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IMPACT ASSESSMENT

Accompanying the document

**Proposal for a Regulation of the European Parliament and of the Council
establishing the Digital Europe programme for the period 2021-2027**

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Glossary

<i>Term or acronym</i>	<i>Meaning or definition</i>
AI	Artificial Intelligence
CEF	Connecting Europe Facility
CSIRT	Computer Security Incident Response Team
DEP	Digital Europe Programme
DESI	Digital Economy and Society Index
DIHs	Digital Innovation Hubs
DSM	Digital Single Market
EAFRD	European Agricultural Fund for Rural Development
ERDF	European Regional Development Fund
ESFRI	European Strategy Forum on Research Infrastructures
ESIF	European Structural and Investment Funds
HPC	High Performance Computing
ISA2	Interoperability solutions for public administrations, businesses and citizen
MFF	Multiannual Financial Framework
MSs	Member States

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1. Scope and context

The digital transformation impacts all sectors of the economy and transforms the way we live, work and communicate. Much as our transport, industrial infrastructure, education and high quality public services have ensured Europe's prosperity in the past, continued investments in strategic digital capacities and infrastructures, upskilling and modernising the interaction between governments and citizens will underpin our future prosperity.

In Tallinn, European Heads of State and Government agreed that high performance computing and data, cybersecurity, artificial intelligence, digital skills and digitisation of areas of public interest and industry were the main pillars that the EU should invest in for a strong digital economy.¹ These were subsequently endorsed by the Council and the European Parliament.

The current EU investment framework covers important aspects of these pillars and notably research and innovation (R&I).² However, lessons learnt from successful public policies for high tech areas show that, in addition to R&I, public action which supports "upstream input" in rapidly developing technology fields can be instrumental in generating value while addressing public sector needs.

This is indeed the case for the key areas that underpin the digital transformation of the economy and society for the next ten years at least, i.e. advanced computing and data handling, cybersecurity, and artificial intelligence. Investment in acquiring the most advanced capacities in these fields and ensuring their best use in an interoperable way across the EU will provide an essential boost to digitization of our areas of public interest and our industry.

In Europe, this upstream investment gap for large scale deployment, in addition to R&I, is evident from the mismatch between the growing demand for latest technology and the supply. In High Performance Computing, insufficient supply is pushing EU scientists and engineers to turn massively to computing resources outside Europe notably the US where governments' programmes maintain supply for high end computing at the frontier of performance³.

Europe is also home to a world-leading Artificial Intelligence (AI) research community as well as a host of small companies providing AI expertise, but its AI market is underdeveloped compared to the US, where the capacities available, notably in data, provide supportive conditions for innovation at scale.

The fragmentation and relatively low public investment in cybersecurity⁴ is putting our society and economy at risk while the European cyber industry remains highly dispersed, with no major market players⁵. Highly skilled technical expert jobs in areas such as AI,

¹ Tallinn Digital Summit, Conclusions of the Prime Minister of Estonia

² Support for research and innovation in next generation technologies, research infrastructures and applications under Horizon Europe, support for digital infrastructure projects under the CEF and support for Media under the Creative Europe Programme

³ The EU currently consumes one third of HPC resources worldwide, but provides only around 5% (European Parliamentary Research Service (2017) Developing Supercomputers in Europe, p.3)

⁴ Current public investment in EU in cybersecurity is estimated to be between 1 and 2 B€ per year while investments in the US are almost ten times higher.

⁵ Building an Effective European Cyber Shield, EPSC, 2017. The same report mentions that the dominance of the US is partly the result of a cybersecurity investment strategy that saw federal funding raised to 19 billion US dollars in 2017 – a 35% increase compared to 2016.

data analytics and cybersecurity go unfilled - there are currently more than 350,000 EU vacancies in these fields.⁶

Addressing this investment gap cannot be left to market forces alone given the rapid pace of development, the importance that these capacities have on improving quality of public sector and the spillover effect that the investment has on wide areas of the economy. The role of the public sector as first mover to acquire latest technologies is widely recognised.

