suggest that growing and developing companies first need to use traditional operating methods to develop their client base and business, and invest in key technologies such as cloud computing later.

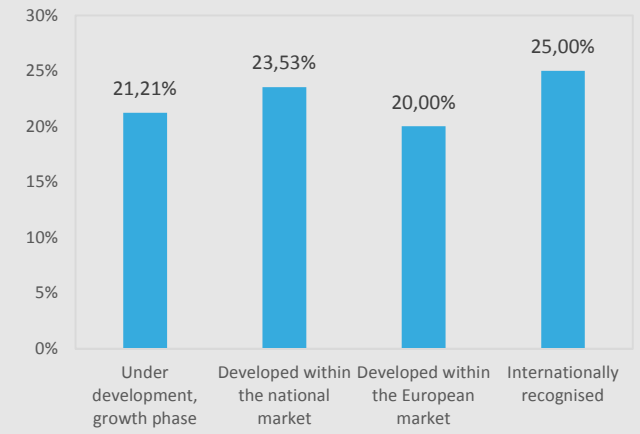
Figure 6.22: Adoption of cloud technology by business age



N= 112
Source: Digital Transformation Scoreboard 2018

Respondents claiming to have adopted cloud technologies are rather evenly distributed across different stages of business development, with internationally recognised firms presenting the highest level of cloud technology adoption.

Figure 6.23: Adoption of cloud technology by company development stage

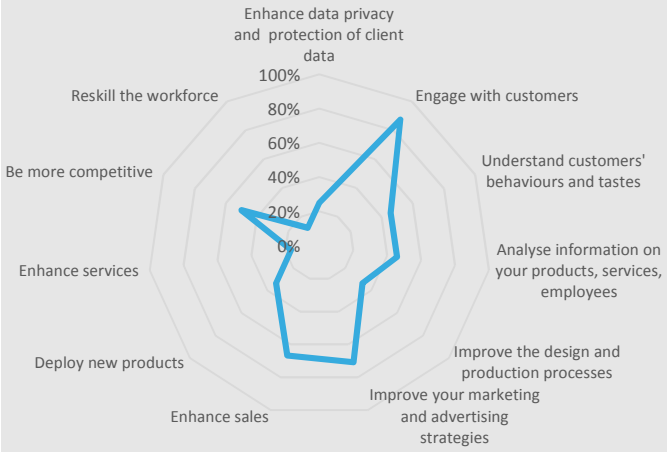


N= 109
Source: Digital Transformation Scoreboard 2018

Purpose

These results indicate that businesses adopting this technology say that they have done so with the purpose of engaging with clients (88%), improving marketing and advertisement strategies (71%), enhancing sales (67%), and increasing competitiveness (50%).

Figure 6.24: Purpose of cloud technology adoption

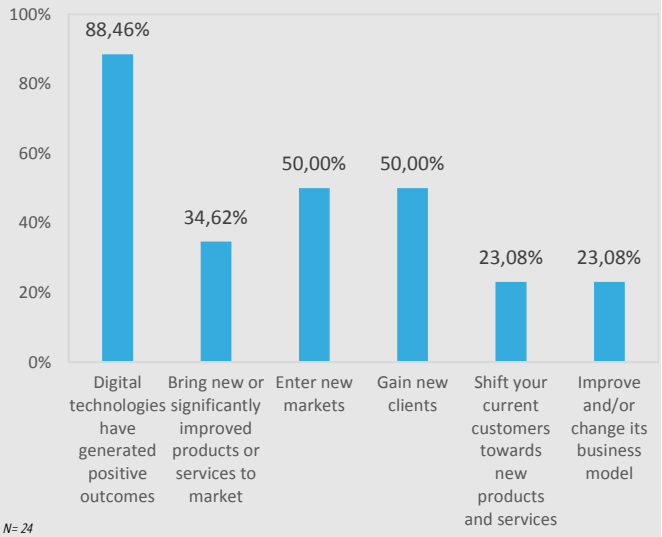


N= 24
Source: Digital Transformation Scoreboard 2018

Impact

The adoption of cloud-based CRM and operational marketing functions proves to be beneficial since half of the surveyed companies reported the gain of new clients and penetration of new markets. In addition, one in three firms reported that adopting cloud technologies helped them bring new or significantly improved products or services to the market. These findings suggest that adopting cloud technologies has a positive impact on firms' business development, and consequently their turnover.

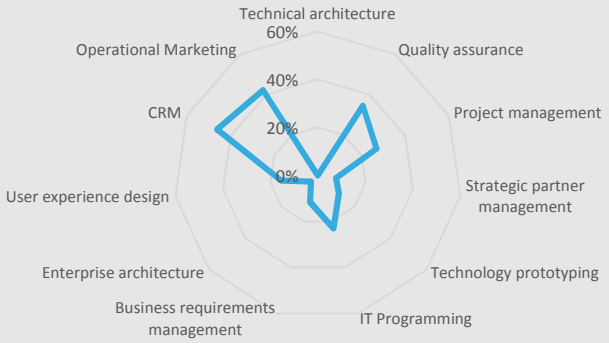
Figure 6.25: Outcomes of cloud technology adoption



N= 24
Source: Digital Transformation Scoreboard 2018

Companies adopting cloud technology also state that utilising it mainly affects their CRM, operational marketing, quality assurance, and project management functions, in descending order of importance.

Figure 6.26: Business functions affected by cloud technology adoption



N= 24
Source: Digital Transformation Scoreboard 2018

Conclusions

Adopting cloud computing technologies has the potential to improve productivity and reduce costs, but it also brings challenges. One of the biggest challenges, and which has a long-term impact, is human resources. Existing staff will need to acquire new skills to manage cloud computing applications. Skills typically required for using cloud technologies include cloud architecture, cloud engineering and cloud security. Migrating from traditional internal databases and applications to cloud computing is also a challenge, and is often outsourced to IT system migration experts. Finally, to make the most of data available in the cloud, a company will need staff with data science and analytics skills, such as machine learning and visualisation tools.

6.5 Internet of things

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91% of respondents who have adopted the Internet of things use this technology to engage with their clients

Figure 6.27: Profile of survey respondents who have adopted the Internet of things

40% are companies with more than 250 employees

60% of users have witnessed effects on their CRM function

50% are start-ups

11% are businesses aged 0-2 years

65% use the Internet of things to be more competitive

87% report a positive outcome from the adoption

Source: Digital Transformation Scoreboard 2018

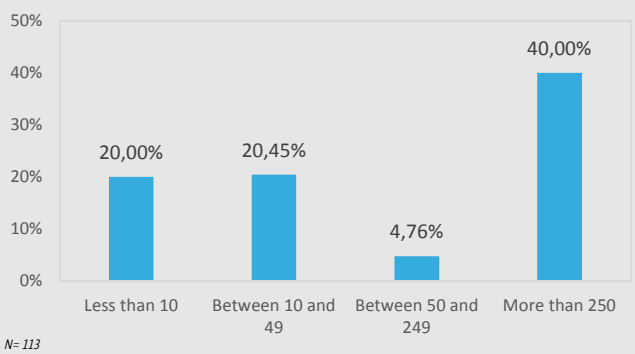
Business characteristics

The Internet of things (IoT) is an emerging technology that transforms the world in which we live and work. Gartner[22] forecasted early last year that more than 11 billion connected things would be in use worldwide in 2018. In the food industry for example, IoT can transform the entire production, processing and supply chain.[23] Drones and autonomous devices enable cost improvements in farming, while sensors can monitor and predict machinery maintenance in food-processing factories.[24] IoT devices are also being used for food safety.

Amongst the companies surveyed, IoT technologies have mainly been adopted by large businesses of more than 249 employees (40% of them), while the proportion is spread evenly throughout small firms of fewer than 50 employees (20% of respondents in both categories) (figure 6.28).

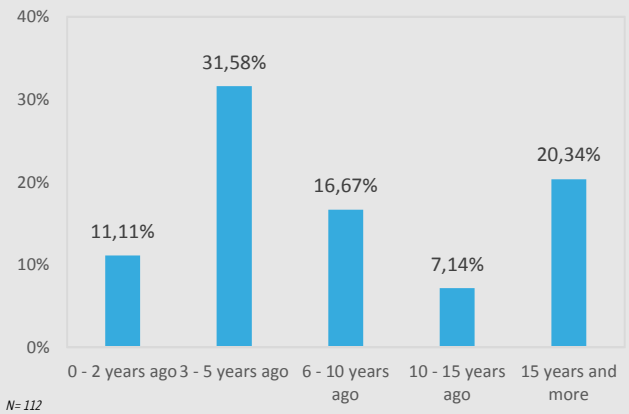
Businesses operating for 3-5 years exhibit the highest share of IoT adoption (32%), followed by mature businesses (20%). Among those surveyed, businesses operating for 10-15 years have the lowest level of IoT adaptation (7%).

Figure 6.28: Adoption of IoT by company size



N= 113
Source: Digital Transformation Scoreboard 2018

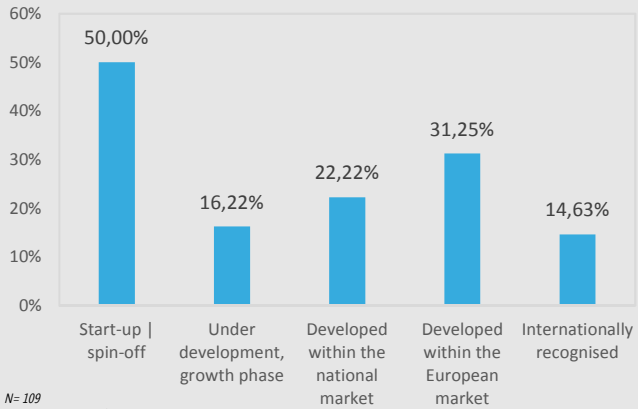
Figure 6.29: Adoption of IoT by business age



N= 112
Source: Digital Transformation Scoreboard 2018

The adoption level of IoT technologies varies, with start-up/spin-off companies exhibiting the highest level (50%), followed by firms developed in the European market (31%).

Figure 6.30: Adoption of IoT by company development stage



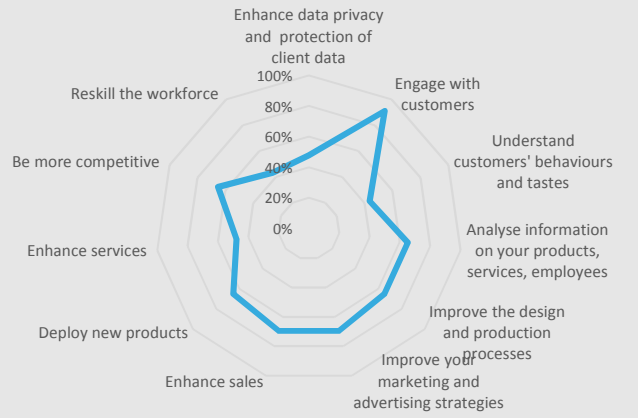
N= 109
Source: Digital Transformation Scoreboard 2018

Purpose

These results indicate that businesses adopting this technology say that they have done so with the purpose of engaging with customers, deploying new products, improving the design of production processes, and enhancing sales, amongst other considerations. IoT also helps a significant share of the surveyed companies to improve their marketing and advertising strategies (70%) and to analyse information about their products, services and employees (65%).

Generally, IoT generates large volumes of data, and thus is highly associated with both cloud and big data/data analytics technologies. This combination of technologies is transforming the way in which the food and construction industries work. For example, on a construction site, wireless-connected sensors on equipment, material and structures, and wearables on workers help monitor and improve productivity, assess the efficiency and enhance the quality of construction while increasing the protection of staff and machinery.[25] In existing buildings, sensors measuring energy consumption and microclimate conditions (temperature, humidity) help owners to make informed decisions about renovations aiming to reduce energy consumption.

Figure 6.31: Purpose of IoT adoption

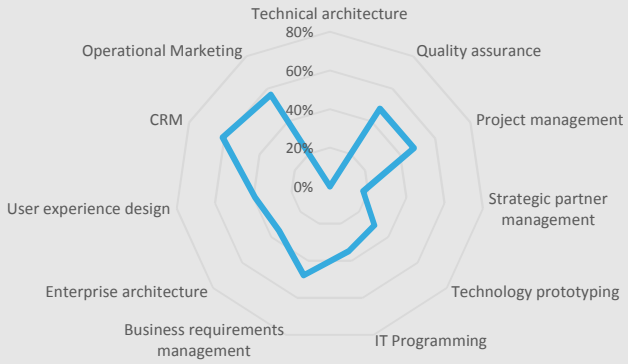


N= 23
Source: Digital Transformation Scoreboard 2018

Impact

The implementation of the technology adoption has also resulted in changes to business functions, primarily CRM, business requirements management, project management and quality assurance.

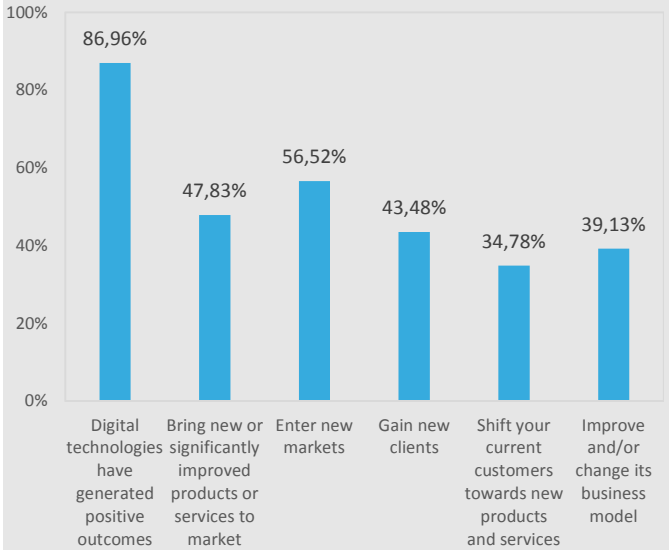
Figure 6.32: Business function affected by IoT adoption



N= 23
Source: Digital Transformation Scoreboard 2017

Specific impacts attributable to the adoption of Internet of things technology principally relate to expansion into new markets and the introduction of new or significantly improved products or services to the market.

Figure 6.33: Purpose of IoT adoption



N= 23
Source: Digital Transformation Scoreboard 2018

6.6 Cybersecurity solutions

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50% of respondents who have adopted cybersecurity use the technology to shift their current customers towards new products and services

Figure 6.34: Profile of survey respondents who have adopted cybersecurity

30% are companies with more than 250 employees

80% have observed changes in their operational marketing function

20% are public-private entities

15% are businesses aged over 15 years

80% use cybersecurity to enhance data privacy

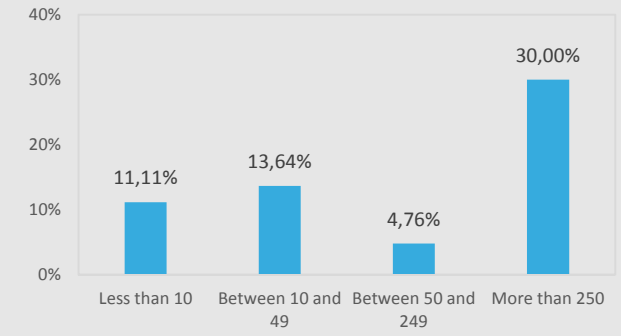
15% are internationally recognised businesses

Source: Digital Transformation Scoreboard 2017

Business characteristics

According to the sample of respondents in the present survey, cybersecurity adoption is high (30%) amongst large firms of more than 250 employees and low for SMEs (ranging from 5% to 14%). This observation contrasts with the current economic environments, in which the frequency and cost of cyberattacks on businesses has increased sharply. These results demonstrate the need for raising awareness among companies, especially SMEs, about the threats, the need to comply with the new EU General Data Protection Regulation (GDPR)[26] and the cybersecurity solutions that are available to them.

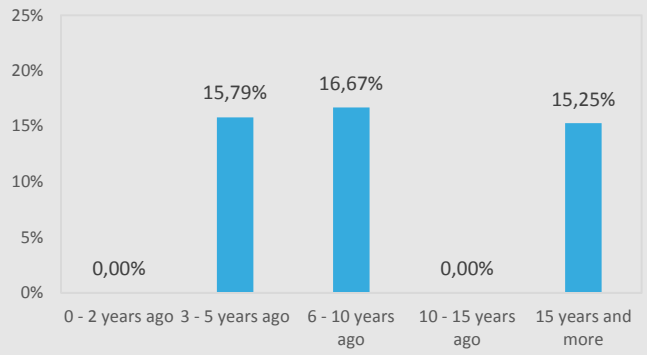
Figure 6.35: Cybersecurity adoption by company size



N= 113
Source: Digital Transformation Scoreboard 2018

Further to these observations, there is a low level of adoption (around 15%) or no adoption when the firms surveyed are divided by age (see figure 6.36).

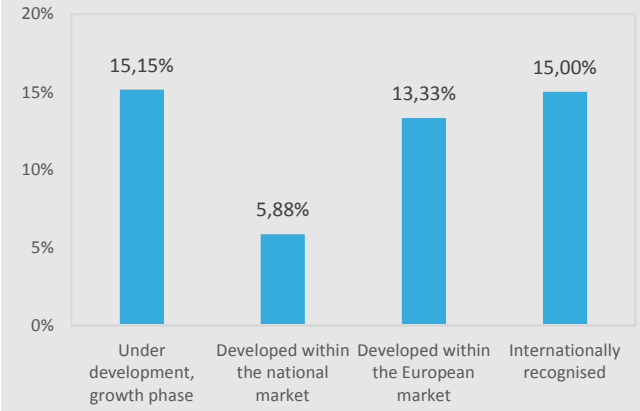
Figure 6.36: Cybersecurity adoption by company age



N= 112
Source: Digital Transformation Scoreboard 2018

A similar pattern is observed when looking at the cybersecurity adoption level by firm stage of development: the adoption level is relatively even across all stages of development at around 15%, with the exception of companies developed within the national market.

Figure 6.37: Cybersecurity adoption by company development stage

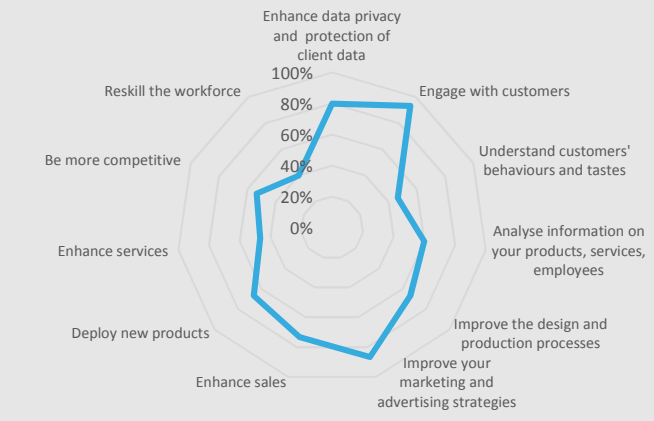


N= 109
Source: Digital Transformation Scoreboard 2018

Purpose

Companies adopting cybersecurity are aiming to improve engagement with customers, marketing strategies, data privacy, and the protection of client data. This observation suggests that firms integrating cybersecurity have an interest in their reputation in terms of security and how this factor relates to the protection of their customers, therefore sending a message about their ability to enhance privacy.

Figure 6.38: Purpose of cybersecurity adoption

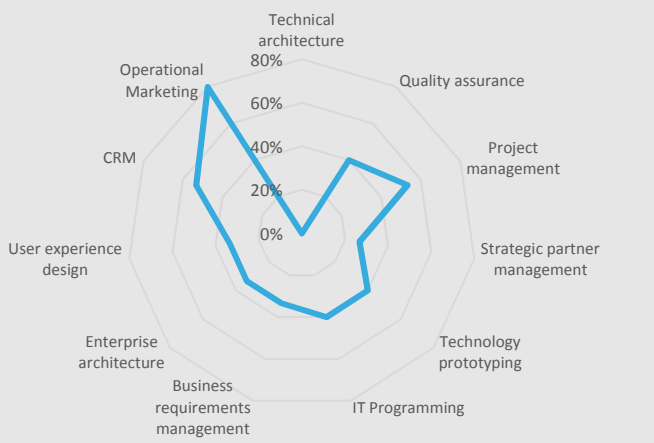


N= 14
Source: Digital Transformation Scoreboard 2018

Impact

Companies adopting cybersecurity also claim to have undergone changes in their business functions relating to operational marketing, CRM, project management and quality assurance. The main impacts of adopting this key technology are improvements to business models and to products and services traded in the market, and gaining new clients.

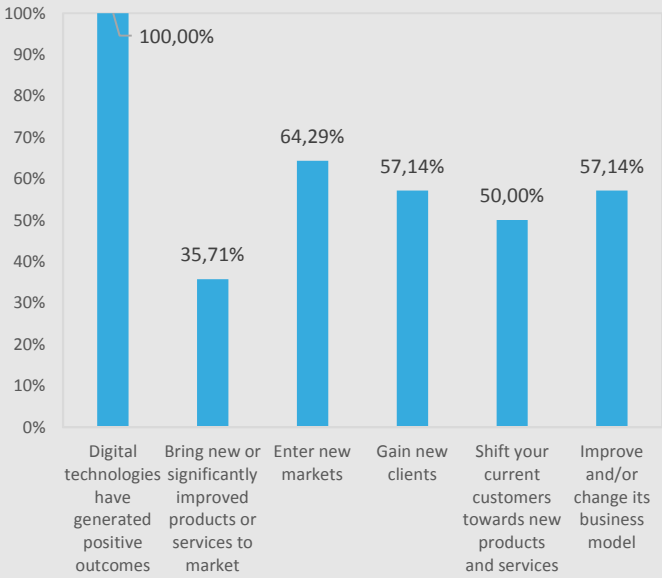
Figure 6.39: Business function affected by cybersecurity adoption



N= 14
Source: Digital Transformation Scoreboard 2018

It is noteworthy that while all the surveyed firms that have adopted cybersecurity measures have seen positive outcomes, only one third of them have brought new or significantly improved products or services to the market.

Figure 6.40: Outcomes of Cybersecurity adoption



N= 14
Source: Digital Transformation Scoreboard 2018

6.7 Robotics and automated machinery

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33% of respondents who have adopted robotic and automated machinery use the technology to bring new or significantly improved products or services to market

Figure 6.41: Profile of survey respondents who have adopted robotic and automated machinery

30% are companies with more than 250 employees

68% of users have experienced changes in their quality assurance function

83% adopted the technology to become more competitive

15% are businesses aged 15 years or over

56% used the technology to gain new clients

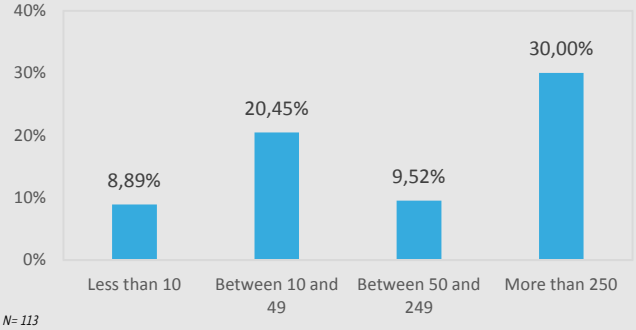
15% are internationally recognised businesses

Source: Digital Transformation Scoreboard 2018

Business characteristics

In terms of business-size class characteristics, robotic and automated machinery is mainly adopted by an significant proportion of large businesses of more than 250 employees, although the share of adoption in that category is only 30%. Large businesses are closely followed by small and medium-sized companies, with a 20% adoption rate for businesses of between 10 and 49 employees and less than 10% for businesses of between 50 and 250 employees. Only 9% of very small companies have adopted robotics and machinery.

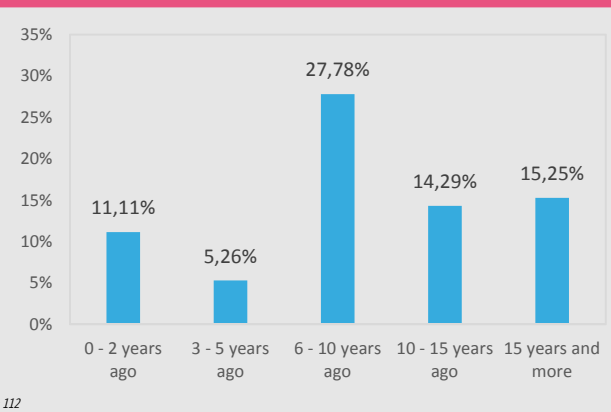
Figure 6.42: Adoption of robotic and automated machinery by company size



N= 113
Source: Digital Transformation Scoreboard 2018

Robotic and automated machinery adoption is also characterised by young businesses between 6 and 10 years old (28% adoption rate among respondents in this category), followed by older and mature businesses (at least 15% of respondents in older groups) and newly established companies with 11% adoption. In addition, robotic and automated machinery is mainly adopted by firms developed in the European market, closely followed by firms under development and growth, and by internationally recognised firms (15% of firms in each category).

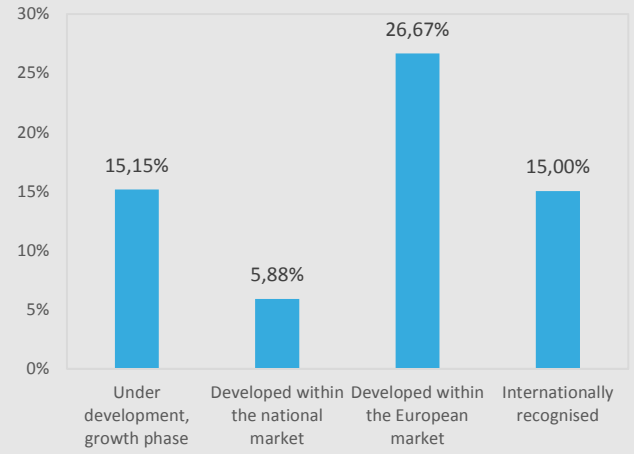
Figure 6.43: Adoption of robotic and automated machinery by company age



N= 112
Source: Digital Transformation Scoreboard 2018

According to Gray and Davis,[27] the food manufacturing industry – which represents some 13% of all manufacturing in the European Union – contributes approximately €900 billion to the economy and employs 4 million people. This industry is one of the only recently adopted machinery technologies to allow automation.

Figure 6.44: Adoption of robotic and automated machinery by company development stage

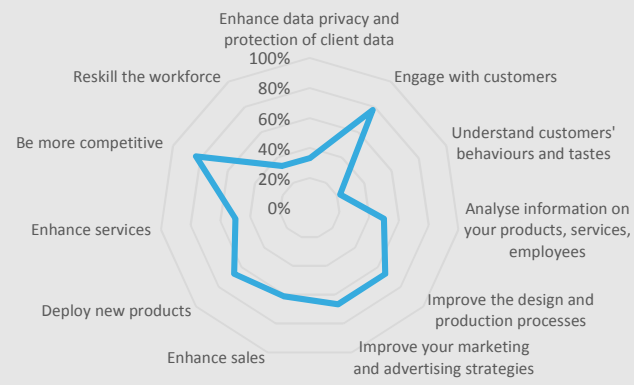


N= 109
Source:: Digital Transformation Scoreboard 2018

Purpose

The survey results reveal that businesses adopting robotic and automated machinery state that they did so mainly with the purpose of increasing competitiveness (83%) and engaging with customers (78%); other purposes pursued are deploying new products, improving design and production processes, and improving marketing strategies. These objectives are still critical, as in the digital economy, robotic and automated machinery plays a vital role for businesses looking to transform their processes and benefit form productivity gains and improved quality, therefore increasing their competitiveness.

Figure 6.45: Purpose of robotic and automated machinery adoption

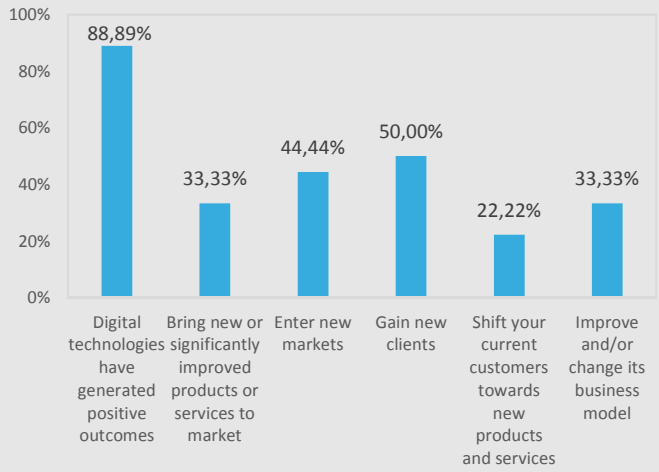


N= 16
Source: Digital Transformation Scoreboard 2018

Impact

Most of the businesses that have adopted robotic and automated machinery (89%) report positive impacts. More specific impacts have also been felt, with 50% of these businesses stating that they have gained new clients and 44% being able to enter new markets.

Figure 6.46: Outcomes of robotic and automated machinery adoption

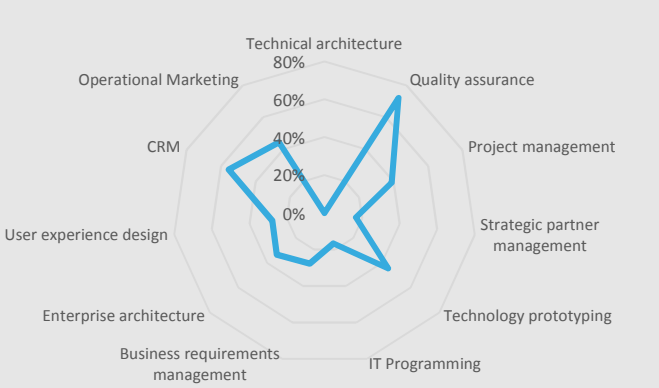


N= 16
Source: Digital Transformation Scoreboard 2018

Furthermore, businesses adopting this technology also state that they have seen changes to their business functions, especially quality assurance, CRM, and technology prototyping.

Another benefit of adopting this technology is increased workplace safety for employees of all industries in question (food and construction) as well as the safety of the end products and services for the clients.

Figure 6.47: Business functions affected by robotic and automated machinery adoption



N= 16
Source: Digital Transformation Scoreboard 2018

6.8 Big data and data analytics

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86% of respondents who have adopted big data and data analytics consider digital technologies to have generated positive outcomes

Figure 6.48: Profile of survey respondents who have adopted big data and data analytics

60% are companies with more than 250 employees

64% have experienced changes in their project management function

12% are start-ups formed from another company

32% are businesses between 3 and 5 years old

27.5% are internationally recognised businesses

39% use the technology to bring new or significantly improved products or services to market

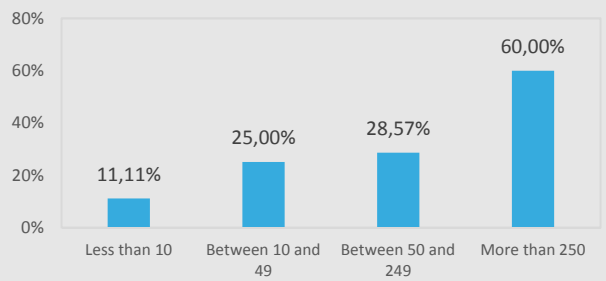
Source: Digital Transformation Scoreboard 2018

Business characteristics

Big data and data analytics allow companies to extract information and knowledge from their data and make informed decisions. The exciting news about current technological developments is that real-time data collection and analysis using machine-learning algorithms allow for real-time analytics. This in turn enables CEOs to run their businesses more efficiently.

Big data and data analytics have been adopted by a significant proportion of large businesses of more than 250 employees (60%) and moderate proportions of small businesses (28.6% for companies of between 50 and 249 employees, and 25% for businesses of between 10 and 49 employees).

Figure 6.49: Adoption of big data and data analytics by company size

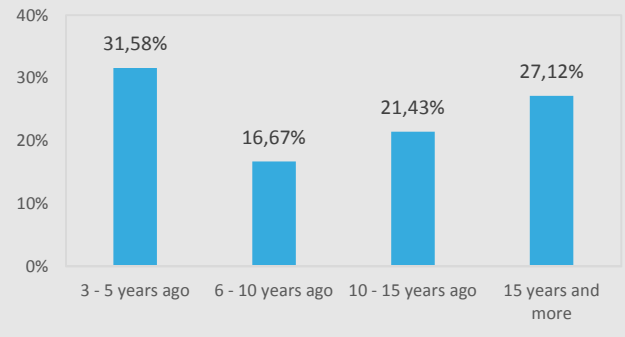


N= 113
Source: Digital Transformation Scoreboard 2018

Amongst the firms in the sample, big data and data analytics was mainly adopted by very young firms under 5 years old and by older firms more than 15 years old, confirming the general pattern of a U-shaped relationship between technology adoption and firm age.

Big data and data analytics enable companies to become more competitive and quickly gain big shares of the market. Companies such as Amazon, Google and Netflix have managed to dominate the market in only a few years by heavily investing in this and other connected technologies, such as cloud and AI.

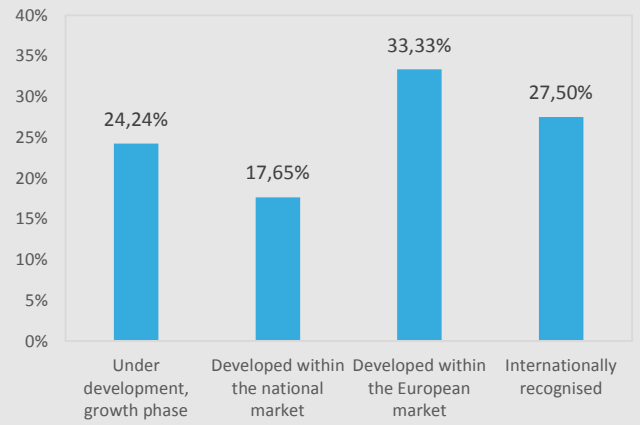
Figure 6.50: Adoption of big data and data analytics by company age



N= 112
Source: Digital Transformation Scoreboard 2018

In addition, this technology is mainly adopted by businesses developed in the European market or internationally recognised, with 33% and 27.5% of these two categories respectively stating that they have adopted this technology. In essence, big data and data analytics capabilities seem to be mainly adopted by businesses that find it easy to integrate complex analytical technologies. These observations indicate that companies likely to adopt analytical tools find it useful to treat large volumes of data mainly to enhance their competitive advantage.

Figure 6.51: Adoption of big data and data analytics by company development stage

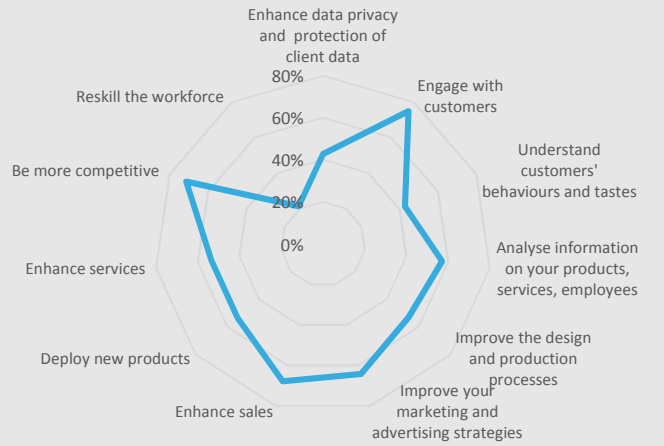


N= 109
Source: Digital Transformation Scoreboard 2018

Purpose

The technology is reported to meet the purpose of engaging with customers, increasing competitiveness, enhancing sales and analysing information about products, services, and employees. These observations illustrate the informational advantage provided by big data and data analytics when used for business purposes.

Figure 6.52: Purpose of adoping big data and data analytics

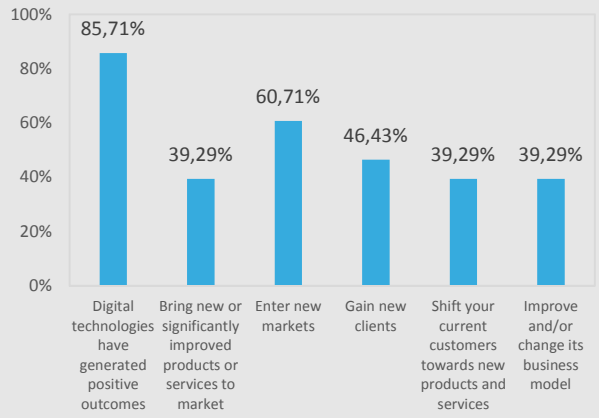


N= 28
Source: Digital Transformation Scoreboard 2018

Impact

86% of the companies adopting big data and data analytics state that adopting the technology has had a positive impact. As illustrated by figure 6.53, these positive impacts mainly relate to the conquest of new markets and gaining new clients.

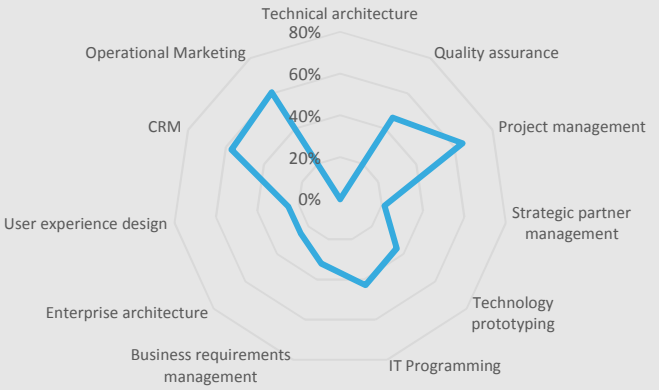
Figure 6.53: Outcomes of big data and data analytics adoption



N= 28
Source: Digital Transformation Scoreboard 2018

Furthermore, an analysis of the usefulness perceived by respondents indicated that the adoption of big data and data analytics has enabled these companies to transform three key business functions: operational marketing, CRM, project management, and quality assurance.

Figure 6.54: Business functions affected by big data and data analytics adoption



N= 28
Source: Digital Transformation Scoreboard 2018

Small companies grow faster using big data

One big share of the food industry is in the preparation of snacks and meals for people on the move and for lunch boxes. New companies, such as Graze in the UK, take advantage of the big data they collect from their clients in order to improve their products and replace unpopular products.[28] Thus, they can grow by increasing productivity and sales.

Big data and food safety

Big data and data analytics help with food safety in many ways: they allow consumers to track the supply chain of food products from the farm to their plate; they can help design warning systems when a problem with a product is identified (such as using social media); and they can provide much more information about the food products than the labels printed on their packaging. National governments and the European Commission are supporting research and development in this area, according to an interesting review by Marvin and colleagues.[29]

6.9 3D printing

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80% of respondents who have adopted 3D printing consider digital technologies to have generated positive outcomes

Figure 6.55: Profile of survey respondents who have adopted 3D printing

20% are companies with more than 250 employees

100% use the technology improve design and production

25% are start-ups or university spin-offs

5% are businesses aged 15 years or over

60% of the companies adopting this technology improved and/or changed their business model

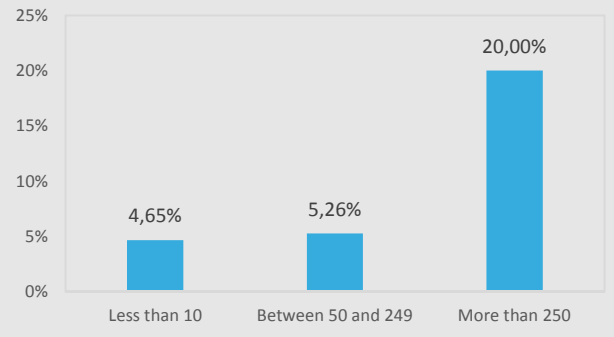
80% of those that use this technology saw an impact in their technology prototyping

Source: Digital Transformation Scoreboard 2018

Business characteristics

3D printing has huge potential to disrupt the way in which products are designed, developed and manufactured. The recent advances in the technology have pushed many manufacturers to increasingly use it for fast prototyping and product customisation in particular. The results of the 2018 DTM survey show that 3D printing technology is widely used by large firms of more than 250 employees. According to the characteristics sample of respondents to this survey, its adoption seems less important to smaller firms: only 5% of SMEs have adopted 3D printing.

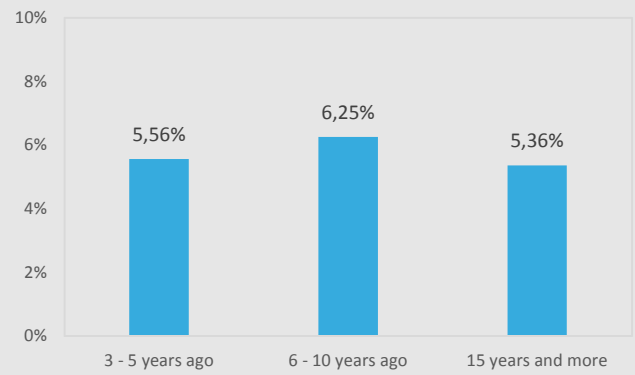
Figure 6.56: Adoption of 3D printing by company size



N= 113
Source: Digital Transformation Scoreboard 2018

Further to these observations, 3D printing has been adopted by a relatively small proportion of firms across various categories of firm age (5-6%). This may be because it is a new and costly technology that will take some time to be widely adopted by the food and construction industries.

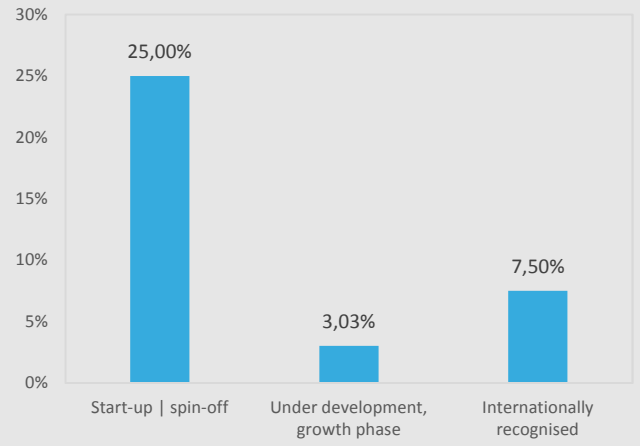
Figure 6.57: Adoption of 3D printing by company age



N= 112
Source: Digital Transformation Scoreboard 2018

A similar pattern can be seen when looking at how firms adopting this technology are distributed across stages of development: the share of adopting firms is relatively even at two stages of development, ranging between 3% and 8%, with the exception of start-up/spin-off companies, which have 25% share of adoption.

Figure 6.58: Adoption of 3D printing by company development stage

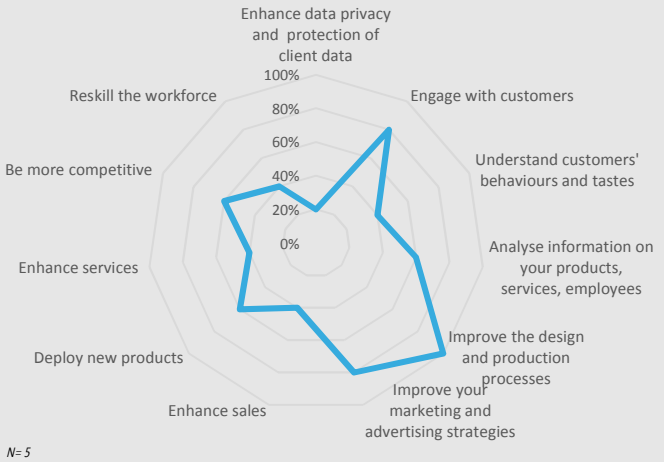


N= 109
Source: Digital Transformation Scoreboard 2018

Purpose

Companies adopting 3D printing stated that they adopted this technology mainly with the purpose of improving the design and production processes, engaging with customers, and improving marketing and advertising strategies. These observations indicate that firms adopting 3D printing are exploring ways to adapt digital technologies to benefit from productivity gains, to improve processes, and therefore to increase their competitiveness.

Figure 6.59: Purpose of 3D printing adoption

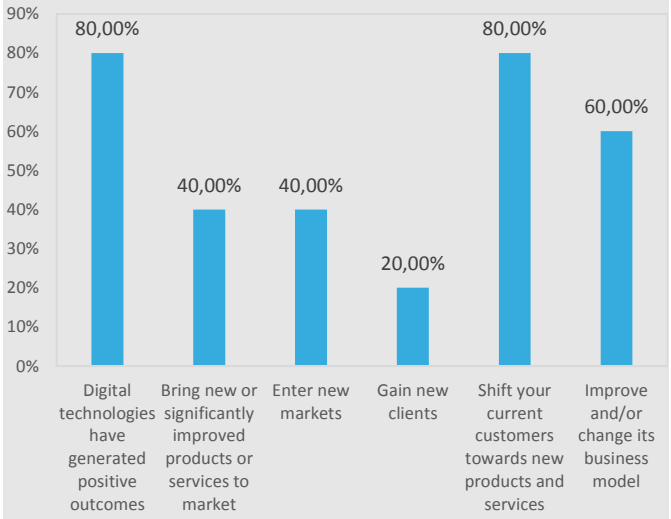


N= 5
Source: Digital Transformation Scoreboard 2018

Impact

Most of the businesses adopting 3D printing (80%) report a positive impact. More specific impacts have also been felt, with 60% of these businesses stating that they have improved or changed their business models, and 80% having been able to shift their current customer base towards new products and services.

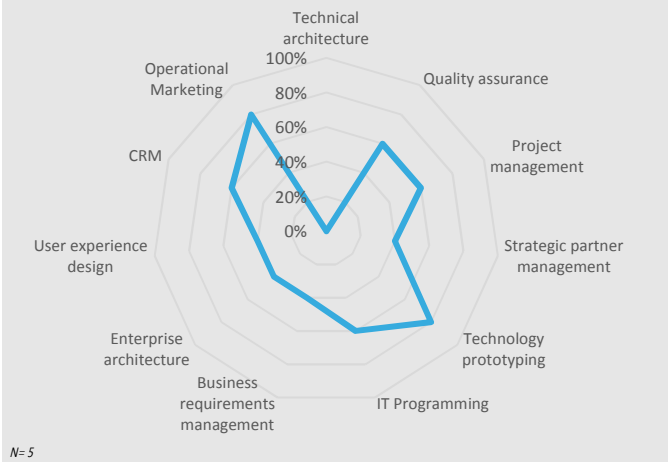
Figure 6.60: Outcomes of 3D printing adoption



N= 5
Source: Digital Transformation Scoreboard 2018

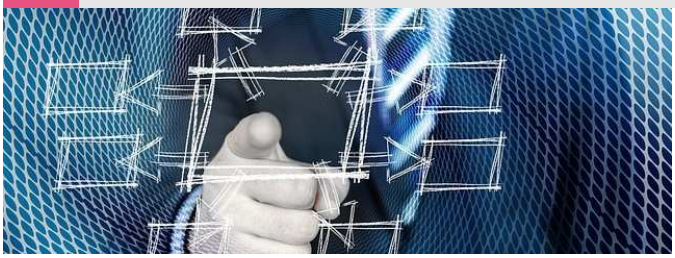
The adoption of 3D printing is largely associated with several functions affected by digital technology adoption, primarily operational marketing and technology prototyping.