The internet would not exist without early publicly-funded support. The continuous public investment in acquiring highest end computing systems in the US is a key factor behind the US's technology and industrial leadership in digital. The spillover from the US's space or defense programmes are other examples of government acting as first mover to deploy technology and building common goods and capacities. As Mariana Mazzucato puts it, the role of the state is "*not only to 'de-risk' the private sector, but to envision the risk space and operate boldly and effectively within it to make things happen*"⁷.

In the past, Member States governments have played important roles as first movers and successful examples can be found in transport or healthcare. At the EU level, Europe's success in the Space field is also a clear example of a collective effort to build an invaluable and strategic common good.

However, in the digital area, while competing countries such as the US or China have been able to invest heavily - for instance in successive waves of computing technology, or more recently in Artificial Intelligence and robotics - Member States alone have not been able to reach the necessary scale of investment to compete effectively on a global scale through the wide coordinated deployment of digital technologies.

Given the considerable level of investment required, action at EU level is the only way the necessary scale can be achieved. Public intervention at EU level can play a key role as first mover in supporting the joint acquisition of "common goods" and capacities and in facilitating their use to address our societal challenges and drive innovation and competitiveness across the board.

EU intervention is needed in areas where the necessary funding is so significant that no Member State can act - in a timely way - alone, in areas where there is a need to aggregate resources that are scattered throughout Europe (e.g. data), and in areas where interoperability is key to the deployment of pan-European services.

In principle, amending the structure and legal requirements of existing programmes to implement this agenda would be possible. However, this would create a tension between different missions, which are subject to different time and implementation constraints, as well as fragmentation of actions - at a time where efficiency of deployment is essential.

The EU therefore needs a new, integrated and ambitious financing programme to support the large-scale deployment and optimal use of the digital capacities that underpin innovation in areas of public interest and business.

This impact assessment accompanies the proposal for a Regulation of the European Parliament and Council on a new programme dedicated to enlarging and maximising the benefits of digital transformation to all European citizens and businesses: The Digital Europe Programme.

⁶ An analysis of vacancies in 7 EU Member States by Victory Database

⁷ The Entrepreneurial State, Mariana Mazzucato, 2013

On 2 May 2018, the European Commission adopted its proposals for a new Multiannual Financial Framework (MFF) for 2021-2027. Under these proposals, the Digital Europe programme would have a budget of EUR billion 9.194 over this period.

This impact assessment report reflects the decisions of the MFF proposals and focuses on the changes and policy choices which are specific to this instrument.

This impact assessment satisfies the requirements of the Financial Regulation in respect of preparing an ex-ante evaluation.

1.2. Lessons learned from previous programmes

Existing programmes cover important aspects related to digital transformation of the economy and society: support for research, technological development, demonstration, piloting, proof-of-concept, testing and innovation including precommercial deployment of innovative digital technologies under Horizon 2020, support for digital infrastructure projects under the CEF - where experience in current MFF showed that the programme was best suited for physical connectivity - and support for Media under the Creative Europe Programme. All these are important investments and need to be continued in the next MFF. They are not sufficient though. As shown in the following paragraphs, there is no current programme that enable the EU as a whole to act as first mover in acquiring common digital capacities in essential areas that underpin growth, jobs and the sustainability of high quality public services i.e. advanced computing and data, cybersecurity and artificial intelligence.

Lessons learned for capacity building

For computing, the European High Performance Computing strategy is currently implemented using both the Horizon 2020 (under three different program parts) and CEF programs. Despite the effort done to bring these funding streams into one agenda in the proposed EuroHPC initiative, the limitations linked to these implementation models have shown major shortcomings. First, there are the difficulties in implementing the HPC roadmap coherently and effectively because its activities are still funded through four different funding streams. Second, the rigidity of CEF⁸ as well as the scope of possible actions under Horizon 2020 makes it difficult to keep pace with technology progress and the growing demand for using these technologies also outside the scientific community. This results in Europe lagging behind in responding to the ever increasing computing needs in areas of public interest and industry. Third, by being "late movers" in acquiring the best HPC systems, we offer fewer opportunities for industry to integrate, under open competition, advanced European technologies developed in R&I programmes (including Horizon 2020) into final products. A pan-European vision with a more strategic and rational planning of development and procurement is necessary.