Figure 6.61: Business functions affected by 3D printing adoption



N= 5
Source: Digital Transformation Scoreboard 2018

6.10 Artificial intelligence



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90% of respondents who have adopted artificial intelligence consider digital technologies to have generated positive outcomes

Figure 6.62: Profile of survey respondents who have adopted artificial intelligence

20% are companies with more than 250 employees

80% of users have experienced changes in project management and prototyping

80% use the technology to enter new markets

12.5% are businesses aged under 2 years

7.5% are internationally recognised businesses

80% use the technology to bring new or significantly improved products or services to market

Source: Digital Transformation Scoreboard 2018

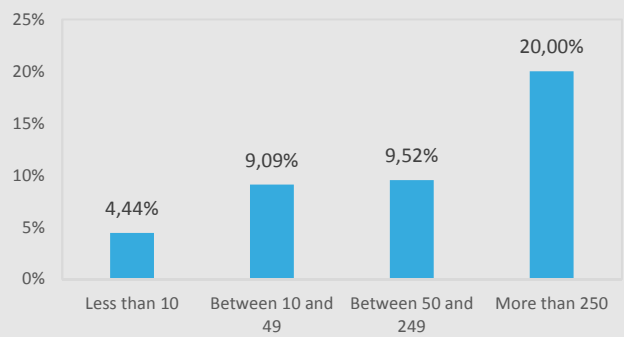
Business characteristics

The adoption of artificial intelligence by businesses has gained speed in recent years[30]. Currently, the share of adoption of artificial intelligence amongst firms is relatively even and low across small firms of less than 250 employees. The share of adoption ranges from 4% in very small firms of less than 10 employees, up to 9% in firms of between 10 and 250 employees. As for large companies in the sample, artificial intelligence is only adopted by 20% of companies in this category.

In addition, amongst the firms in the sample, artificial intelligence was mainly adopted by very young companies under 5 years old (22% for firms between 3 and 5 years old), indicating that although artificial intelligence has been around for some time, its business use by firms is only just taking off, mainly in younger firms.

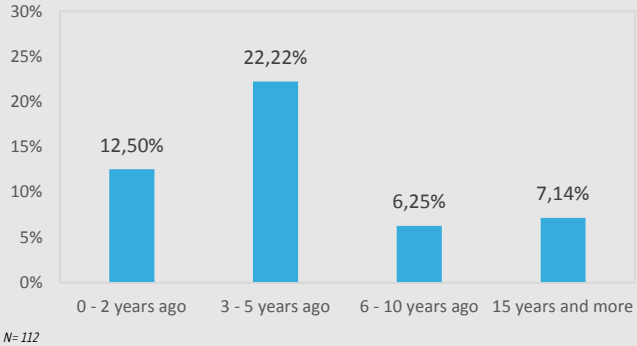
AI was born in the 1950s.[31] However, it has been able to grow in the last few decades due to improvements in machines' computing capacity. One of the recent advancements of AI is deep learning, through which machines can become intelligent by learning from data in natural human language.[32]

Figure 6.63: Adoption of artificial intelligence by company size



N= 113
Source: Digital Transformation Scoreboard 2018

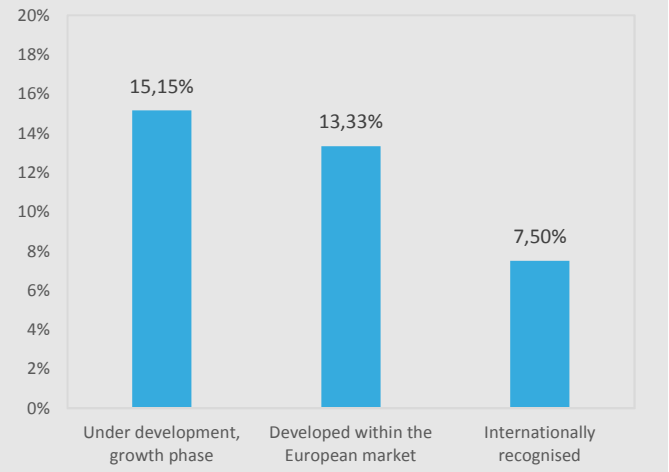
Figure 6.64: Adoption of artificial intelligence by company age



N= 112
Source: Digital Transformation Scoreboard 2018

Finally, artificial intelligence is adopted more frequently by firms in a development and growth phase and by those developed in the European market (15% and 13% respectively), and less so by internationally recognised companies (7.5%).

Figure 6.65: Adoption of artificial intelligence by company development stage

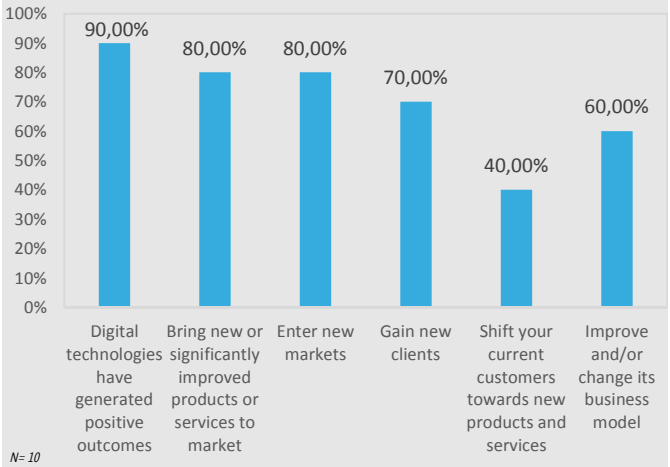


N= 109
Source: Digital Transformation Scoreboard 2018

Impact

90% of the companies adopting artificial intelligence state that they have felt positive impacts from adopting the technology. In particular, most of the companies indicate that they have been able to enter new markets, bring new or significantly improved products or services to the market, and gain new clients, with more than 70% of respondents in each category.

Figure 6.67: Outcomes of artificial intelligence adoption



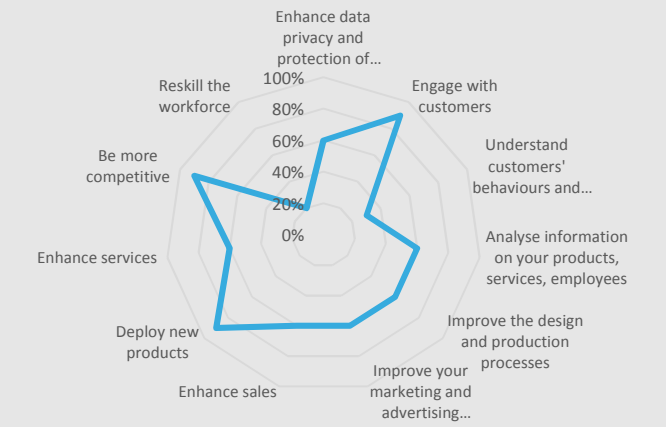
N= 10
Source: Digital Transformation Scoreboard 2018

Purpose

Analysis of the usefulness perceived by respondents indicated that the adoption of artificial intelligence is mainly carried out with the purpose of engaging with customers, increasing competitiveness, and deploying new products.

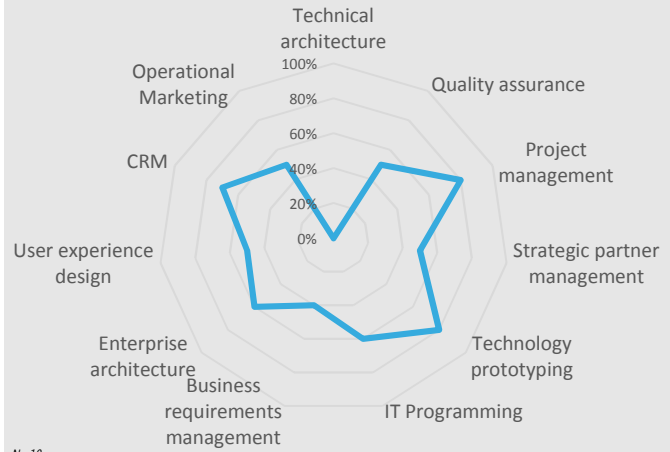
Finally, and as illustrated by the figure below, adopting this technology has enabled these companies to transform three key business functions: project management, technology prototyping, and CRM.

Figure 6.66: Purpose of artificial intelligence adoption



N= 10
Source: Digital Transformation Scoreboard 2018

Figure 6.68: Business functions affected by artificial intelligence adoption



N= 10
Source: Digital Transformation Scoreboard 2018

Digital pulse – Using media analytics to assess the uptake of Industry 4.0 technologies

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The digital transformation of European industry is accelerating: analysis of national indicators on the framework conditions and the outcome of digitisation[b] shows that Europe is adapting quickly to the digital economy paradigm, benefiting from the wide spectrum of opportunities it creates. While digital innovation is moving rapidly in Europe, global competition is also increasing in North America and Asia. Digital technologies such as big data analytics, artificial intelligence and blockchain are disrupting business, leading to changes in business models, the service delivery, and staff training (upskilling). Powerful new digital solutions continue to crowd the marketplace, even though businesses struggle to implement and use mature new technologies (such as cloud computing) upon which next-generation innovations are built.

Therefore, it is essential to use tools enabling data to be gathered as close to real time as possible to identify and assess the latest technological advances and their future impact on businesses and industry. This chapter examines the use of a Digital Intelligence Platform to measure digital pulse as a digital advancement KPI of the interest and acceptance of the technologies in EU Member States.

7.1 Building a Digital Pulse Index

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Introduction

This analysis uses information collected from open sources available on the Internet. These sources mainly include articles from online press, articles from dedicated blogs, comments from industry web pages (home pages of companies and industry associations), all major social media websites, forums, broadcast television and other online media.

The data collected refers to text corpora and images and covers billions of web conversations from 150 million sources in 187 languages. This data is accessible through a **Digital Intelligence Platform** that provides an interface between the database and the user. By defining particular keywords, hashtags and filters and applying data-analytics techniques, such as text mining and sentiment analysis, it is possible to extract the most relevant data and quantify an online discussion on a topic in question, as well as the noise generated by this discussion.

The approach of estimating technology uptake using real-time data extracted from open sources on the Internet is entirely new. The results presented in this chapter should therefore be taken with caution, as uncertainties remain as regards the methodology and the exact nature of the algorithms used by the platform. Nevertheless, it is an interesting pilot study subject to improvement. As exemplified in the next sections, this new tool can help policymakers (a) identify technologies that are the most debated and/or perceived as controversial, and (b) determine what aspects of the technology (e.g. regulatory, technical, financial, skills) can be addressed by policy actions if the technology´s full potential has to be released.

Design and raw-data collection

The following methodology was developed under the DTM framework. In order to calculate the online media analytics of public information relating to the uptake of digital technologies in Europe, a set of keywords was defined for each EU Member State (MS) in the official languages. Then, for each technology and each MS, a query in a high-level programming language (SQL) was defined to enable the appropriate data to be selected. The results were cross-tabulated to allow for their analysis and visualisation.

Quantitative data were retrieved for six specific technologies and technological solutions: cybersecurity, autonomous driving, artificial intelligence (including machine learning), robotics, 5G, and blockchain. The time frame set for this analysis was the year 2017 (from 1 January to 15 December) and the results were aggregated by week. In more detail, a eight-step process was undertaken to define the set of queries that helped select and extract the data:

1. **Defining a rationale for the variables** to be retained based on the assumptions that a) the higher volume of observations on a digital topic in a given geographic area (country) implies that the area is digitally advanced, b) a country that is more digitally advanced than another country has a higher propensity to display a higher level of awareness of a technology topic, and c) Internet users' engagement (shares, likes, comments) on a technology topic represents an interest in this topic.
2. **Defining a set of principal technologies/technological solutions**: cybersecurity, autonomous driving, 5G, artificial intelligence, blockchain, and robotics.
3. **Defining the selected technologies** and **selecting certain keywords** that are relevant to each technology: For example, keywords selected for searching the database for mentions relating to artificial intelligence are: "artificial intelligence", "machine learning", "natural language processing", "predictive analytics", "cyber physical systems", "chatbot" and the hashtag *#AI*. The equivalents of these keywords were translated into all EU Member States' languages. For each query, English keywords were included in addition to native-language keywords.

[b] See section 8, pages 66-67

4. **Designing the queries** in house by leveraging the expertise of data science and analytics experts. The queries were coded using high-level SQL-like scripting that can be interpreted and executed by the Digital Intelligence Platform.
5. **Defining the geographical scope** to collect data either posted from a specific country (e.g. local mentions where a local or international user has enabled geotagging and identifies the post as coming from France), or posted by a person who identifies themselves as a native of a country (e.g. local or international mention, posted by a person identifying themselves as a French citizen). Observations where neither the author nor the text corpus are geotagged were automatically indexed as coming from the country whose national language is the language of the text corpus.
6. **Defining the sample size**: A random sample of 5% of data per query was retrieved for each week of 2017. This explains why only a limited amount of observations are used when drawing up this index.
7. **Extracting raw data**: When all the scripts were in place, the platform searched the database to retrieve mentions containing the defined keywords in the defined geographical area.
8. **Aggregating the data**: The extracted results were automatically aggregated by a number of groupings (topics, engagement, demographic characteristics, themes) and visualised (tables, charts, graphs and maps).

The desired outcome of the data analytics on the sample was a structured data set indicating the frequency of occurrence of discussions about a specific technology and the direction or sentiment associated with each observation. This data set is distributed across EU Member States and the US, and spans a total of 50 weeks, representing one year of discussion about these technologies. These discussions provide information about the digital pulse of the European industry regarding the selected technologies.

Digital pulse and its three dimensions

Raw-data treatment and analysis provide us with a set of frequencies and sentiment analysis regarding online media discussions about six key digital technologies relating to Industry 4.0. The raw data refers to the number of online media mentions (news, blogs and social media) of the topic per week for the period of observation, which is the year 2017. This analysis was carried out using this raw data, standardised by the number of active firms per country for all 28 EU Member States and the USA.

The quantitative analysis technology enabled us to understand the pulse or trend in the technology. The computation of a Digital Pulse Index is based on a linear combination of the standardised scores of three main variables:

- Frequency of mentions of a specific topic (number of times a specific keyword or set of keywords assumed to define a specific topic is mentioned).
- Importance of the specific topic expressed by volume of reuse of a given observation (e.g. the number of times an article has been forwarded, shared or commented on), which is interpreted as the level of engagement on a given corpus.
- The direction of the observation or sentiment, providing information on whether the context in which the keyword or set of keywords appeared related to a positive or negative view of it.

The sentiment assessment provided an insight into whether the general opinion streaming from online discussions about a given technology is positive or negative. This analysis was carried out on the total sum of sentiment scores (ranging from the values -1 for a negative view to 0 for a neutral view and 1 for a positive view) during a one-week period across all territories.

Based on these metrics, the Digital Pulse Index has been developed, which reflects a topic's popularity amongst social media users at a specific time. The index relies on weekly data corresponding to observations between 2 January and 15 December 2017. In order to limit the effects of extreme values, a winsorisation procedure was applied to the set of raw data prior to performing a linear combination to obtain the scores per country for each technology for each given week.

The linear combination of the three standardised variables (mentions, engagement and sentiment) aims at providing a composite index that enables us to drawn conclusions from the discussion of these key technologies. The weight of each variable was multiplied before being added to the other variables as follows:

- Frequency of occurrence (FO) – 45%
- Engagement/importance (EI) – 45%
- Net sentiment (positive/negative values - NS) – 10%

The formula defining the Digital Pulse Index (DPI) is as follows:

$$DPI = 0.45 \times FO + 0.45 \times EI + 0.10 \times NS$$

Following the calculation of the linear combination associated with each week within the period, we focused on two main aggregates:

- The average score over the period for each country; and
- The average score over the period for each technology.

Finally, the average scores at country level were transformed to fit on a scale of 0-100 trough a min-max standardisation procedure. This procedure enabled the index to be established, reflecting the pulse of digital technologies for each technology and across each country for the period on a scale of 0-100. In essence, the index illustrates, on a comprehensible scale, a combination of parameters relating to the volume of discussion, sharing and sentiment over a set of technologies in a given geographical area.

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7.2 General observations

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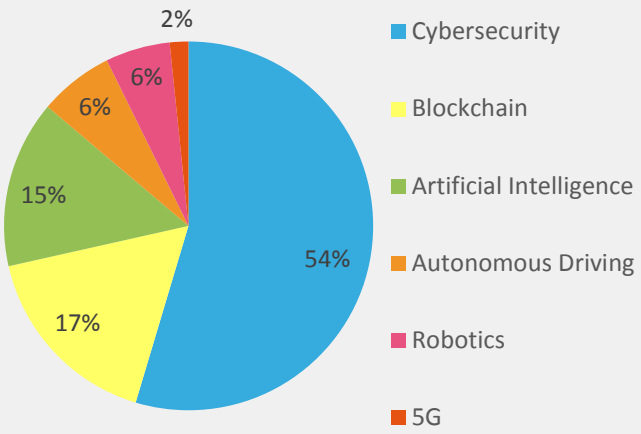
Most popular digital technologies

A first general analysis of the index scores aggregated for each technology and country provides an insight into the level of popularity associated with each technology studied. During the period of 2 January to 15 December 2017, **the most popular technology discussed in online sources was cybersecurity** (53% share of averaged scores over the period). The popularity of cybersecurity was distantly **followed by discussions about blockchain technology** (17%) **and artificial intelligence** (15%), forming the top three most popular technologies. Figure 7.1 below provides an illustration of the share of average scores over the period.

Figure 7.1: Online popularity of digital technologies (EU-28 and USA)



It is important to highlight that these scores and popularity levels may not be directly related to technology adoption.

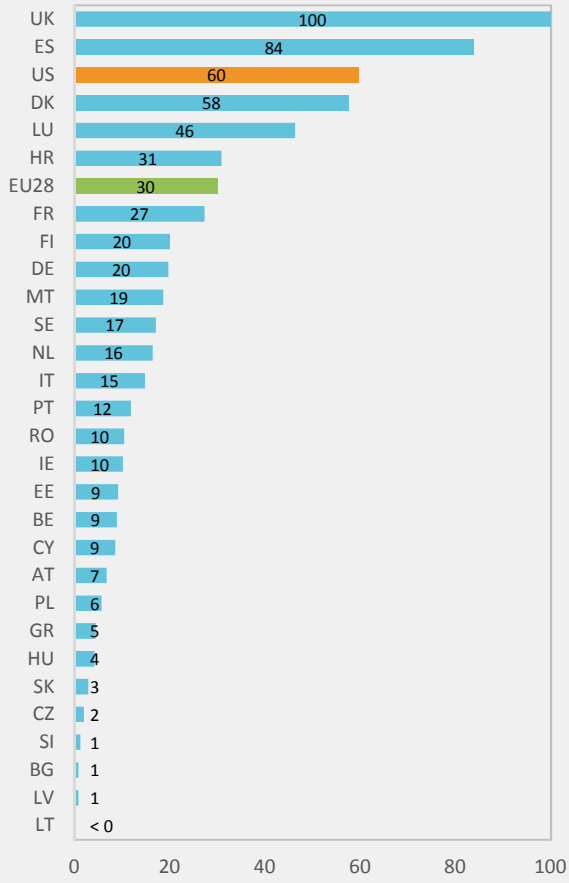
As an illustration, several cybercrime scandals hit the news in 2017 (e.g. the WannaCry and Petya cybersecurity disasters). This news, coupled with the introduction of new legislation such as the General Data Protection Regulation, which was adopted in April 2016 and whose implementation will start in May 2018, may have had an impact on the discussions about cybersecurity, and hence on the data collected.

Moreover, recent excitement and speculation on cryptocurrency may have made discussions about blockchain technology more intense. In this particular case, as is illustrated in the following sections, the popularity of the technology is related more to a conjectural context at an early stage of development of decentralised currencies than to the actual uptake of distributed ledger (or blockchain) technology, despite its numerous applications.

Most digitally aware countries

The index scores aggregated over the six technologies can also be used to compare countries in terms of their level of digital awareness. The analysis of index scores, aggregated over the period of observation for each country of interest (EU-28 and USA), indicates the extent to which discussions on digital technologies dominate in certain regions. Results from this analysis reveal that **the average index scores per country, standardised by the total population of active firms in each of them, was the highest in the UK, Spain, the USA, Denmark, and Luxembourg** in 2017. Figure 7.2 below illustrates the digital pulse index across countries on a scale of 0-100.

Figure 7.2: Digital awareness across countries (EU-28 and USA)



Surprisingly, the analysis indicates that the importance of technology discussion, expressed by the average index scores over the period, places Spain amongst the top countries, in second place. A closer look at the underlying data shows that Spain's average score is driven by the volume of discussions about cybersecurity, which in this case accounts for four times the volume observed in the UK (the top performer) and a third of the volume observed for the USA.

In addition, Croatia is among the top performers, ranking 6th for discussions relating to digital technologies. It is important to emphasise that this ranking is driven by the intensity of discussions observed in the country. The IT sector in Croatia has grown drastically in the last five years, with an increase in the capacity of data centres and a growing use of mobile applications and big data analytics. The progress seen in Croatia may thus explain its high score in the digital pulse index.

Future research on the development of technology uptake in Croatia will be needed to contrast established (and lagging) national statistics, with insight provided by real-time data such as the data used in the present analysis.

Comparison between EU-28 and USA

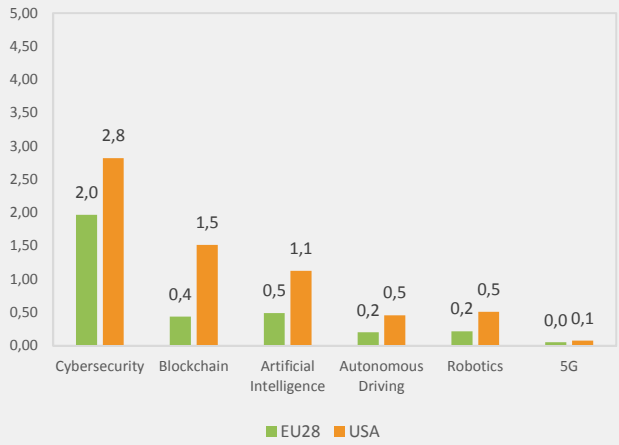
This analysis illustrates the digital pulse across the six digital technologies for two main economies, the EU-28 and the US. In order to perform a comparative analysis across both territories, the total scores obtained by the EU-28 as a whole were aggregated as follows.

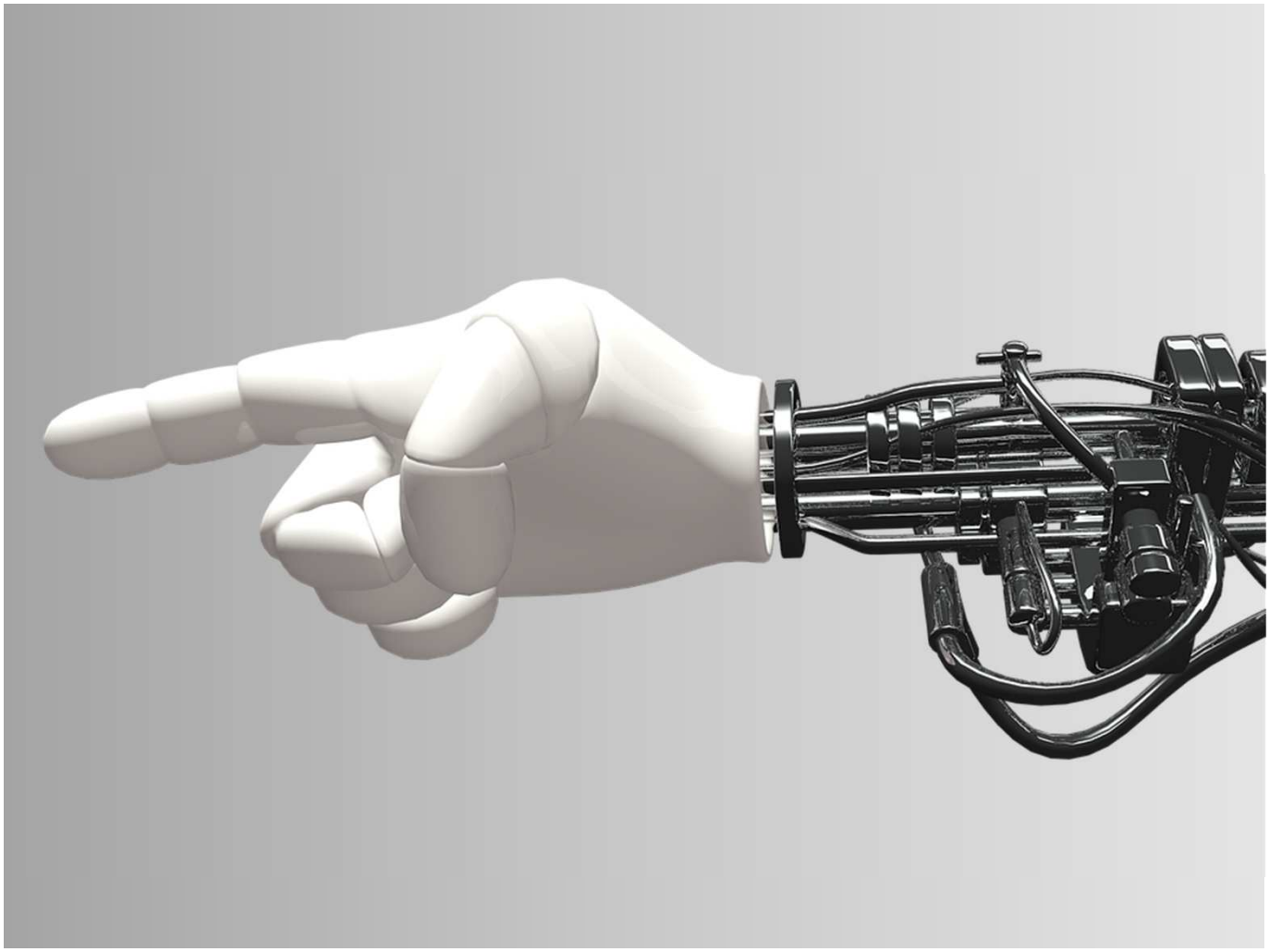
The analysis was carried out using the total observations in terms of discussion, engagement and net sentiment for all EU-28 Member States across the period and the total number of companies that these economies comprise. The same weighting system (45% for frequency of occurrence, 45% for level of engagement, and 10% for net sentiment) was applied to the sum of observations per week, and the resulting linear combination value was also divided by the total number of firms operating in the whole territory (i.e. EU-28). The ratio obtained equals the digital pulse for the EU-28 as a whole, and is thus comparable to the observations made for the US.

As indicated in figure 7.3, the analysis is expressed in net digital pulse values, instead of a scale of 0-100, given its focus on only two geographical regions. This figure shows that, **with the exception of blockchain, interest in digital technologies online is relatively similar in both the EU-28 and the US, with American interest slightly higher**. The USA also showed a slightly higher interest in cybersecurity technology and artificial intelligence (indicated by a 0.8 and 0.6 difference in the digital pulse respectively). These results suggest that there is a general and comparable interest in autonomous driving, robotics, and 5G in both regions, whereas differences in general interest appear in blockchain, cybersecurity and artificial intelligence, which have higher intensity in the US.

In the case of blockchain we can see a different picture, with a more pronounced difference in the digital pulse values between the EU-28 and the US. General interest in the technology in the EU appears to be around three fourths less important than in the US. This observation may be related to the wider adoption of cryptocurrencies in the US than in Europe.

Figure 7.3: Online popularity of digital technologies across EU-28 and USA





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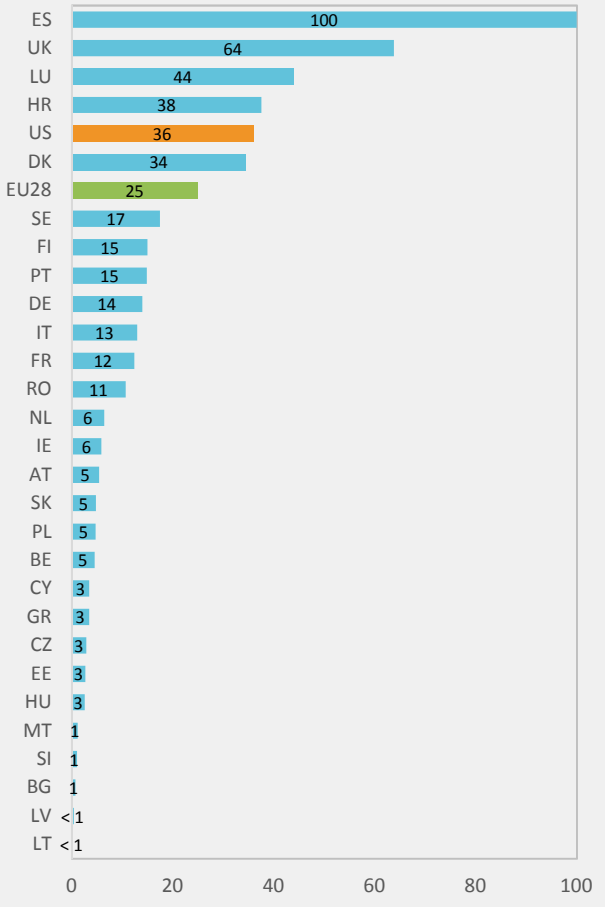
7.3 Cybersecurity

The analysis of index scores limited to cybersecurity reveal that **the country in which cybersecurity is discussed the most is Spain, followed by the UK and Luxembourg.** Croatia, the USA and Denmark are also in the top tier of distribution. Figure 7.4 illustrates the average index scores per active firm, expressed on a scale of 0-100.

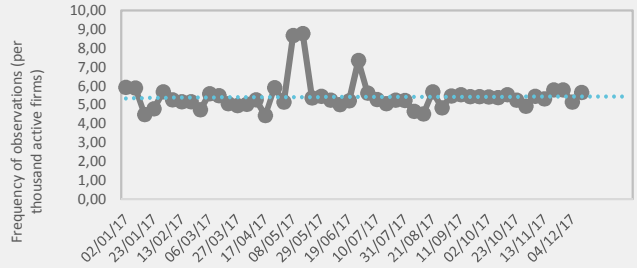
As already observed in the generalised results, Spain and Croatia again rank in the top tier. It is important to treat these results with caution, as discussions about cybersecurity may not be completely related to digital technology uptake, and may be influenced by the current need to spread this technology across industries to improve security in the digital economy paradigm. On the contrary, Luxembourg's position in the top tier can clearly be associated with the uptake of the technology, as is demonstrated by the success of the first edition of Cybersecurity Week in October 2017, which aimed to promote cybersecurity among citizens, corporates and SMEs.

Figure 7.4: Cybersecurity awareness across EU-28 countries and USA in 2017



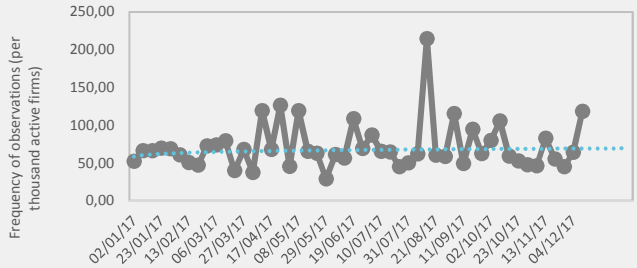
In addition, the analysis of the total sum of discussions per thousand active firms for the period shows a **stable trend in the volume of discussions about cybersecurity**, ranging between 4 and 7 observed discussions per thousand active firms. However, this trend shows two distinguishable peaks, in mid-May and at late June. Analysis of the posts indicates that these peaks are associated with the WannaCry ransomware strain, which spread around the world on 12 May, targeting thousands of victims, including public organisations and large firms; and the Petya (or Goldeneye) malware, which infected networks of organisations in multiple countries, such as American pharmaceutical company Merck and Russian oil company Rosneft, in June 2017.

Figure 7.5: Volume of discussions about cybersecurity in 2017 (EU-28)



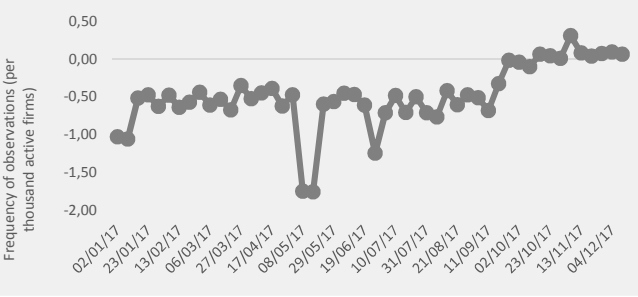
On the other hand, the trend in the cybersecurity engagement level reveals that the **degree of interest in discussions about the technology varied considerably during the year** (between a total of 28 and 120 re-diffusions of observed text corpora per thousand active companies). However, this variation pattern peaks at more than 200 re-diffusions in the week of 14 August. These peaks may be associated with the massive Equifax data breach discovered in late July 2017, which included names, social-security numbers, birthdates, addresses and, in some instances, driving-licence numbers of 143 million customers, and contrasts with the observations made on the total discussion volume during the year.

Figure 7.6: Engagement level on cybersecurity in 2017 (EU-28)



The cybersecurity sentiment analysis provides an insight into the nature of the discussions under analysis in terms of optimistic and pessimistic views. In this case, **negative or pessimistic views on cybersecurity were observed in the first three quarters of the year**. The total sum of sentiment scores per thousand active firms oscillated between negative values until mid-October, when discussions were suddenly evaluated in positive terms. This behaviour may be associated with the alarm raised by a Belgian white hat who discovered a security gap in BNP Paribas's French server on 27 October.

Figure 7.7: Development of cybersecurity sentiment in 2017 (EU-28)

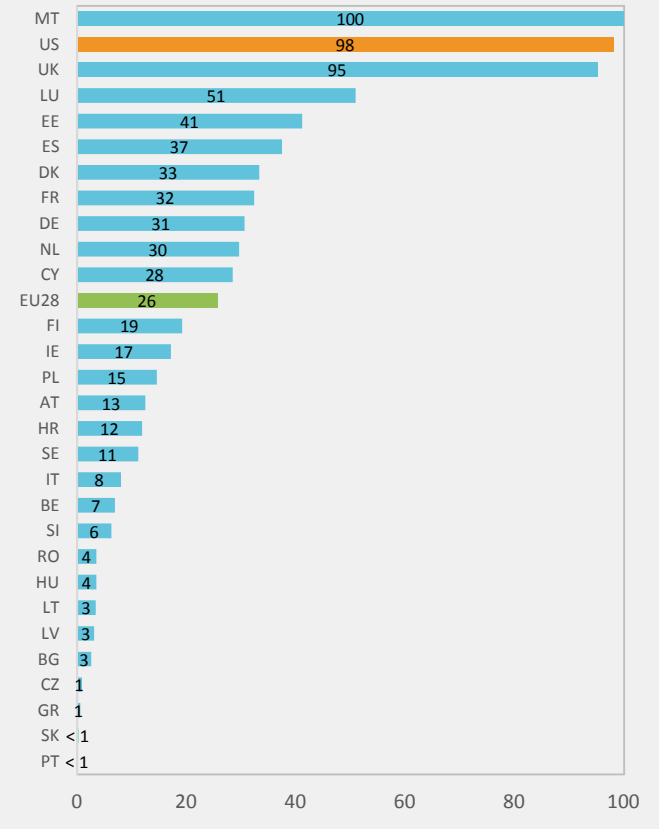


7.4 Blockchain

The analysis of the discussions about blockchain technology is quite particular, given the significant media coverage of the technology in 2017 following recent excitement and speculation regarding cryptocurrencies. It is therefore important to highlight that such media coverage, which is likely to be captured in the data used for this study, discusses blockchain technology mostly as being applied to cryptocurrencies, rather than relating to the whole spectrum of applications that distributed ledger technology (widely known as blockchain) may affect in the near future. Blockchain technology shows a lot of promise beyond the financial industry. For example, in the energy sector, it can not only be used to execute energy supply transactions, but could also provide the basis for metering, billing and clearing processes and help to document ownership, asset management, emission allowances and renewable energy certificates.[33] It could also be used to increase the effectiveness of public-service delivery, for example by helping to streamline tendering and purchasing across departments and agencies.[34]

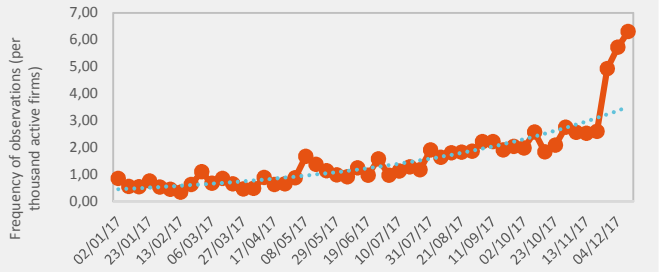
The analysis of the blockchain index scores across countries shows a significant concentration of scores in three main countries: Malta, the USA and the UK, which score nearly twice as highly as the countries ranked immediately below them. Analysis of posts shows that in 2017, Malta hosted a series of high-level events (e.g. EY's Annual Attractiveness Event in October) discussing the impact of emerging technologies on existing industries, that might explain the high score obtained for the country.

Figure 7.8: Blockchain awareness across EU-28 and USA in 2017



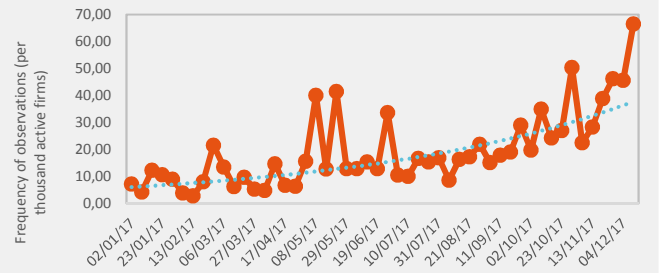
Alongside the analysis of the distribution of blockchain technology discussions across countries, **the analysis of total discussions or observed text corpora confirms an increase in popularity of the technology in online media.** Figure 7.9 illustrates the dynamic in 2017, where a steady increase in total discussions per thousand active firms can be seen across all territories under review. Moreover, a steep increase in popularity is seen towards the end of the year. This trend presents a similar pattern to that of the bitcoin trading value over the same period, which accelerated towards the end of October and dramatically increased from November onwards.

Figure 7.9: Volume of discussions about blockchain in 2017 (EU-28)



Needless to say, the analysis of the engagement or and the re-diffusion of associated text corpora confirm these observations. The engagement trend follows a very similar pattern, with a higher variation between time periods (weeks), but with a similar increasing trend.

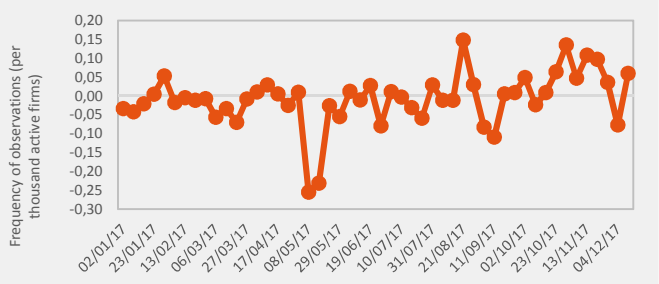
Figure 7.10: Engagement level on blockchain in 2017 (EU-28)



Interestingly, the overall sentiment on blockchain technology has oscillated between negative and positive views. Nevertheless, it is important to highlight two peaks in negative views in May and September, and a few mild peaks in positive views in August, October and November.

This highly varied nature of views and opinions points to significant volatility and uncertainty about the future of the technology, although such uncertainty may only be related to cryptocurrency applications of the technology, rather than the full potential of applications it can have. Since distributed ledger technology will be key to the development of the digital economy paradigm, the Scoreboard can only call for further research into the potential applications and economic impact of the technology in order to better assess the benefits that it may bring to the European industry.

Figure 7.11: Development of blockchain sentiment in 2017 (EU-28)

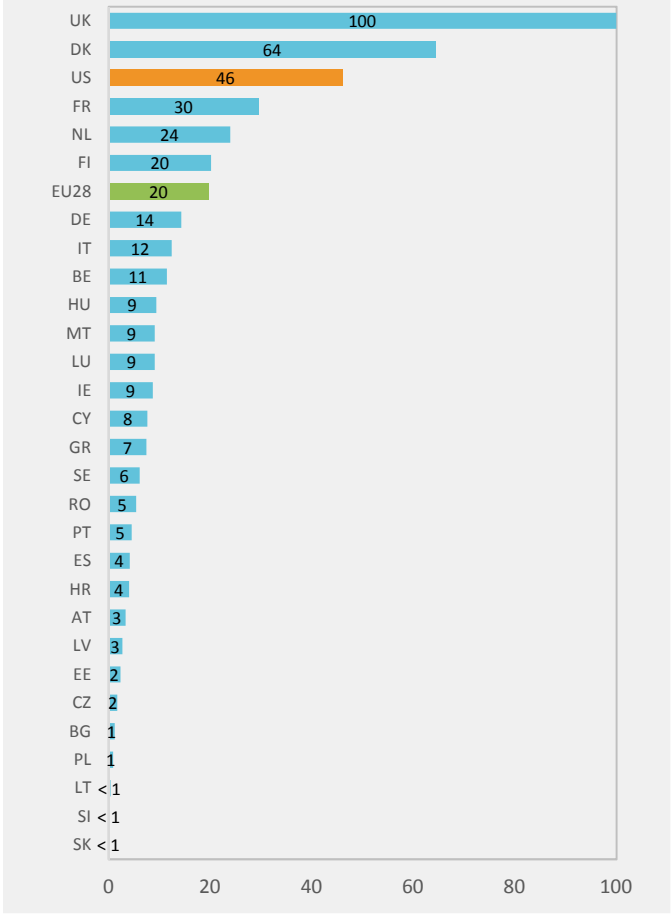


7.5 Artificial intelligence

The digital pulse index aggregated at the technology level throughout 2017 reveal a positively skewed distribution across countries. Even though the average index values per thousand active firms for each country are concentrated in a handful of countries, the decreasing rate across these countries is nearly 30% from one country's score to another's. **The UK leads the ranking, followed distantly by Denmark and France.**

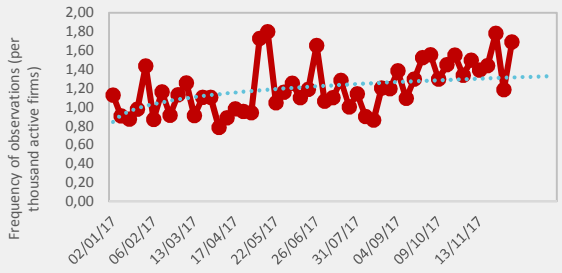
Artificial intelligence has caught the interest of the media in recent years, especially with the spread of business tools and applications relying on supervised and unsupervised classification algorithms, machine learning or neural networks. Much of the discussion volume and engagement observed in online media with regard to this technology has taken place in northern and western European economies. Overall, the score aggregates indicate that many of these discussions, standardised by the number of active firms in a territory, originated in the EU-28.

Figure 7.12: AI awareness across EU-28 and USA in 2017



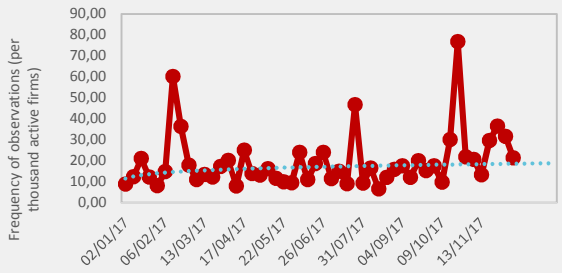
The analysis of the total volume of discussion about artificial intelligence shows that **the trend marginally increased during the period**, ranging between 0.8 and 1.8 discussions per thousand active firms per week. However, this trend shows three distinguishable peaks in mid-May, late June and late November 2017. Analysis of posts suggests that these peaks corresponds to the excitement around NASA´s Kepler space telescope, which analysed thousands of exoplanets using machine-learning technologies developed by Google, and ultimately helped to discover a new exoplanet in December 2017.

Figure 7.13: Volume of discussions about AI in 2017 (EU-28)



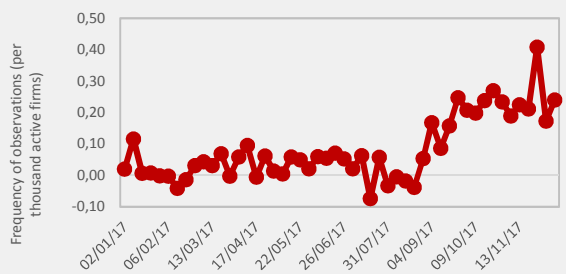
In addition, the discussion trend contrasts with the engagement trend in the same period. The re-diffusion of discussions oscillated between 6 and 25 observations per thousand active firms per week. However, the peaks of engagement were observed in mid-February, late July and late October, when the humanoid robot, Sophia, told the audience at a conference in Riyadh how honoured she was to be a Saudi citizen.

Figure 7.14: Engagement level on AI in 2017 (EU-28)



The general perception of artificial intelligence is positive and optimistic. The sentiment analysis was performed on the trend of total net scores from the nature of the opinions associated with each discussion observed. For this technology, the trend indicates a stable and rather positive opinion until the end of August, after which the trend intensified through the rest of the year. The net sentiment scores increased progressively to reach nearly five times the score observed earlier in the year (0.5 points per thousand active firms, compared to 0.1 before the end of August).

Figure 7.15: Development of AI sentiment in 2017 (EU-28)



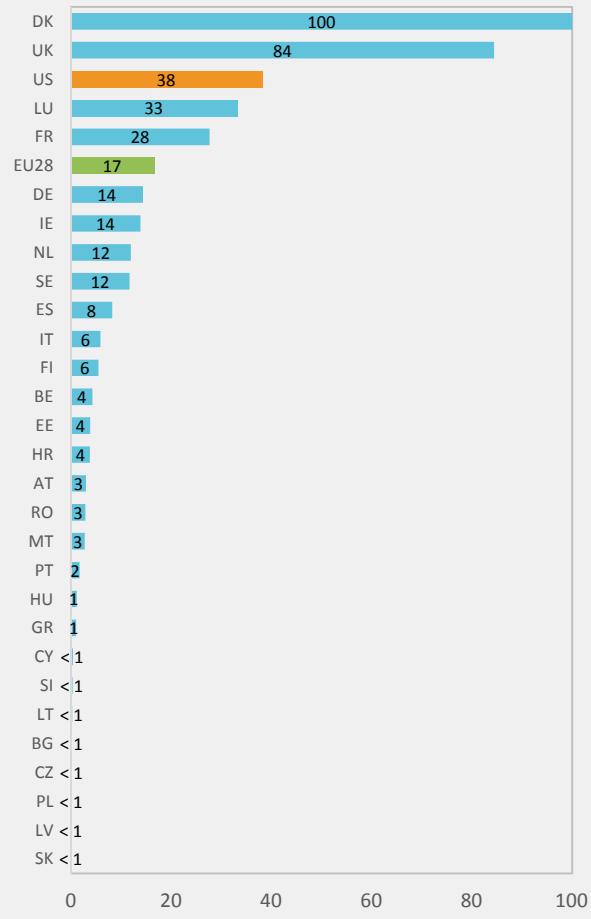
Overall, the analysis of artificial intelligence indicates a steady growth in discussions and a positive opinion as regards the technology, with a stable engagement level. This points towards constant diffusion of the technology across the EU industry.

7.6 Autonomous driving

The digital pulse index for autonomous driving also presents a skewed distribution across countries, with scores concentrated in three main countries: Denmark, the UK, and Luxembourg, although there are significant differences across them.

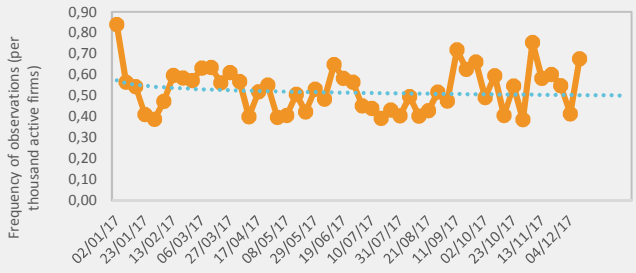
It is interesting to observe that discussions are taking place not only in the EU's leading automotive countries, but also in smaller countries such as Denmark and Luxembourg, whose automotive industries are less significant than in other EU Member States. In reality, autonomous driving consists of a set of digital technologies comprising not only connectivity and short-range communication technologies, but also sensors and laser systems to monitor the road and traffic conditions, and AI and machine learning enabling external data to be combined with car data. Therefore, this observation may indicate that autonomous driving technologies are not necessarily concentrated n industry-leading regions, but rather in regions where development and growth factors are present and easily accessible (e.g. access to finance, infrastructure, skilled labour, etc.).

Figure 7.16: Autonomous driving awareness across EU-28 and USA in 2017



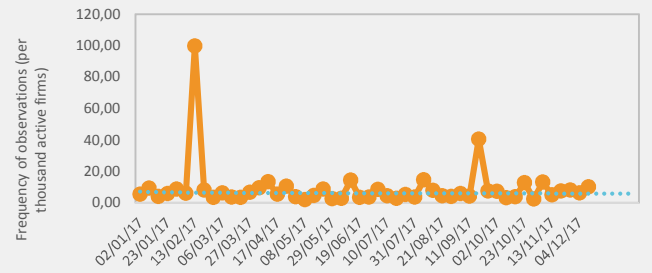
An analysis of the total volume of discussions observed in online media in 2017 shows that autonomous driving is present in the minds of individuals discussing digital technologies. **Discussions appeared to take place in a rather stable trend through the year**, oscillating from a reduced interval of 0.3 to 0.9 discussions per thousand active firms. Furthermore, even though the oscillation points to a few peaks in January, September and November, these sudden variations in the volume of discussions do not correspond to transcendental events related to the technology.

Figure 7.17: Volume of discussions on autonomous driving in 2017 (EU-28)



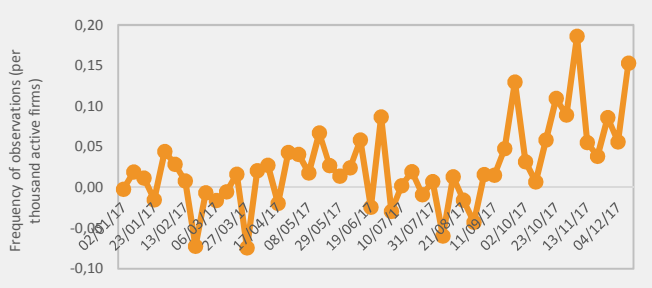
These observations contrast with the analysis of the engagement trend on autonomous driving technologies, which shows that **excitement about these technologies is not as intense as it is for other technologies** such as blockchain, cybersecurity and artificial intelligence. The re-diffusion of discussions observed ranges consistently between 1 and 7 observations per thousand active firms. This result, combined with the analysis of the overall discussion trend, indicates that **autonomous driving technologies have become a mainstream element of discussion regarding digital technologies.**

Figure 7.18: Engagement level on autonomous driving in 2017 (EU-28)



Finally, an analysis of the net sentiment perceived on the discussions observed during the period provides an insight into how the population's acceptance of autonomous driving technologies has progressed. Even though the trend oscillated between positive and negative views in the first three quarters of the year, it is important to highlight that **positive views dominated the sample of discussions**. Interestingly, since the end of September, peaks of positivity about these technologies were observed and the trend itself has grown.

Figure 7.19: Development of sentiment about autonomous driving in 2017 (EU-28)

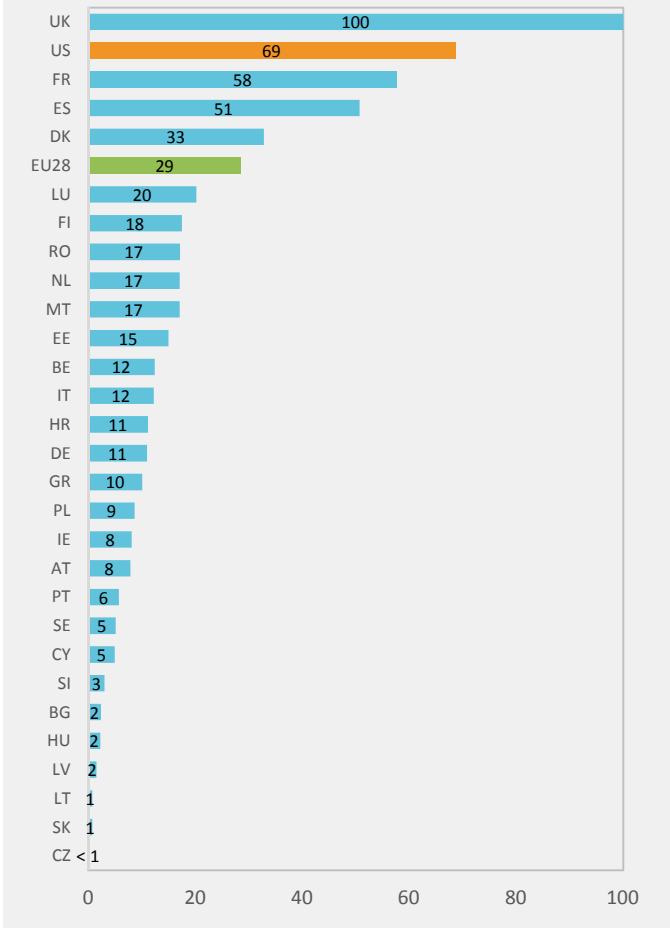


In general, the trend analysis of discussions, engagement and sentiments about autonomous driving technologies indicates that its adoption by the European industry is steadily ongoing. However, it is interesting to note that the concentration of discussions in countries that are not leaders in the automotive sector indicates a concentration of technology, driven by factors that are worth investigating.

7.7 Robotics

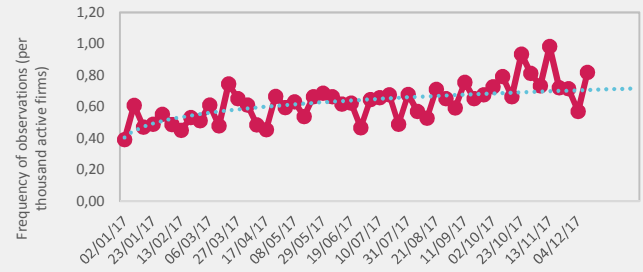
Online media discussion on robotics technologies has largely taken place in the UK, France and Spain. Index scores are heavily concentrated amongst these three countries, followed by Denmark, Luxembourg and Finland to a lesser extent. Given the weight of the industry in some of these top performers, interest and attention has been directed towards the impact that robotic technology may have on production, competitiveness and jobs across the EU. Differences in scores across EU-28 Member States are not as pronounced for other technologies, such as artificial intelligence and autonomous driving. Overall, the digital pulse index performed better in the USA than in the EU-28 in 2017, indicating more excitement about robotics technologies in the USA.

Figure 7.20: Robotics awareness EU-28 and USA in 2017



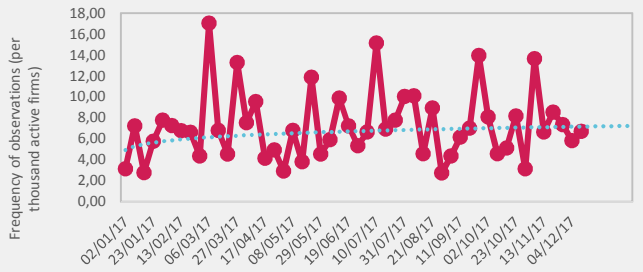
The total volume of discussions relating to robotics technologies during the period shows an increasing trend throughout the year, with oscillations ranging between 0.4 and 1 observations per thousand active firms. This trend indicates a **steady increase in interest in the technology**. It is important to highlight that much of the attention attracted by these technologies is related to the impact that it may bring to the industry in terms of not only competitiveness, but also changes in job characteristics and needs. In 2017, myths about robotics and automated machinery destroying jobs were debunked by rising awareness of the ability of robotics to work hand in hand with humans to improve production processes and competitiveness.

Figure 7.21: Volume of discussions about robotics in 2017 (EU-28)



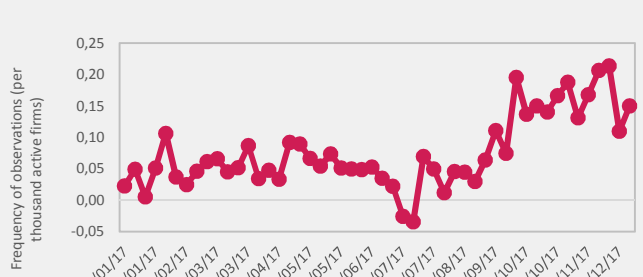
Further analysis on the engagement relating to the discussions observed show significant volatility in the re-diffusion of discussions and the messages that they convey. The rate of engagement over the period oscillated between 2.5 and 17 re-diffusions of discussions per thousand active firms, with sizeable peaks and inflections throughout the period on a weekly basis.

Figure 7.22: Engagement level on robotics in 2017 (EU-28)



On the other hand, the analysis of sentiments associated with the discussions and messages under scrutiny shows that **positive views on these technologies dominate**. Aside from a negative peak towards the end of July, these technologies have benefited from an increasing and positive trend in net sentiment scores, which intensified during the last quarter of the year.

Figure 7.23: Development of robotics sentiment in 2017 (EU-28)

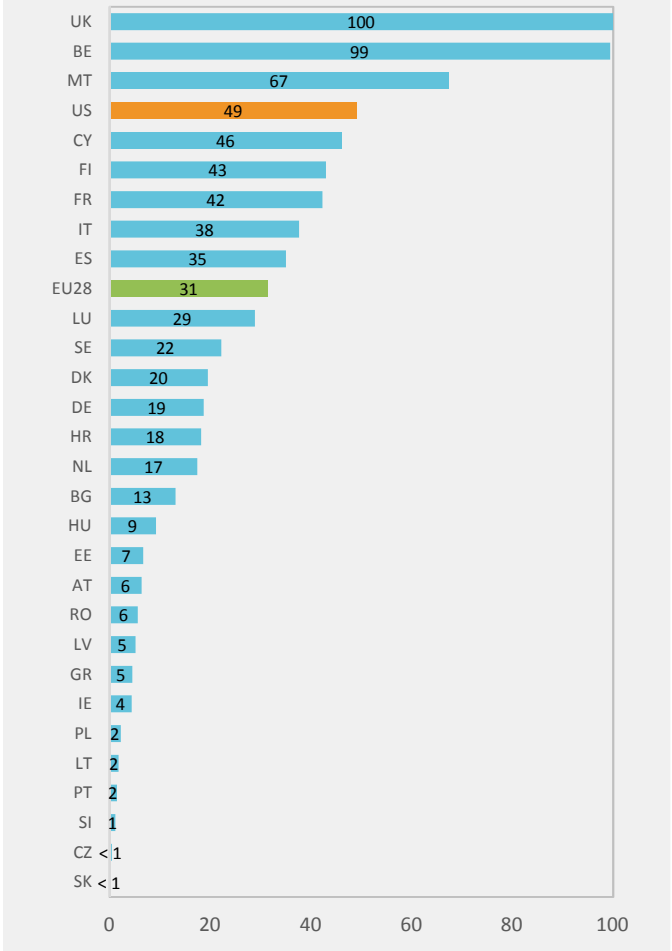


These observations indicate that considerable attention is still placed on the topic, and that the society's overall perception and acceptance of these technologies is increasing at an ever-faster rate. The development of the digital pulse in robotics technologies provides an insight into its diffusion and acceptance.

7.8 5G

By 2017, the novelty of 5G technologies seemed to be wearing off. As one of the most important digital technologies, enabling the acceleration of the 4th industrial revolution, 5G is often taken for granted. However, **the diffusion of the technology across the European industry is ongoing**. An analysis of the volume of discussion about 5G across online media and EU Member States shows that most attention is paid to the technology in the UK. In this digital pulse ranking, Belgium and Malta round up the group of top performers, followed by Cyprus, Finland and France.

Figure 7.24: 5G awareness across EU-28 and USA in 2017



Breaking down the digital pulse index on 5G technology across territories, we have analysed the volume of discussion about this technology to understand the behaviour of the attention that society pays to it. This analysis shows that the discussion trend is still increasing and showed two clear peaks in 2017: at the end of February, when the Mobile World Congress took place, and in mid-June, at the time of the third annual Connected Britain conference. It also shows minor peaks from October onwards.

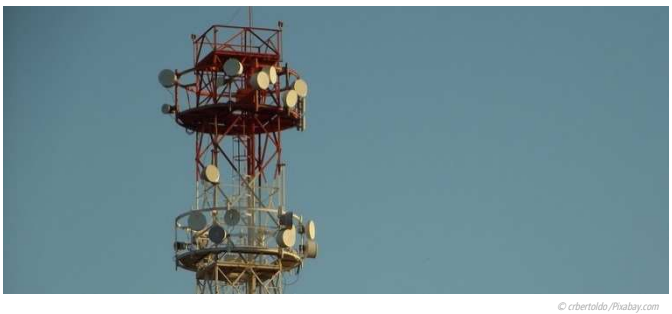


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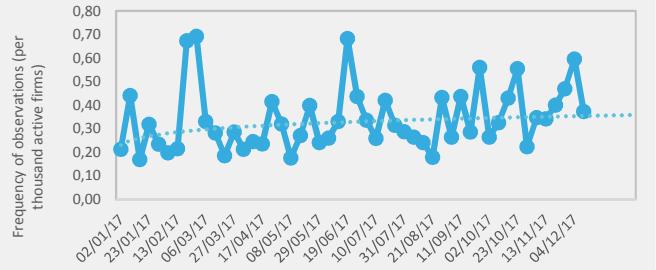
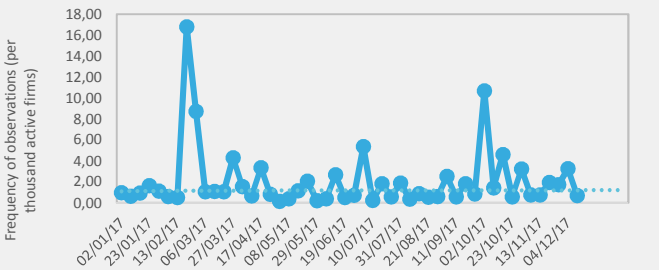
Figure 7.25: Volume of discussions about 5G in 2017 (EU-28)



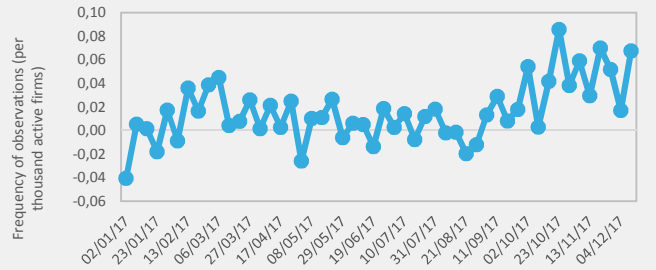
In addition, these observations corroborated the behaviour of the engagement trend, which reflects the re-diffusion of discussions and messages observed during the period. The analysis of the engagement indicates a stable pattern throughout the period, with three significant peaks towards the end of February, the beginning of July and the beginning of October, when Vodafone Italia has made the first 5G data connection in Italy, within the framework of tests promoted by the Ministry of Economic Development. These peaks also correspond to the timing of those observed in the discussion trend.

Figure 7.26: Engagement level on 5G in 2017 (EU-28)



Finally, the sentiment analysis associated with 5G technologies shows a mitigated perception of these technologies during the first three quarters of the year, where negative and positive views alternated on an almost weekly basis. This behaviour was outweighed by an increasing trend in net positive views in the last quarter of the year, linked to the discussions under observation.

Figure 7.27: Development of 5G sentiment in 2017 (EU-28)



These observations from the different trend analyses relating to the components of the digital pulse index on 5G technologies indicate that **attention and interest is still given to 5G, suggesting that its diffusion through the European industry is ongoing.** Results for engagement and net sentiment scores confirm this behaviour and provide an insight into the relative importance and positive views that society still gives to a technology that represents one of the most important vectors of the 4th industrial revolution.

Digital integration and enabling factors

8

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The 2018 DTS places significant emphasis on a macro-perspective approach in addition to using data from a group survey across two specific industries to analyse broader digitisation trends across European industry. The macro-perspective relates to the analysis of a wide range of national data sourced from national statistics offices and international organisations, namely the European Commission, Eurostat and the World Economic Forum.

This section describes country comparisons drawn from the analysis of data available from national statistics offices. The analysis focuses on the current trends in digital technology integration and the factors enabling it. The level of integration suggests that the food and construction industries are becoming more digitised. The results reported and discussed provide a snapshot of Member States based on the conditions for digitisation and the outcomes observed in each Member State. These results are presented in a comparative format with respect to the analysis carried out under the DTS 2017.

This analysis uses a number of national indicators grouped across seven 'pillars' reflecting enabling conditions and outcomes within the context of digital transformation. It establishes a global index for each pillar, which provides a rank and benchmark for countries against selected aggregates, such as the EU28 mean to illustrate their individual situation with respect to the EU average. Finally, it provides a comparison with the results obtained during previous analysis.

8.1 Building an index for enabling conditions and outcomes

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Enabling conditions and outcomes of digital transformation

Information on enabling conditions for digital transformation is presented using a five-category typology or 'pillars' that capture the principal aspects of the transformation across the 28 EU Member States, allowing them to be positioned and ranked.

As a general hypothesis, enabling factors for digital transformation have an impact on the extent to which national industries integrate new digital technologies and foster an environment for the birth and growth of start-ups and new businesses. By measuring the degree of a Member State's digital transformation through two main 'output' categories (integration of digital technologies, and changes in the start-up environment) and by measuring the factors enabling digital transformation across five main categories (digital infrastructure, investments and access to finance, supply and demand of digital skills, e-leadership, and entrepreneurial culture), we have provided an overview of the relationships that underline the digital transformation process of European industries.

Furthermore, a revised list of national indicators not only integrates suitable outcome indicators that have become available – such as the adoption of cloud computing services, the usage of social media, or the use of mobile solutions within the business – but also integrates more up-to-date indicators of enabling conditions that allow an accurate analysis to be carried out.

Within the scope of the five enablers, skills and e-leadership can be measured by the development of all employees' ICT skills, which is central to the digital transformation of traditional companies. As an illustration, the percentage of businesses providing employees with training to help them develop their ICT skills constitutes a relevant indicator to be captured. Furthermore, cloud computing, social media and mobile devices are technological advances transforming traditional businesses. Indicators focusing on these categories enable us to obtain insights into the degree of transformation of European businesses. Monitoring the use of these technologies is also a prime indicator of how digital technologies influence the way in which businesses work.

New indicators used by the DTS 2018 were assessed and selected on the basis of their relevance under each pillar and their capacity to replace outdated indicators for which no new data has been provided in the last five years, such as the indicators relating to the entrepreneurial culture pillar, for which the last data available was observed in 2012. Figure 8.2 overleaf provides a detailed summary of the individual indicators contained in each category of enablers and outcomes.

Figure 8.1: Summary of framework conditions for digital transformation

Enablers:

- Digital infrastructure
- Investments and access to finance
- Supply and demand of digital skills
- E-leadership
- Entrepreneurial culture

Outputs:

- Integration of digital technology
- Changes in the ICT start-up environment

Source: Digital Transformation Scoreboard 2018

Figure 8.2: Composition of framework condition dimensions

Dimension	Digital Transformation Monitor indicators	Source	Last update	Last year available	
Digital infrastructure	Enterprises using DSL or other fixed broadband connection	Eurostat	14/12/2017	2016	Enablers
	Internet bandwidth	Global Competitiveness Index	11/05/2017 (Ed. 2016-2017)	2016	
	Percentage of enterprises who have ERP software package to share information between different functional areas	Eurostat	14/12/2017	2017	
	Percentage of enterprises using Customer Relationship Management to analyse information about clients for marketing purposes	Eurostat	14/12/2017	2017	
Investments and access to finance	Business enterprise R&D expenditure in all NACE activities from high-tech sectors	Eurostat	28/11/2017	2015	
	Direct investment in the reporting economy (inward) in the Information and communication sector (sector J) (NACE Rev. 2)	Eurostat	28/11/2017	2017	
	Total Tax rate (percentage of Commercial Profits)	Global Competitiveness Index	11/05/2017 (Ed. 2016-2017)	2016	
	Venture Capital Availability	Global Competitiveness Index	11/05/2017 (Ed. 2016-2017)	2016	
	Ease of Raising Money Through Local Equity Markets	Global Competitiveness Index	11/05/2017 (Ed. 2016-2017)	2016	
	Ease of access to loans	Global Competitiveness Index	11/05/2017 (Ed. 2016-2017)	2016	
Supply and demand of digital skills	Innovation output (derived by aggregating two output pillars: Knowledge & technology output and creativity output)	Global Talent Competitiveness Index, 2017	16/01/2017	2016	
	Ease of finding skilled employees	Global Talent Competitiveness Index, 2017	16/01/2017	2016	
	Enterprises that employ ICT specialists and had hard-to-fill vacancies for ICT specialists	Eurostat	14/12/2017	2017	
	Persons employed, which were provided a portable device that allows a mobile connection to the internet for business use	Eurostat	14/12/2017	2017	
e-leadership	Percentage of enterprises that provided training to ICT/IT specialists to develop/upgrade their ICT skills	Eurostat	14/12/2017	2017	
	High-Level Skills: Workforce with tertiary education	Global Talent Competitiveness Index, 2017	16/01/2017	2016	
	Enterprises giving portable devices for a mobile connection to the internet to their employees	Eurostat	14/12/2017	2017	
Entrepreneurial culture	Activity: Total Early-Stage Entrepreneurial Activity (TEA)	Global Entrepreneurship Monitor, 2016	04/02/2017	2016	
	Self-Perceptions: Entrepreneurial Intentions	Global Entrepreneurship Monitor, 2016	04/02/2017	2016	
	Societal Values: Entrepreneurship As A Good Career Choice	Global Entrepreneurship Monitor, 2016	04/02/2017	2016	
ICT start-ups	Information and Communication Technology Birth rate (NACE Rev. 2)	Eurostat	28/11/2017	2017	Outcomes
	Employment share of Information and Communication Technology enterprises (NACE Rev. 2)	Eurostat	14/02/2017	2014	
	Change over time of Share of ICT SMEs in total number of SMEs	Eurostat	28/11/2017	2017	
	Change over time of Share of ICT sector (NACE Rev. 2) value added as a percentage of GDP	Eurostat	14/02/2017	2014	
Integration of digital technology	Enterprises who have in use an ERP software package, to share information between different functional areas (e.g. accounting, planning, production, marketing)	Eurostat	14/12/2017	2010	
	Enterprises using RFID technologies as part of production and service delivery process	Eurostat	14/12/2017	2010	
	Enterprises use two or more social media	Eurostat	14/12/2017	2012	
	Enterprises sending invoices in an agreed standard format which allows their automatic processing, without the individual message being manually typed.	Eurostat	14/12/2017	2016	
	Enterprises that buy at least one cloud computing services	Eurostat	14/12/2017	2017	
	SMEs´ selling online (at least 1% of turnover)	Eurostat	14/12/2017	2017	
	SMEs´ total turnover from e-commerce	Eurostat	14/12/2017	2017	
	SME´ that carried out electronics sales to other EU countries	Eurostat	14/12/2017	2017	

Source: Digital Transformation Scoreboard 2018

Building up indices for enablers and outcomes of digital transformation

The synthesis of selected national indicators reflecting enablers and outcomes of digital transformation in Europe was carried out by **developing a series of rank indices** focusing on the geographical scope of digital transformation and providing depth to the analysis of enabling conditions for digital transformation at EU level and for individual Member States.

The resulting indices are used to **perform an EU-level analysis and monitoring of digital transformation**; in addition, this set of indices is used to support the comparative analysis of individual Member States' enabling conditions and outcomes, which are provided in the country profiles in section 9 of this report.

The Digital Transformation Enablers' Index (DTEI) and the Digital Technology Integration Index (DTII) developed under the previous DTS are detailed on pages 48 and 49 respectively. The objective of these indices is to rate **the performance of Member States in terms of enabling conditions and digital transformation** through a positioning score of between 0 and 100. These scores provide visibility and insight into how individual countries are performing in terms of fostering conditions that enable digital transformation, as well as the resulting outcomes, relative to each other and to the EU 28 average score.

Methodology used for constructing the indices

The construction of an index for each enabling condition and outcome dimension was based on an analysis of data availability and coverage for each Member State. As shown in figure 8.2, most indicators of enabling conditions are available until 2016 and 2017, with a few exceptions, mainly in automated data exchange and transmission for business-to-business and business-to-client interactions. The latest available data of the latter refers to the period from 2010 to 2012. Furthermore, the latest data available on the employment share of ICT enterprises and the temporal change of the ICT sector share of the GDP refers to 2014.

The indices were constructed following rules **on data imputation and transformation to overcome availability issues and ensure comparability** across countries. In addition, following the application of the imputation procedure, two other steps were carried out when constructing all rank indices (one for each enabling and output dimension): a data-transformation process to limit the effects of extreme values (outliers in statistical terms) and a min-max normalisation process to define the rank index within a common scale for each Member State.

Close relationship between the Digital Economy and Society Index (DESI) and the Digital Transformation Scoreboard (DTS)

The Digital Economy and Society Index (DESI) of the European Commission (DG CONNECT) provides key insights into Europe's digital performance and serves to track developments in EU Member States across five main dimensions: Connectivity; Human Capital; Use of Internet; Integration of Digital Technology; and Digital Public Services.

The DESI's 'Integration of Digital Technology' dimension and the DTS output dimension on digital transformation intend to capture the same effects. The **use of a common composite index to analyse the digitisation of Europe's industry** helps to highlight the links and the complementarity between the two tools. The DTS uses the values provided by the DESI's dimension on technology integration (DESI-2017) as part of the outcome categories in its framework conditions for digital transformation. [c]

Analysis of data availability and coverage and imputation of missing values

The DTS 2018 relies on the methods and procedures for data cleansing, treatment and analysis adopted under the DTS 2017. The first step highlighted the fact that several of the national indicators present limitations regarding data coverage. In order to overcome such limitations, **a strategy of data imputation was adopted**; this strategy enabled the set of indices to be constructed based on the following rules:

- Limitations regarding missing information for individual indicators across Member States (where no information was available) were overcome by imputing the EU average of the indicator calculated using the set of available values for the specific indicator.
- Limitations regarding data availability for a single year for a given Member State were overcome by imputing the data from the closest year available. Where data was available for both adjacent years, the average of the two available years was retained.

Data transformation to limit the influence of extreme values and standardisation to ensure comparability

The second step following analysis and imputation involved a **data-transformation process to control outlying values** present in the different groups of indicators.

The effects of extreme or outlying values were addressed by transforming the data set of indicators through the application of a **winsorisation method**, which limits and reduces the impact of outlying data (OECD, 2008). A **min-max standardisation** procedure was then applied to allow country comparisons by means of a common range between 0 and 1, measuring the distance between the value of a given Member State and the minimum value in the EU-28, in the context of a specific indicator.

The **ratio provided by the standardisation is observed as a percentage and ensures comparability, providing the rank of the Member States** within EU-28 in the context of the specific indicator. As a result, the rank index per framework condition was calculated ensuring the comparability of scales in the construction of the indices.

Figure 8.3 overleaf provides a heat map of the changes in the indices and a detailed ranking of Member States across the five enabling dimensions and the two output dimensions described above. The changes refer to the difference in scores between the assessments carried out under the DTS in 2017 and 2018. Overall, these differences suggest that the integration of digital technologies has undergone positive changes, illustrating a positive trajectory in the transformation of the European industry, although a number of Member States have seen significant negative changes in the start-up environment.

Compared to the previous results obtained under the DTS 2017, these indices still reflect **general dominance of western and Scandinavian economies across most of the enabling conditions**, indicating that they have led the way through the transformation of industries.

This leading position of western and Scandinavian economies can be seen in most of the enabling dimensions (infrastructure, investments and access to finance, skills, and e-leadership), with the exception of the entrepreneurial culture dimension.

Most of the enabling conditions for digitisation also show negative changes. In particular, the supply and demand of digital skills and investments and access to finance show several negative changes across Member States. This observation between the analyses carried out in the two DTSs suggests a possible lag between enabling and outcome dimensions, which is worth investigating in future reports.

[c] DESI (Digital Economy and Society Index – 2017), available at: https://digital-agenda-data.eu/charts/desi-composite#chart={"indicator":"DESI_SLIDERS","breakdown":{"DESI_1_CONN":0,"DESI_2_HC":0,"DESI_3_UI":0,"DESI_4_IDT":10,"DESI_5_DPS":0},"unit-measure":"pc_DESI_SLIDERS","time-period":"2017"}

Figure 8.3: Index scores by framework conditions - Scores and scores variation (2017 – 2018) per dimension of the DTM*

Country	Digital Infrastructure	Investments and access to finance	Supply and demand of digital skills	e-Leadership	Entrepreneurial culture	ICT Start-ups	Digital Transformation
Austria	59 (+2,8)	69 (+6,6)	55 (-8,2)	76 (-1)	33 (+0,6)	35 (-7,6)	39 (-1,6)
Belgium	76 (-0,2)	77 (+2,6)	65 (-15,5)	84 (+13,2)	77 (+44,1)	24 (-13,1)	52 (+1,9)
Bulgaria	13 (-9,6)	34 (+3,4)	30 (+4,5)	41 (+35)	78 (+26,3)	67 (+5,3)	22 (-1,5)
Croatia	24 (+5,7)	14 (+2)	24 (-7,9)	54 (-4,7)	91 (+29,5)	38 (-1,3)	35 (-1,4)
Cyprus	52 (-12,6)	13 (+11,2)	53 (+22,2)	67 (+3,8)	80 (+32,1)	34 (-21,7)	34 (-0,8)
Czech Republic	42 (-1,9)	67 (+20,7)	34 (+11,5)	47 (+4,1)	71 (+60,7)	41 (-10,5)	41 (+1,8)
Denmark	78 (-2,6)	48 (+2,4)	84 (-5,7)	78 (-10,1)	46 (+7,4)	71 (+10,8)	62 (+9,4)
Estonia	35 (-10,8)	51 (+3,3)	47 (+20,5)	54 (-1,2)	78 (+36)	68 (-3,9)	32 (+3,6)
Finland	76 (+1,6)	80 (+8,9)	83 (+12,5)	97 (-2,7)	51 (-8,6)	60 (-0,3)	37 (+1,3)
France	52 (-0,8)	68 (+4,7)	58 (-5,3)	60 (+2,3)	77 (+11,4)	34 (-15,8)	56 (+8,7)
Germany	57 (-8,3)	68 (-10,5)	53 (-14,5)	51 (-12,3)	72 (+39,8)	22 (-29,3)	35 (+0,7)
Greece	23 (+0,9)	55 (+16,2)	24 (+7,3)	19 (-19,6)	58 (+2)	27 (-4,4)	43 (-1,2)
Hungary	14 (+3,7)	51 (+9,6)	38 (+6,9)	35 (-5,6)	70 (+13)	45 (+8,2)	24 (+1,4)
Ireland	60 (+0,9)	37 (-9,8)	94 (+20,7)	86 (+22,6)	76 (+3,1)	35 (-6,9)	24 (+0,5)
Italy	45 (+3,9)	47 (+2,1)	27 (+7,9)	33 (-9,6)	62 (+6,3)	29 (-2,5)	56 (-0,3)
Latvia	16 (+3,7)	16 (-3,4)	18 (-1,5)	37 (-4,7)	80 (+21,7)	54 (-6,5)	33 (+2)
Lithuania	59 (-3,4)	34 (+2,1)	21 (+5,6)	64 (+22,1)	79 (+26,6)	79 (-10,9)	23 (+0,7)
Luxembourg	80 (+1,6)	74 (+1,4)	65 (+9,9)	86 (-0,7)	60 (+12,9)	65 (+22,8)	44 (+0,1)
Malta	67 (-2)	53 (+12)	55 (+15,6)	57 (-14)	71 (+45,5)	75 (-4)	30 (+1,9)
Netherlands	85 (+1,2)	71 (+6,1)	89 (+12,9)	65 (-1,5)	100 (+56,5)	32 (-9,5)	40 (+3,1)
Poland	16 (-3,2)	45 (+1,9)	20 (+7,7)	36 (-8,6)	60 (-7,5)	48 (-12,4)	48 (0)
Portugal	66 (+3,1)	40 (+14,4)	34 (+19,3)	38 (-9,2)	96 (+24,5)	70 (+27,6)	22 (-1,4)
Romania	12 (-3,4)	30 (+15,1)	6 (+5,4)	(0)	91 (+10,9)	62 (+22,1)	43 (-0,1)
Slovakia	37 (+5,4)	46 (+5,3)	11 (-12,9)	39 (0)	63 (+11,9)	50 (-23)	19 (-1,4)
Slovenia	48 (+1,3)	19 (-2)	34 (-3)	69 (-1,4)	79 (+72,7)	52 (-12,9)	30 (-1,8)
Spain	67 (+7,4)	39 (-7,3)	55 (+27,7)	72 (+33)	77 (+8,9)	33 (-3,7)	46 (+5)
Sweden	70 (-9,2)	76 (-7,2)	86 (+1,3)	76 (-12)	75 (+43,8)	76 (+53,1)	42 (+4,7)
United Kingdom	46 (-1,8)	68 (-2)	66 (+20,8)	70 (-0,6)	58 (-25,1)	71 (+9,1)	54 (+2,8)
European Union (28 countries)	48 (-1)	46 (+1,6)	45 (+5,3)	55 (-0,1)	68 (+20,8)	43 (-4,7)	37 (+1)

*The table above should be read by dimension (that is by column). It shows the scores per country in a given dimension and their variation in time (value in brackets). The colour code indicates the variation in scores at the dimension level and is calculated based on the value differences between the assessments carried out under the DTS in 2017 and 2018. Dark blue corresponds to the maximum variation, white to the median variation, and dark red to the minimum variation. This heatmap is intended to rapidly indicate, dimension per dimension, which countries have progressed the most. For visual information on the evolution of scores by country, please refer to chapter 9 and the radar charts provided for this purpose.

Source: Digital Transformation Scoreboard 2018

8.2 The Digital Transformation Enablers' Index (DTEI)

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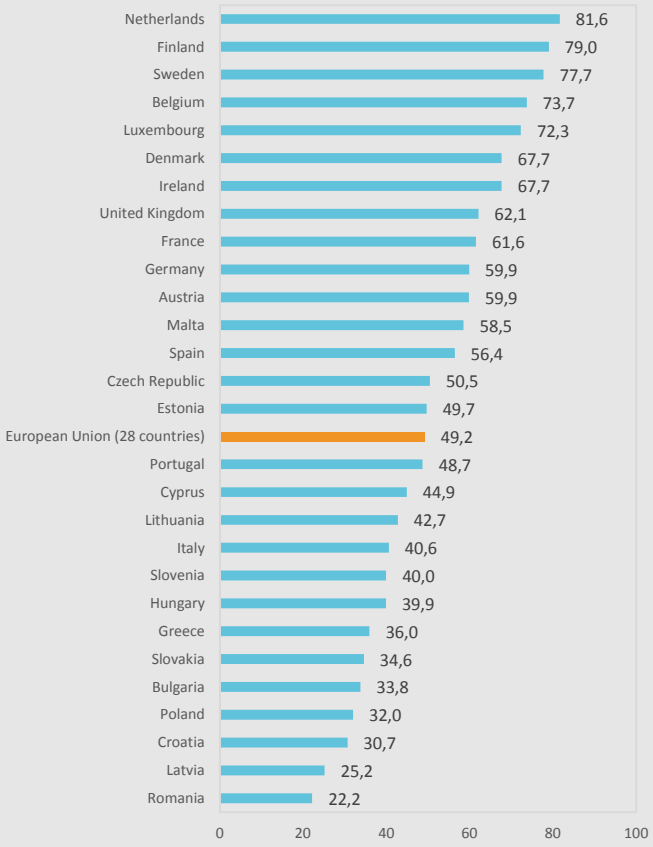
Using the methodology adopted under previous analyses, the DTS 2018 presents a comparative analysis of the Digital Transformation Enablers' Index (DTEI), which was developed through a linear combination of each of the enabling conditions indices.

The Digital Transformation Enablers' Index (DTEI) provides a ranking for Member States based on the **assumption that infrastructure, access to finance, and the demand and supply of skills are the most important factors driving digital transformation** (with a respective weight of 20%, 30%, and 30% of the DTEI), whilst the indices on the environmental enabling conditions (e-leadership and entrepreneurial culture) are assumed to have a lower weighting in the DTEI (10% each). The weights of these dimensions have been preserved under both DTSs.

Figure 8.4: EU Digital Transformation Enablers' Index



Source: Digital Transformation Scoreboard 2018

The more powerful the enablers, the better the digital transformation!

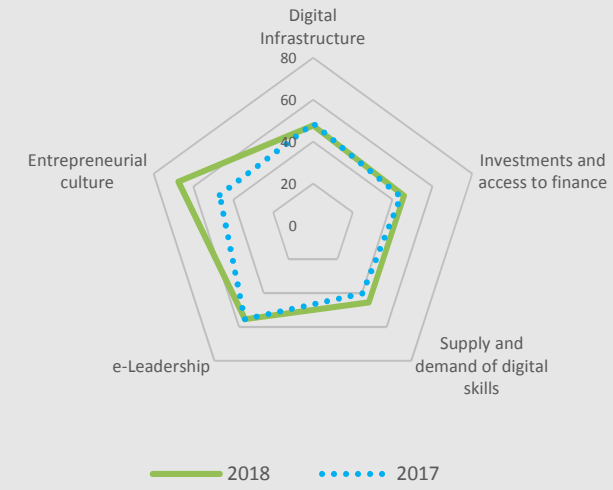
Key findings

According to the resulting index of enabling conditions for digital transformation, there are some changes in terms of the top 5 ranked Member States with the highest scores in digital capital, digital skills and business environment. The Netherlands climbed up from the 4th place to the top, while Finland kept its position, Sweden dropped two places and Belgium one compared to last year´s ranking to positions 2, 3 and 4 respectively. Luxembourg and Denmark switch positions, with the latter no longer in the top 5 Member States in terms of the DTEI. In general, Scandinavian and western European economies still dominate the top positions in the index. Furthermore, it is particularly encouraging to observe how countries in lower positions are making progress in terms of enabling conditions, such as the Czech Republic, which jumped 7 places from 19th to 14th. It is important to note that most of the Member States below the EU-28 score of enabling conditions for digital transformation are located in eastern and southern Europe.

Overall EU performance in enabling conditions for digital transformation

The overall EU performance of enabling conditions is shown in figure 8.5, which illustrates changes in the average scores per pillar for the EU-28. This graph shows that in essence, only enabling factors relating to entrepreneurial culture have made significant progress across the EU between 2017 and 2018, followed by supply and demand of skills and investments and access to finance. Unfortunately, digital infrastructure has deteriorated.

Figure 8.5: EU Digital Transformation Enablers' Index (EU-28 average)



Source: Digital Transformation Scoreboard 2018

8.3 The Digital Technology Integration Index (DTII)

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Digital technology integration is advancing in the majority of EU MS, but a few are still lagging behind

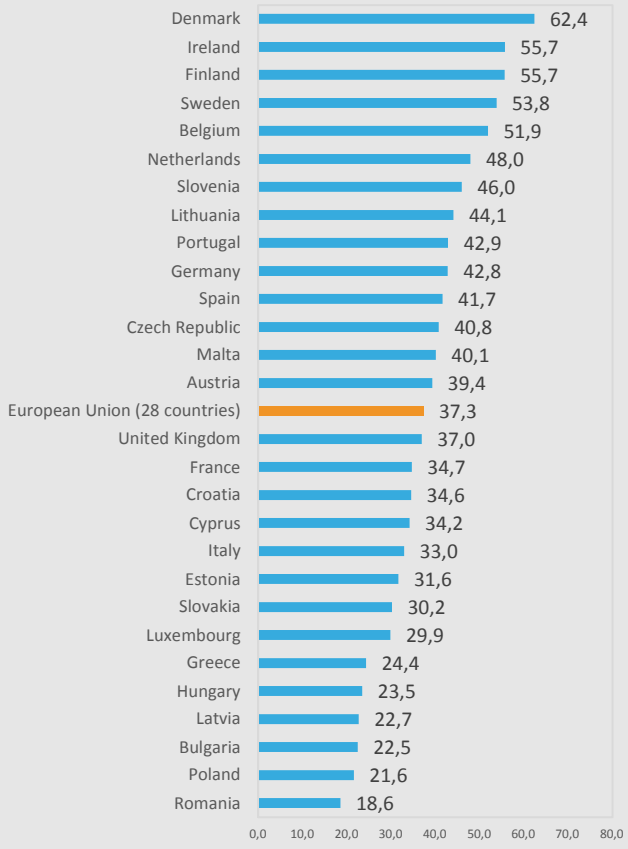
The DTII, which is adopted for a comparative analysis against enabling conditions, only takes into account the eight individual indicators measured at national level and assumed to reflect changes in the digital transformation of European businesses. The resulting indicator shows that the three highest-scoring economies are now Denmark, Ireland, and Finland. The DTII has increased since 2017, showing significant progress in industrial digitisation.

The index also shows that with respect to the previous DTS, a higher number of Member States perform considerably above the EU-28 average rank in terms of digital technology integration. This shows that such integration is on a positive trajectory in most EU Member States, while improvements are necessary for eastern and southern Member States, which still lag behind.

Key findings

According to the index on digital transformation, northern and western EU Member States score highest in terms of digital transformation, with Denmark showing the biggest improvement since 2017. Another Member State that has jumped up the ranking is Spain in 11th position, up from 14th the previous year.

Figure 8.6: EU Digital Technology Integration Index



Source: Digital Transformation Scoreboard 2018

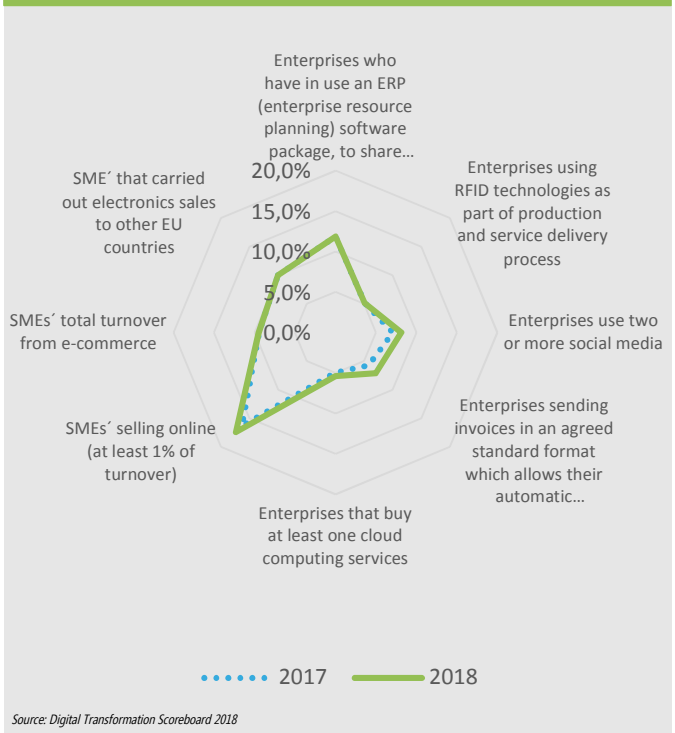
Overall EU performance in digital technology integration

Figure 8.7 below provides an illustration of EU-28 performance across each individual dimension of the Digital Technology Integration Index.

This illustration reveals better EU performance in terms of digital sales between EU Member States compared to the previous indicator. In addition, the number of firms that buy and use cloud computing services, delivered through both shared servers and dedicated servers, has improved, while the use of e-invoicing and social media increased by more than 1% in 2018 compared to the 2017 indices.

On the contrary, it is important to highlight that the electronic sales to other EU countries has remained unchanged over the previous scoreboard.

Figure 8.7: EU Digital Technology Integration Index (EU-28 average and median)



Source: Digital Transformation Scoreboard 2018

Digital skills for digital transformation

For comparative purposes, we have followed the methodology adopted under the DTS 2017 to assess the relationship between digital technology integration and the supply and demand of digital skills, by mapping each Member State according to its scores in each dimension. Figure 8.9 illustrates how Member States are positioned in terms of digital transformation as a function of digital skills.

Member States providing the best digital skills for digital technology integration

In general, there are several changes in the ranking of Member States in terms of the supply and demand of digital skills, which may be associated with the change of indicators in this year´s scoreboard. In particular, some have made significant progress in these enabling conditions, namely Spain, which was ranked 17th last year but ranks 11th in 2018 for digital skills. In addition, several countries such as Portugal, Estonia and Cyprus have made significant progress by rising between 4 and 6 places. In terms of the top three performers in digital skills, Ireland, the Netherlands and Sweden lead the group, while Denmark and Belgium have moved slightly downwards.

These top performers are closely followed by Finland, the UK, and Luxembourg, which are also leaders in the dimension with a performance well above the EU average.

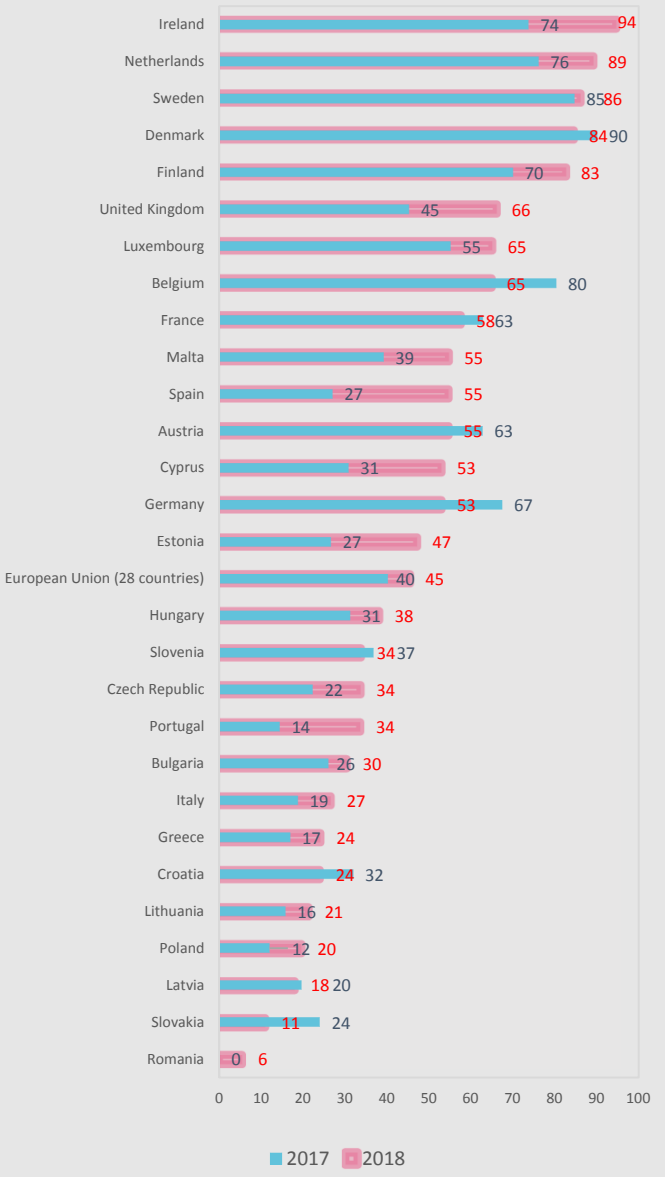
Member States lagging behind in digital technology integration

Romania, Slovakia and Latvia are lagging behind with performance levels well below the EU average. It is important to note that some Member States' levels – and therefore their rankings – are lower in the DTS 2018 than the previous year, including Belgium, Germany, Austria, and Croatia. The weaker performance of these Member States is particularly worrying given the significant speed of digital transformation and the size of the workforce, especially in Germany. Eastern and southern EU Member States lag behind in terms of digital skills, which is one of the most important factors to take into account to seize the benefits of digitisation across their industrial fabric.

Positive impact of digital skills on digital technology integration

Figure 8.9 (below) demonstrates the positive correlation between the level of supply and demand of digital skills and performance in terms of digital technology integration. The highest-performing Member States in terms of digital skills are also the best performers in terms of digital technology integration, and the same holds true for low-performing countries. We note that compared to the analysis carried out in 2017, the slope has increased denoting an acceleration in the capacity of digital skills to drive digital transformation, future analysis will allow to better understand these dynamics.

Figure 8.8: Supply and demand of digital skills



Source: Digital Transformation Scoreboard 2018

Figure 8.9: Supply and demand of digital skills

Source: Digital Transformation Scoreboard 2018

Entrepreneurial culture and digital transformation

In general, the trend observed in the DTS 2017 has moved in an upward direction, indicating an increase in scores for both entrepreneurial culture and digital transformation. In addition, the negative trend observed in the relationship has decreased and became slightly less steep, indicating marginally increased positive dynamics in the relationship. These observations can be interpreted as a performance improvement, as positive effects from policies adopted during recent years aim at boosting entrepreneurship across the EU. Figures 8.10 and 8.11 illustrate these findings.

Net development of the European entrepreneurial culture

With respect to the previous edition of the Scoreboard (2017), it is important to note that many of the disparities in terms of entrepreneurial culture that had previously been observed no longer exist today. The distribution of entrepreneurial culture scores across Member States is rather concentrated in the range of 60 to 80, with no outstanding asymmetries. It is important to highlight that these changes are mainly due to the use of newer data from different institutional sources under the entrepreneurial culture pillar. Nevertheless, the scores show a net progression in the development of a true European entrepreneurial culture.

An entrepreneurial culture spread widely across the majority of EU Member States

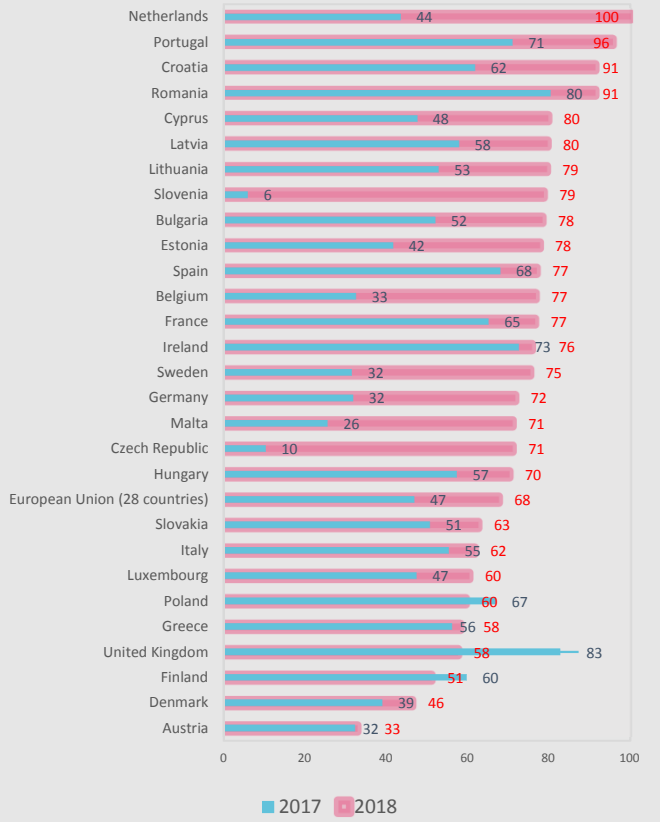
The Netherlands is now the best-performing Member State in the "entrepreneurial culture" dimension, closely followed by Portugal, Croatia and Romania. Further leaders in these enabling conditions are Cyprus, Latvia, and Lithuania, with a performance well above the EU average. It is interesting to note that two Member States, namely Slovenia and Czech Republic, have made significant progress in their entrepreneurial environment with a marked increase in their score.

The high performance and net progression of Balkan and Baltic Member States, such as Romania, Croatia, Slovenia, Latvia and Lithuania, reflect the success of the recent active implementation of policies conducive to the creation of a business-friendly environment. Consequently, "entrepreneurial intentions and entrepreneurship" is a desirable career choice in these countries.

Opportunity vs necessity-driven entrepreneurial activity

The motivation behind starting up a business may influence the propensity of business leaders to adopt digital technologies. High-performing Member States in entrepreneurial culture with a high share of opportunity-driven entrepreneurs are more likely to adopt digital technologies than business-friendly Member States with a higher share of necessity-driven entrepreneurs.

Figure 8.10: Entrepreneurial culture



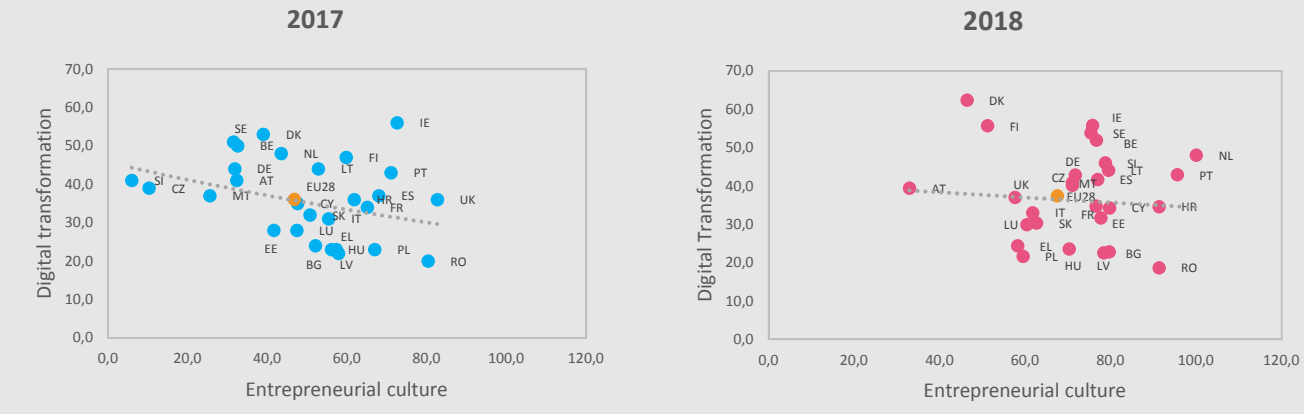
Source: Digital Transformation Scoreboard 2018

This assumption could explain why some Member States such as Romania, with a low rate of opportunity-driven entrepreneurial activity[35] but high performance in terms of entrepreneurial culture, perform poorly in terms of digital technology integration.

A few EU Member States are lagging considerably behind in terms of entrepreneurial culture

At the bottom of the scale, several Western and Scandinavian Member States appear to have an entrepreneurial environment that is less likely to follow the transformation and growth set-up in the digital industrial paradigm. However, it is important to note that even though Member States such as Austria, Denmark, Finland and the UK are now at the bottom of the index for entrepreneurial culture, this ranking takes into account new and very recent institutional data, which was not the case – and was rather a limitation – in the DTS 2017.

Figure 8.11: Entrepreneurial culture



Source: Digital Transformation Scoreboard 2018

Investments and access to finance for digital transformation

Reduced disparities in "investments and access to finance" between EU Member States

In the previous DTS, the EU average in the "investments and access to finance" dimension revealed huge discrepancies between Member States: while the performance score for Sweden (best-performing Member States last year) was above 80, that of Cyprus (worst-performing Member State) was below 5, and the distribution of scores was positively skewed, indicating that only a handful of Member States scored highly, while the majority scored poorly in terms of investments and access to finance. Today (2018), the development of this dimension indicates that disparities have marginally changed, with scores seeming to be distributed less diversely. There have been few changes in the ranking, although the gap between scores has narrowed.

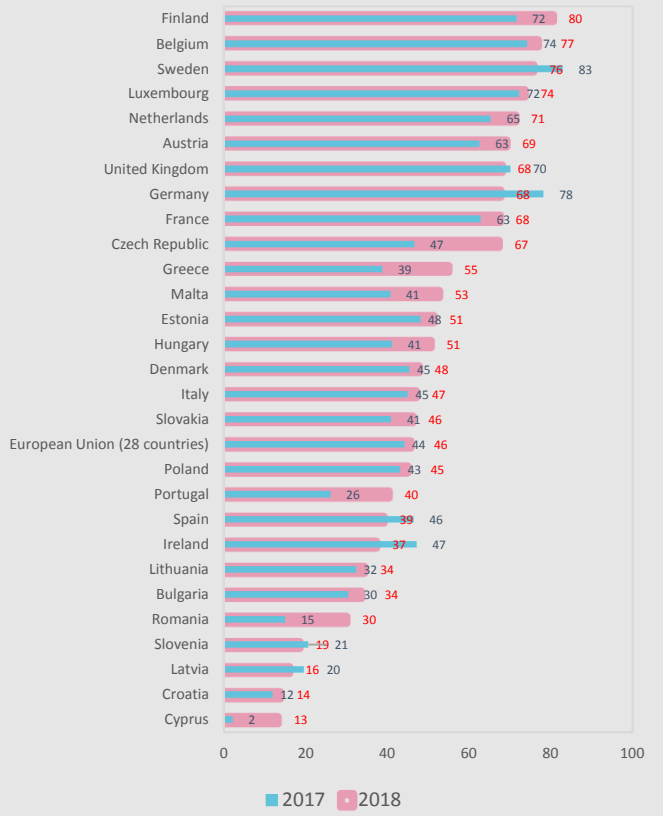
Today, the top performers are Finland, Belgium and Sweden, followed by Luxembourg and the Netherlands, which has gained 2 places, moving from 7th to 5th, while Germany has lost 6 places, falling to 8th in terms of investments and access to finance.

In general, between 2017 and 2018, little has changed in the trends in the relationship between the integration of digital technologies and the level of investments and access to finance. Nevertheless, it is important to note that although the slope and intercepts remain very similar, many Member States that were previously outside the trend have reduced the gap by drawing closer to it. This behaviour can be interpreted as Member States committing to a stable trajectory of factors relating to investment and its positive effects on digitisation.

A favourable investment environment in the majority of EU Member States

Finland, Belgium and Sweden are the top-performing Member States in "investments and access to finance" for businesses, which is regarded as one of the most important factors driving the digital transformation of the industry within business and academic communities. The top tier in this dimension also comprises Germany, Austria and the UK, which are also recognised as being business-friendly and perform well above EU average.

Figure 8.12: Investments and access to finance

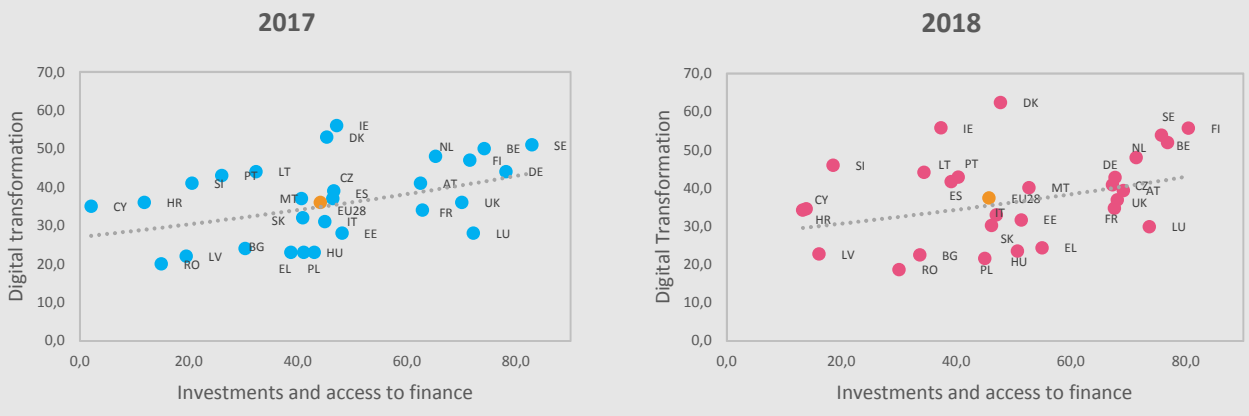


Source: Digital Transformation Scoreboard 2018

A few EU Member States lag considerably behind in terms of investments and access to finance

At the bottom of the scale, the weak performance of Cyprus and (to a slightly lesser extent) Croatia, Latvia, and Slovenia are particularly worrying given the significant gap in terms of scores compared to all other EU Member States. Bulgaria and Romania also lag behind with a performance equivalent to half of the EU average score. This indicates that there have been few changes at the bottom of the "investments and access to finance ranking" between the two DTSs.

Figure 8.13: Investments and access to finance



Source: Digital Transformation Scoreboard 2018

E-leadership for digital transformation

Following the analysis of the relationship between the integration of digital technologies and e-leadership across Member States, it is important to highlight that the trend has moved upwards, indicating that e-leadership is bearing its fruit to help improve the digitisation of the industry. In addition, the gap between several Member States and this trend has narrowed, indicating that factors relating to e-leadership have gained in importance across the EU.

Fewer e-leadership disparities between EU Member States

As mentioned above, the gap between several Member States and the general trend indicates that disparities have narrowed between Member States, with the distribution of scores in the present DTS reflecting a normal distribution. Nevertheless, a few Member States perform significantly worse in this index. These include Greece, Slovakia, Malta and Sweden. On the contrary, Belgium, Ireland, Spain, Lithuania and Bulgaria have significantly increased e-leadership scores. In general, the development of e-leadership scores is positive, showing the increasing importance of such factors and soft skills within the transformation dynamics of the industry.

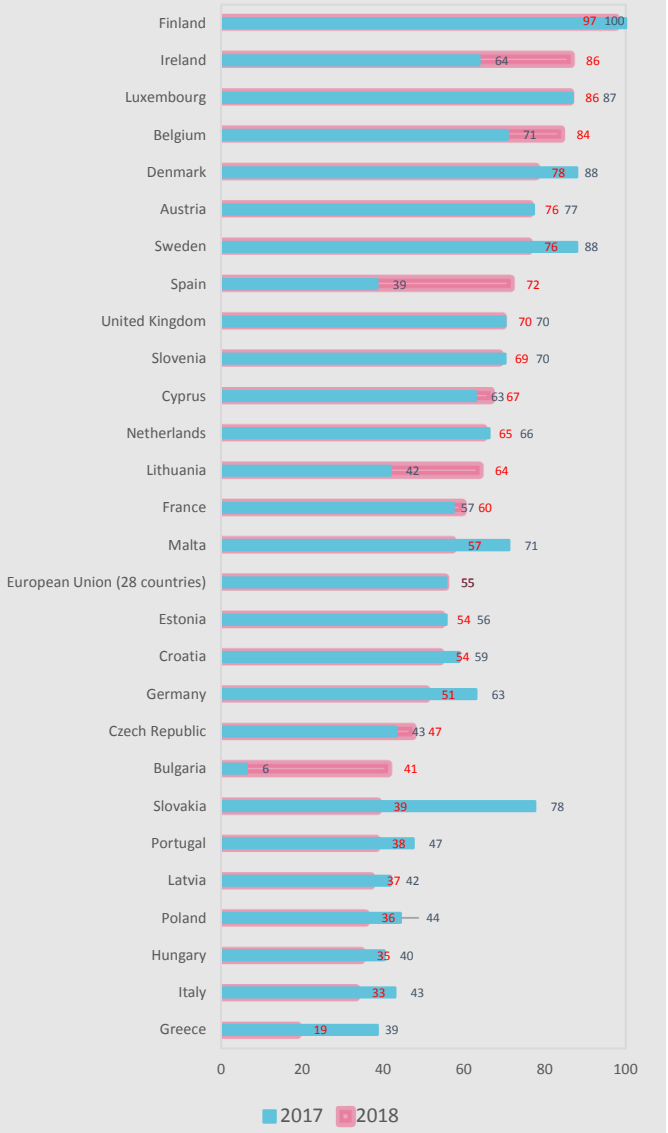
Scandinavian Member States have given up their lead, allowing western Member States to lead the way in terms of e-leadership

In both the 2017 and 2018 DTSs, Finland is the best-performing country in the "e-leadership" dimension. However, Denmark and Sweden, which previously ranked 2nd and 3rd respectively, now rank 5th and 7th. Luxembourg and Ireland have entered the top three in terms of e-leadership. Moreover, it is important to highlight that Belgium, which ranks 4th, and Spain have seen significant changes in their scores, indicating their growing strength in developing leadership within the digital economic paradigm.

Eastern and southern EU Member States still lag considerably behind in terms of e-leadership

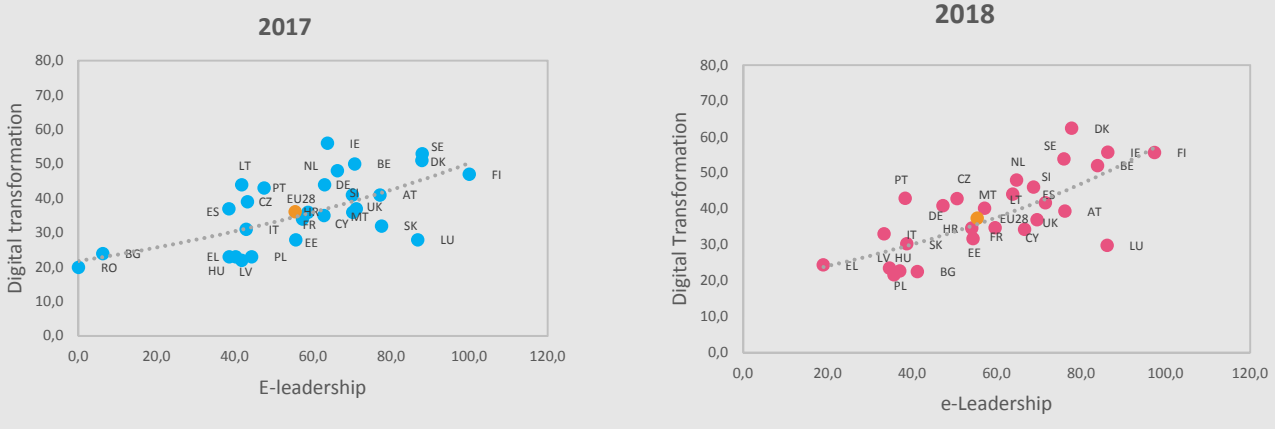
Nonetheless, the bottom of the scale reveals a weak performance for Greece, Italy and Hungary, whose scores are particularly worrying given the significant gap compared to all other EU Member States. It will be in our interest to further analyse the development of this dimension to understand how these factors affect the digital transformation of the European industry in southern and eastern EU Member States.

Figure 8.14: e-leadership



Source: Digital Transformation Scoreboard 2018

Figure 8.15: e-leadership



Source: Digital Transformation Scoreboard 2018

Digital infrastructure for digital transformation

A comparative analysis of the relationship between the integration of digital technologies and the existing digital infrastructure at national level shows that there has been little change between 2017 and 2018 in terms of the distribution of scores. However, a closer analysis of trends in the relationship between these two dimensions reveals that the trend has moved upwards, showing an increased level of digital transformation, while the slope is slightly steeper, indicating an increase in the impact of digital infrastructure on the digitalisation of the industry.

Digital infrastructure increasingly available in the majority of EU Member States

Today, the Netherlands is the best-performing Member State in the "digital infrastructure" dimension, followed by Luxembourg, Denmark, Finland and Belgium. The distribution of scores shows that the majority of Member States perform above the EU average, indicating high availability of digital infrastructure across most of the EU.

A few EU Member States lag considerably behind in terms of digital infrastructure

At the bottom of the scale, the distribution of lower scores seems to be rather linear amongst Romania, Bulgaria, Hungary, Poland and Latvia, whose scores in terms of digital infrastructure performance must improve significantly if they are to catch up with the EU average.

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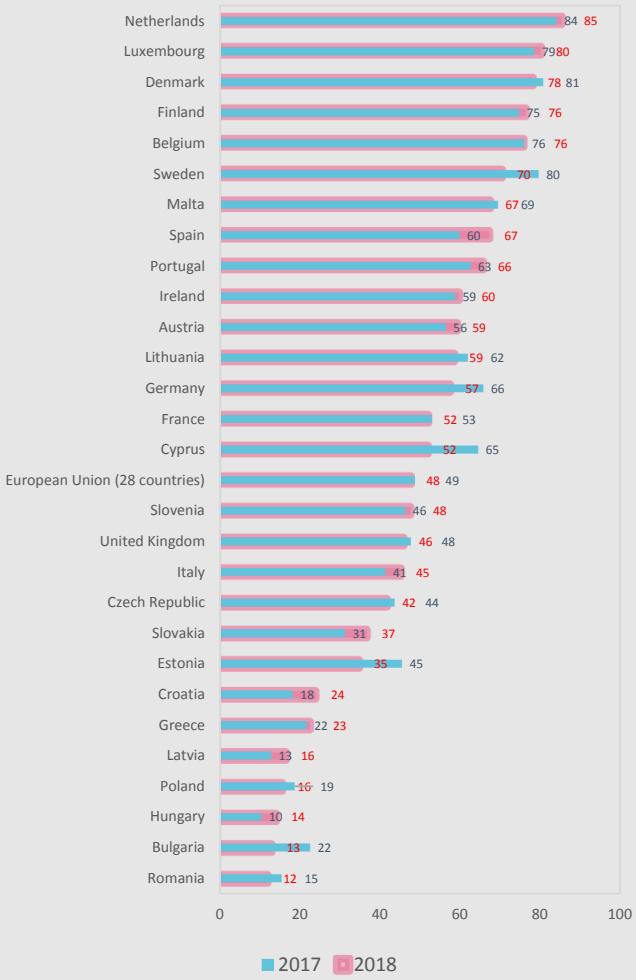
Figure 8.16: Digital infrastructure



Source: Digital Transformation Scoreboard 2018

Figure 8.17: Digital infrastructure

Source: Digital Transformation Scoreboard 2018

8.4 Changes in the ICT start-up environment in relation to digital transformation

Changes in the relationship between digital technology integration and changes in the ICT start-up environment were analysed by mapping Member States based on their scores in each of the two output categories. We present this analysis in a comparative manner, illustrating how the relationship trend has evolved.

Figure 8.19 overleaf shows that the scatter plots representing the Member States have moved upwards, indicating a general increase in the level of digitalisation of the European industry, even if there have been few changes in the start-up environment.

Fewer disparities in "changes in the ICT start-up environment" between EU Member States

The distribution of Member States' scores in terms of the changes in the start-up environment show disparities have decreased compared to the previous Scoreboard, resulting in a fairly standard score distribution.

It is important to highlight that the best performer in terms of the start-up environment is now Lithuania, followed by Sweden. The latter ranked last in this dimension in the previous DTS. As was discussed in the DTS 2017, Sweden was suffering from a lack of up-to-date indicators in this dimension: this problem has been solved by integrating newer data from institutional sources.

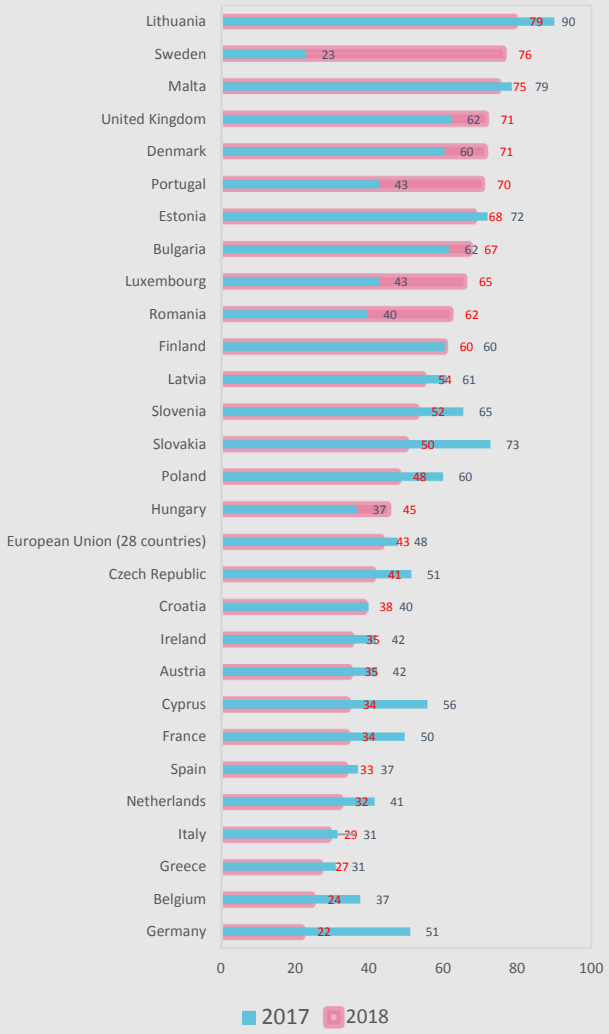
Strong progress for current leaders in the "changes in the ICT start-up environment" dimension

Amongst the top tier of the ranking are countries that have seen a significant increase in scores in this specific dimension. For instance, Sweden, Portugal, Luxembourg and Romania have risen highly in their index scores. The top three countries in the ranking are Lithuania, Sweden, and Malta, closely followed by the UK, Denmark, Portugal and Estonia. Some of the eastern EU Member States in the top tier were already among the top performers in terms of the start-up environment in 2017, indicating that their economic environment is favourable to the birth and growth of new digital businesses compared to other western EU Member States.

Member States lagging behind in the "ICT start-ups" dimension

Germany, Belgium and Greece are at the bottom of the ranking in 2018. These Member States are lagging behind with a performance level well below the EU average. Italy, the Netherlands and Spain are also at the bottom of the performance scale (slightly higher than the abovementioned Member States) with a performance about quarter lower than the EU average. In addition, these Member States have all seen major changes in their scores in this dimension compared to the previous DTS. This suggest that the economic environment in these Member States is not fully favourable to the birth and growth of new digital businesses.

Figure 8.18: Changes in the ICT start-up environment

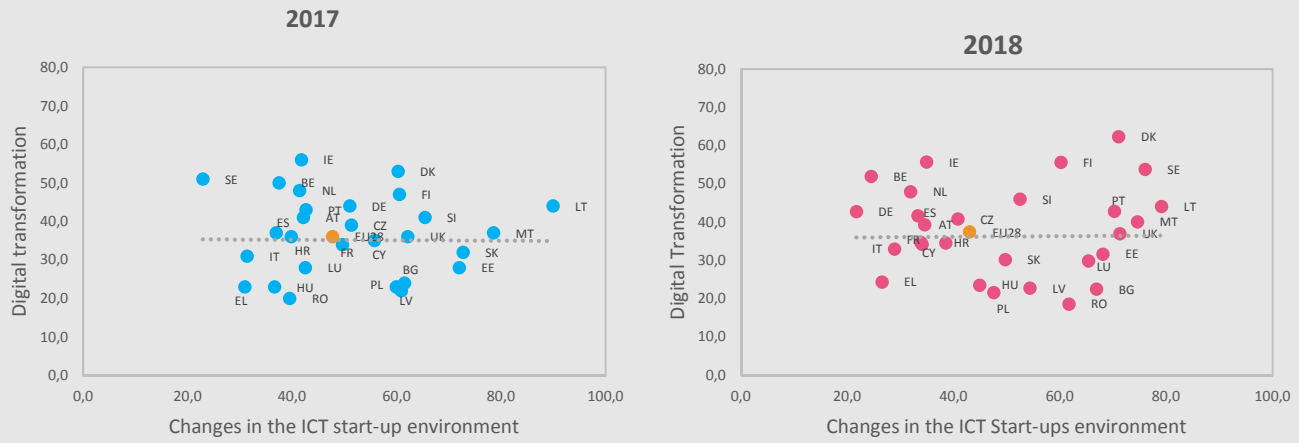


Source: Digital Transformation Scoreboard 2018

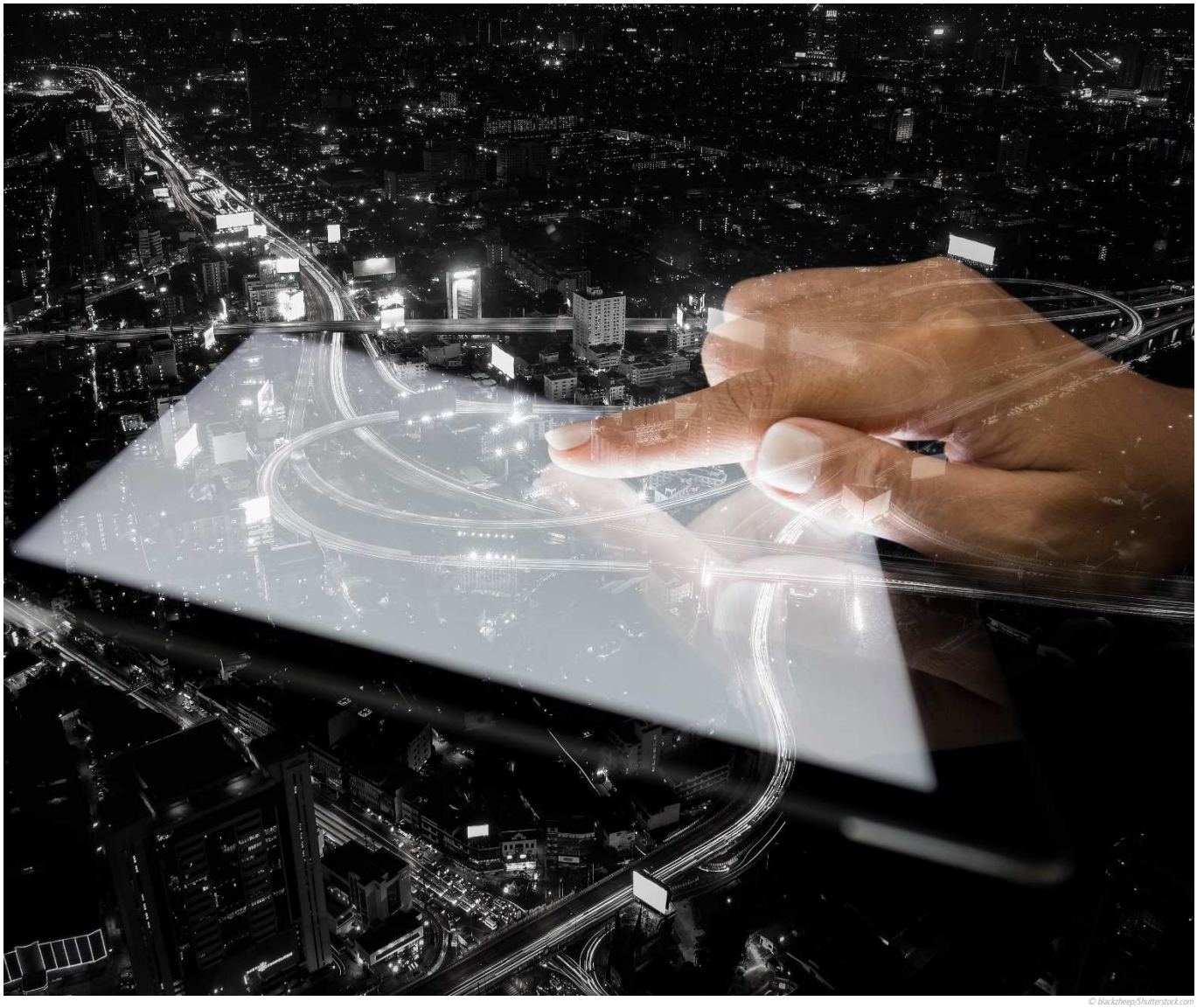
Heterogeneity in the development of the ICT start-up environment and digital technology integration performance

The "changes in ICT start-ups" dimension reflects the developments experienced by the ICT start-up environment in recent years. The best performers in this dimension are Member States in which the number of ICT start-ups has recently increased. On the other hand, low-performing Member States are ones in which the ICT start-up environment has stagnated in the last few years. In this respect, a low performance in this dimension does not necessarily indicate a poor ICT environment. If limited changes in ICT start-ups are made in a vibrant ICT ecosystem, the number of already existing ICT start-ups does not necessarily decrease. This assumption may explain the low performance in changes in the ICT start-up environment experienced by high performers in terms of digital transformation, as is the case for Germany, Belgium, the Netherlands and Italy, which despite ranking poorly for changes in the start-up environment, are still above the EU average in terms of digital transformation.

Figure 8.19: Changes in ICT start-ups



Source: Digital Transformation Scoreboard 2018



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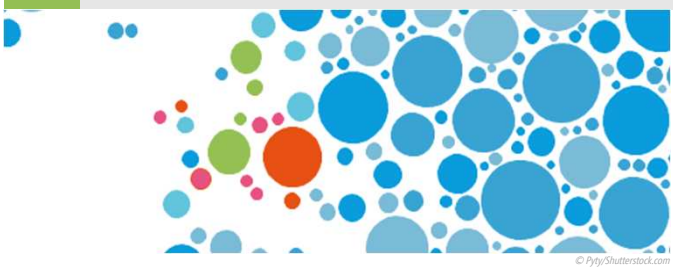
8.5 Cluster analysis at national level



Following the methodology adopted under the previous Scoreboard, we have performed a clustering analysis of enabling conditions for digital transformation with the objective of **grouping Member States based on their similarities in terms of enabling conditions leading to digital transformation.**

This analysis helped define four principal groups of Member States based on their enabling conditions:

- Best enabling environment;
- Good enabling environment;
- Moderate enabling environment; and
- Modest enabling environment.

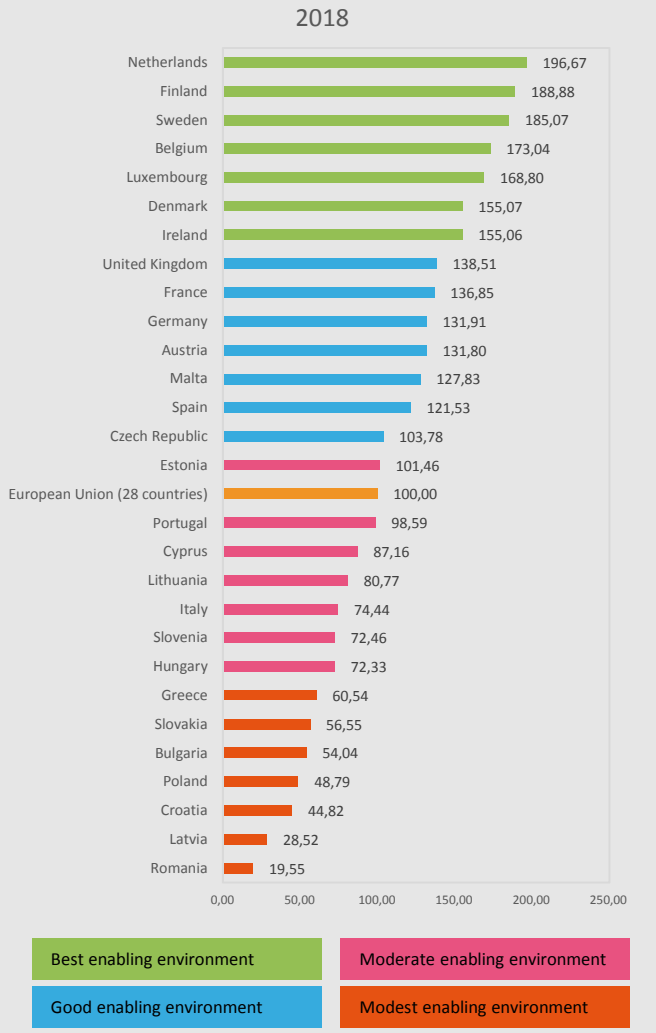
Aggregating enabling conditions into a summary index

The clustering analysis relies on the **aggregation of the enabling framework conditions indices** into a single Digital Transformation Enablers' Index (DTEI). This index comprises a linear combination of the scores associated with each Member State for each of the five enabling conditions described earlier in this section.

Grouping Member States across four enabling environments

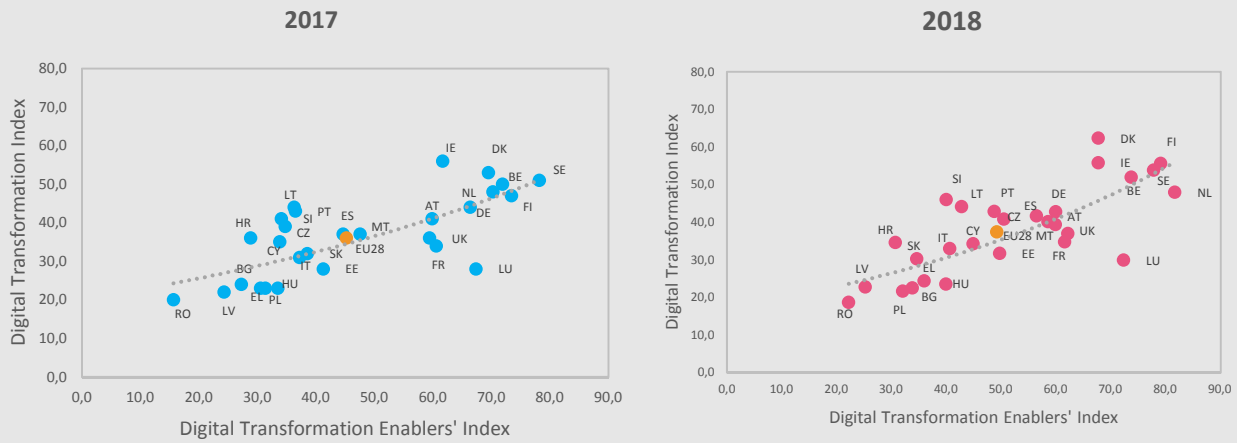
The methodology used to group the Member States into the four categories involves normalising the DTEI scores prior to calculating each Member State's relative performance in terms of enabling conditions with respect to the EU-28 index average. Member States were **grouped according to the performance distribution of the enabling conditions**; these groups were delimited using distribution quartiles. The figure below illustrates the main groups of Member States based on their enabling conditions.

Figure 8.20: Clustering of Member States´ enabling environment in comparison to the EU average



Source: Digital Transformation Scoreboard 2018

Figure 8.21: Digital transformation scores based on enabling conditions scores



Source: Digital Transformation Scoreboard 2018

Results and discussion

Comparative analysis

A comparative analysis of Member States according to their digital transformation rank based on their DTEI rank indicates that in general, the higher the DTEI, the higher Digital Technology Integration Index is likely to be, suggesting a positive relationship between digital transformation and the set of enabling conditions. In summary, **the more powerful the enablers, the better a Member State's digital transformation**.

In essence, the clustering analysis of Member States based on the performance of their enabling conditions with respect to the EU-28 index average indicates that **mostly north-western and Scandinavian Member States still have the best allocation of framework conditions in terms of infrastructure, investments, skills, e-leadership and entrepreneurial culture**. On the opposite side of the distribution, primarily eastern and southern Member States still form the group in which enabling conditions can be improved.

It is important to note that the differences between the clustering under the DTS 2017 and this DTS 2018 mainly point to changes in the ranking within a specific group. Only Slovakia lost enough places to change groups from moderate environment to modest environment. Furthermore, Hungary moved up from the modest to the moderate group by gaining 1 place in the ranking (23rd to 22nd), the Czech Republic moved into the good enabling environment by gaining 6 places (20th to 14th), and Ireland moved into the best enabling environment, gaining 1 place.

Following the development of the Digital Transformation Enablers' Index and the geographical clustering of Member States, the analysis of the impact of enabling conditions on digital transformation at national level, which was performed by comparing both indices (DTEI and DTII), did not show any significant differences between the two DTSs.

Best enabling environment

Member States in the "Best enabling environment" group are **strong economies that have led the way into the digital paradigm**. Many of these Member States account for a number of big caps in high-tech industries and are examples of how spreading technology across other sectors of the economy ensures its transformation and creates value. As an illustration, major telecoms companies in Scandinavian economies have helped change and shape the way in which services have been provided in these Member States over the last 20 years.

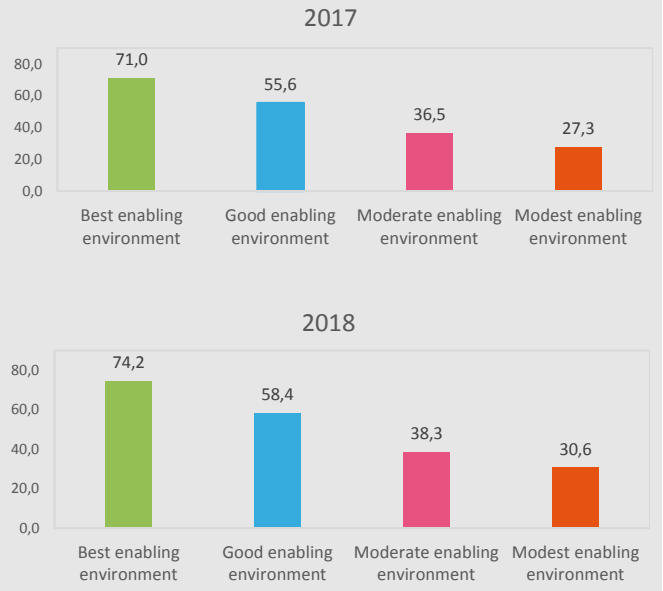
Good enabling environment

Member States in the "Good enabling environment" group are characterised by **a mix of large and small economies whose fiscal and industrial policies differ in several ways**. This creates diverse effects on the adoption of digital technologies by their industry, which may slow down the impact that these technologies should have on economic growth. As an example, fiscal instability and complex fiscal systems observed in some Member States may have pervasive effects on the fast adoption of digital technologies and the transformation of the industry, as is the case in France. France presents good enabling conditions but does not seem to be able to fully convert them into its digital transformation.

Moderate enabling environment

Member States in the "Moderate enabling environment" group are **in a position of catch-up and converge**. It is their decision-making in terms of industrial policy that will determine whether they will succeed in transforming their industries.

Figure 8.22: Average digital enabling performance by enabling environment



Source: Digital Transformation Scoreboard 2018

Modest enabling environment

Member States in the "Modest enabling environment" group are currently **at risk of missing the trajectory of digital transformation** that should enable their industry to converge towards the EU average and enable their economies to be competitive within the digital economic paradigm.

Conclusions

According to the results of the analysis, and contrary to what is expected, the group of Nordic and western EU **Member States, which lead the Digital Transformation Enablers' Index, are not the highest performers in terms of digital transformation**. It is the group of Member States comprising the UK, Luxembourg, and Ireland that performs best in digital transformation.

This analysis leads to a final observation on the existence of differences between Member States grouped into different enabling environments, which **are able to outperform in digital transformation given their initial enabling conditions**.

This observation can be explained by several factors such as:

- **barriers to adoption**: these are not measured in this research; and
- **adoption dynamics**, which may increase more slowly past an inflection point.

These factors could affect how well Member States can perform in digital transformation given their enabling conditions and how quickly their digitisation process has taken place – and how advanced this process is.

It is important to note that **most Member States below the trend line (see figure 8.22) are those whose digital transformation is lower than their performance** in enabling conditions. These Member States comprise both western and eastern economies, which may suggest that their digitisation process is either suffering from adoption barriers, which slow down its dynamics, or simply lagging behind.

In contrast, the group of Member States above the trend line comprises mainly northern and eastern economies, and indicates that **their digitisation process is outperforming their enabling conditions.** These Member States can be characterised as outperforming or converging quickly in digital transformation.

8.6 Further insight into the monitoring of industry digitisation at national level

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Following the indicator analysis, it is worth investigating the future of monitoring digital technology uptake and industry digitisation.

Monitoring digital economy and society

For more than a decade, Eurostat has been collecting statistics on the digital economy and society together with National Statistical Offices of Member States with the objective of monitoring two aspects:

1. Production of digital technologies;
2. Uptake and usage of digital technologies by businesses and individuals.

Each year, these primary statistics are collected through two annual Community surveys on ICT usage in households and enterprises. The information requested is reviewed every year and can be adjusted to meet the evolving needs of users and decision makers.

At the current time, the available national statistics and indicators used under the present analysis are fully aligned with the latest design of the Community Survey on the use of ICT by households, individuals and enterprises. Nevertheless, it is not the aim of the Digital Transformation Index to include all available indicators from the survey but rather use those deemed particularly useful to analyse the uptake of digital technologies in the European industry.

Tracking future developments

A closer look at the 2018 model questionnaire used for the Community Survey on ICT Usage and E-commerce in Enterprises provide insight into how future developments as regards the use of emerging new technologies will be monitored.

The key modules described in the model questionnaire[36] address several technologies described in the present scoreboard, most notably, the use of cloud computing services, 3D printing technologies, robotics, big data analysis, and e-commerce. In addition to these technologies, the key modules also address important drivers of technology adoption by the industry, such as availability of ICT specialists and skills, use of computers, and access and use of the internet.

Designing robust indicators and methodologies

Monitoring the uptake of digital technologies is challenging. On the contrary to other technologies such as the telephone, the automobile and television to name just a few, digital technologies are less likely to settled into a manageable rate of change. On the contrary, they will change at an increasing pace as the products of their own processes enable them to develop even more rapidly.

It is therefore essential to:

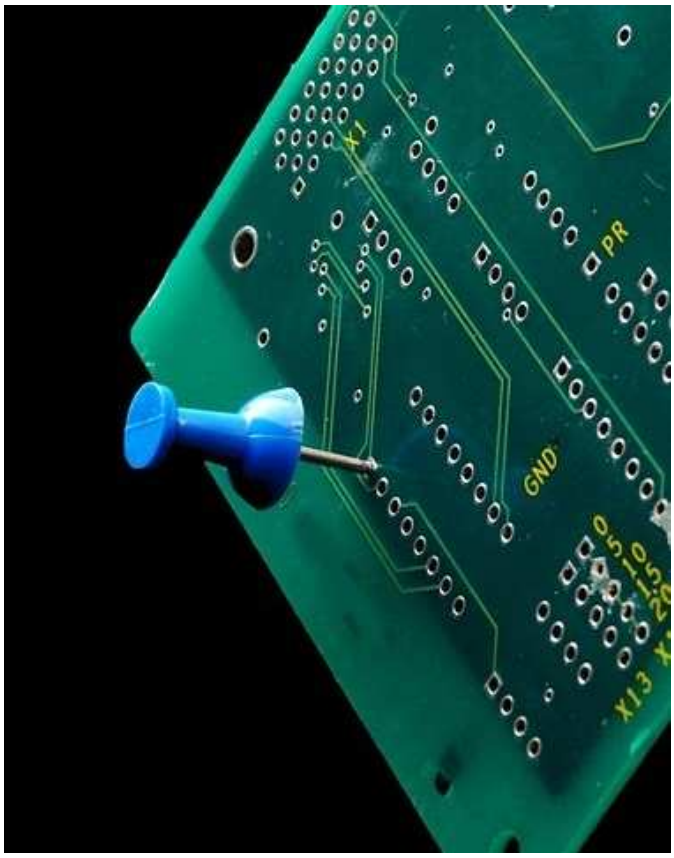
- Define clearly the technology of interest: in general, several iterations are required before being able to come up with a definition understood by all;
- Understand the roots of potential changes in the use of the technology being monitored: as incremental innovations are being diffused, a stabilisation or decline in use may indicate that the name and/or concepts associated with the technology have evolved;
- Track technology upgrade: it is not only important to take into account the utilisation of the technology, but also the rate of updates and upgrades in order to provide a more accurate view on the uptake of digital technologies.

Figure 8.23: Community Survey on ICT Usage and E-commerce in Enterprises – model questionnaire

Module	Description	Mandatory questions	Optional questions
A	Use of computers	1	1
B	ICT specialists and skills	12	0
C	Access and use of the internet	16	0
	Other use of the internet (internet advertising)	5	0
D	Use of cloud computing services	10	0
E	Use of 3D printing technologies	6	0
F	Use of robotics		9
G	Big data analysis		6
H	Invoicing	3	8
I	E-commerce	10	4
X	Background characteristics	(3)	(0)
	Total number of questions/responses	**66 (63)**	**28**

In parenthesis the number of questions without Module X: Background characteristics

Source: Eurostat, 2018[36]



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National focus

Country profile reports

9

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The country profile reports (CPRs) serve as a basis for the 28 EU Member States (MS) to measure progress, account for results and identify areas for improvement in their efforts towards the digital transformation of their industries and enterprises. The CPRs can be seen as a snapshot of an EU Member State's digital transformation performance at a specific time. Radar charts summarize visually the progress that each MS has made since last year across the seven key Scoreboard dimensions. The CPRs also include sections on relative strengths, areas for improvement, best practices and comparisons at EU level. This allows for trend analysis, fair comparisons and effective benchmarking in order to identify solutions that can be used by each EU Member State to accelerate their transition to the digital age.

9.1 Aim of the country profile reports

Objectives

The main objective of this section is to provide key insights into the digital transformation performance of each EU Member State through qualitative and quantitative data.

General approach

The CPRs are based on the results of the following two main Scoreboard tools:

- The survey-based monitoring approach (qualitative part)
- The indicator-based monitoring approach (quantitative part)

Content

The CPRs are divided into the following 4 main sections:

A. "In a nutshell"

This section provides a brief analysis of the country performance across 7 key dimensions of the Scoreboard and highlights major trends in digital transformation.

B. "Strengths and areas for improvement"

This section outlines the country's digital assets and area dimensions requiring further action.

C. "Comparison with other EU Member States"

This section offers a better understanding of the country's position in terms of digital transformation compared to other EU MS.

D. "Interesting policy practices"

This section focuses on key national or local policies implemented to accelerate the digital transformation of industries and enterprises.

9.2 Country profile reports: table of contents

9.1

Belgium

Belgium is very well-advanced on the road towards its digital transformation. Thanks to its high overall performance, the country ranks as a European front runner in the fields of supply and demand of digital skills, investments and access to finance, and digital infrastructures. However, Belgium lags slightly behind in the field of business creation in the ICT sector. Taking stock of this challenge, several dedicated policy measures have been put in place with a view to boosting digital innovation and the digitisation of Belgian companies.

A Belgium in a nutshell

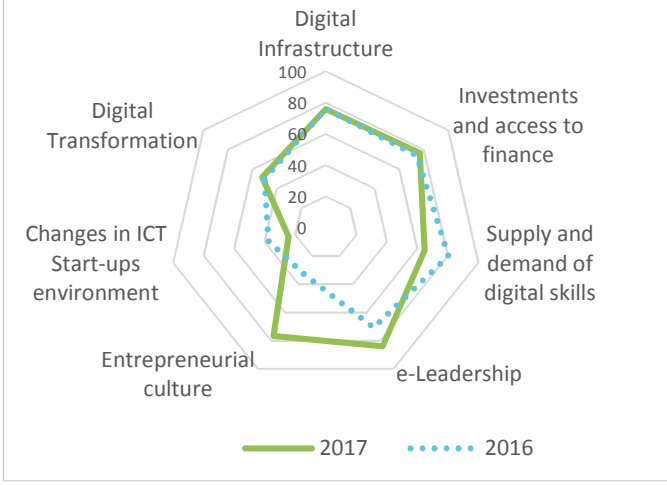
Digital transformation in Belgium has not unfolded equally among the different pillars. On the one hand, the country is one of the EU's front runners in digital infrastructure and e-leadership. It also shows strong results in the fields of investments and access to finance and the supply and demand of digital skills. There is a notable increase in the entrepreneurial culture in 2017 compared to 2016.

On the other hand, Belgium scores poorly in ICT start-ups, in particular in comparison to its relatively high scores in related dimensions.

The country's overall performance did not change significant over the 2016-2017 period, except for a slight decrease in digital skills and ICT start-ups. The changes identified across dimensions, in particular for entrepreneurial culture, can be mainly explained by changes in the set of indicators.

In summary, while ICT and digital technologies are successfully embedded, Belgium's start-up environment is still in need of further support measures.

Figure 9.3: Belgium´s framework conditions for digital transformation



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

The overwhelming majority of companies in Belgium are equipped with a fixed broadband connection. In addition, enterprises make wide use of software solutions aimed at sharing information and/or analysing information for marketing purposes.

Furthermore, Belgium secures its strong position in e-leadership thanks to few factors. First of all, the percentage of enterprises offering ICT training to their employees is steadily growing. Employees can also put their acquired skills into practice and have secure access to the Internet through portable devices provided by their employers.

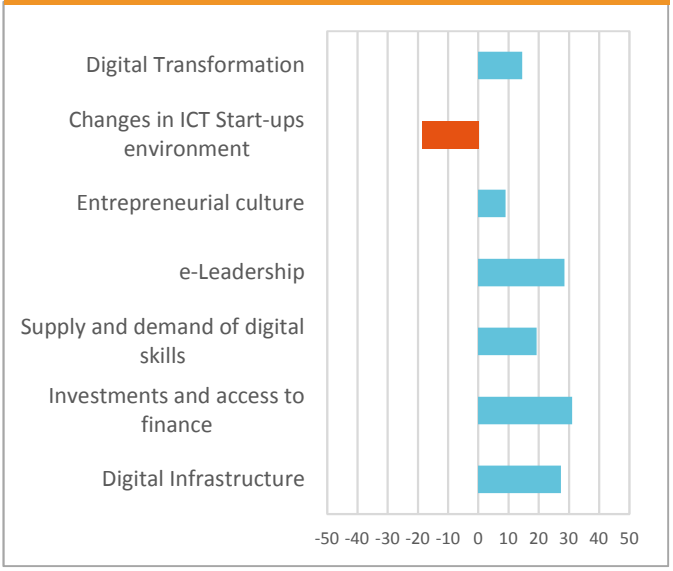
- Areas for improvement

The number of newly created ICT start-ups shows a downward trend in the last 5 years. Belgium performs below the EU average with regard to the creation of ICT start-ups. Further efforts should be made to support the creation of new companies in the ICT sector.

Despite some improvement between 2016 and 2017, further effort could be made with a view to supporting the digital transformation of Belgian companies. Although Belgium does not lag behind in this dimension, encouraging the uptake of digital solutions, such as software and e-commerce platforms, would significantly benefit its business sector.

C Comparison with other EU Member States

Figure 9.4: Belgium´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Belgium is well advanced in its digital transformation in comparison to other EU Member States. It scores above the EU average in six out of seven dimensions. Belgium performs particularly well (more than 20% higher than the EU average) in investments and access to finance, e-leadership, digital infrastructure and digital transformation.

In addition, Belgium's performance in entrepreneurial culture is around 10% higher than in the EU average.

Nevertheless, the country performs below the EU average concerning its ICT start-up environment, representing the country's main weakness.

In summary, Belgium significantly outperforms in comparison to the EU average, and hence can be considered one of the EU's digital front runners. However, further support for business creation in the ICT sector is needed to catch up with the average EU performance.

D Interesting policy practices

Made Different

In 2013, the Flemish Government, together with technology federations Agoria and its joint research centre Sirris, launched the Made Different initiative. This programme aims to increase the competitiveness of the manufacturing industry by supporting the digital transformation of production processes. The overall goal of Made Different is to transform manufacturing companies into "factories of the future".

The main activities of the Made Different initiative involve organising awareness-raising events and providing tailored and long-term guidance services to companies willing to transform their production processes (up to around two years). In addition, the ´Factory of the Future Awards´ are organised every year to reward companies that have successfully achieved their transformation. Taking stock of its success, the initiative was replicated in 2016 by the Walloon Government with similar positive results.

Around 300 companies have already been included in the transformation process and more are following the example. By 2018, Made Different expects to involve about 500 business in the initiative and to have at least 50 companies fully ready to transform into factories of the future.

Plan Marshall 4.0 and the new Investment Plan

In 2015, the Walloon Government launched Plan Marshall 4.0, which aims at supporting the development of an effective and ambitious industrial policy. Based on the lessons learnt from two previous plans, this initiative is structured around four key guidelines: research and innovation, upskilling of the workforce, local development and the green economy. The initiative will last for four years in total (2015-2019).

With the ambition of placing Wallonia at the forefront of the Fourth Industrial Revolution, various actions have been taken. For instance, the Walloon Government has been developing measures to support the innovation potential of local SMEs and to incentivise the digitisation of production processes.

Plan Marshall 4.0 is an ambitious and strategic framework programme that takes advantage of synergies and links with other similar initiatives (such as Made Different-Digital Wallonia). The Walloon Government has allocated €2.9 billion and plans to inject an additional €468 million from alternative funding over the period 2015-2019.

On January 17, the Walloon Government has revealed the directions of its new Investment Plan which will benefit of a budget of €5 billion over the period 2019-2024. This plan will mainly focus on three areas: mobility, energy and research/innovation/digital.

9.2

Bulgaria

Bulgaria displays a moderate level of digital transformation, facing significant challenges in the fields of digital infrastructure, e-leadership and digital transformation. Despite performing strongly in entrepreneurial culture and ICT start-ups, Bulgaria's low score in investments and access to finance prevents it from translating the establishment of start-ups into sustainable business growth. Bulgaria scores above the EU average in three out of seven dimensions. Despite existing challenges, the Bulgarian Government is implementing several measures to drive forward the country's digital transformation in different sectors.

A Bulgaria in a nutshell

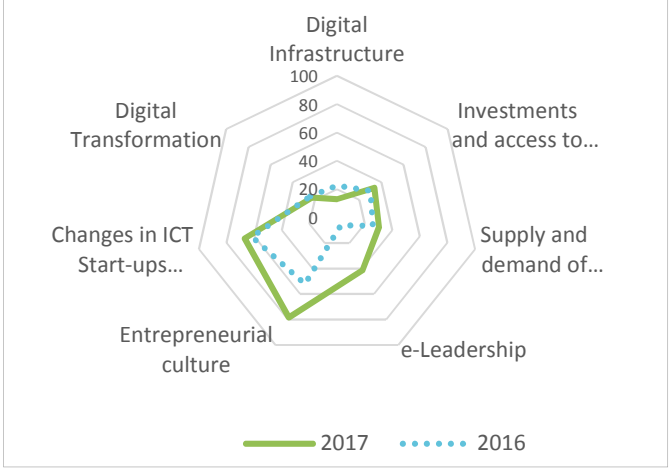
Bulgaria scores highly in entrepreneurial culture and e-leadership, which is likely to encourage the further development of Bulgaria's thriving ICT start-up environment. This is perhaps due to very low salaries in both the public and private sectors compared to other EU Member States, which motivates people to create a business and take advantage of the global market.

This alone is not enough to ensure that the country will not be left behind in terms of digital transformation. There are several dimensions of digital transformation that require more attention so that relevant policies are put in place to improve each of these dimensions. For example, there are no significant changes in the field of investments and access to finance in 2017 compared to 2016. This is a dimension in which Bulgaria scores relatively poorly.

This year, the digital infrastructure score has declined.

Overall, Bulgaria's profile indicates three areas with a fairly high score, with a moderate to low performance in the remaining four fields.

Figure 9.5: Bulgaria´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Bulgaria excels in the field of entrepreneurial culture due to the high level of its citizens' entrepreneurial intentions. Many Bulgarians consider entrepreneurship a good career choice and would be willing to start their own business if the conditions (legislation, tax incentives) were advantageous for them.

Recent data shows a good level of ICT personnel in the overall employment system; however, it is still difficult to find skilled ICT specialists. Moreover, the ICT sector has considerable weight in the national GDP. In addition, there is a growing ecosystem of digital and tech entrepreneurs at national level.

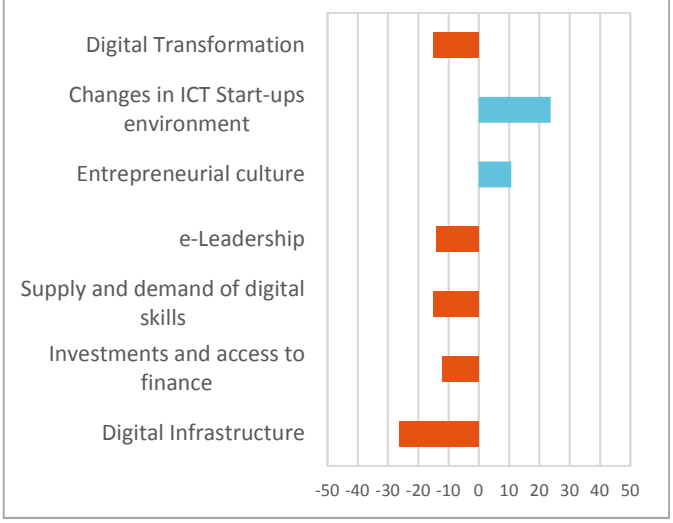
- Areas for improvement

Bulgaria is still facing significant drawbacks in the field of investments, even though access to finance and loans has grown. Bulgaria could boost its competitiveness by making efforts to encourage domestic companies to increase their use of DSL or a fixed broadband connection.

Furthermore, the data shows a low performance in terms of skilled ICT specialists. Bulgaria's performs far below the EU average in the number of enterprises using software that allows for automatic electronic sharing and information processing.

C Comparison with other EU Member States

Figure 9.6: Bulgaria´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Bulgaria's performs below the EU average in five out of seven dimensions, especially digital infrastructure.

The country scores high in terms of ICT start-ups, exceeding the EU average by more than 20%. Bulgaria also scores well in entrepreneurial culture, achieving results slightly above the EU average.

Digital infrastructure continues to be the dimension with the lowest score, and one of the lowest results of all EU Member States. Despite improvements over last year, Bulgaria's performance is still not in line with other EU Member States regarding e-leadership and investments and access to finance. Overall, challenges persist in five different dimensions, in particular the supply and demand of digital skills.

D Interesting policy practices

The Innovation Strategy for Smart Specialisation of the Republic of Bulgaria 2014-2020

This strategy is being developed according to the European Union Strategy for smart, sustainable and inclusive growth (Europe 2020). Its main goal is to strengthen research, technological development and innovation in Bulgaria.

The strategy recognises the importance of SMEs' ICT enablers for higher competitiveness and includes measures to update educational programmes for better and wider use of IT skills.

The main activity carried out within the strategy is to identify the country's unique characteristics and potential to develop in "smart" areas of comparative advantages. The idea is to create a new domain to identify/find entrepreneurial opportunities and ensure an effective entrepreneurial discovery process in several fields, such as mechatronics, ICT, biotechnology, nanotechnology, the creative industry, pharmacy, the food industry, niche markets, computing, and ICT industry, for a healthy life.

The National Strategy for SMEs 2014-2020 – Small Business Act

This strategy is adapted to the European Small Business Act (SBA), in order to reconcile the priorities supporting SMEs in Bulgaria with those at European level.

The strategy aims to implement the SBA principles, such as: creating a favourable environment for entrepreneurs and family businesses; ensuring a second chance for bankrupted entrepreneurs; designing rules according to the "Think Small First" principle; making public administrations responsive to SMEs' needs; facilitating SMEs' access to finance; promoting the upgrading of skills in SMEs and all forms of innovation; and encouraging and supporting SMEs to benefit from the growth of markets.

The strategy provides a comprehensive list of measures targeting the removal of barriers and the provision of incentives for SMEs to enhance innovation capabilities.

9.3

Czech Republic

The Czech Republic shows a moderate level of digital transformation with a strong position in the area of investments and access to finance. Its performance is broadly in line with the EU average in most of the dimensions. In particular, the fields of digital skills and changes in the ICT start-up environment leave room for improvement. The Czech Government has launched several programmes seeking to further support digital transformation, aiming to promote entrepreneurship, boost the uptake of new technologies and support new business ideas.

A The Czech Republic in a nutshell

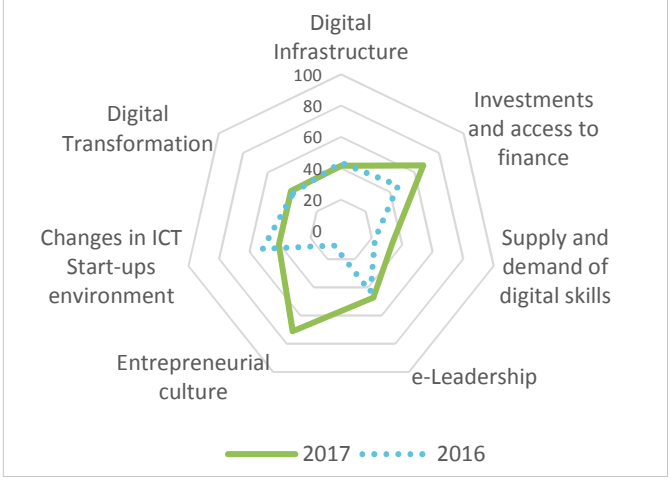
The Czech Republic shows a relatively balanced development in all dimensions. It performs moderately better in four out of seven dimensions, including entrepreneurial culture, investment and access to finance, supply and demand of digital skills and e-leadership.

The main challenges are in the dimension of changes in the ICT start-up environment.

Compared to 2016, the country is performing slightly better in terms of investments and access to finance, followed by a strong entrepreneurial culture, which is the Czech Republic's strongest area in 2017.

The significant difference in the country's performance in entrepreneurial culture compared to last year must be taken with some caution, since this score may to some extent be due to changes in the set of indicators used.

Figure 9.11: Czech Republic´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Although investments and access to finance is not the strongest dimension, the Czech Republic has a high direct investment in the ICT sector. Furthermore, Czech businesses benefit from an easy access to loans.

A strong position in the area of e-commerce among EU Member States is due to the active participation of businesses in online trade. Overall, the country scores well in the Global Competitiveness Index.

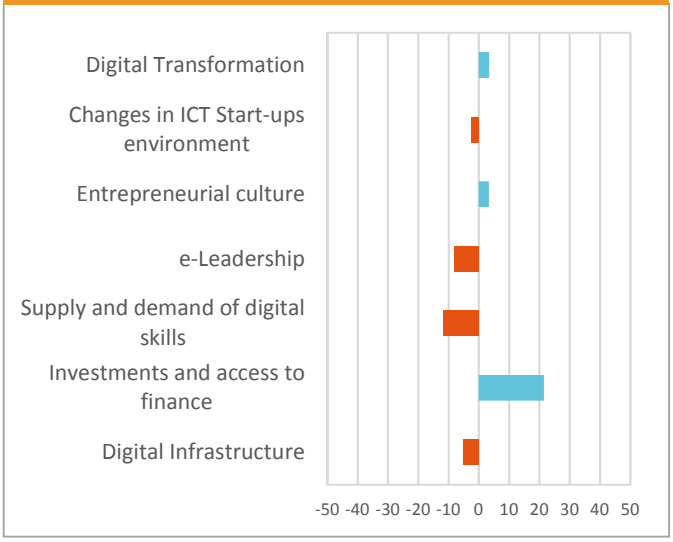
- Areas for improvement

The poor performance in the area of digital transformation derives from lower use of new technologies, such as cloud computing and social media, for business purposes. The ICT sector provides an opportunity for further enhancement, particularly in terms of the employment share and birth rate of ICT enterprises.

Despite high DSL and broadband connection usage, the country's average Internet bandwidth leaves significant room for improvement.

C Comparison with other EU Member States

Figure 9.12: Czech Republic´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Despite an average e-leadership scores at national level, the Czech Republic performs below the EU average regarding this dimension. Together with digital skills, it is the country's lowest-scoring dimension in comparison to other EU Member States, followed by changes in the ICT start-up environment and digital infrastructure, which are slightly below the EU average.

On the contrary, access to finance is the country's strongest area, performing over 20% above the EU average. In terms of entrepreneurial culture, the country sits marginally above the EU average.

Overall, the Czech Republic performs broadly in line with the EU average in three out of seven dimensions; however, room for improvement remains, especially in e-leadership and digital skills.

D Interesting policy practices

Low-carbon technologies (*Nízkouhlíkové technologie*)

This measure is part of the SME support programme and was introduced by the Ministry of Industry and Trade in 2016. The Business and Investment Promotion Agency, CzechInvest, is responsible for implementing the programme.

The main objective is to support and enhance the competitiveness of enterprises and the sustainability of the Czech economy by introducing new technologies. The programme provides financial aid to entities that produce certain innovative technologies relating to electro-mobility, renewable energy management, and secondary raw-material uses. The amount of financial support depends on the type of activities, and is a maximum of €13,700 per project.

Overall, the initiative strives to increase the use of more efficient and reliable low-carbon technologies that are not yet commonly applied in the Czech Republic and to facilitate the transition to a low-carbon economy.

Innovation vouchers (*Inovační vouchery*)

The main objective of the *Innovation vouchers* programme is to encourage collaboration between businesses and research organisations in order to intensify the innovation activities of small and medium-sized enterprises.

Innovation vouchers is one of the SME support programmes for the period of 2014-2020, implemented by the Czech Ministry of Industry and Trade in cooperation with CzechInvest (Investment and Business Development Agency).

The vouchers can be used for product/service development (innovation), consulting, testing, designing new systems and solutions, prototype or software development, optimising business processes, and product design.

The total budget available for the purpose of the programme is almost €14 million. Each applicant may submit up to three projects, with the subsidy for each project not exceeding €9,800. The maximum aid intensity amounts to 75% of the eligible costs. *Innovation vouchers* is a support programme within OPEIC (Operational Programme Entrepreneurship and Innovations for Competitiveness).

9.4

Denmark

In 2017 Denmark cemented its strong position in digital transformation performance. The country excels in areas such as the level of digital skills, e-leadership and digital infrastructure. However, Denmark scores relatively poorly in dimensions relating to entrepreneurial culture and investments and access to finance. Recent policy initiatives are wide-ranging and seek to promote start-up funding, including efforts to promote the uptake of digital technologies in production.

A Denmark in a nutshell

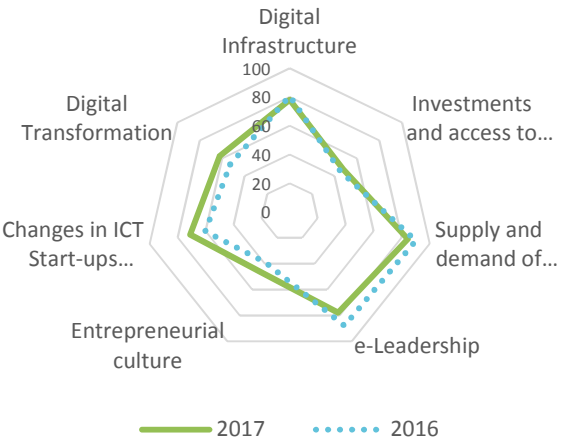
Denmark's outstanding performance in e-leadership and the supply and demand for digital skills continues in 2017, showing only a minor decline.

Moreover, the country continues to perform solidly in digital infrastructure. Compared to 2016, Denmark has notably improved in the areas of digital transformation, the ICT start-up environment, entrepreneurial culture and investments and access to finance, while its performance slightly fell in the other dimensions.

Denmark's broader investment and financial climate performed modestly and is stable over time.

The decline observed in the supply and demand of digital skills and e-leadership does not pose a threat, since both scores are above 80%.

Figure 9.13: Denmark´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Denmark's strong performance in the supply and demand of digital skills is attributable – among other things – to a high level of recruitment of ICT specialists and the provision of portable devices with mobile connections to employees.

The well-rounded performance in e-leadership is supported in particular by enterprises' efforts to offer ICT skills training. This is complemented by an educational system that emphasises the IT training.

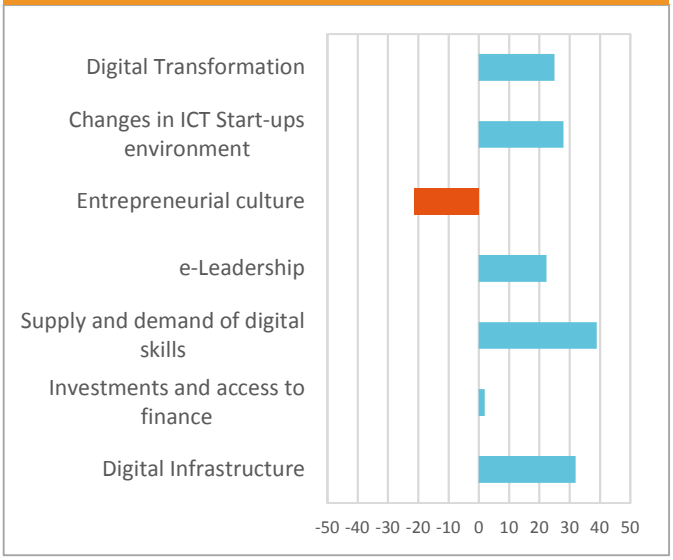
- Areas for improvement

Given the relatively low performance in the field of investments and access to finance, there is room for improvement in this area for Denmark. In particular, this concerns the relatively low level of EU direct investment income.

Meanwhile, Denmark's scores are average for financing through venture capital and ease of loans on the local equity market. However, the country performs very well in business R&D expenditure.

C Comparison with other EU Member States

Figure 9.14: Denmark´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Denmark performs above the EU average in six out of seven dimensions.

The best relative performance is for the supply and demand of digital skills, where Denmark scores nearly 40% above the EU average.

This is followed by a strong relative performance in digital infrastructure and changes in the ICT start-up environment, where Denmark scores 32% and 28% higher than the EU average respectively.

Denmark's performance with regard to digital transformation and e-leadership are also well above the EU average, albeit to a lesser extent than the pillars discussed above.

Denmark faces its greatest challenge in the field of entrepreneurial culture, scoring well below the EU average. This is Denmark's weakest dimension, highlighting that there is room for improvement in this area.

D Interesting policy practices

Scale-Up Denmark

Scale-Up Denmark is a training concept for entrepreneurs and small enterprises, aiming to establish an elite of high-growth companies in Denmark. Scale-Up Denmark is a cross-regional initiative founded on regional business development strategies.

The training focuses on access to capital and venture capital and how to engage market-leading firms from the regional ecosystem. Furthermore, Scale-Up Denmark involves leading universities, research institutions and science parks and provides easy access to the services of the entire Danish business-support system.

Scale-Up Denmark offers a wide variety of business fields, which all have a potential to foster accelerated growth among business, including health and welfare technology, energy-efficiency, offshore industry, bioeconomy, ICT, life science (biotechnology), food, maritime industry, smart industry and Cleantech.

The initiative is overseen by an Advisory Board consists of 12 members representing the five Danish regions along with various representatives from Danish business and trading institutions.

Digital Growth Panel

In 2016, the Danish Government established Production Panel 4.0 (*Productionspanel 4.0*), later renamed the Digital Growth Panel (*Digitalt Vækstpanel*). The aim of the panel is to prepare Denmark for the digital economy. 15 members from Danish companies and social partners have been appointed to the panel and will provide recommendations to the Government on how enterprises, especially SMEs, can benefit from digitisation and new production technologies. The Digital Growth Panel will address the need for digital skills in enterprises and how the public sector can support new digital business cases.

The panel is part of a long-term strategy to increase productivity in enterprises by using new technology, such as robots, and maximising the benefits offered by the digital economy. The Government will use the panel's recommendations to present a consolidated strategy for Denmark's long-term strategy on how to benefit from the digital economy. The goal is to maintain existing production in Denmark and expand into new areas offered by the Fourth Industrial Revolution.

9.5

Germany

Germany shows a strong overall performance, with some deviations. Its high performance in the fields of investments and access to finance, supply and demand of digital skills, and e-leadership have dropped since 2016, while entrepreneurial culture has significantly improved. Surprisingly, the country scores very poorly in ICT start-ups. Notwithstanding this challenge and e-leadership, Germany performs above the EU average in all other fields. Recent policy examples show a focus on Industry 4.0 initiatives. Along with high-level, strategic initiatives such as the Industrie 4.0 platform, smaller policy initiatives targeting SMEs have been adopted by the German authorities.

A Germany in a nutshell

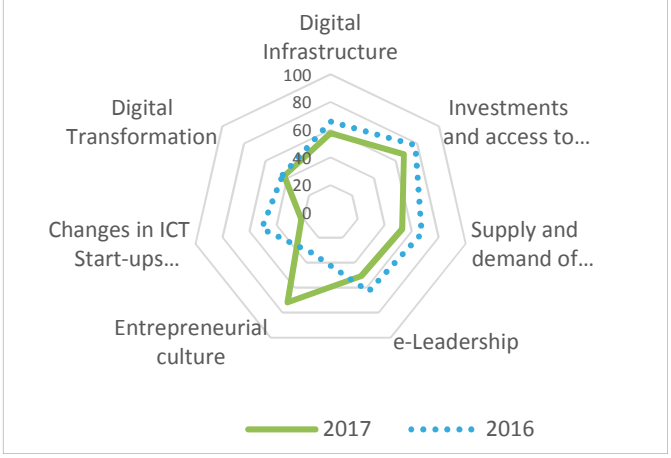
In 2017, Germany continues to be a high performer in investments and access to finance, but to a lower extent than last year. Germany's labour market also has a relatively high supply and demand of digital skills, despite a significant decline since 2016.

Although German enterprises can rely on high-quality digital infrastructure, the score for the digitisation of Germany's industry and enterprises has dropped since 2016.

Germany's performance in entrepreneurial culture has increased significantly; however, updates in the use of indicators may account for this difference to some extent. On the contrary, Germany's score in the ICT start-up environment shows a dramatic decline.

In summary, Germany's performance in 2017 shows improvements in only one area and decreases in the remaining six areas.

Figure 9.21: Germany´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Germany's strong performance in the field of investments and access to finance derives in particular from its strong equity market. Companies in Germany can count on the high availability of venture capital and relatively easy access to financial loans.

Furthermore, Germany's relatively high score in the supply and demand of digital skills is supported by a high innovation output and relative ease in finding skilled employees on the labour market.

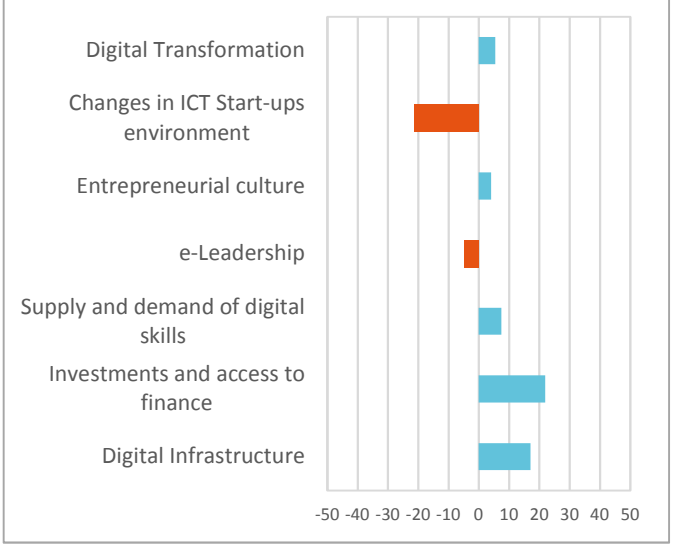
- Areas for improvement

Germany's low performance in the field of ICT start-ups appears to be linked in particular to its low birth rate of ICT companies as a proportion of total company birth rates. In addition, its overall share of active ICT companies has room for improvement.

Despite significant improvements in the field of entrepreneurial culture compared to last year, Germany's score in that field could be further enhanced. The country's performance would greatly benefit from a higher degree of entrepreneurial intentions among its citizens.

C Comparison with other EU Member States

Figure 9.22: Germany´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Germany scores above the EU average in five out of seven dimensions. Outperforming the EU average by almost 22% and 18%, Germany is among the EU's leaders in the dimensions of investments and access to finance and digital infrastructure.

Moreover, Germany performs above the EU average in supply and demand of digital skills and digital transformation. Meanwhile, in the field of entrepreneurial culture, Germany only scores marginally above the EU average.

Finally, the dimension in which Germany performs below the EU average are the ICT start-up environment (-21%) and e-leadership (-5%).

Compared to 2017, Germany has strengthened its entrepreneurial culture, while a decline was experienced in all other fields.

D Interesting policy practices

Mittelstand 4.0 — Digital Production and Work Processes

The main purpose of the 'Mittelstand 4.0 – Digital Production and Work Processes' initiative is to support SMEs in digitising, networking and introducing Industry 4.0 applications. The objectives of the programme include raising SMEs' awareness of the technical and economic challenges of digitisation and supporting the development of secure digital solutions and processes tailored to meeting market needs.

The initiative involves 11 competence centres and four agencies focusing on the prerequisites for successful digital processes, such as electronic standards and user-friendly applications. The role of the four agencies is to deal with the overarching questions of digitisation and e-business. They respectively on cloud computing, process management, innovation management and communication, and e-commerce.

The agencies disseminate knowledge directly to SMEs and through intermediaries such as associations and chambers of commerce. The 11 competence centres raise awareness, inform and train companies and offer concrete teaching, learning, viewing and testing opportunities in their regions.

Investment grant for venture capital

Through the Investment grant for venture capital, the Federal Ministry for Economic Affairs and Energy supports investments by business angels in young, innovative companies by fronting 20% of the amount invested. The programme therefore seeks to help young companies access venture capital while supporting business angels in providing the financing needed. Since January 2017, the conditions of the programme have been considerably improved and restrictions have been removed.

Innovative companies from all economic branches can now become eligible (if the start-up can demonstrate its innovativeness by an independent expert). Previously, only companies from specific economic branches defined in a list of innovative branches could apply. Additional eligibility criteria include a maximum age of the company of seven years, to be headquartered in the European Union with at least one branch in Germany, and to have fewer than 50 full-time-equivalent employees.

Grants per investor have been increased (up to €100,000 per year). Capital gains tax in the event of a successful exit may be partly reimbursed (25%).

9.6

Estonia

Estonia's performance in digital transformation is relatively balanced. Its scores highly in relation to entrepreneurial culture, the ICT start-up environment, e-leadership, and investments and access to finance; yet challenges are noticeable in the fields of digital transformation and infrastructure. The country performs above the EU average in four out of seven dimensions. A look at recent national policy efforts reveals that Estonia is focusing on innovation procurement in the field of information technology, as well as on enhancing the digital connected economy by creating an Estonian ICT Center of Excellence.

A Estonia in a nutshell

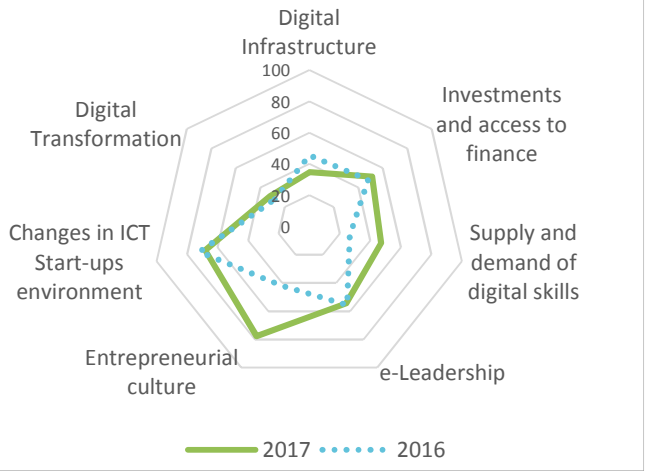
Estonia performs well in the pillars of entrepreneurial culture and the ICT start-up environment. It also performs strongly in e-leadership and investments and access to finance.

Given its strong record in entrepreneurial culture and the ICT start-up environment, it is not surprising that Estonia scores also highly in supply and demand of digital skills.

On the contrary, the country is facing challenges in the fields of digital transformation and infrastructure. However, compared to 2016 Estonia is getting on the right track in terms of digital transformation, although it is losing its competitiveness in terms of digital infrastructure.

Overall, Estonia's performance is mixed. Despite high scores in four out of seven pillars, there is considerable room for improvement in two particular pillars: digital transformation and digital infrastructure.

Figure 9.15: Estonia´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Estonia's strong performance in ICT start-ups is primarily attributable to the full employment of its ICT workforce. In addition, the share of its ICT sector in total GDP underpins the high result for this dimension.

Estonian entrepreneurial culture has undergone a positive development. Compared to 2015, more skilled workers consider starting a business to be a desirable career choice. Estonia's solid e-leadership score is due more to skills obtained from academic education than to in-work training provided by companies.

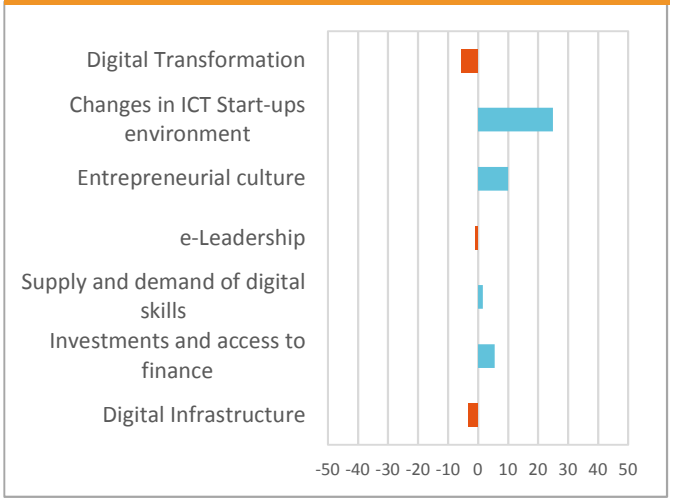
- Areas for improvement

Estonia's performance in the supply and demand of digital skills shows significant room for improvement. The data available indicates that the reasons for this are poor ICT skills among employees. Moreover, a substantial number of companies encounter problems finding skilled employees.

Another key challenge for Estonia is the need to improve in the field of digital transformation. Although most companies use automated data exchange for receiving orders from customers and use two or more social media platforms, e-commerce in companies could be improved.

C Comparison with other EU Member States

Figure 9.16: Estonia´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Estonia performs above the EU average in four out of seven dimensions. In particular, Estonia stands out in ICT start-ups, scoring 25% higher than the EU average.

Estonia's performance in entrepreneurial culture and access to finance is also above the EU average. In addition, this year, it performed well in the supply and demand of digital skills.

In spite of the high performance in ICT start-ups, Estonia's digital infrastructure is slightly below the EU average.

The data indicates that Estonia's challenges lie in the field of digital transformation. In particular, the share of enterprises' total turnover from e-commerce could also be improved.

D Interesting policy practices

Innovation Procurement Initiative

In 2015, the Estonian Ministry of Economic Affairs and Communications strategically introduced the innovation procurement policy 'The public sector as a smart customer' into its wider innovation policy.

Enterprise Estonia (EAS) is in charge of setting up and managing the €20 million scheme, which is co-financed by the EU Structural Funds, to support Estonian public procurers in innovation procurements.

From Autumn 2015 onwards, the Ministry and EAS organised several discussions and workshops with public procurers, potential consultants and companies, which culminated in the first Estonian innovation procurement conference in April 2016.

The EAS conducted research analysis showing that 84% of the potential innovation procurements are in the field of information technology.

The Information of System Authority, Estonian e-health foundation, the Ministry of Economic Affairs and Communication, IT centre of Ministry of Finance and Tallinn University of Technology carry out most of the potential procurements.

ICT Center of Excellence

At the beginning of October 2015, Estonia promoted and supported the need for establishing an R&D and innovation centre of excellence in the ICT field.

The aim of the ICT Center of Excellence is to support knowledge transfer between universities and the private sector and to accelerate research and development to create new technologies. The centre is a joint venture between Tallinn University of Technology, the University of Tartu and the University of Edinburgh.

Estonia's main objective in introducing the ICT Center of Excellence is to enhance levels of research and development, as well as the degree to which programmes create critical mass in the field of ICT. Furthermore, Estonia will be able to increase its international competitiveness and cooperation between scientists and entrepreneurs.

The centre covers the full 'technology stack' of ICT, from hardware to software. The top-ranked ICT research groups in Estonia work jointly with the University of Edinburgh, aiming to capitalise on the existing expertise to create synergies on the well-preformed but fragmented landscape of Estonian research in ICT.

9.7

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Ireland

Ireland's overall performance in digital transformation is strong. Its highest scores are in the areas of supply and demand of digital skills and e-leadership. On the other hand, the areas of access to finance and the ICT start-up environment have room for improvement. Given its strong performance in e-leadership, it is not surprising that this field, together with the supply and demand of digital skills, is far above the EU average. Recent policy examples, such as the creation of the Digital Skills and Jobs Coalition and the implementation of entrepreneurship summer camps, confirm the Ireland's strong performance of Ireland in these fields.

A Ireland in a nutshell

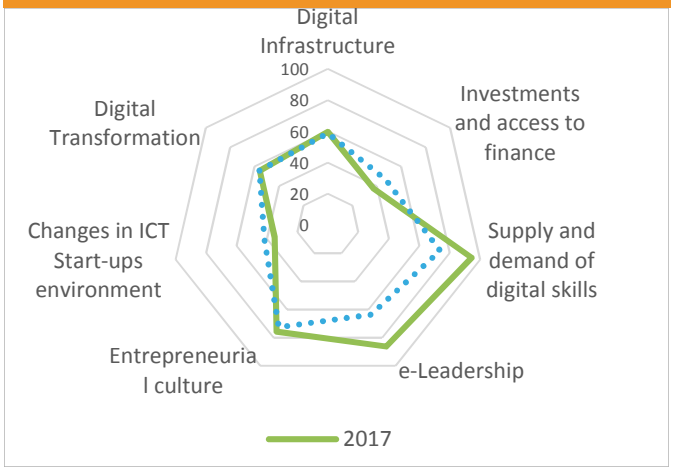
Compared to last year, Ireland's performance in e-leadership and the supply and demand of digital skills has increased significantly.

Ireland's strongest asset is the supply and demand of digital skills, while it also performs well in e-leadership. Nevertheless, its performance in the area of entrepreneurial culture is also high.

Despite well-developed digital infrastructure, Ireland scores lower in investments and access to finance compared to 2016. Moreover, the field of ICT start-ups has declined slightly compared to the previous year.

Overall, Ireland receives relatively high scores in five out of the seven dimensions. The two fields in which the country has room for improvement are ICT start-ups and investments and access to finance.

Figure 9.27: Ireland´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Ireland's strong performance in the field of the supply and demand of digital skills is backed by the country's high innovation output.

Moreover, a large workforce with tertiary education, as well as training provided to ICT employees by companies, explains why e-leadership is Ireland's second-strongest pillar. This is supported by a high number of enterprises providing their employees with portable devices.

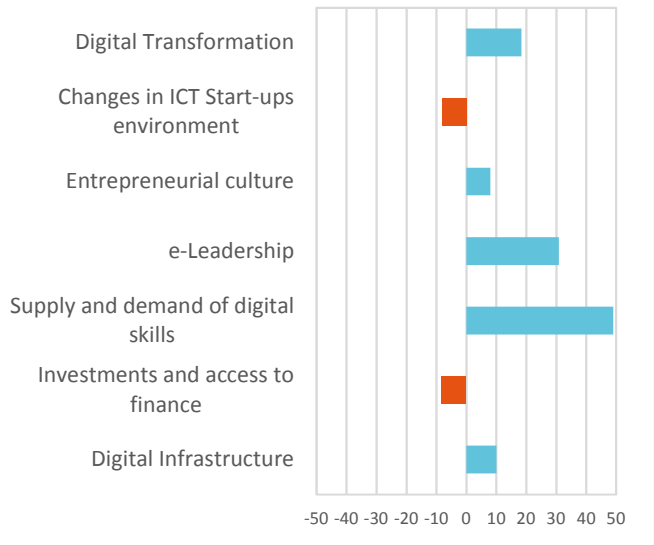
- Areas for improvement

Ireland scores lowest in the field of ICT start-ups. Its relatively low performance in this dimension is mainly caused by a low birth rate of Irish ICT companies.

At the same time, the area of investments and access to finance has moderate values. This performance can be explained by a low percentage of commercial profits of Irish companies. However, the average score in this field contrasts with the solid business R&D expenditure.

C Comparison with other EU Member States

Figure 9.28: Ireland´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Ireland scores above the EU average in five out of seven dimensions.

Ireland's strongest performance continues to be the supply and demand of digital skills, leading by nearly 50%. It also scores well in the areas of e-leadership and digital transformation.

Meanwhile, Ireland displays a rather average to narrow lead performance in entrepreneurial culture and digital infrastructure.

The area of ICT start-ups performs lower than last year, leaving room for improvement. The performance in investments and access to finance shows the same trend.

Overall, Ireland performs far above the EU average in the supply and demand of digital skills, e-leadership and digital transformation. While entrepreneurial culture and digital infrastructure are slightly above the EU average, the fields of ICT start-ups and investments and access to finance could be improved.

D Interesting policy practices

Irish Digital Skills and Jobs Coalition

The Irish Department of Jobs, Enterprise and Innovation launched the National Digital Skills and Jobs Coalition in April 2017 as part of the European Commission's Skills Agenda for Europe.

It is a multi-stakeholder partnership between representatives of academia, industry, the public sector and the non-profit sector. Its main goal is to tackle the digital skills shortage and improve digital skills to enable Irish citizens to benefit from the digital economy.

The coalition's main priorities are to:

- modernise pedagogies and upgrade teachers' digital skills;
- promote research-industry cooperation;
- guarantee the proper use of competence frameworks, DigComp, e-CF, etc.;
- Define the concept of digital skills and identify the main obstacles hindering them;
- upskill workers by encouraging employers to train them;
- generate public awareness of the need for digital skills;
- strengthen access to funding; and
- advocate for ICT as a career choice and search for alternative approaches to IT careers.

Entrepreneurship summer camps

In March 2017, the Department of Education and Skills announced a call for higher education institutions to submit proposals to organise entrepreneurship summer camps.

The Entrepreneurship Summer Camps programme is intended to provide students with environments that stimulate their creativity, innovation and invention. In the same vein, activities aiming at stimulating entrepreneurial thinking and design skills among students will be developed.

This policy measure is expected to contribute to the delivery of the Action Plan for Education, whose main goal is to strengthen cooperation between education and the wider community and to ensure that entrepreneurship, creativity and innovation are nurtured by the education system.

€250,000 has been invested to provide nearly 1,000 places on summer camps in higher education institutions across the country.

9.8

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Greece

Greece's record in digital transformation is mixed: it performs solidly in some areas but has room for improvement in others. Regarding the EU average, challenges remain in all fields except for investments and access to finance, which comes as a surprise given the long-term austerity measures. A look at recent national policy initiatives demonstrates Greece's efforts to tackle the challenges encountered. In this regard, Entrepreneurship Fund II and the escrow account aim to facilitate investments and access to finance.

A Greece in a nutshell

Greece has a well-developed entrepreneurial culture. This favourable entrepreneurial environment is backed up by a strong performance in the field of investments and access to finance.

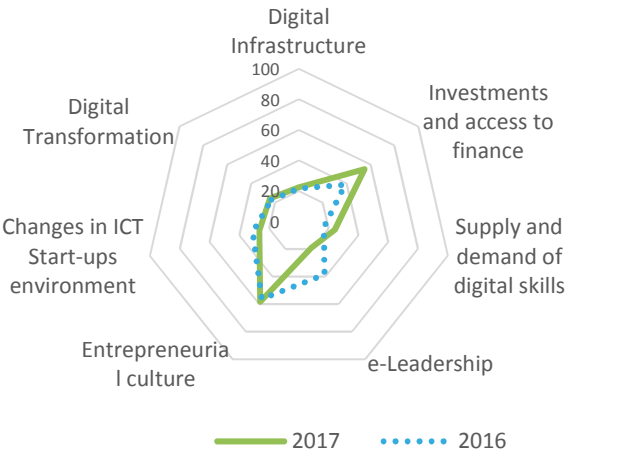
All other fields have either moderate or low scores. Digital transformation and infrastructure, the supply and demand of digital skills, and ICT start-ups have score lowly, thus there is tremendous room for improvement.

As one of the dimensions in which Greece performs the lowest, e-leadership is a major challenge; the score has dropped significantly since 2016.

Despite the brain drain estimated at over 700,000 people leaving Greece since 2009, there has apparently been a small improvement in the performance of supply and demand of digital skills. This is perhaps due to new university graduates, who have excellent IT skills.

Whereas Greece's strongest asset is entrepreneurial culture, improvements are needed regarding all other pillars.

Figure 9.23: Greece´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

The majority of Greeks consider entrepreneurship a good career choice. However, recent data shows that the their entrepreneurial intentions are not in line with Greece's strong performance in entrepreneurial culture. This may be due to the complex administrative environment that makes it hard to open a new company and even harder to close it if it fails.

Greece finds another strength in the field of digital transformation. E-commerce and the use of social media are widespread among businesses. In addition, Greek companies are used to purchasing online from suppliers located out of Greece.

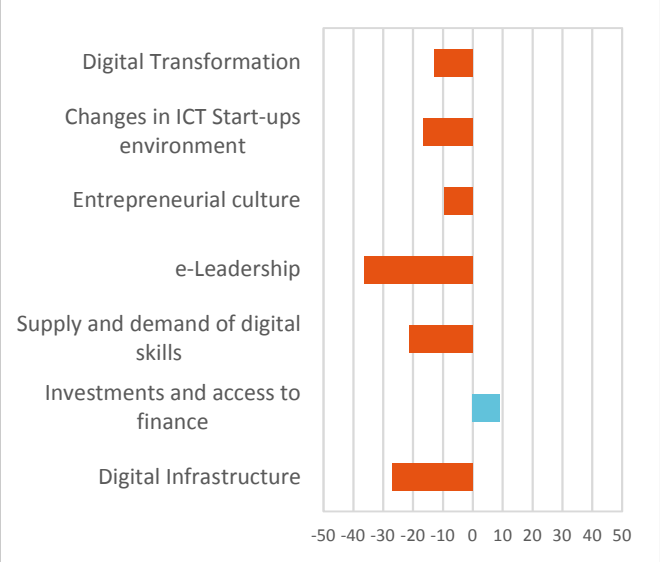
- Areas for improvement

Despite a well-developed workforce base with tertiary education, investments and access to finance is the only improvement for Greece compared to 2016. This is mainly due to the fact that public investment fell in order to reduce the deficit, and foreign investment sees opportunities in a recovering economy.

Another key challenge for Greece is in the field of digital infrastructure, as the country has one of the lowest shares of companies using DSL or another fixed broadband connection. At the same time, the use of customer relationship management for marketing purposes is not widespread among Greek companies.

C Comparison with other EU Member States

Figure 9.24: Greece´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Greece performs below the EU average in six out of seven dimensions.

Greece's strongest asset is investments and access to finance, despite being below the EU average last year. In this field, Greece ranks 9% above the average.

Greece ranks slightly below the EU average regarding entrepreneurial culture (which was the only dimension above the EU average in 2016), while the other areas below the average, as in 2016, are ICT start-ups, digital transformation and supply and demand of digital skills.

The data indicates that Greece's greatest challenges are digital infrastructure and e-leadership, where it scores 27% and 36% below the EU average respectively.

In summary, there is significant room for improvement in all dimensions to foster Greece's digital transformation, and the country should make serious efforts in this direction.

D Interesting policy practices

Entrepreneurship Fund II

The Managing Authority for the Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020 (EPAnEK) launched Entrepreneurship Fund II in November 2016. This policy measure aims at facilitating access to finance for new and existing companies, particularly microenterprises and SMEs.

The fund will provide access to finance through loans and guarantees for establishing new innovative, outward-looking and dynamic businesses; developing existing businesses through by modernising them technologically and organisationally; strengthening their operation by introducing innovative practices; and strengthening businesses and other organisations active in the social economy.

The overall budget is €400 million.

Escrow account

In place since June 2016, this mechanism aims at enhancing market liquidity and stimulating business activity.

The requirement to deposit an advance payment guarantee is no longer needed once beneficiaries (SMEs, self-employed, entrepreneurs, etc.) have signed a contract under the Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020 (EPAnEK).

This way, beneficiaries' investments are substantially reduced and projects are easier to implement.

This policy practice is being implemented by the Ministry of Economy, which has created an account for each of the four EPAnEK programmes already launched in 2016.

The overall budget is €400 million.

9.9

Spain

The Spanish record of digital transformation shows a mixed performance, featuring high- and low-performing fields. Spain's score stands out in e-leadership and supply and demand of digital skills. Compared to the EU average, Spain faces challenges in the investments and access to finance area. A look at recent national policy efforts reveals that the Spanish focus is on stimulating the digital economy and promoting the adoption of patents protecting intellectual property rights.

A Spain in a nutshell

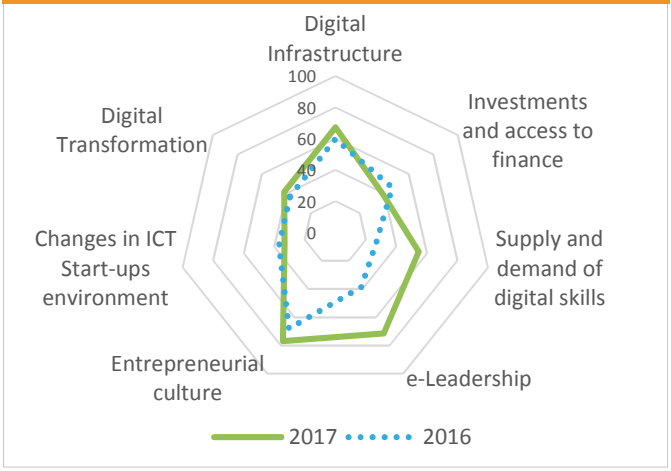
Overall, Spain's performance has improved in comparison to last year's results.

The dimension of e-leadership shows significant progress over the last year, performing above the EU average. This is mainly due to an increase in the number of companies that provide portable devices to their employees for business use. The area of supply and demand of digital skills also reveals a remarkable improvement, while some progress has been achieved in digital transformation and entrepreneurship culture.

Compared to last year, Spain maintains its steady performance in digital infrastructure, scoring in line with the EU average. However, the country faces challenges in the areas of investments and access to finance and the ICT start-up environment.

In summary, Spain displays a mixed performance with relatively high scores in four areas, average results in two fields and one low-performing field.

Figure 9.51: Spain´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Spain's strong performance in e-leadership is attributable to the ease of finding skilled employees within the country and the high number of enterprises recruiting ICT specialists. The broadband and connectivity indicator also scores among the highest in the EU.

Similar to last year, Spain's solid digital infrastructure is due to the percentage of enterprises using ERP software to share information between different functional areas. In addition, the number of enterprises using DLS or another fixed broadband connection is significant.

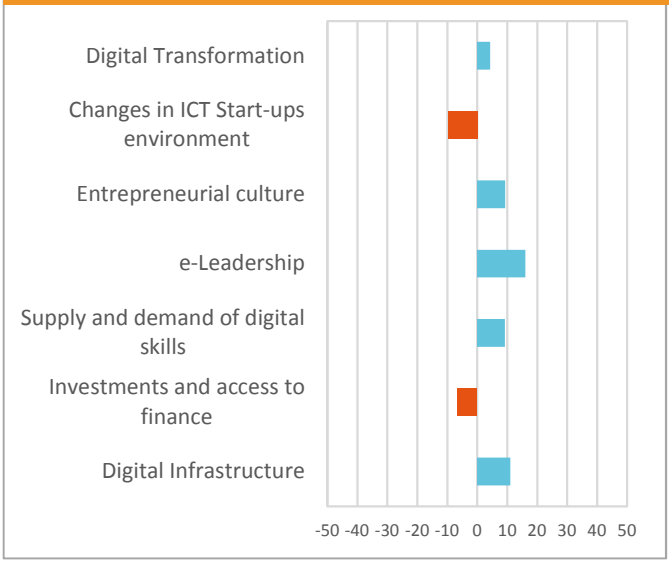
- Areas for improvement

Spain's key challenge is the area of investments and access to finance. In this regard, data shows a lack of sufficient R&D expenditure among business enterprises in the high-tech sector. In addition, there is not enough direct investment in the information and communication sector.

Another challenge is the need to strengthen Spain's ICT start-up environment. Although Spain performs in line with the EU average, there is room for improvement in the ICT birth rate.

C Comparison with other EU Member States

Figure 9.52: Spain´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Spain performs above the EU average in five out of seven dimensions. Its strongest assets are e-leadership and digital infrastructure. In both cases, the country scores more than 10% above the EU average.

E-leadership is the area that shows the biggest improvement compared to last year's results.

The presence of changes in ICT start-up environment is significantly weak compared to its EU partners, as it scores 10% lower than the EU average. The level of investments and access to finance is also low compared with other EU Member States.

The country continues to perform well in the fields of entrepreneurial culture and digital skills, scoring around 9% higher than the EU average. Lastly, its score in digital transformation is marginally above the EU average.

D Interesting policy practices

Red.es

Red.es is a programme launched in 2016 under the Digital Agenda for Spain. Red.es aims to stimulate the country's digital economy, innovation and entrepreneurship by encouraging efficient and intensive use of ICTs.

The programme consists of helping mainly SMEs and public administrations to adopt business solutions based on cloud computing.

Regarding the implementation of cloud computing policies in public administrations, the programme advocates for programmes on smart cities, connected schools, open data, digital culture, e-health, broadband connectivity and telematic payments. On the other hand, the programme boosts the digital economy for SMEs by promoting entrepreneurship and internationalisation, e-commerce, digital skills, e-tourism and cloud computing platforms.

CEVIPYME

The CEVIPYME platform provides information and personal assistance to SMEs on how to protect their intellectual property rights. In addition, the CEVYPYME analyses the most effective way to manage and monitor these rights after they are obtained.

In order to facilitate the adoption of patents in Spain, the platform also provides information on financing and the start-up a business. This policy measure was adopted by the Spanish Government in 2017 and is supported by the European Regional Development Fund.

CEVIPYME's ultimate goal is to increase the number of patent, trademark and design applications filed in Spain.

The main services provided by the CEVIPYME platform are:

- Technical support from the Spanish office of Patents and Trademarks;
- Providing tools such as database, technical documents or information tools; and
- Making it easier to access relevant documentation and links of interest.

9.10

France

France shows an average performance in digital transformation. It scores well and stands out from its European partners in the fields of entrepreneurial culture and investments and access to finance. The country also recently made significant progress in the digital transformation of its business sector. However, efforts could be stepped up to support the development of ICT start-ups and to improve digital infrastructure. Taking stock of these challenges, the French Government recently launched strategic and tailored policies, based in particular on industry involvement and collaboration, to further push forward digital transformation.

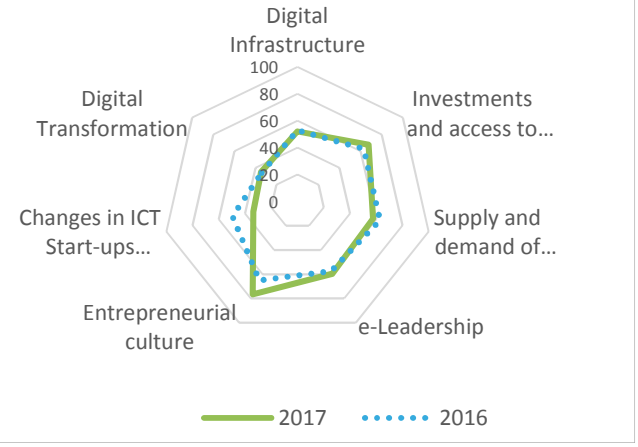
A France in a nutshell

France´s key strengths lie in its entrepreneurial culture, high level of investments and access to finance. Between 2016 and 2017, France significantly improved in terms of entrepreneurial culture.

Despite this favourable context, the country´s results deteriorated in three out of seven dimensions, with a notable drop in the ICT start-up environment.

Overall, France's profile seems relatively homogeneous in most dimensions except for its ICT start-ups environment and digital transformation, where it lags behind.

Figure 9.19: France´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

France significantly improved its performance in digital transformation compared to 2016 levels. Efforts have been made to integrate digital technologies into their production processes and to adapt business models accordingly (social media, etc.).

In addition, France has a financial framework that incentivises private investment in ICT. French companies have easy access to private funding in local equity markets and make high levels of R&D investment in digital technologies.

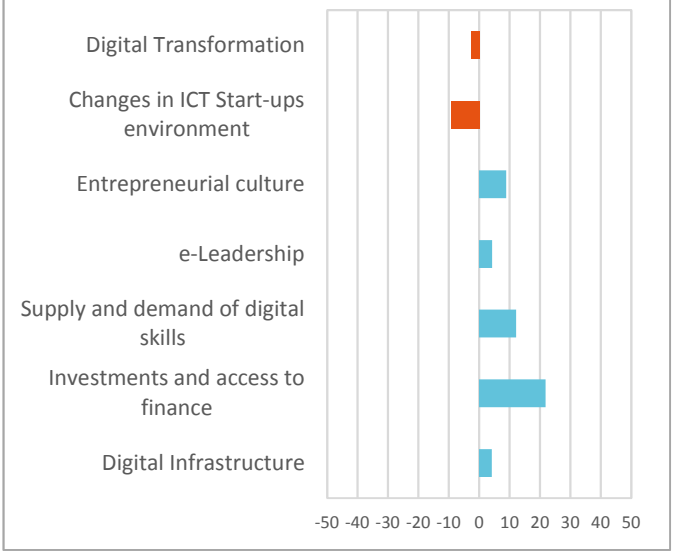
- Areas for improvement

France's performance in digital infrastructure could be improved. In particular, more effort could be made to increase the average Internet bandwidth speed available and to further support the uptake of enterprise resource planning (ERP) software in the business sector.

France would also significantly benefit from the further development of ICT companies, in particular SMEs, which could act as a key driving force in the digital transformation of its industry.

C Comparison with other EU Member States

Figure 9.20: France´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

France performs above the EU average in five out of seven dimensions. In particular, the level of investments and access to finance is France's biggest strength.

In two out of five dimensions, the country scores around 10% higher than the EU average. France has made a significant effort in investments and access to finance, followed by digital skills, in comparison to other EU Member States.

On the contrary, France does not stand out much from its European partners in e-leadership and digital infrastructure. France's main weakness lies in its ICT start-up environment, where it lags behind EU Member States.

Overall, France scores well in investments and access to finance, supply and demand of digital skills, entrepreneurial culture, while it performs poorly in regard to ICT start-ups and digital transformation.

D Interesting policy practices

Industrie du Futur

Launched by the French government in April 2015, the *Industrie du Futur* (IdF) programme aims to support companies in accelerating their uptake of digital technologies, transforming business models and modernising production practices. IdF's overall objective is to address the significant underinvestment adversely affecting industry, in particular SMEs and mid-tier firms.

The programme relies on the private sector playing a significant role and contributing a large amount financially. The *Alliance Industrie du Futur (AIdF)*, a platform bringing together public and private industry and digital technology stakeholders, was created to design and monitor its implementation and to ensure constant cooperation and dialogue. In addition, the €10 billion of public funds made available in the form of subsidies and loans is expected to attract five times more funding from private investors.

IdF has so far supported around 4,100 companies in obtaining a diagnosis for the modernisation of their production tools, of which 31 have already been awarded the label *Vitrines Industrie du Futur* ("Factory of the Future Models").

In March 2017, the AIdF, together with the key digitising manufacturing Industry initiatives of Germany (Platform Industrie 4.0) and Italy (Piano Industria 4.0) set-up a joint Steering Committee in order to ensure better coordination. The trilateral Steering Committee addresses diverse issues such as standardisation, SMEs engagement and policy support.

La French Tech

On 27 November 2013, the French Government launched a new certification scheme called *La French Tech* that identifies cities providing proactive support to ICT start-ups. The label aims to foster and streamline the development of local digital innovation ecosystems – mainly those outside of the Paris area, which currently contains 50% of France´s potential – and to promote them at international level.

So far, 13 cities have been awarded the label. The programme led to the establishment of a €200 million fund, managed by the *Banque Publique d´Investissement* (Public Investment Bank), which directly supports private start-ups through a grant-allocation process.

The *French Tech* programme has an important international dimension by creating the *French Tech Hub* label, which identifies existing and active networks of French start-ups, entrepreneurs and investors based abroad. The French Government also launched a €15 million campaign to promote its digital innovation start-ups at international level (e.g. by making it easier for them to participate in international technology and innovation conferences).

9.11

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Croatia

Croatia's performance in digital transformation is highly diverse, featuring areas with both high and low scores. Croatia's strengths lie in entrepreneurial culture, e-leadership and digital transformation. This good performance could be the result of policy measures such as the e-Schools Pilot Project. However, challenges remain in capital-intensive fields – investments and access to finance and digital infrastructure – yet Croatia is responding to them through policy initiatives focusing on financial support for innovative SMEs.

A Croatia in a nutshell

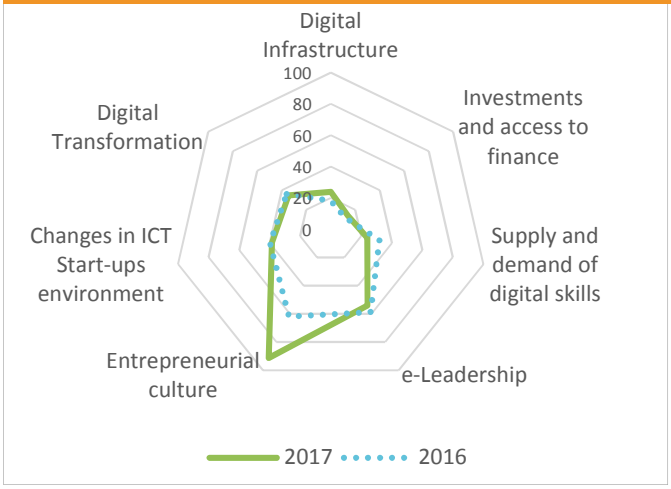
Entrepreneurial culture is the field in which Croatia performs the strongest. Given this fact, it is not surprising that it scores solidly in e-leadership.

On the other hand, Croatia needs to make an effort to improve areas such as the supply and demand of digital skills, investments and access to finance, and digital infrastructure, which score poorly, and in most cases worse than in 2016.

Furthermore, despite Croatia's solid performance in digital transformation, it scores much lower in the ICT start-up environment. In this area, the country's performance has decreased slightly since 2016.

Overall, Croatia's performance is decent in less capital-intensive fields, such as entrepreneurial culture and e-leadership, whereas capital-intensive fields such as investments and access to finance and digital infrastructure remain challenging.

Figure 9.7: Croatia´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Croatia's highest score is in the field of entrepreneurial culture. Along with a high total early-stage entrepreneurial activity, recent data shows that the vast majority of the population would start a business within three years if they had sufficient funding.

Moreover, Croatia's solid performance in e-leadership is more heavily attributable to the training provided by companies than to its education system. Companies in Croatia provide regular training to ICT specialists, as well as portable devices enabling their employees to have a mobile Internet connection.

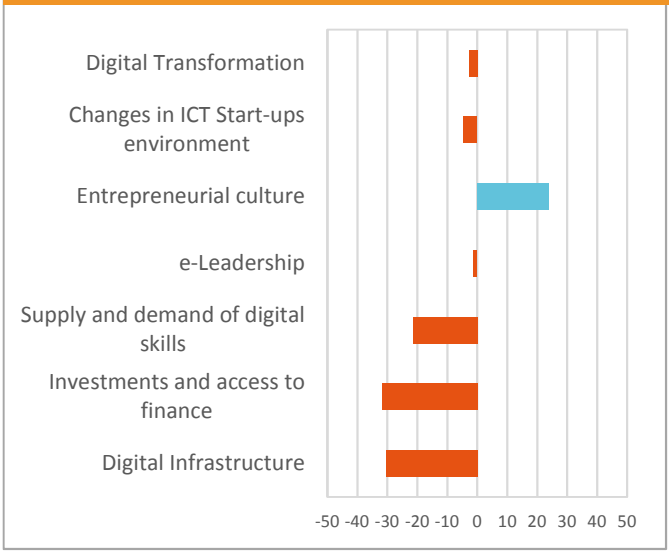
- Areas for improvement

Croatia's performance in the supply and demand of digital skills leaves room for improvement. In particular, efforts are needed to foster the innovation output and to increase the amount of skilled employees available in the country.

Moreover, Croatia's performance in investments and access to finance could be improved. This challenge is linked to a lack of companies' R&D expenditure, which could be caused by a low percentage of commercial profits.

C Comparison with other EU Member States

Figure 9.8: Croatia´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used

Croatia scores above the EU average only in one out of seven areas, entrepreneurial culture, wherein it performs nearly 24% better than the EU average. E-leadership, digital transformation and changes in the ICT start-up environment lie just below the EU average.

However, significant challenges remain in the fields of digital infrastructure, supply and demand of digital skills, and investments and access to finance. These pillars are well below the EU average in 2017, as they were in 2016, as can be seen in the graph on the left.

To summarise, there is a risk that the strong entrepreneurial culture will be wasted if the foundations of sustainable economic development (digital infrastructure, digitally skilled professionals and access to finance) are missing.

D Interesting policy practices

Commercialisation of innovation in SMEs

The Commercialisation of Innovation in Entrepreneurship grant programme aims at involving SMEs in the innovation and commercialisation processes for their products and services.

The main goal of the programme is to support projects targeting the development of new products and services with higher added value, which have a positive effect on companies' business performance, growth and international market potential.

Specifically, this policy measure defines the objectives and procedures for allocating state aid and granting SMEs projects that have an innovation component.

The Ministry of Entrepreneurship and Crafts began implementing the programme in April 2016 for a duration of 20 months.

Approximately 100 SMEs are expected to benefit from an overall budget of €15.2 million.

E-Schools Pilot Project

The e-Schools Pilot Project aims at establishing a system for developing digitally mature schools. To achieve that aim, an evaluation of the application of ICT in the educational and operational processes of around 140 schools is being carried out.

This pilot project is part of a wider programme whose objective is to introduce ICT into the Croatian school system between 2015 and 2022.

A strategy based on the outcome of the pilot project will be developed with the objective of implementing a system of digitally mature schools in the entire primary and secondary education structure, to be applied in the main project (2019-2022).

The 3-year implementation of the project started in March 2015, and its total value is €40.8 million, of which 63% is financed by the European Regional Development Fund (ERDF), 22% by the European Social Fund (ESF) and 15% by national funding.

9.12

Italy

Italy's digital transformation performance varies widely. It scores highly in the fields of entrepreneurial culture and e-leadership, and its score in the field of digital transformation has improved since 2016. The country's challenges mainly involve the fields of the ICT start-up environment, supply and demand of digital skills, and investments and access to finance. A look at recent policy shows that the Italian authorities are focusing on assisting innovative companies in the continuous uptake of new technologies and activities relating to R&D and innovation, as well as on improving companies' access to finance.

A Italy in a nutshell

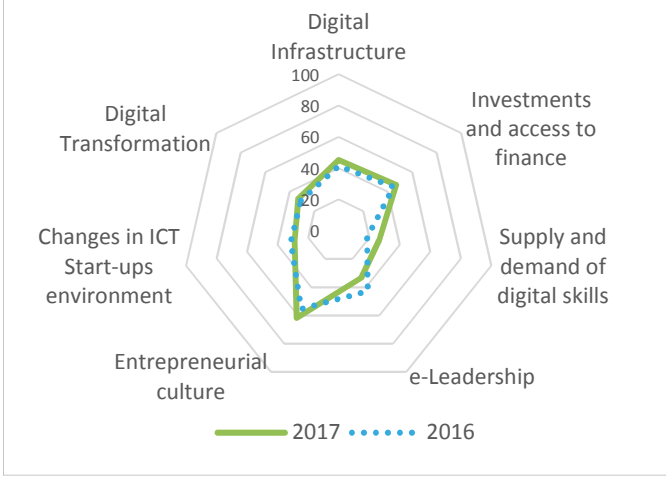
Italy performs strongly in the field of entrepreneurial culture, and also receives a solid score in the field of digital transformation and e-leadership.

Given these favourable framework conditions, it is striking that the country's performs relatively poorly in ICT start-ups. Meanwhile, Italy has room for improvement in the field of supply and demand of digital skills and investments and access to finance.

Italy is performing better in digital transformation than last year. Meanwhile, the data for investments and access to finance, e-leadership, and changes in ICT start-up environment shows a decline.

Overall, Italy's profile is rather pronounced, featuring solid performances in the technological and entrepreneurial fields. Meanwhile, shortcomings are mainly in digital skills, ICT start-ups and digital transformation.

Figure 9.29: Italy´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Italy scores highly in the field of entrepreneurial culture. As well as considering entrepreneurship a good career choice, recent data shows a high rate of total early-stage entrepreneurial activity.

In addition, Italy's strong performance in digital transformation is aided by a high share of businesses using electronic solutions for automated data exchange and data processing with external businesses. Similarly, Italian businesses regularly use cloud computing services.

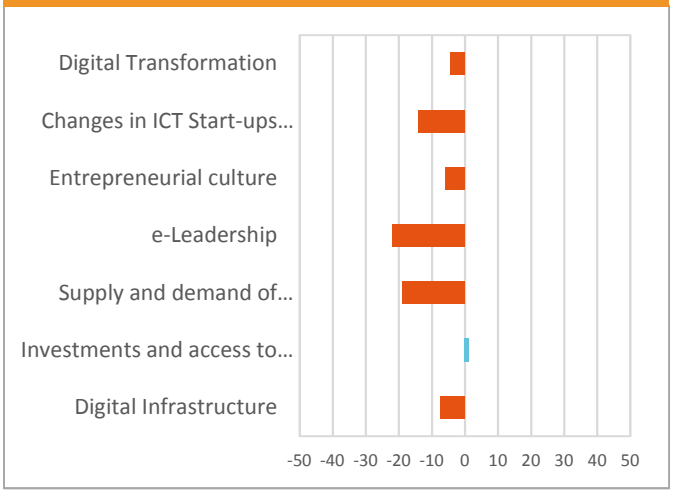
- Areas for improvement

Italy's main challenges lie in digital skills and the ICT start-up environment. Italian businesses rarely provide employees with devices for mobile Internet connection for business purposes. Given the size of the country, Italy could also improve in terms of high-tech patents.

Meanwhile, Italy's low performance in changes in the ICT start-up environment is primarily due to the low share of ICT businesses in proportion to the total number of SMEs. Furthermore, Italy has a relatively low birth rate of ICT enterprises.

C Comparison with other EU Member States

Figure 9.30: Italy´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used

Italy scores above the EU average in one out of seven dimensions: investments and access to finance, but even here, it scores only 2% above the EU average.

In terms of digital transformation and entrepreneurial culture, the country scores somewhat lower, leaving room for further improvement.

Italy's core challenges lie in the fields of e-leadership, digital skills and changes in the ICT start-up environment. The country performs 22%, 19% and 14% below the EU average respectively in these three areas.

D Interesting policy practices

Fondo 'Italia Venture I' / 'Italia Venture I' fund

The Italian Ministry of Economic Development created the Italian Venture I Fund in 2015, aiming to support innovative SMEs and innovative start-ups operating in high-growth sectors or launching new products/services innovations.

The fund's focus is on equity acquisition operations of up to 70% of company risk capital, combined with 30% private investment. The average single investment is between €500,000 and €1,500,000. The application process is online and an evaluation committee is responsible for assessing the projects.

Within the *Industria 4.0* initiative, the Italian Government has prepared a whole package of measures ensuring better access to finance, among, other things. The fund improves the availability of venture capital, business angels and equity financing, as well as supporting new businesses in crucial phases of their life cycle and helping them grow.

The fund is managed by Invitalia Ventures SGR and controlled by Invitalia, the National Agency for Inward Investment and Economic Development. Overall, €50 million has been invested in the fund, which will have a duration of 10 years.

Brevetti+2 / Patents+2

Launched by the Ministry of Economic Development and the Italian Patent and Trademark Office (UIBM) in 2015, Patents+2 seeks to support microenterprises and SMEs in the economic exploitation of patents obtained after 01/01/2013 (or after 01/01/2012 for academic spin-offs).

Each project has a maximum duration of 9 months. The measures finance 80% of eligible project costs (100% for spin-offs) up to a maximum of €140,000 per company. Selected enterprises also receive assistance in drawing up a project plan for the patent's economic exploitation.

The measure was launched through a call for applications. The programme is implemented through the support of Invitalia SpA, the National Agency for Inward Investment and Economic Development, which is owned by the Italian Ministry of Economy and Finance.

Targeting microenterprises and SMEs officially registered with operations in Italy, the programme is part of Brevetti+, which has a budget of €30.5 million. There is no annual budget. Instead, resources are split among periodic reopenings of the funding scheme.

9.13

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Cyprus

Cyprus continues on the right track, mainly thanks to its good performance in entrepreneurial culture, e-leadership, the supply and demand of digital skills, and digital infrastructure. Cyprus's main challenge is investments and access to finance, where little progress has been made and the country is still below the EU average. Recent national policy practices and initiatives show why Cyprus is far above the EU average in entrepreneurial culture, for example by promoting entrepreneurship through the Startup Visa or fostering innovation thanks to the Social Entrepreneurship Programme.

A Cyprus in a nutshell

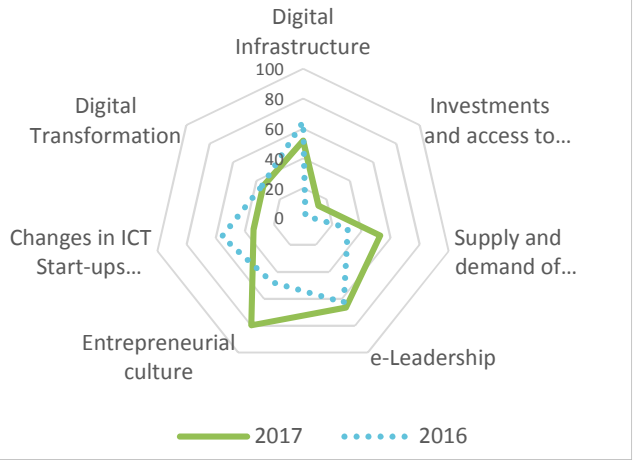
Cyprus has improved in all areas except for digital infrastructure and the ICT start-up environment. Cyprus' progress in entrepreneurial culture has been remarkable and is the highest-scoring area, though updates to the indicators used may account for some of the progress.

The country also scores highly in e-leadership and digital infrastructure. The latter still has some room for improvement as the score has fallen slightly. Moreover, Cyprus has a consolidated supply and demand of digital skills.

A key challenge that Cyprus is facing relates to investments and access to finance, where little progress has been made since last year. It is necessary to note that Cyprus had a major financial crisis (2011-2013) and its central bank received a €10 million bailout, from which it has been recovering since 2016. The score in the field of the ICT start-up environment in 2017 has also fallen since 2016.

Overall, Cyprus has improved in five out of seven dimensions.

Figure 9.9: Cyprus´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

In Cyprus, starting a business is a desirable career choice, explaining to great extent its high score in entrepreneurial culture. The ICT birth rate is also high, thanks to the country's beneficial entrepreneurial environment.

Similarly, Cyprus' strength in e-leadership is based on a high share of its workforce obtaining a degree from tertiary education. In addition, workers regularly receive in-work ICT training from their companies. Cyprus' performance would improve if more portable Internet devices were distributed to employees.

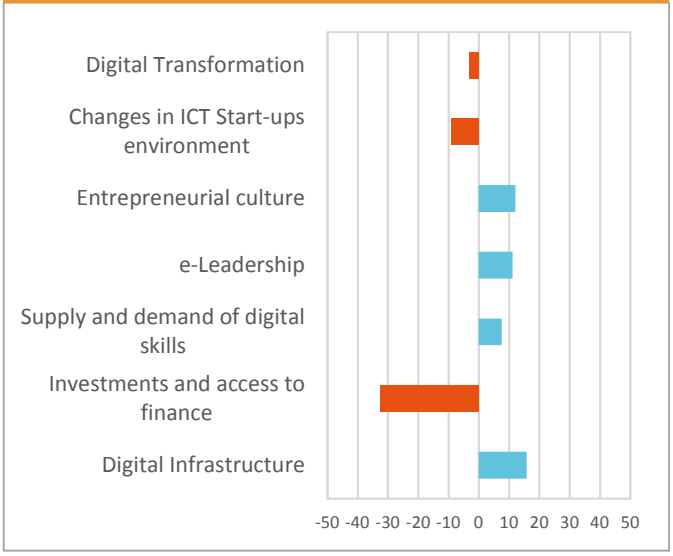
- Areas for improvement

Despite high direct investment in the ICT sector, a rather low performance in private R&D expenditure and commercial profits makes the area of investments and access to finance a key challenge for Cyprus.

Another area for improvement is the dimension of the ICT start-up environment. Although Cyprus has one of the highest shares of ICT SMEs in proportion to the total number of SMEs, it has one of the EU's lowest rates of ICT sector added value as a percentage of GDP.

C Comparison with other EU Member States

Figure 9.10: Cyprus´ performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Cyprus scores above the EU average in all pillars except for digital transformation, investments and access to finance and the ICT start-up environment.

Whereas Cyprus ranked below the EU average in 2016 regarding the supply and demand of digital skills, this indicator lie above the EU average this year. Other dimensions in which Cyprus performed above the EU average were e-leadership, entrepreneurial culture and digital infrastructure.

Concerning challenges, the data indicates that Cypriot investments and access to finance could be improved. The country scores 32% lower than the EU average in this area. Although the ICT start-up dimension was above the EU average in 2016, it scored 9% below the EU average in 2017.

In conclusion, Cyprus's strength lies in digital infrastructure, together with entrepreneurial culture and e-leadership. However, improvements are needed in the field of investments and access to finance and the ICT start-up environment. With recovering economic and political stability and a vision for the future, Cyprus shows major potential.

D Interesting policy practices

Cyprus Startup Visa

The Startup Visa scheme, which part of the Cypriot Ministry of Interior's Policy Statement on Strengthening the Entrepreneurial Ecosystem, benefits individuals or groups from non-EU and non-EEA Member States wishing to establish, operate and develop start-ups in Cyprus.

The main goal of the Cyprus Startup Visa is to create new jobs and promote research and innovation in order to enhance competitiveness and achieve economic development in the country.

Operating on a pilot basis since February 2017, it is expected that around 150 residence permits will be issued to talented entrepreneurs who wish to enter, reside and be employed in Cyprus during the two-year duration of the programme.

Promoting social entrepreneurship

The Social Innovation programme, implemented by the Research Promotion Foundation, is seen as one of the key instruments to achieve the objectives of the Europe 2020 strategy in terms of inclusive and sustainable growth. Cyprus aims at promoting a social innovation culture and adopting innovative practices through this policy practice.

The targeted beneficiaries are SMEs and research institutions wishing to implement innovative ideas, products, services, technologies, models (for organisations, governance, empowerment and capacity building) and strategies for addressing social challenges and creating new relationships and partnerships between social and other partners.

The overall budget of the programme is €1.5 million.

9.14

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Latvia

Latvia continues to display a mixed performance in digital transformation. Its strongest assets are entrepreneurial culture and ICT start-ups. Latvia has room for improvement compared to other EU Member States in areas such as digital infrastructure, digital skills, and investments and access to finance. Latvia has implemented various policy practices over the last few years to improve in areas of moderate performance (e.g. the Innovation Voucher) and consolidate the dimensions of strong performance (e.g. the Law on Aid for Start-up Companies).

A Latvia in a nutshell

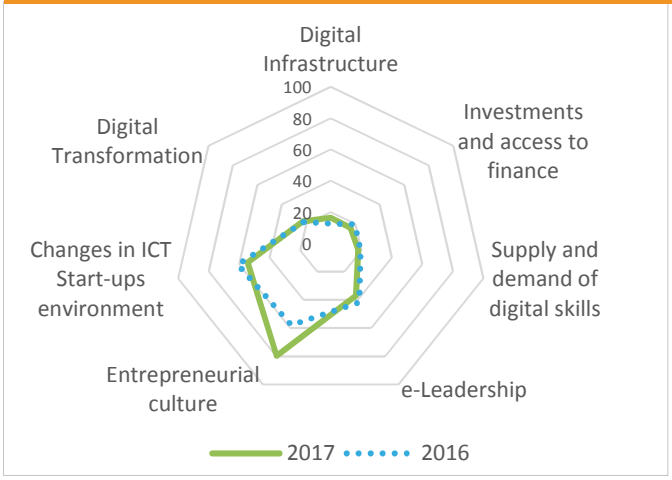
The dimension of entrepreneurial culture has developed significantly over the last year, although updates to the indicators may account for this development to some extent. Moreover, slight progress has been made in digital infrastructure.

Latvia's strongest asset is its entrepreneurial culture, while it also performs solidly in the field of ICT start-ups. More modest results are seen in the area of e-leadership.

However, Latvian performance in digital transformation, digital infrastructure and the supply and demand of digital skills is relatively low, as it was in 2016. The lowest performance is in investments and access to finance.

To summarise, Latvia provides a mixed performance with relatively high scores in entrepreneurial culture and ICT start-ups, average scores in e-leadership, and four dimensions with challenges remaining.

Figure 9.31: Latvia´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

The Global Entrepreneurship Monitor shows that Latvia's strong performance in entrepreneurial culture is backed by its citizens' well-developed entrepreneurial intentions and a widespread perception of entrepreneurship being a desirable career choice.

Latvia also performs well in the dimension of ICT start-ups. This favourable environment supports one of the highest ICT enterprise birth rates in the European Union.

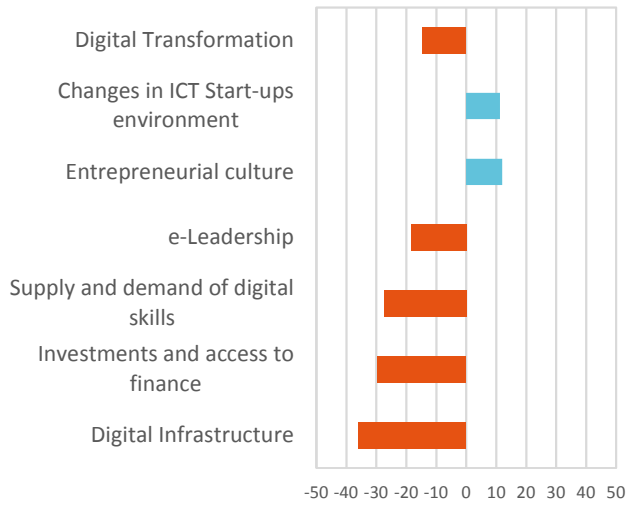
- Areas for improvement

The country's low performance in digital infrastructure is linked, among other things, to the fact that the use of ERP software, DLS and customer relationship management is uncommon among Latvian companies.

With one of the lowest rates of direct investment in the ICT sector in the EU, it is unsurprising that the dimension of investments and access to finance has room for improvement.

C Comparison with other EU Member States

Figure 9.32: Latvia´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Latvia's performs above the EU average in two out of seven dimensions: ICT start-ups and entrepreneurial culture.

As in 2016, the best performances are in ICT start-ups and entrepreneurial culture, where the country performs above the EU average by 11% and 12% respectively.

The dimensions of digital transformation and e-leadership are still below the EU average, and have not improved in comparison to the scores of last year.

Challenges remain in the fields of investments and access to finance and the supply and demand of digital skills, which perform well below the EU average. However, the weakest relative performance concerns digital infrastructure (-36%).

Overall, Latvia performs above the EU average in only two dimensions, while there is significant room for improvement in all other dimensions.

D Interesting policy practices

Law on Aid for Start-up Companies

This law was approved by the Latvian Parliament in November 2016 and entered into force 1 January 2017. The Investment and Development Agency of Latvia (LIAA) is the body responsible for implementing the law.

The main aim of this piece of legislation is to promote the creation of new companies and to foster the development and research of innovative ideas, products and processes.

To qualify, a start-up must meet nine basic criteria, including being less than 5 years old, having earned less than €200 000 in revenue during the first two years since registration, not be paying dividends, and offering an innovative product or service.

The duration of the aid programme is twelve months starting from the day on which the decision to grant the aid enters into force.

It is expected that at least 20 start-ups will benefit from the law each year and around 120 highly qualified employees will be attracted to these companies.

Innovation Motivation Programme

The Innovation Motivation Programme is a support programme whose main goal is to raise awareness among the community about innovative entrepreneurship. It also aims to support those wishing to develop a new innovative business idea.

Within the framework of the Innovation Motivational Programme, various hackathons, networking meetups, workshops, capacity-building activities, and various award-winning competitions are organised to encourage the widest possible participation among society and business in the development and use of innovative solutions.

The programme also aims to increase the proportion of innovative businesses in the economy and motivate the setting up of commercial activities in the specialisation priorities or areas specified in the Latvian Smart Specialisation Strategy.

The programme's budget is €5.6 million, of which 85% is provided by the European Regional Development Fund and 15% comes from the Latvian state budget. The programme was launched at the end of 2016 and is implemented by the LIAA (Investment and Development Agency of Latvia).

9.15

Lithuania

Lithuania's performance has improved considerably since last year. The country continues to be perform strongly in several areas. Lithuania scores highest in entrepreneurial culture, the ICT start-up environment and e-leadership, followed by digital infrastructure. Lithuania exceeds the EU average in five out of seven digital transformation areas. Furthermore, the Government is planning various initiatives and programmes, such as the Startup Visa programme to innovate and stimulate the uptake of digital technologies in the start-up ecosystem, especially for non-EU start-ups.

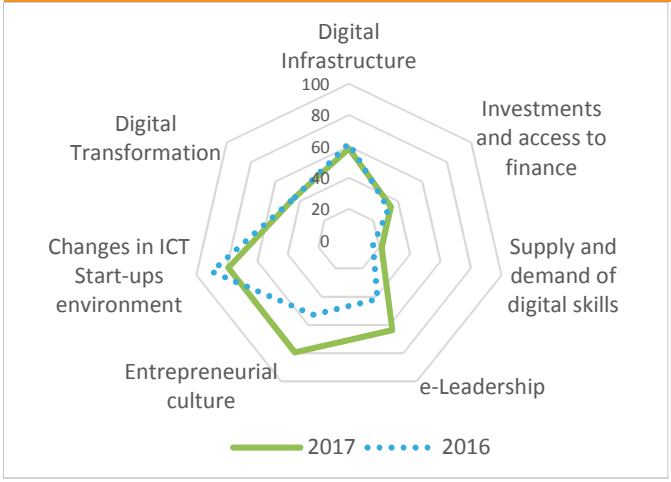
A Lithuania in a nutshell

Overall, Lithuania performs well in fields relating to digital development. It has a fairly advanced digital infrastructure and a highly developed entrepreneurial culture, e-leadership and ICT start-up environment. In 2016, Lithuania scored outstandingly in ICT start-ups, while its strong point this year was in entrepreneurial culture.

Meanwhile, Lithuania's challenges are in the fields of supply and demand of digital skills. However, given its relatively strong digital infrastructure, there may be spillover effects from the country's performance in digital skills.

Lithuania performs modestly in investments and access to finance. Given the country's burgeoning entrepreneurial culture, progress in its local capital markets have the potential to boost Lithuania's digital transformation.

Figure 9.33: Lithuania´s framework conditions for digital transformation



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Following a dive caused by the global financial crisis, the Lithuanian entrepreneurial scene is recovering fairly quickly. An indicator reflecting this trend is the fact that the number of newly established start-ups has tripled in the last five years.

Lithuanian entrepreneurial culture performs very well. Compared to 2015 indicators, a relatively high number of skilled workers are either nascent entrepreneurs or owner-managers of new businesses. In addition, most people consider starting a business to be a desirable career choice.

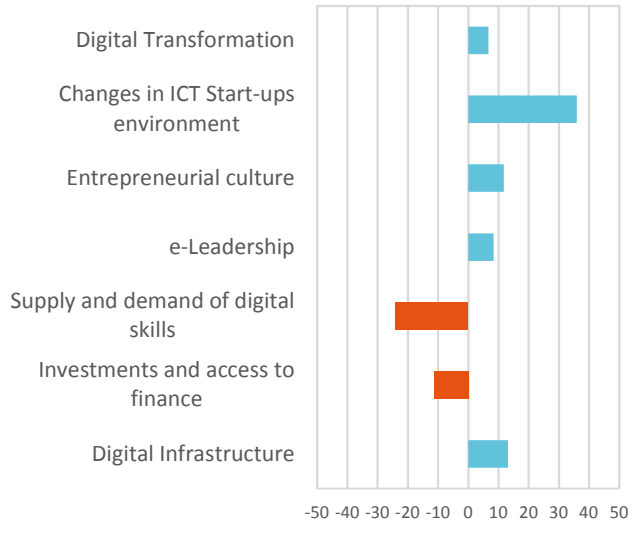
- Areas for improvement

Lithuania's low performance in the supply and demand of digital skills can be seen as its main point of improvement. To a large extent, this performance is caused by employees' low ICT and IT skills. In addition, relatively few enterprises employ ICT specialists.

Moreover, only a low proportion of Lithuanian employees have portable devices to connect to the Internet for business purposes.

C Comparison with other EU Member States

Figure 9.34: Lithuania´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Lithuania performs above the EU average in five out of seven indicators.

Digital transformation is taking off, with an increasing number of enterprises using software solutions. Moreover, the share of enterprises' total turnover from e-commerce is also steadily growing.

Entrepreneurial culture is showing better results than the EU average with over half of employees willing to be self-employed and start a business within three years, with or without governmental support. The entrepreneurial culture is also reflected in the high number of newly created ICT start-ups. The number of ICT personnel in employment has increased in the last two years.

Lithuania performs moderately in e-leadership in comparison to the EU average. Similarly, the supply and demand of digital skills and investments and access to finance are areas for improvement in order to meet to the EU average.

D Interesting policy practices

Lithuanian Innovation Development Programme 2014-2020

This programme was initiated with the aim of gathering and mobilising resources at state level to enhance innovativeness in the country. Through the programme, the Lithuanian Government seeks to foster a more competitive economy based on a digitally and technically qualified labour force, in line with its smart specialisation strategy.

The overarching goal is to embed innovation across all sectors and in different aspects such as business models, branding and services, industrial design, and creative solutions.

The programme addresses all relevant stakeholders that can benefit from innovation policies. Along with SMEs, start-ups, businesses and public associations, major companies are also defined as target groups.

With the Innovation Development Programme, the Lithuanian Government intends to further improve the country's HR capacities and skills.

Startup Visa programme

Aiming at boosting innovation and being more accessible to innovative businesses, the Lithuanian Ministry of Economy has introduced a Startup Visa programme for non-EU start-ups.

The Startup Visa programme is legislation containing simplified rules and regulations for non-EU start-ups to obtain a temporary work permit, provided that they operate in an innovative field and have enough financial resources to meet their goals for one year.

The programme aims to bring high-impact new technologies that will help to spread innovative ideas while at the same time creating new jobs in the field of ICT.

Non-EU start-ups eligible for Lithuania's Startup Visa programme include any that adhere to "scalable and innovative business models" across electronics, biotech and the broader IT umbrella. To date, four companies have participated in this programme.

The Startup Visa programme has a low administrative burden and a fairly simple application procedure.

9.16 Luxembourg

Luxembourg remains one of the EU leaders in digital transformation. Its high-quality digital infrastructure and e-leadership are the driving forces behind its strong performance. Luxembourg offers an all-round advantageous environment that incentivises companies to engage in digital business and technology. Despite these excellent achievements, further effort should be made to increase access to finance and investments. A look at recent national policy efforts reveals that Luxembourg's focus is on stimulating digital skills and promoting the adoption of digital tools for business.

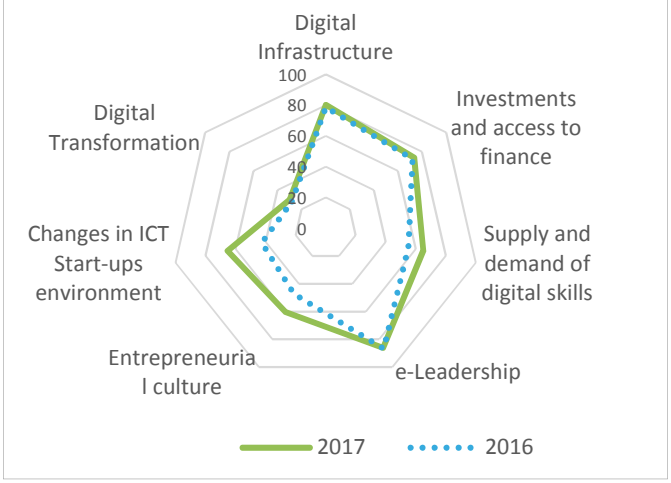
A Luxembourg in a nutshell

Luxembourg's performance has improved in all dimensions in comparison to last year's results, showing one of the strongest overall performances in the EU.

Like last year, Luxembourg yields excellent results in digital infrastructure and has improved in supply and demand of digital skills. There is also a significant positive trend in entrepreneurship culture.

Regarding the ICT start-up environment, Luxembourg has made significant progress over the last 12 months. Its level of investments and access to finance remains high as is the level of e-leadership.

Figure 9.35: Luxembourg´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Luxembourg's strong performance in e-leadership is attributable to the high number of people who have obtained IT skills through formal education and the significant number of companies providing ICT skills training to their employees. In addition, the number of companies that provide their employees with portable devices with an Internet connection is remarkable.

Luxembourg's solid digital infrastructure is due to excellent access to high-speed broadband Internet and high proactivity in digital business.

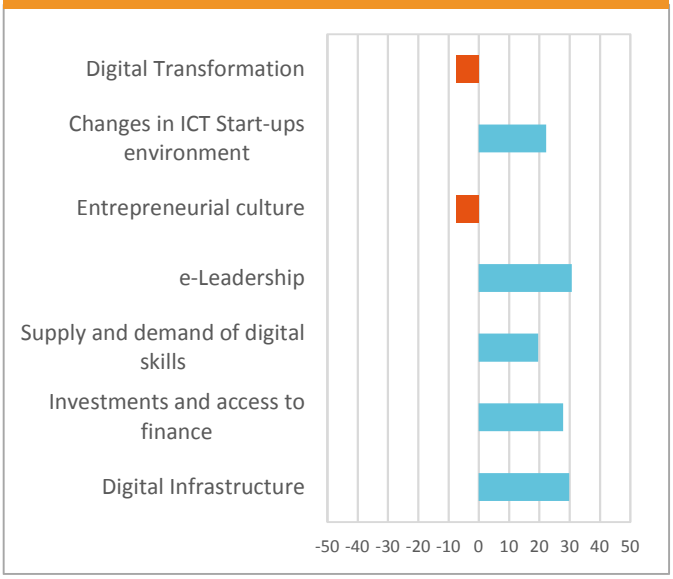
- Areas for improvement

Luxembourg's record in investments and access to finance has not improved since last year. The ability to raise funding through local equity markets, as well as access to loans, also remains stable.

Therefore, particular effort is needed to improve direct investment in the information and communication sector to support the fast pace of digital transformation.

C Comparison with other EU Member States

Figure 9.36: Luxembourg´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Luxembourg´s performs above the EU average in five out of seven dimensions. Its strongest advantages are digital infrastructure and e-leadership. In both cases, Luxembourg scores approximately 30% above the EU average.

In addition, the country is significantly more advanced than its European partners in the supply and demand of digital skills. The development of ICT start-ups has increased remarkably over the last 12 months. Luxembourg now scores more than 20% above the EU average.

Moreover, in the field of finance for digital transformation, the country also performs almost 30% above the EU average.

Despite these positive achievements, Luxembourg is not in line with other EU Member States in entrepreneurial culture and digital transformation, where its results are approximately 7% and 9% below the EU average.

D Interesting policy practices

Fit 4 Digital

Fit 4 Digital is an initiative launched by the Ministry of the Economy and Luxinnovation, aimed at improving the competitiveness of Luxembourgish companies, especially SMEs, by introducing new digital tools.

The programme was adopted in 2016 and identifies what information and communication technologies (ICT) opportunities exist and how the new processes can be introduced to the companies concerned.

The initiative the following assistance to companies:

- Providing an analysis of all parts of the company in order to determine the benefits of using ICT;
- Giving concrete recommendations about the implementation of ICT tools in the company;
- Providing advice from reliable experts during the company's digitisation process; and
- Involving staff in the digitisation process.

Hello-Future

In 2017, the Luxembourg Government established the Hello-Future initiative together with the Chamber of Commerce, Luxinovation and Fedil. This campaign aims at bringing together education, students and industrial sector in an online platform.

In this sense, the initiative brings school and business closer. On the one hand, the platform gives entrepreneurs the opportunity to present their industry and know-how to young trainees and help them discover the workings of the business environment. On the other hand, students can learn, receive feedback and interact with business leaders in a particular industrial sector. This interaction also helps students further develop their skills and discover new talents that will be useful in their future professional career.

The most relevant industry sectors that participate in this initiative are: biohealth, automotive, ICT, aerospace and construction, eco-innovation, materials and logistics, and maritime.

9.17

Hungary

In comparison to 2016, Hungary has improved its achievements in six out of seven dimensions, displaying a strong average performance in digital transformation. Hungary scores well and stands out in the field of entrepreneurial culture, investments and access to finance, and changes in the ICT start-up environment. However, efforts could be stepped up to support the development of digital infrastructure and e-leadership. To further push forward digital transformation, the Hungarian Government has recently launched policies aiming at increasing entrepreneurial spirit through a business e-portal and helping more women to become entrepreneurs.

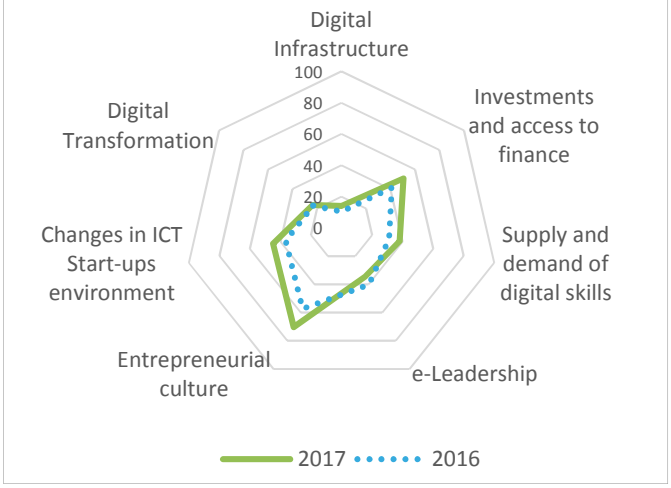
A Hungary in a nutshell

Hungary appears to be a modest performer in the digital transformation of its industry and businesses. In comparison with values recorded in 2016, Hungary shows improvements in six out of seven dimensions. In particular, the dimensions of investments and access to finance and entrepreneurial culture show the greatest progress since the last year. Moreover, Hungary has improved in the dimensions of changes in the ICT start-up environment, digital transformation and supply and demand of digital skills.

Despite a slight improvement, digital infrastructure continues to be the country's greatest challenge. In addition, its performance in terms of e-leadership has dropped by almost 10% since 2016; however, updates to the indicators may account for some of this figure.

To summarise, Hungary has a rather well-balanced country profile. However, poor performances in terms of digital infrastructure and e-leadership indicate that further policy efforts are needed to advance the country's digital transformation.

Figure 9.25: Hungary´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Hungary excels in the field of entrepreneurial culture thanks to an increased interest in becoming entrepreneurs among its population. In 2017, the share of people saying that they would set up a new business or take over an existing one if they had the means to do so has risen significantly.

Furthermore, there is a generally favourable investment climate in Hungary. Low tax rates and easy access to loans create incentives for both domestic and international ICT enterprises to invest in the country.

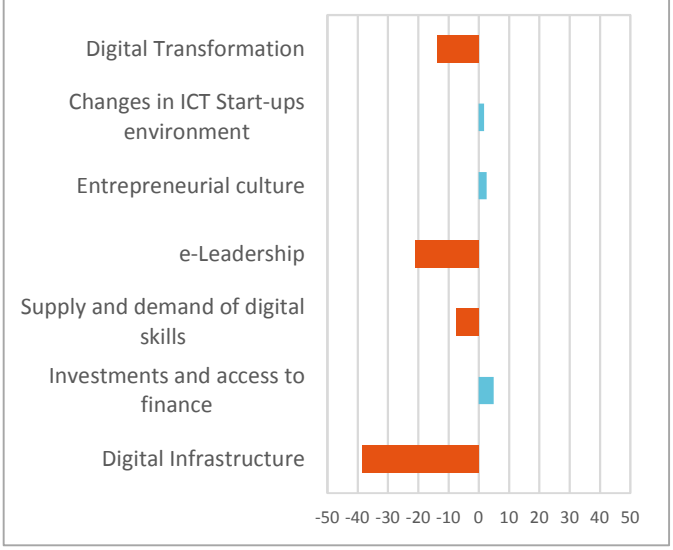
- Areas for improvement

Digital infrastructure continues to represent the greatest challenge for the country. Particular effort should be made to improve the quality of Internet bandwidth and to increase the integration of ERP software by Hungarian businesses.

In comparison to data from 2016, e-leadership is the only dimension showing a negative trend. This trend could be reversed by increasing the distribution of portable Internet devices to employees, thus ensuring good access to mobile Internet.

C Comparison with other EU Member States

Figure 9.26: Hungary´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Hungary performs slightly above the EU average in three out of seven dimensions. It exceeds the EU average by approximately 8% in terms of investments and access to finance.

Similarly, Hungary benefits from a solid entrepreneurial culture and ICT start-up environment, scoring marginally higher than the EU average.

The gap between Hungary and the EU average is the widest in the fields of digital infrastructure and e-leadership. In these two dimensions, Hungary scores 38% and 20% below the EU average respectively.

Overall, Hungary scores highest in investments and access to finance, with major challenges persisting in four dimensions.

D Interesting policy practices

Dobbantó képzések

The 'Women entrepreneurs' competence development programme' was introduced by the Foundation for Small Enterprise Economic Development (SEED) with the support of the Hungarian Ministry for National Economy. First launched in 2004, the programme was renewed in 2015. The total budget of €183,870 is mostly earmarked by Budapest Bank and participants' financial contributions.

SEED provides intensive courses for women intending to start a business or already running one. It uses a combination of methods – training, advice, peer support and networking – to support and encourage them to start their own business. The training lasts for 90 hours spread over six weeks, and is accredited.

Groups of 20 female participants learn basic management, planning, accounting and IT skills, how to make presentations, how to bid for tenders, increase self-confidence and communication skills. In addition, the programme includes a restricted online knowledge-sharing facility, personal mentoring, and a club system to create opportunities for networking.

Since its launch, the programme has helped more than 470 female entrepreneurs to start or renew a business, thus creating at least 200 new enterprises in the country.

Magyar vállalkozói portál elindítása

The 'Hungarian business e-portal' was launched in April 2015 and implemented by the Deputy State Secretary for Informatics of the Ministry of the Interior. The total budget of €420,000 is primarily earmarked from Hungary´s state budget.

The key objective of the e-portal is to provide relevant information for new and existing entrepreneurs, SMEs and start-ups, according to a life-cycle-based structure.

In particular, the e-portal provides (1) descriptions of administrative procedures for entrepreneurs and businesses, (2) information on the availability of online services for the administrative procedures, (3) information on current development-policy issues, (4) market information, (5) entrepreneurial know-how, and (6) a description of administrative proceedings according to the entrepreneurial life cycle.

The portal is currently available in Hungarian and is linked to other key e-government portals running in the country, including magyarorszag.hu and netenahivatal.gov.hu.

9.18

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Malta

Malta shows a high level of digital transformation in the majority of the dimensions. Its performs strongly in ICT start-ups, entrepreneurial culture and digital infrastructure, while challenges persist in the area of investments and access to finance. Compared to its EU partners, Malta's performance is well above average in five dimensions and marginally better in the two remaining areas. Recent policy measures, such as the Mobile Government Strategy and the Start-up Investment Grant Scheme, aim at further enhancing the digital transformation of the country.

A Malta in a nutshell

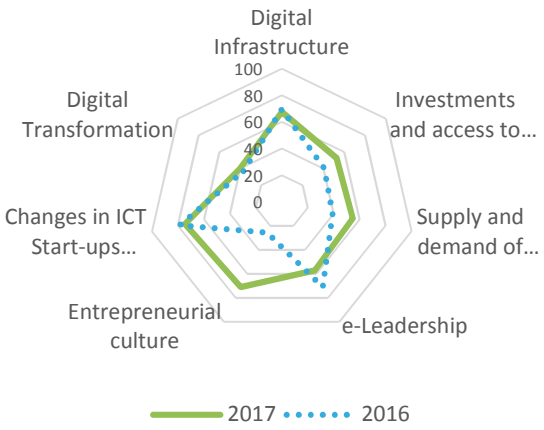
Malta's performance in entrepreneurial culture has improved remarkably in the last year, although part of this development may be due to updates to the indicators.

Despite scoring slightly lower than in 2016, ICT start-ups continue to be the country's main strength. This area is supported by a solid performance in entrepreneurial culture and digital infrastructure.

Although Malta displays decent values in the fields of e-leadership, supply and demand of digital skills and digital transformation, the area of investments and access to finance could be improved. Despite progress being made in this area over the last year, the country scores lowest in this dimension.

To summarise, Malta performs well in most of the dimensions, while its scores in investments and access to finance, and digital transformation show room for further improvement.

Figure 9.37: Malta´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Malta's strongest asset, a well-developed environment for ICT start-ups, is supported by one of the highest employment shares of ICT companies in the EU, according to Eurostat. Therefore, the high share of the ICT sector in proportion to Malta's GDP is less surprising.

Entrepreneurial culture and digital infrastructure are also high-performing areas in Malta. One of the reasons for the high score in entrepreneurial culture is people's support of starting a business as a desirable career choice. Malta's strong digital infrastructure, on the other hand, benefits from high Internet bandwidth.

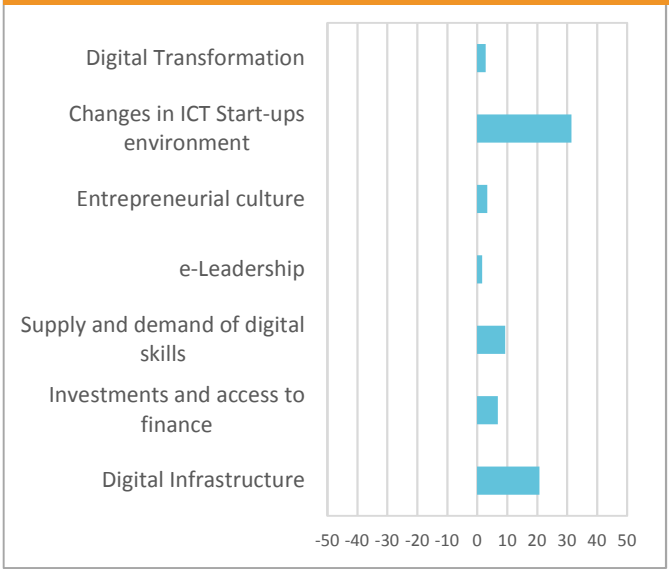
- Areas for improvement

Although it is not difficult for Maltese businesses to access loans and finance through local equity markets, Malta's performance in the area of investments and access to finance leaves some room for improvement.

There is also room for improvement in the dimension of the supply and demand of digital skills. For instance, recent data shows that the innovation output could be further increased, as well as the number of employees with portable devices provided by their companies.

C Comparison with other EU Member States

Figure 9.38: Malta´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Malta shows a good level of digital transformation, with scores well above the EU average in four dimensions.

ICT start-ups is the field in which Malta performs the strongest, as it did in 2016, at 31.5% above the EU average.

The country also scores above the EU average in digital infrastructure (20%), digital transformation (11%) and the supply and demand of digital skills (9%).

In addition, Malta performs well in investments and access to finance. Great progress has been made in this area since last year, when the country ranked below the EU average. The areas of entrepreneurial culture and e-leadership have some room for improvement, despite being slightly above the EU average.

In conclusion, while Malta performs above the EU average in five dimensions, minor challenges persist in entrepreneurial culture and e-leadership.

D Interesting policy practices

Mobile Government Strategy 2017-2018

Launched in November 2016 as part of the Digital Malta Strategy 2014-2020, the Mobile Government Strategy 2017-2018 will enable public services to be accessible on mobile devices at any time and from anywhere.

This policy practice rests on the following principles: enabling mobility; service channels; citizen-centricity; simplification; personalisation; user experience; collaboration; agility and timeliness; accessibility; awareness and training; and trust.

The initiative aims at empowering citizens, enabling mobility within public administration, achieving increased take-up of electronic public services, and facilitating the availability of public-sector information.

Last but not least, the strategy has three phases. In November 2016, 17 mobile apps were produced for testing and launched for the general public in March 2017. More mobile apps will follow the same procedure in phase two. Finally, the official launch will take place in December 2018.

Start-up Investment Grant Scheme

The Ministry of European Affairs and Implementation of the Electoral Manifesto implemented the Start-up Investment Grant Scheme in 2016.

The initiative aims at providing non-repayable grants to SMEs to help finance initial investments and implement growth strategies in the first three years of their activities.

The Grant Scheme assists start-ups engaged in activities such as research and technological innovation, ICT development and eco-innovations, among many others.

Eligible costs are the lease/rental or construction/upgrade of private operational premises, patents and licenses, and the purchase of new equipment, machinery and plant.

The maximum grant value is €300,000 and the maximum aid intensity is 50%. The scheme has an overall budget of €7 million and is administered through a series of competitive calls that will last until December 2020.

9.19

The Netherlands

The Netherlands is a digital transformation leader, excelling above all in the supply and demand of digital skills, entrepreneurial culture, e-leadership and digital infrastructure. The Netherlands' lowest score is in the field of the ICT start-up environment. However, the country performs above EU average in six out of seven digital transformation pillars. In the light of the moderate performance in the field of ICT start-up environment, the Dutch authorities have adopted various initiatives (e.g. TekDelta) to foster the Dutch start-up ecosystem.

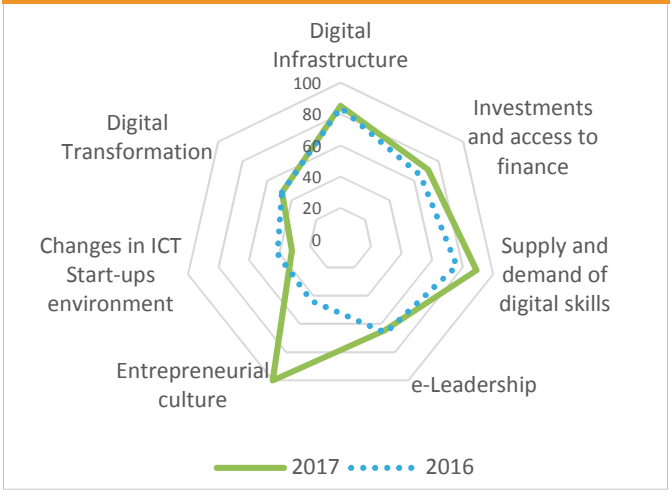
A The Netherlands in a nutshell

Dutch digital development shows very good results. However, the process has not progressed equally along all the different pillars.

The Netherlands performs relatively poorly in the number of ICT start-ups. Most striking is the country's improved performance in entrepreneurial culture, reaching absolute levels (100%); although updates to the indicators used may account for this development to some extent. Moreover, the country has developed a high supply and demand of digital skills.

Companies in the Netherlands are well equipped with the Internet and different software solutions to improve business processes. Moreover, companies widely provide portable devices to their employees. These effective actions result in a strong digital infrastructure.

Figure 9.39: The Netherlands´ framework conditions for digital transformation



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

The majority of enterprises in the Netherlands have a fixed broadband connection. Employees of the companies draw not only on a high-quality Internet connection, but also on ERP software to share information between functional areas.

In addition, the country's entrepreneurial culture shows high activity compared to last year. In part, this is due to an increased desire among the workforce to become owners/managers of a new business. Moreover, a great number of employees consider starting a business to be a desirable career choice.

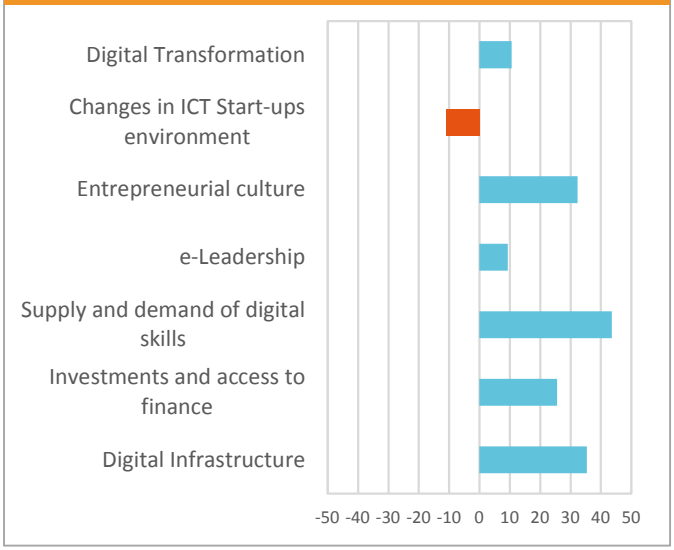
- Areas for improvement

In the Netherlands, the main challenge lies in the field of ICT start-ups. Here, the number of newly-established start-ups shows a decreasing trend and the overall performance in this pillar is moderate.

Moreover, enterprises use social media only moderate in their daily business. Overall, the digital transformation in the Netherlands shows an improved performance; however, the score in this field could be improved to some extent.

C Comparison with other EU Member States

Figure 9.40: The Netherlands´ performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Overall, the Netherlands is a strong performer in comparison to other EU Member States.

The country scores above the EU average in all dimensions except for ICT start-ups. This year in particular, the Netherlands performs much more strongly in supply and demand of digital skills, followed by digital infrastructure.

More employees are provided with portable devices, ensuring that skills can be further developed and employees have access to the Internet for business purposes when needed. Additionally, the majority of enterprises in the Netherlands use broadband Internet and various software solutions to improve business processes.

The number of employees willing to be self-employed and start a business within three years significantly grew compared to last year, which is apparent from the entrepreneurial culture advantage. In addition, more and more skilled workers consider starting a business to be a desirable career choice. However, e-leadership is only slightly higher than the EU average.

D Interesting policy practices

TekDelta

In 2016 TekDelta became a multi-year joint programme open to key players in R&D and start-up acceleration. It is a joint initiative of Dutch corporates and research organisation TNO, in collaboration with the start-up community. It fosters connections between tech start-ups and high-tech organisations.

The TekDelta initiative aims to provide start-ups with easy access to high-end research labs, world-class experts and state-of-the-art technology. The initiative forges connections between start-ups and corporates, facilitating connections between the two domains. Additionally, TekDelta facilitates matchmaking between these two domains.

TekDelta provides access to the start-up ecosystem, consisting of a) a large amount of start-up hubs and their preselected, high-quality tech startups, and b) a peer network of relevant innovation managers to share knowledge and improve start-up collaboration.

Digitaal 2017

Digitaal 2017 is a Dutch Government initiative that aims to offer all governmental services online by 2017.

The goal is to develop an integral service and to operate from one central website, regardless of the particular service offered. With this new programme, the Dutch Government aims at improving, simplifying and accelerating public services. Additionally, the government hopes to ensure a quicker exchange of information and to increase trust in their services by operating faster and more efficiently.

The programme allows not only for written requests to be submitted, but also online meetings where citizens and companies can communicate to officials using an app.

Additionally, the government app will display both demand and supply of services offered at local level. This includes contacting volunteers to help elderly and disabled people.

9.20

Austria

Austria's digital transformation record varies significantly, featuring high- and low-performing fields. Austria scores relatively highly in relation to investments and access to finance, e-leadership and digital infrastructure; yet challenges remain in the fields of entrepreneurial culture and ICT start-ups. Austria performs above the EU average in 80% of digital transformation dimensions. A look at recent national policy efforts reveals that the Austrian focus is on Industry 4.0 and start-up support, providing both strategic and operational policy approaches.

A Austria in a nutshell

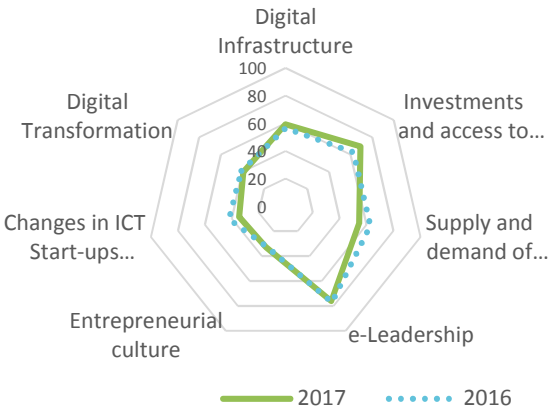
Austria performs strongest in e-leadership, despite a slight decline compared to 2016. Within the same year, its score for supply and demand of digital skills dropped significantly, despite two of the indicators in this field improving.

Austrian enterprises have access to a high-quality digital infrastructure, which has improved since 2016. Austria's ranking in investment levels and access to finance is somewhat lower. Despite its favourable investment climate, Austria's performance regarding ICT start-ups is relatively low.

On average, businesses in Austria perform poorly in digital transformation. The dimension in which Austria performs the lowest is in entrepreneurial culture.

Overall, Austria performs lower in three pillars, while showing improvement in two pillars.

Figure 9.1: Austria´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Austria's strong performance in e-leadership is attributable to many companies distributing portable Internet devices to employees. In addition, companies regularly provide training to ICT specialists to improve their skills.

Austria's solid digital infrastructure is due more to the heavy use of ICT software in enterprises than to its average Internet speed. Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) softwares are used widely by Austrian businesses, allowing for effective information sharing and clients analysis.

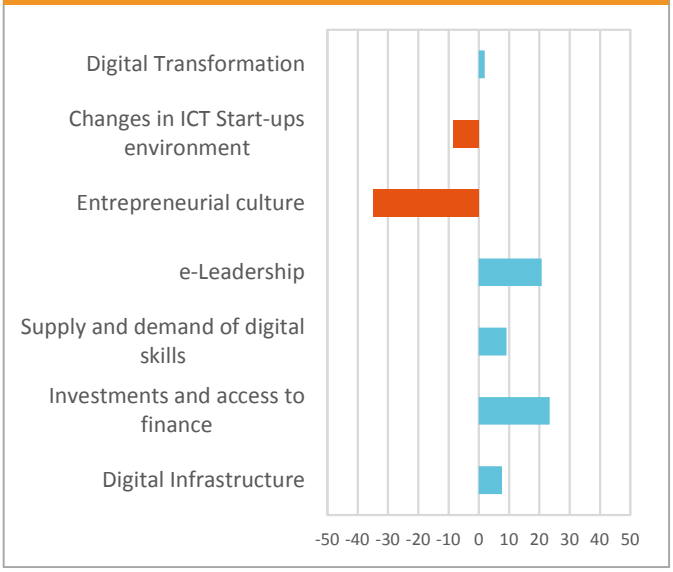
- Areas for improvement

Austria's performance in entrepreneurial culture leave significant room for improvement. All related indicators show a relatively low performance – for example, Austria is among the lowest performers in terms of early-stage entrepreneurial activity[d]. Moreover, the share of the population considering entrepreneurship a good career choice is very low.

[d]Percentage of 18-64 population who are either a nascent entrepreneur or owner/manager of a new business

C Comparison with other EU Member States

Figure 9.2: Austria´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Austria performs above the EU average in five out of seven dimensions.

Austria's strongest asset is investments and access to finance, followed closely by e-leadership. In these two dimensions, the country scores around 15% and 12% higher than the EU average respectively.

Furthermore, Austria provides a solid digital infrastructure. It also scores relatively well in the supply and demand of digital skills and digital transformation. The dimensions in which Austria scores below the EU average are ICT start-up environment and entrepreneurial culture – in the latter, its performance is around 35 % lower than the EU average.

The improvement of the entrepreneurial culture would also provide motivation for an ICT start-up-friendly environment to be established, to further assist the Austrian economy in its digital transformation process. Plattform Industrie 4.0, described below, is a good step in this direction.

D Interesting policy practices

Plattform Industrie 4.0

INDUSTRIE 4.0 ÖSTERREICH

Austria's national *Plattform Industrie 4.0* (PI4.0) started in 2014 on the initiative of the Ministry of Transport, Innovation and Technology. PI4.0 was established in June 2015 and became operational in October 2015. The platform acts as an observatory, network and strategic advisory body creating working groups, strategies, focus areas and case studies on Industry 4.0 topics.

The platform facilitates the implementation of digital transformation in Austria and brings the Industry 4.0 community together. It aims to secure and create highly innovative industrial production and to boost high-quality employment, thus strengthening Austria's future competitiveness.

Unique in its ample involvement of employee associations, PI4.0 has successfully built an inclusive ecosystem intending to overcome employees' concerns regarding digitisation.

In 2017-early 2018, the Platform extended its research and technology deployment activities. Among other achievements, the platform presented research results on qualifications and competences in industry 4.0 with a total of 81 recommendations in seven fields of action. The Platform also set up the Business Model Lab helping companies to explore new business model approaches - incl. a focus on security and safety issues - in a secure framework in order to obtain market feedback, test overall viability and acquire pilot customers.

Start-up programme

In July 2016 the Austrian Federal Government passed through a comprehensive start-up programme investing a total of €185 million over a 3-year period. In launching the programme, the Government seeks to provide increased support to entrepreneurs, boost the Austrian start-up scene and turn Austria into a bridgehead between Asia, central and eastern Europe.

The programme includes a series of measures embracing tax relief, increased targeted financing to start-up support structures, fellowships for academic spin-offs, visa facilitation for self-employed key workers, and adding programmers to the list of understaffed occupations.

The new measures have applied since January 2017. The programme is part of the "founders" strategy launched by the Austrian Government in 2015, which includes fields such as financing, infrastructure and regulations.

9.21

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Poland

Poland's performance in digital transformation displays some dimensions with high performance, while scoring below the European average in most dimensions. Poland's greatest asset is its performance in entrepreneurial culture and ICT start-ups. However, major challenges remain in the supply and demand of digital skills and digital infrastructure. Recent Polish policy efforts seem to focus on enhancing technology and innovation development, such as the ScaleUP Pilot Programme.

A Poland in a nutshell

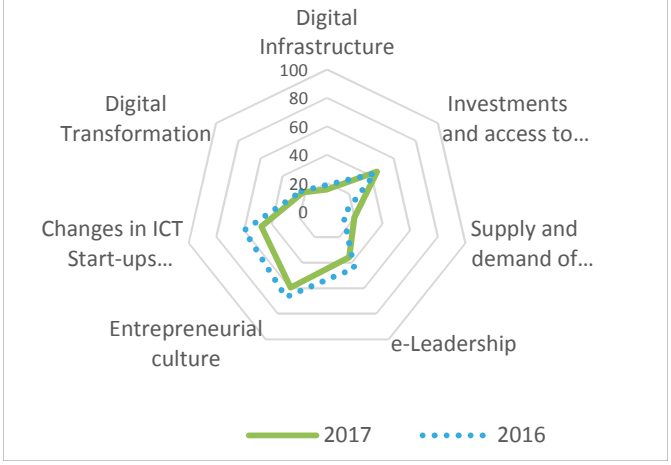
Poland continues to perform well in the dimension of entrepreneurial culture. However, the area of digital transformation needs to be fully addressed.

The country shows good performance in e-leadership and ICT start-ups, albeit with a lower score than in 2016. Investments and access to finance and e-leadership have also developed, with the former improving and the latter deteriorating since last year.

However, challenges remain in two dimensions, even though progress has been made compared to 2016. There is still room for improvement in Poland's digital infrastructure, and especially in the supply and demand of digital skills.

To summarise, although Poland benefits from a strong entrepreneurial culture, targeted policy efforts may help it advance in its digital transformation.

Figure 9.41: Poland´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Entrepreneurial culture is the field in which Poland shows the strongest performance. Therefore, it is unsurprising that Poland presents high total early-stage entrepreneurial activity.

Poland also has a high score in ICT start-ups. This good performance is the result of one of the highest birth rates of ICT companies in the EU.

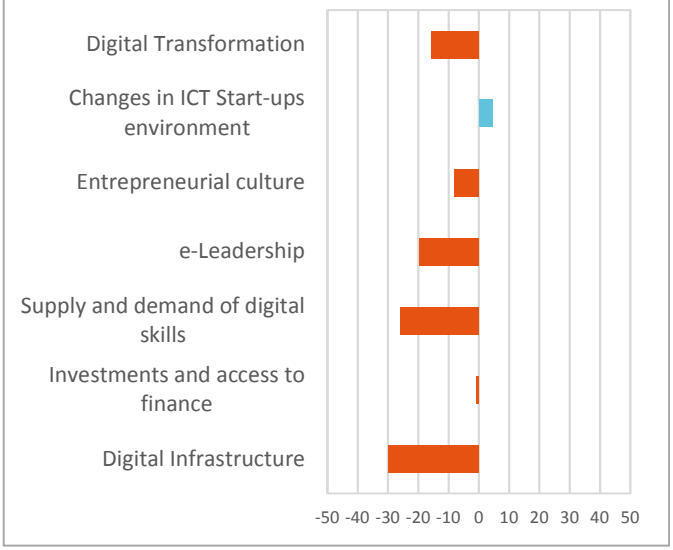
- Areas for improvement

The lack of skilled employees and low innovation outputs have a negative impact on Poland's score in the supply and demand of digital skills.

Moreover, Poland's poor performance in digital infrastructure can mainly be attributed to its low Internet bandwidth and the low percentage of Polish companies using enterprise resource planning software.

C Comparison with other EU Member States

Figure 9.42: Poland´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

In comparison to other EU Member States, Poland continues to stand out marginally in one out of the seven dimensions: ICT start-ups.

However, effort is needed in other areas, such as digital infrastructure, digital skills, e-leadership and entrepreneurial culture. While entrepreneurial culture was 10% above the EU average in 2016, it is now below it, likely as a result of changes in the use of indicators.

Poland's most challenging area continues to be digital infrastructure, scoring 30% below the EU average, as in 2016. Despite the abovementioned shortfalls, improvements have been made in several fields.

D Interesting policy practices

ScaleUP

The ScaleUP Pilot Programme, part of the 'Start in Poland' government programme, is being implemented by the Polish Agency for Enterprise Development.

The main objective is to accelerate the development and growth of start-ups by fostering cooperation with large and state-owned companies. This goal will be achieved by combining entrepreneurs' potential and creativity with companies' infrastructure, experience and resources.

Specifically, this initiative develops acceleration programmes for selected start-ups, where they receive financial assistance, mentoring or access to business networks.

With an overall budget of €13.44 million, the programme will run until the end of June 2018, benefiting more than 200 start-ups.

The future Industry Platform

The Future Industry Platform was announced as part of the Responsible Development Plan ('Morawiecki Plan') by the Ministry of Finance and Development in 2016. Providing industrial financing over a 25-year period, the Morawiecki Plan pursues an agenda of reindustrialisation through new partnerships, export-oriented support measures and comprehensive regional development.

The main mission of the Platform is to act as an integrator of all stakeholders interested in Industry 4.0 as well as an accelerator of the digital transformation of Polish industry. The Platform seeks to achieve these goals through a mix of activities comprising knowledge transfer and awareness raising, as well as the development and application of digital transformation support measures.

While the financing will initially be based on public funds serving as leverage for expected private investments in the future, the initiative is enabled by the so-called Industrial Transformation Team as well as the network of Competence Centres. This Platform is based on activities developed by the private sector, its original promoter.

9.22

Portugal

Portugal's performance in digital transformation has improved significantly since 2016. It scores exceptionally high in relation to entrepreneurial culture, while showing a good performance in digital infrastructure and the ICT start-up environment; however, challenges remain in investments and access to finance and in e-leadership. Portugal performs above the EU average in four out of seven dimensions. A look at recent national policy initiatives reveals that Portugal continues to support the development of start-ups, primarily through financial support measures, such as incubation vouchers.

A Portugal in a nutshell

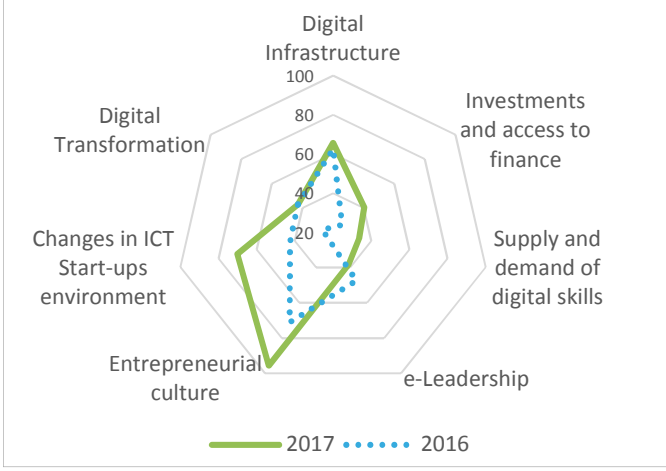
Portugal's performance in digital transformation shows improvements in comparison to 2016's results.

Over the past year, the pillars of supply and demand of digital skills and entrepreneurial culture have experienced a significant boost, as have ICT start-ups. The most significant improvement is in the area of supply and demand of digital skills. However, these increases may also be related to updates to the indicators used.

The country also shows some progress in access to finance. Although there have been no major changes in the area of digital infrastructure, Portugal continues perform well in that field.

In spite of its favourable entrepreneurial climate, the areas of investments and access to finance and digital transformation continue to be challenging for Portugal. There is also room for improvement in the area of e-leadership, as its performance has slightly declined compared to 2016.

Figure 9.43: Portugal´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Portugal's strong performance in entrepreneurial culture continues to rely on the Portuguese's great interest in self-employment and setting up their own companies. The boost experienced in this pillar is due to the changing public image of entrepreneurship as a career choice.

Portugal's solid digital infrastructure continues to be based on companies' solid uptake of ICT software solutions and extensive use of a fixed broadband connection. However, this overall good performance could be consolidated with a faster Internet connection speed.

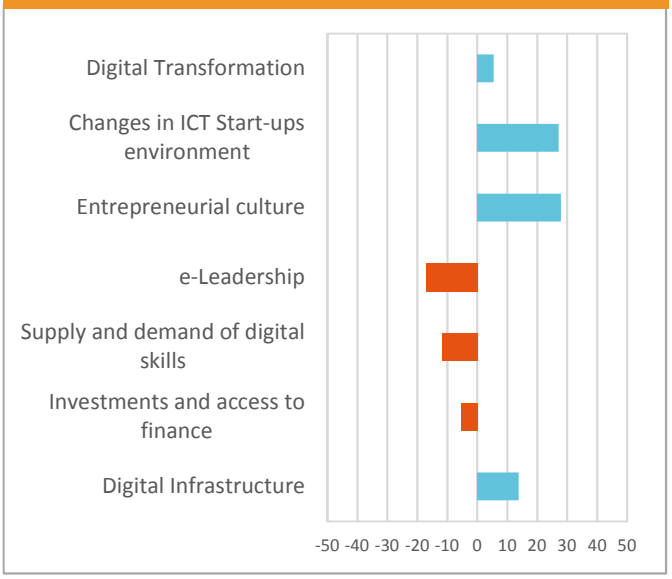
- Areas for improvement

Portugal's key challenge is the need to boost investments and access to finance. Companies still face difficulties accessing local equity markets and loans. Furthermore, private R&D investment is also rather low.

Portugal's performance in e-leadership could also be enhanced. Efforts should focus on increasing the number of people gaining certified IT skills. The data also shows that Portugal's performance concerning the provision of portable devices to employees and enterprise's training to upgrade their employees' ICT skills is in line with the EU average.

C Comparison with other EU Member States

Figure 9.44: Portugal´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Portugal performs above the EU average in four out of seven dimensions. In particular, it stands out in entrepreneurial culture and the ICT start-up environment, scoring nearly 28% higher than the EU average.

Compared to last year's data, there has been a trend change in the score of ICT start-ups, which is now far above the EU average. Meanwhile, the country continues to perform well in digital infrastructure and digital transformation in comparison to its European partners.

The data indicates that Portugal's greatest challenges are in e-leadership, where it scores nearly 19% below the EU average. Similar challenges persist in the supply and demand of digital skills and investments and access to finance, in which Portugal could equally improve.

D Interesting policy practices

Vale Incubação

Vale Incubação is one of the measures included in the 'StartUP Portugal' plan, which was launched with the aim of boosting entrepreneurship.

The measure aims to support companies in operation for less than a year by providing incubation services in the area of entrepreneurship. The objective is to boost entrepreneurial capacity and foster the acceleration and success of new companies. The incubation services are provided by one of the 135 business incubators certified by IAPMEI. Companies willing to participate must have consulted at least two of the accredited certified incubators and received a declaration of interest.

The incubation voucher is designed to help start-ups face their first business expenses, such as incubation and professional advice in accountancy, marketing, legal, management and product development.

The program targets young companies active for less than a year in creative and cultural areas; sectors with high technology and knowledge intensity; and in the application of R&D results in the production of new goods and services.

Companies will receive a voucher of up to €5,000 to cover 75% of the cost for services provided by the incubator (40% in the Lisbon region).

Programa QUALIFICA

The QUALIFICA programme is Portugal's adult qualification programme. Its objective is to improve the population's qualification levels, and thus their employability.

Launched in August 2017, the programme is integrated into the National Reform Programme, which includes the revitalisation of adult education and training as a central pillar of the qualification system and as a national policy priority. The objective is to ensure the continuity of lifelong learning policies and the permanent improvement of quality learning processes.

This programme is unique in that that emphasis is placed on the effective certified qualification obtained, which is adjusted to the needs of each trainee.

A technological platform, *Portal Qualifica*, was set up to make it easier to search for offers by region, service and instrument. The portal also allows users to obtain and update a qualification passport, which registers the training performed.

The programme aims to ensure that by 2020, half of the country's active population completes secondary education; the adult participation rate in lifelong learning activities reaches 15% (and 25% by 2025); to attain 40% of higher education graduates in the 30-34 age bracket; and to widen the Qualifica Centres network.

9.23

Romania

Romania's performs poorly overall in the field of digital transformation. Its scores relatively highly in relation to entrepreneurial culture, as well as having a dynamic ICT start-up environment. The main challenges that Romania faces relate to the lack of high-quality digital infrastructure, a weak investment climate and a very low level of digital skills among professionals. The Romanian Government's recent policy measures focus on addressing the challenges in digital transformation by facilitating SMEs' access to finance, as well as by developing the country's digital infrastructure.

A Romania in a nutshell

Romania performs strongly only in the dimension of entrepreneurial culture and ICT start-ups, improving since 2016.

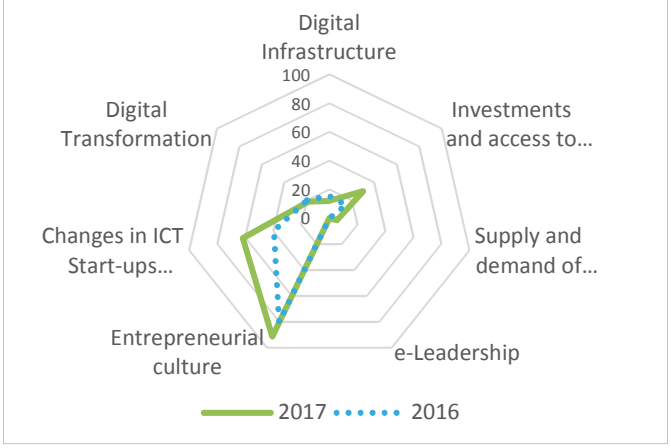
However, Romania performs poorly in five out of seven dimensions, in particular in the fields of e-leadership, digital skills and digital infrastructure.

Despite higher results compared to last year, the country continues to be impeded by an unfavourable investment climate with additional challenges in the field of digital transformation.

Overall, further efforts are needed in the supply and demand of digital skills, as the data shows that professionals have a rather low level of digital skills.

Overall, there is a particular need for improving Romania's digital transformation and digital infrastructure, as well as further concrete measures for enhancing all dimensions.

Figure 9.45: Romania´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Romania´s strongest asset is its entrepreneurial culture, which is attributable to the business-friendly attitude of its citizens. A high number of Romanians would prefer to be self-employed and intend to set-up their own businesses.

Furthermore, the share of ICT specialists in the workforce is rising. In addition, the ICT start-up environment in Romania continues to expand by increasing the ICT birth rate.

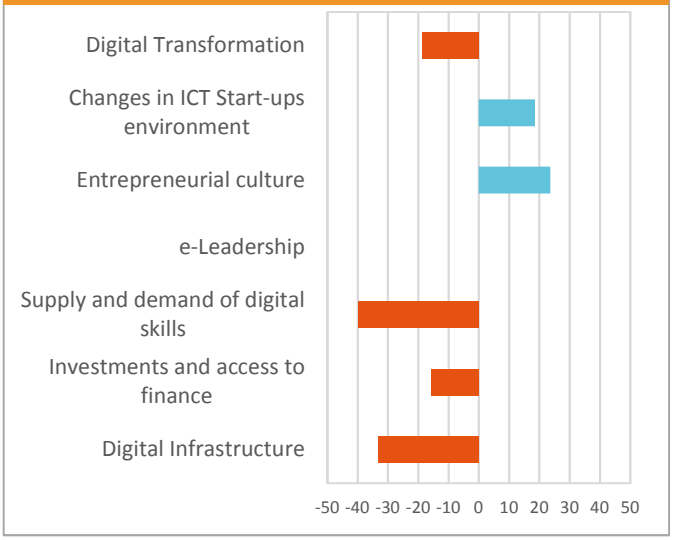
- Areas for improvement

Romania needs to concentrate further efforts across all dimensions. However, there is a particular need for improving the digital skills of its workforce, as it is difficult for enterprises to find employees with suitable ICT skills. Moreover, the number of enterprises recruiting ICT specialists is under the EU average.

There is also room for improvement concerning investments in the ICT sector, given that access to loans in Romania is below the EU average.

C Comparison with other EU Member States

Figure 9.46: Romania´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values Where no data was available, the EU average was used.

Romania scores below the EU average in five out of seven dimensions. The main gap between Romania and its European partners relates to the supply and demand of digital skills, digital infrastructure and digital transformation, with scores 30-40% below the EU average.

Romania scores lower than the EU average regarding companies' access to investment and finance. There is no data for e-leadership.

However, Romania scores higher than the EU average in entrepreneurial culture. In addition, the development of ICT start-ups in Romania is nearly 20% above the EU average.

Overall, the data shows that significant challenges remain for Romania's digital transformation. However, there is a good score for ICT start-ups and entrepreneurial culture.

D Interesting policy practices

Government Strategy for developing SMEs and improving the business environment in Romania – Horizon 2020

This strategy updates the Romanian policy priorities in the field of SMEs to new developments in Europe.

The strategy sets out a series of priorities: smart growth, by developing an economy based on knowledge and innovation; as well as sustainable growth, by promoting a more efficient, greener and competitive economy in terms of resources use.

The strategy aims to develop a viable entrepreneurial ecosystem for businesses by implementing ambitious objectives, such as: supporting and promoting entrepreneurship through developing entrepreneurial education at all levels; facilitating SMEs' access to adequate financing through specific operational instruments; stimulating innovative SMEs by encouraging technology transfer; improving SMEs' access to international markets by stimulating the use of information technology; and supporting e-commerce and other forms of online business.

This strategy is an important policy measure for supporting the SMEs and growing start-up ecosystem in Romania.

Business Incubators Law (Legea 102/2016 incubatoarelor de afaceri)

The Business Incubators Law regulates the legal establishment and functioning of such undertakings by providing incentives for stimulating the establishment of business incubators, creating jobs, diversifying economies and supporting entrepreneurship in local communities. It is a significant measure that aims to stimulate facilities for incubators, such as: tax relief for lands and buildings; a tax exemption for the local budget; and other facilities granted according to the law by local or central government.

According to the Law's provisions, there are several types of business incubators that can benefit from all these facilities, including: incubators with a mixed portfolio of SMEs in various industries; incubators with a technological portfolio catering to the needs of SMEs in the technology industry; academic incubators for SMEs active in the R&D sector; virtual incubators; and sector-specific incubators.

Although the measure does not specifically target the ICT sector, it can support the SME ecosystem in Romania. By facilitating access to finance for SMEs, the Business Incubators Law addresses one of the key barriers to the further development of innovative IT start-ups in Romania.

9.24

Slovenia

Slovenia displays a moderate digital transformation performance, featuring strong points and significant challenges. It performs strongly in e-leadership, entrepreneurial culture and digital infrastructure, but the unfavourable investment climate remains a key challenge for the country. Slovenia scores above the EU average in three out of seven dimensions. The Slovenian Government is implementing measures at both strategic and operational levels to drive forward digital transformation, in particular to facilitate access to finance and investment.

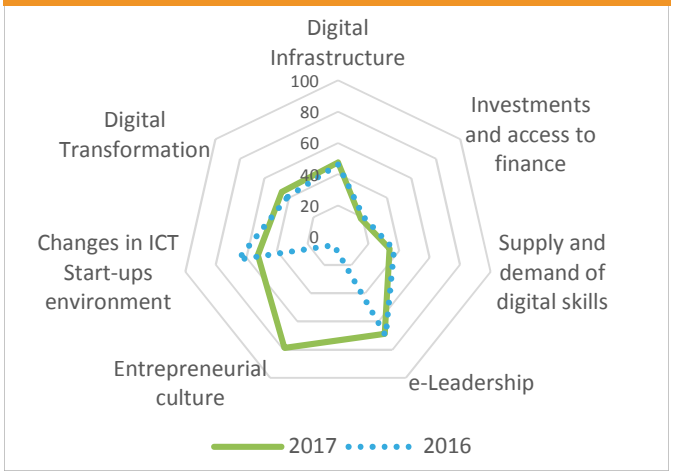
A Slovenia in a nutshell

Slovenia performs strongly in the field of e-leadership and entrepreneurial culture. The latter score is the only one that improved since 2016 together with digital transformation. However, the significant difference in the country's performance in entrepreneurial culture compared to last year may to some extent be due to changes in the set of indicators used.

While Slovenia scores highly in e-leadership, its performance in the supply and demand of digital skills is average. An additional field in which Slovenia performs solidly is digital infrastructure.

Judging from the basis of its low performance in digital transformation, it appears that Slovenian enterprises have not made effective use of the country's good digital infrastructure. Despite the low score in access to finance, the performance in the ICT start-up environment remains solid.

Figure 9.49: Slovenia´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Slovenia's moderate score in the field of ICT start-ups can largely be explained by the birth rate of ICT companies; however, the share of ICT companies is also growing in terms of the population of active businesses. Furthermore, Slovenia has a high rate of total early-stage entrepreneurial activity. Recent data shows that having your own business is thought of highly among the Slovene population.

The high score in e-leadership is attributable to the provision of regular ICT training to employees, as well as employees being provided with portable devices with a mobile Internet connection by their employers.

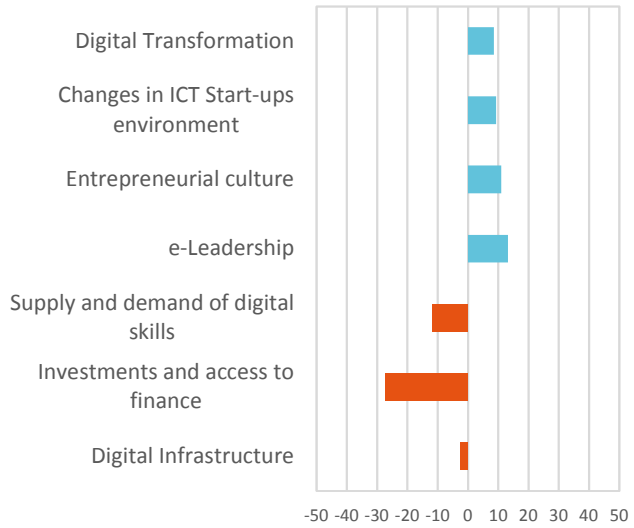
- Areas for improvement

Access to finance is a major challenge in Slovenia. To a large extent, this is linked to the local financial environment. Slovenian enterprises face difficulties accessing loans and the probability of local equity-market financing is very low. Moreover, Slovenia has a rather low level of direct investment in the ICT sector.

In terms of digital transformation, there is room for improvement, above all, regarding the use of automated data exchange, cloud computing services and online marketing via social media.

C Comparison with other EU Member States

Figure 9.50: Slovenia´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Slovenia scores above the EU average in four out of seven dimensions. It has strengths in the field of e-leadership and entrepreneurial culture performing around 10% better than the EU average.

Despite apparent challenges in field investments and access to finance, ICT start-ups exceed the EU average. One possible reason is that they can build upon an adequate digital infrastructure.

Contrary to e-leadership and entrepreneurial culture, Slovenia's performance in digital infrastructure is somewhat below the EU average, while investments and access to finance and digital skills leave significant room for improvement.

By further enhancing its performance in business financing and supply and demand of digital skills, Slovenia may become a top performer in ICT start-ups.

D Interesting policy practices

Public call for support of "RDI in the value chains and networks"

In 2016, the Ministry of Economic Development and Technology and the Ministry of Education, Science and Sport published a call for supporting "Research, Development and Innovation in the value chains and networks", aiming at fostering cooperation between SMEs and R&D facilities and developing skills and innovation activities.

This public call is a key instrument in the field of research, development and innovation investment that, for the first time, combines support for all phases, from industrial research and experimental development to commercialisation on the market. It is structured in two parts, the first supporting the implementation of R&D programmes and the second supporting R&D projects.

The main objective is a better use of available research infrastructures, more specifically to simplify access to these facilities, to support national and international cooperation among companies, research and knowledge institutions, and to facilitate companies' innovation activities.

All enterprises, including foreign enterprises with established branches in Slovenia, are eligible to apply. The overall budget for this measure is €62 million.

MEDT's programme of financial instruments and measures for the period 2015-2020

In 2015, the Ministry of Economic Development and Technology (MEDT) adopted the MGRT Financial Incentives Programme, aiming to support the competitiveness of Slovenian businesses by facilitating investment and promoting innovation and entrepreneurship. It promotes the combination of different financial measures to better address SMEs' needs.

The main objective of the 2015-2020 financial programme is to promote and support entrepreneurship, in particular to boost the creation of new businesses and start-ups, the growth of SMEs, the promotion of innovation activities in SMEs, and international competitiveness and clustering. Part of the funds will also be directed towards promoting local and regional development and other measures (e.g. natural disasters, assistance to SMEs in financial difficulties).

The programme defines an indicative estimation of the financial resources for proposed measures. The funds will be adjusted with respect to the state budget.

9.25 Slovakia

Slovakia shows a moderate level of digital transformation, revealing strengths and areas for further improvement. The country performs well in entrepreneurial culture and ICT start-ups, while major challenges remain in the fields of the supply and demand of digital skills and digital infrastructure. A similar pattern can be observed in comparison to other EU Member States, with ICT start-ups the strongest dimension and supply and demand of digital skills the weakest. In order to further improve the digital transformation of industry and enterprises, the Slovak Government has launched several programmes aiming at enhancing the country's entrepreneurial culture and start-up environment.

A Slovakia in a nutshell

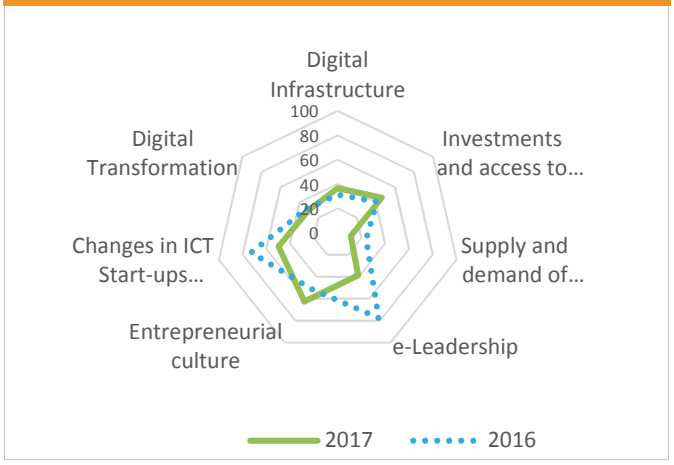
In comparison to 2016, when Slovakia was a strong performer in the dimension of e-leadership, in 2017 it is the dimension of entrepreneurial culture that yields the best performance; however, these differences may be partially attributed to updates to the indicators used.

Moreover, the country achieves good results in terms of changes in ICT start-up environment.

Meanwhile, the main challenge for Slovakia lies in the field of supply and demand of digital skills, which is the country´s weakest dimension in 2017. Similarly, there is room for improvement in digital infrastructure. Slovakia displays moderate values in digital transformation, investments and access to finance and e-leadership.

In summary, Slovakia performs relatively well in two dimensions, whereas the other dimensions are in need of further enhancement.

Figure 9.47: Slovakia´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Slovakia's strongest asset is its entrepreneurial culture. Its position in this field is due to the high number of people who would prefer to be self-employed if they had the choice.

The country's second-strongest asset is its ICT start-up environment. Slovakia´s good performance in this domain is primarily a result of the share of ICT sector's added value as a percentage of GDP. Additionally, the number of people employed in the ICT sector is also growing.

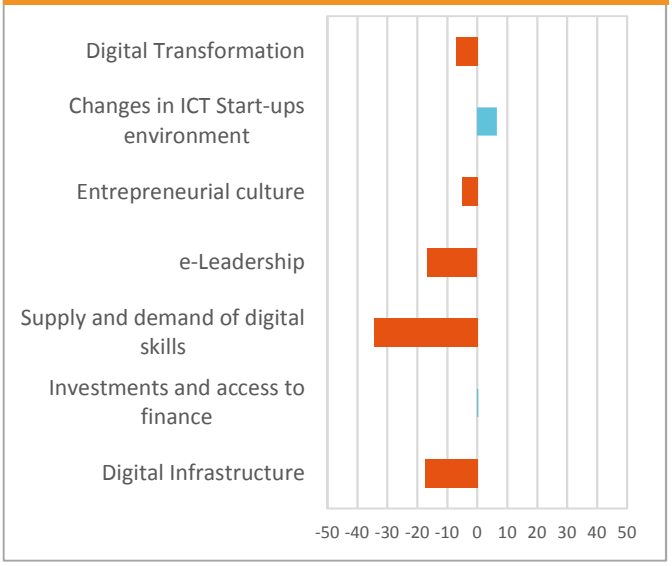
- Areas for improvement

Slovakia's low performance in the supply and demand of digital skills is linked mainly to the low number of employees provided with a portable device with access to a mobile connection for business use.

A significant change was recorded in the dimension of e-leadership in 2017 compared to Slovakia´s performance in 2016. However, this may be a result of changes to one of the indicators in this field. In addition the dimension of ICT start-ups reveals a negative trend.

C Comparison with other EU Member States

Figure 9.48: Slovakia´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Slovakia performs above the EU average in two out of seven dimensions.

Slovakia's strongest asset is the dimension of changes in the ICT start-up environment. In this regard, the country scores slightly higher than the EU average.

Slovakia's supply and demand of digital skills is the dimension lagging the furthest behind the EU average. Major challenges remain in the fields of digital infrastructure and e-leadership.

Slovakia's performance is also below the EU average in terms of entrepreneurial culture, e-leadership and digital infrastructure. However, these three dimensions, have a good potential to reach the EU average if the situation in the country continues to improve.

Overall, the digital transformation of Slovak industry and enterprises shows good efforts regarding ICT start-ups and investments and access to finance; however, challenges persist in the remaining five dimensions.

D Interesting policy practices

Národné podnikateľské centrum

The National Business Centre was introduced by the Ministry of Economy of the Slovak Republic in 2015. The Centre's model is based on best practices observed in other countries in Europe (Austria, the Czech Republic, Poland and the United Kingdom) and internationally (Australia, Israel and the US). First piloted in Bratislava, the project subsequently extended to other regions in Slovakia with centres in Trnava, Trenčín, Žilina, Nitra, Banská Bystrica, Prešov and Košice.

The main objective of the Centre is to serve as a one-stop shop for exhaustive and comprehensive support for challenges that new and existing entrepreneurs may encounter in their establishment and development. In addition, it provides a number of programmes, including acceleration, incubation and growth programmes.

Targeted beneficiaries include natural persons with an interest in doing business in Slovakia, as well as micro-, small and medium-sized enterprises.

Financing for the project is secured from Slovakia's EU funds, namely the Operational Programme for Research and Innovation, and the project is co-financed by the state. The total budget allocation is €70.4 million for a period of seven years. The Slovak Business Agency and the Slovak Centre for Scientific and Technical Information are the Centre's key partners.

The Centre's long-term vision is to create a growing community of entrepreneurs and to promote the country's entrepreneurial qualities and spirit.

Oslobodenie od dane z príjmu pre start-upy

The exemption of start-ups from income tax was introduced by the Ministry of Finance of the Slovak Republic in 2015.

According to the measure, start-ups offering innovative solutions are exempt from income tax, including exemption from the tax licence for the first two years of their existence. Afterwards, they are subject to a lower tax rate than the standard 22% corporate tax rate.

The main objective of the measure is to support the growth of start-ups in Slovakia in order to minimise financial burdens limiting the growth of new companies. In doing so, it supports students and young people with an incentive to undertake an entrepreneurial project. According to first estimates, between 800 and 1,000 start-ups should benefit from the reduced financial burden.

Since SMEs provide a great proportion of employment opportunities, the measure also aims to improve the employment market in the country.

9.26 Finland

Finland performs strongly in digital transformation and stands out in e-leadership, investments and access to finance, and digital infrastructure, yet challenges remain in the fields of entrepreneurial culture and ICT start-ups. Finland performs above the average in the majority of digital transformation dimensions. A look at recent national policy efforts reveals Finland's efforts to foster and stimulate entrepreneurship and innovation through grants and financial incentives.

A Finland in a nutshell

Overall, Finland continues to show high levels of digital transformation.

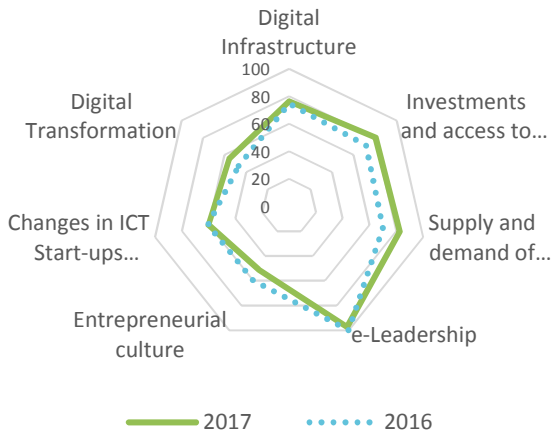
Over the past year, digital skills, digital transformation, and investments and access to finance increased significantly, while e-leadership remains Finland's strongest area.

The country's performance in e-leadership is explained by three main factors: The high share of enterprises providing trainings to IT experts to further develop their ICT skills, the high share of individuals holding a degree in tertiary education and the high share of businesses providing employees with portable devices allowing for a mobile connection.

In addition, Finland continues to perform very well in digital infrastructure and the ICT start-up environment, showing stable scores over time. Nevertheless, the country's performance has declined slightly in entrepreneurial culture.

Overall, Finland should pay attention to improving its entrepreneurial culture.

Figure 9.17: Finland´s framework conditions for digital transformation



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

Finland performs outstandingly in e-leadership. A higher share of its enterprises provide training to IT experts to further develop ICT skills that any other EU Member State. The country also tops the chart of people who have received tertiary education.

Finland's strong performance in investments and access to finance is based on high venture-capital investments, as well as the ease with which companies can raise money through local equity markets and loans.

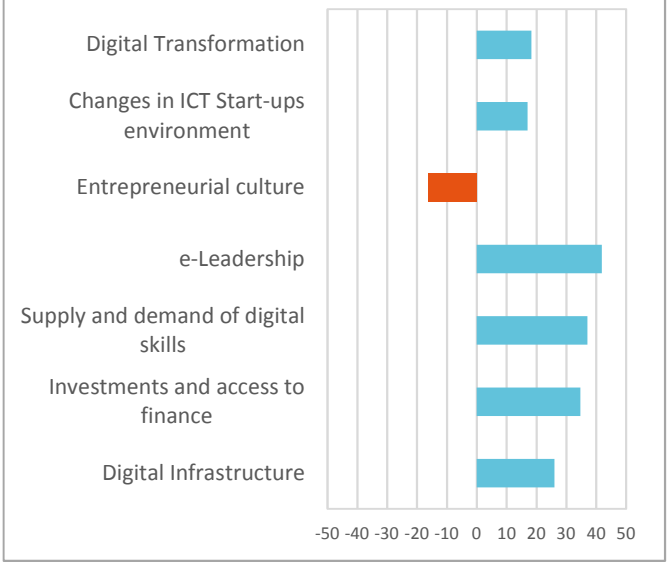
- Areas for improvement

Finland's performance in ICT start-ups leaves some room for improvement. Although the data indicates a high employment rate of IT-savvy people, the relatively low share of its ICT sector in proportion to the total national GDP is limiting the country's potential in this dimension.

Efforts to promote entrepreneurial culture could also be enhanced. The number of employees who would opt for being self-employed is lower in Finland that the EU average. In addition, most Finns do not consider entrepreneurship a good career choice.

C Comparison with other EU Member States

Figure 9.18: Finland´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Finland performs better than the EU average in six out of the seven dimensions.

Finland stands out in e-leadership, supply and demand of digital skills, and investments and access to finance, scoring 30% to over 40% higher than the EU average in these pillars.

Finland's performance in digital infrastructure and transformation and ICT start-ups is also above the EU average.

Finland's greatest challenge continues to be entrepreneurial culture, where it scores 16% below the EU average.

Overall, Finland is a high performer, scoring around 20% higher than the EU average in most of the dimensions.

D Interesting policy practices

Innovation Voucher

The Innovation Voucher is an incentive introduced by Tekes (Finnish Agency for Innovation) to encourage SMEs and micro-businesses to launch innovation activities. The Innovation Voucher is part of the Finnish Entrepreneurship Package, which aims to promote entrepreneurship by providing SMEs with access to tools they may require to realise their innovation potential.

The Innovation Voucher is worth €5,000 and can be used to purchase new knowledge and skills regarding all measures taken by SMEs to develop its products, services or processes, or to acquire knowledge and skills required in innovation activities.

The incentive seeks to provide SMEs with access to knowledge providers such as research institutes, universities and consultants, which could help them translate innovative ideas into market success.

SMEs eligible for the Innovation Voucher must use the funding to develop an innovation with international potential; must not have received funding from Tekes in the last few years; must have a turnover from at least one finished tax year; must not have reached their de minimis limit of €200,000 in 3 years; and must have drawn up a work plan together with one or two service providers.

Start-up grant

The start-up grant aims to encourage new business and promote employment. The grant ensures an income for entrepreneurs during the estimated period required to set up the business, with a maximum of 12 months.

Start-up grants are awarded by Finnish Employment and Economic Development Offices (TE Offices). To be eligible for the start-up grant, entrepreneurs must fulfil the following criteria:

- Be a full-time entrepreneur;
- Have the knowledge, skill sets and resources required for the planned entrepreneurship;
- Be able to run a profitable business, as evaluated by TE Offices;
- Need the start-up grant to make a living; and
- Business operations may be started only after the decision on the start-up grant has been made.

The competitive situation of companies in the relevant sector and the need for new business in the area are considered when deciding whether to award the grant.

The amount is at least equal to the basic unemployment allowance of €32.40 a day and it is paid for a maximum of five days per week. The grant is considered part of the entrepreneur's personal, taxable income.

9.27

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Sweden

Sweden belongs is one of the front runners of digital transformation. It performs particularly well in six out of the seven dimensions, its strongest asset being the supply and demand of digital skills. Nevertheless, Sweden has some room for improvement compared to the EU average in areas such as digital transformation and infrastructure. A digital strategy was launched in 2017 to extend the country's digitisation. In the same vein, a revised broadband strategy will likely boost dimensions such as digital infrastructure and digital transformation.

A Sweden in a nutshell

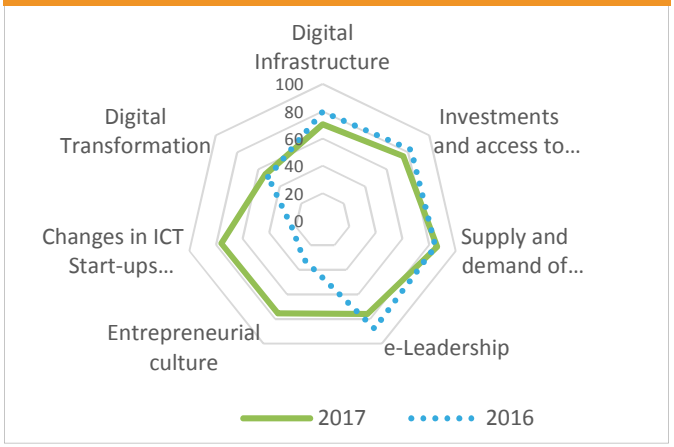
As the graphic indicates, Sweden's performance in ICT start-ups and entrepreneurial culture has improved considerably in comparison to last year.

The strongest dimension is the supply and demand of digital skills. At the same time, other strong points include ICT start-ups and investments and access to finance. It is unsurprising that Sweden's high score in entrepreneurial culture is in line with a high score in e-leadership.

In addition, Sweden's performance in digital infrastructure and digital transformation is good. This last field is the one in which Sweden scores the lowest.

Overall, Sweden's strong performance can be explained by high scores in six out of seven dimensions. Although Sweden performs well in digital infrastructure and digital transformation, these pillars still bear potential for improvement.

Figure 9.53: Sweden´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

The high innovation output and the significant ease of finding skilled employees support the dimension of the supply and demand of digital skills as Sweden's main strength.

Despite not having one of the highest ICT birth rates in Europe, the employment share of ICT companies makes the field of ICT start-ups a fundamental pillar in Sweden's digital transformation.

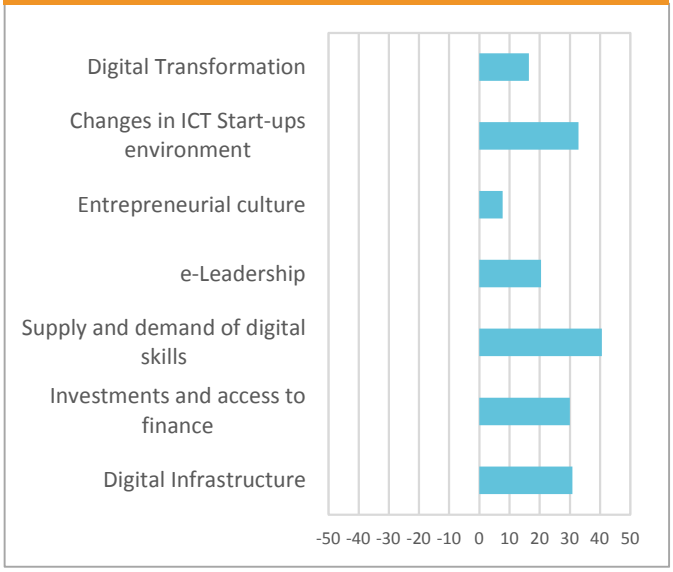
- Areas for improvement

The integration of cloud computing services and extensive online purchases by enterprises support digital transformation in Sweden. However, Sweden scores relatively poorly in one indicator: online purchases from suppliers located in a different EU Member State or outside the EU.

Despite having a well-developed Internet bandwidth, Swedish digital infrastructure has some room for improvement regarding companies' use of ERP software packages and DLS or other fixed broadband connections.

C Comparison with other EU Member States

Figure 9.54: Sweden´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

Sweden performs above the EU average in all dimensions, with its entrepreneurial culture almost in line with the EU average.

The area in which Sweden performs the strongest is the supply and demand of digital skills. Moreover, Sweden also performs well in ICT start-ups, despite having a lower score last year. Scores in digital infrastructure and investments and access to finance are more modest.

Although entrepreneurial culture is one of the areas in which Sweden has the lowest advantage compared to other countries, it has improved compared to its below-EU-average performance of last year.

In conclusion, while Sweden performs above the EU average, there is some room for improvement of both digital transformation and entrepreneurial culture.

D Interesting policy practices

Digital Strategy for a Sustainable Digital Transformation

The Swedish Government presented the Digital Strategy for a Sustainable Digital Transformation in May 2017. Sweden aims at becoming the world leader in harnessing the opportunities of digital transformation.

In order to achieve the aforementioned overall goal, five objectives have been set in five different areas:

- Digital skills: the whole Swedish population will be able to develop and use their digital skills.
- Digital security: a broader secure environment will be ensured so that citizens and companies are confident when using digital services.
- Digital innovation: the best conditions to foster new or improved products and services will be put in place.
- Digital leadership: Swedish digital transformation will be improved, developed and enhanced through governance, evaluation and follow-up.
- Digital infrastructure: the development of a reliable infrastructure that provides high-speed broadband and trustworthy mobile services will be boosted.

Broadband Strategy

The 'Broadband Strategy – A Completely Connected Sweden by 2025' was presented in March 2017 following a revision to adjust its goal with the Europe 2020 strategy.

On the one hand, the main objective in the short term focuses on achieving broadband access for 95% of Swedish homes and workplaces with a minimum capacity of 100 mbit/s by 2020.

On the other hand, access to high-speed broadband and reliable and high-quality mobile services in all of Sweden ("where people usually find themselves") are the main goals in the long term – 2025 and 2023 respectively.

Three strategic areas have been identified to achieve the aforementioned goals: clarifying the roles and rules of the broadband market, expanding of broadband infrastructure in a cost-efficient manner, and infrastructure and services for everyone.

9.28 United Kingdom

The United Kingdom performs very strongly in digital transformation. It scores highly in relation to the digital transformation of companies, e-leadership and investments and access to finance; yet challenges remain in the field of digital infrastructure. The United Kingdom performs above the EU average in the majority of digital transformation dimensions. A look at recent national policy efforts reveals that operational measures have been implemented to support the development of innovative SMEs and improve digital skills among professionals.

A United Kingdom in a nutshell

The United Kingdom's main strengths lie in its strong ICT start-ups environment and supply and demand of digital skills. In addition, the country stands out in e-leadership and investments and access to finance.

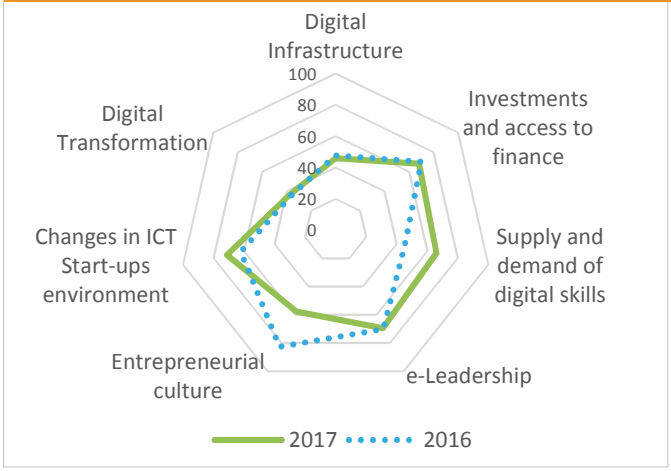
Considering its favourable entrepreneurial culture, it is unsurprising that the United Kingdom displays a consolidated performance in ICT start-ups.

The country's overall performance did not significantly change over the 2016-2017 period, except for a strong improvement in supply and demand of digital skills Other identified changes, in particular the decline in entrepreneurial culture, can mainly be explained by changes in the set of indicators.

The dimension in which the United Kingdom performs the lowest is digital infrastructure.

In summary, the United Kingdom performs strongly, with relatively high scores in three areas, average results in two fields, and two weaker fields.

Figure 9.55: UK´s framework conditions for digital transformation



Note: Based on the average of the latest three imputed values. Where no data was available, the EU average was used.

B Strengths and areas for improvement

+ Strengths

The United Kingdom's strong performance in entrepreneurial culture is attributable to the positive image that people tend to have of entrepreneurs. In addition, data shows that the majority of the population would set up a new business or take over an existing one if they had the means to do so.

The United Kingdom's solid e-leadership dimension is mainly explained by the high level of digital skills that professionals have developed through academic education, rather than through in-work training provided by companies.

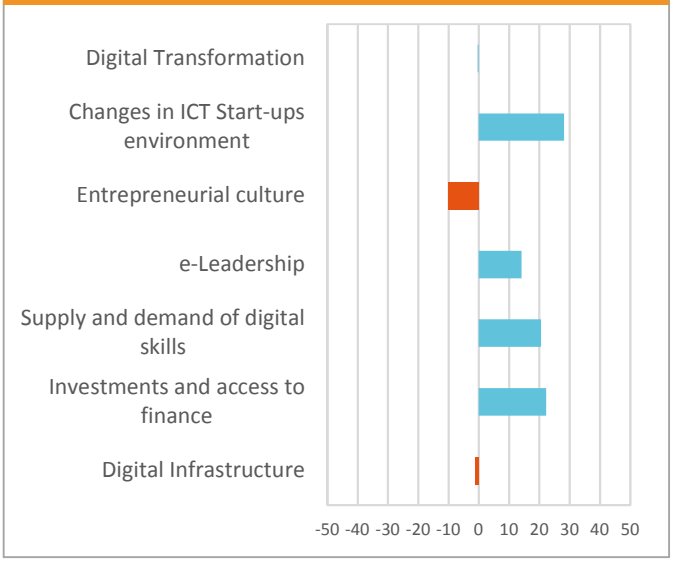
- Areas for improvement

Further effort should be made to improve the country´s digital infrastructure. Although Internet bandwidth is of a high quality, the use of integrated management software solutions could be enhanced.

The United Kingdom could also further improve its performance in supply and demand of digital skills. In particular, available data indicates that the percentage of high-tech patent applications is rather low.

C Comparison with other EU Member States

Figure 9.56: UK´s performance vs. EU average



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

The United Kingdom performs above the EU average in five out of seven dimensions.

The United Kingdom's strongest assets lie in its start-up environment, followed by investments and access to finance, and supply and demand for digital skills. In these four dimensions, the country scores around 20% (and in some cases higher) above the EU average.

Furthermore, the United Kingdom scores relatively high – more than 10% above the EU average – in e-leadership.

However, the United Kingdom does not stand out from its European partners in digital infrastructure, with a score slightly below the EU average. The country also seems to lag behind other EU Member States in entrepreneurial culture.

Overall, the United Kingdom is a strong performer, scoring around 10% or more above the EU average in most of the dimensions.

D Interesting policy practices

Interaction between people and machines

'Opportunities for SMEs and micro-businesses to investigate new approaches to user experience' is a programme launched by Innovate UK in 2015.

The main goal is to help companies to discover new and improved ways for machines, their computing systems and people to interact.

Projects funded under this programme must be collaborative and business-led. The beneficiaries are only micro-, small and medium-sized enterprises, with the option to collaborate with one additional SME or research organisation.

Proposals could address areas such as sensing information about the user, or technologies that help with specific types of experience, such as mobile or wearable devices.

Innovate UK has invested up to £500,000 (ca €600,000) in feasibility studies by micro-, small and medium-sized enterprises in the area of user experience.

Funded projects are expected to last between 3 and 12 months and to have a total project cost of up to £50,000 (ca €60,000). Small businesses would receive up to 70% of their eligible costs, whereas medium-sized enterprises would receive up to 60%.

Skills funding for SME engineering firms

Launched in December 2014, the aim of this fund was to help SME engineering companies to grow and become more productive by investing in the skills of its current and future engineers.

The United Kingdom Government contributed 50% of eligible costs for companies that had plans to provide extra training to employees to support career progression and conversion training. Companies could include staff wage costs as part of their project costs.

The fund was open to any small or medium-sized company directly employing people in engineering occupations. The funding was intended to be more accessible to smaller firms and featured a minimum funding threshold of £10,000 (ca €12,000) (compared with £40,000 – ca €48,000 – for previous funds that were not SME-specific).

The overall budget for this programme was of £10 m (ca €12 m). The fund was part of a £30 million (ca €36 m) that saw government and employers join together to invest in engineering skills. The first two tranches of funding were targeted at improving engineering careers and developing female engineers.

Funding for first and postgraduate degrees, apprenticeships and traineeship programmes, where funding could be obtained through existing funding channels, were supported by this fund.

References

1: FIEC, 2017, "FIEC annual report 2017", available at: http://www.fiec.eu/en/library-619/annual-report-english.aspx

2: FoodDrink Europe, December 2017. "Implementing the EU Food and Drink Industry´s Ambition for Growth and Jobs", available at http://www.fooddrinkeurope.eu/

3: WEF, January 2018, "Innovation with a purpose: The role of technology innovation in accelerating food systems transformation", available at https://www.weforum.org/reports/innovation-with-a-purpose-the-role-of-technology-innovation-in-accelerating-food-systems-transformation

4: EC, Digital Transformation Monitor website, available at https://ec.europa.eu/growth/tools-databases/dem/monitor/

5: EC, "Coordination of European, national & regional initiatives", available at https://ec.europa.eu/digital-single-market/en/cordination-european-national-regional-initiatives

6: EC, "Analysis of National Initiatives on Digitising Industry", available at https://ec.europa.eu/futurium/en/implementing-digitising-european-industry-actions/national-initiatives-digitising-industry

7: EC, "Digitising European Industry", available at https://ec.europa.eu/futurium/en/system/files/ged/15_11_2017_digitising_european_industry_brochure_ec_final_web3.pdf

8: PwC United Kingdom, "Innovation for the Earth - Harnessing technological breakthroughs for people and the planet", available at https://www.pwc.co.uk/sustainability-climate-change/assets/innovation-for-the-earth.pdf

9: EC, "Europe's Digital Progress Report (EDPR) - Integration of Digital Technology", available at file:///C:/Users/jbrown189/Downloads/EuropesDigitalProgressReportIntegrationofDigitalTechnologyChapter.pdf

10: PwC, "21st CEO Survey - The Anxious Optimist in the Corner Office", available at https://www.pwc.com/gx/en/ceo-survey/2018/pwc-ceo-survey-report-2018.pdf

11: PwC, "2017 Global Digital IQ Survey: A decade of digital", available at https://www.pwc.com/us/en/advisory-services/digital-iq/assets/pwc-digital-iq-report.pdf

12: Tom Vander Ark, "The Future of Skills: Employment in 2030", available at http://www.gettingsmart.com/2017/09/the-future-of-skills-employment-in-2030/

13: World Economic Forum in collaboration with the Boston Consulting Group, "Toward a Reskilling Revolution - A Future of Jobs for All", available at http://www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf

14: PwC, "Workforce of the Future - the competing forces shaping 2030", available at https://www.pwc.com/gx/en/services/people-organisation/workforce-of-the-future/workforce-of-the-future-the-competing-forces-shaping-2030-pwc.pdf

15: EC, "The Digital Skills and Jobs Coalition in a nutshell", available at https://ec.europa.eu/digital-single-market/en/news/digital-skills-and-jobs-coalition-nutshell

6: Nesta, "Creativity vs. Robots", available at http://www.nesta.org.uk/publications/creativity-vs-robots

17: OECD, "Skills for Innovation and Research", available at http://www.oecd.org/sti/inno/skillsforinnovationandresearch.htm

18: EC, "A New Skills Agenda for Europe - Working together to strengthen human capital, employability and competitiveness", available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0381&from=EN

19: EC, "New Skills Agenda for Europe", available at http://ec.europa.eu/social/main.jsp?catId=1223#vet

20: EC, "On the Digital Education Action Plan", available at https://ec.europa.eu/education/sites/education/files/digital-education-action-plan.pdf

21: Statista, "Smartphone users worldwide 2014-2020", available at https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide

References

22: Gartner, "Gartner Says 8.4 Billion Connected "Things" Will Be in Use in 2017, Up 31 Percent From 2016", available at https://www.gartner.com/newsroom/id/3598917

23: LoadDelivered, "5 ways the Internet of Things (IoT) impacts the food supply chain", available at https://www.loaddelivered.com/blog/5-ways-the-internet-of-things-iot-impacts-the-food-supply-chain/

24: Kristen Runvik, "Food Industry Using the Internet of Things to Make Processing Smarter", available at http://foodindustryexecutive.com/2017/01/how-the-food-industry-is-using-the-internet-of-things-to-make-processing-smarter/

25: Agarwal, R., Chandrasekaran, S. and Sridharmagining, M., 2016, "Imagining construction's digital future", available at https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/imagining-constructions-digital-future

26: EU, "The EU General Data Protection Regulation", available at https://www.eugdpr.org/

27: Gray, J.O., and Davis, S.T., 2013, "Robotics in the food industry: an introduction, in Robotics and Automation in the Food Industry" in Current and Future Technologies edited by D. Caldwell (pp. 21-35), Oxford: Woodhead

28: McClean, P., 2016, "Small groups mine big data to feed growth", available at https://www.ft.com/content/10b48d74-712b-11e6-a0c9-1365ce54b926

29: Marvin, H.J.P., Janssen, E.M., Bouzembrak, Y, Hendriksen, P. J. M., & Staats, M., 2017, "Big data in food safety: An overview, Critical Reviews in Food Science and Nutrition", 57:11, pp. 2286-2295, available at https://doi.org/10.1080/10408398.2016.1257481

30: DTM, "AI Policy Seminar: Towards an EU strategic plan for AI", available at https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/Main%20findings%20of%20the%20Policy%20Seminar%20FINAL2_0.pdf

31: Or Shani, "From science fiction to reality: the evolution of artificial intelligence", available at https://www.wired.com/insights/2015/01/the-evolution-of-artificial-intelligence/

32: Hof R.D., 2018, "Deep Learning," available at https://www.technologyreview.com/s/513696/deep-learning/

33: PwC, "Blockchain - an opportunity for energy producers and consumers?", available at https://www.pwc.com/gx/en/industries/assets/pwc-blockchain-opportunity-for-energy-producers-and-consumers.pdf

34: Deloitte, "Blockchain applications in the public sector", available at https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/Innovation/deloitte-uk-blockchain-app-in-public-sector.pdf

35: Herman, E. & Szabo, ZK, 2014, "Considerations on Romania's Entrepreneurial Profile: Barriers to Productive Entrepreneurship", available at https://ac.els-cdn.com/S2212567114006492/1-s2.0-S2212567114006492-main.pdf?_tid=d8b9f6ec-fee3-44b8-af3b-e6da92190c7f&acdnat=1522933103_36ad8405fc908146cdf2de348f15a0b8

36: Eurostat, June 2017. "Community Survey on ICT Usage and E-commerce en Enterprises 2018: General outline of the survey", available at: https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp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