The same applies to cybersecurity where Horizon 2020 and the related cybersecurity contractual Public-Private Partnership created in 2016 focus on research and innovation and not on large-scale deployment, for example through the procurement of the necessary equipment, software tools and skills to ensure their wide use. The September cybersecurity policy Communication⁹ concluded that the support to cybersecurity technological capabilities in Europe requires a step change. In addition to research and innovation, the strategic agenda developed within the public-private partnership (under Horizon 2020) highlights the essential role of public sector

⁸ As highlighted by the CEF mid-term evaluation: Rigidity to adapt to new technology developments, ,

⁹ JOIN (2017)450

investments in acquiring latest cybersecurity technology capacities in order to better protect our areas of public interest and to strengthen industrial competitiveness.

Artificial Intelligence technology is supported by a number of current initiatives, primarily under the Horizon 2020 LEIT programme including through public-private partnerships in robotics and big data. These activities concentrate mainly on research and innovation aspects that need to be intensified in the next framework under Horizon Europe to address next generation developments. As highlighted by recent reports, Europe lacks important capacities that are essential for the development of AI such as large data sets or facilities integrating latest technologies into real scale testing and experimentation. Actions to address these shortcomings within Horizon 2020 can cover up to pilot phases but typically do not go for full large-scale deployment in terms of common capacities and infrastructure across Europe.

Regarding delivery mechanisms for large-scale deployment of digital technologies, experience from Horizon 2020, notably through ECSEL as the only tri-partite Joint Undertaking involving the EU, industry partners as well as Member States, has proven illustrative. The interim evaluation¹⁰ of this Joint Undertaking has highlighted its success in leveraging private and public investment in the relevant sector. The same evaluation also notes the success in fostering collaboration between all stakeholders, including industry and national authorities. Under Horizon 2020 the cPPP on cybersecurity also consists of around 200 members including industry, academia and public authorities (at local, regional, national level) from 18 Member States.

Lessons learned for deployment and use of capacities

The CEF Programme has supported broadband networks and facilitated cross-border interaction, and interconnectivity between public administrations, businesses and citizens, by deploying Digital Service Infrastructures (DSIs). This was complemented by the ISA Programme focusing on interoperability in administration applications. The CEF mid-term evaluation acknowledged that the effort devoted in the programme to capacities and infrastructures for digitisation could only support the very first steps towards an EU wide digitisation of areas of public interest¹¹.

It highlighted that available funding levels under CEF and ISA have so far allowed current needs only to be partially addressed, and moreover, that the CEF framework limits the programme's ability to adapt to the latest technological developments and emerging policy priorities (for example cybersecurity-related challenges).

CEF support under the previous framework has led to the creation of a European ecosystem of interoperable and interconnected digital services and focused on cross-border elements. Building on this investment, we now need to rapidly scale up pan-European investments - beyond interconnectivity – and ensure that the benefits of new development (e.g. AI, data analytics and advanced computing) are seized in all public sector services across the EU economy. In CEF, Member States administrations and public sector have built up a cooperation framework for co-investment in digital services. This is an essential achievement to build on with fully up-scaled collective actions ensuring a successful transformation of areas of public interest.

The ISA Programme complemented developments under CEF Digital Services Infrastructures. Its final evaluation highlighted some shortcomings and made recommendations to further align the ISA programme with other relevant EU policies.

¹⁰ Interim Evaluation of the ECSEL Joint Undertaking (2014-2016) operating under Horizon 2020

¹¹ SWD(2018) 44 final

Under Horizon 2020, the support to Digital Innovation Hubs (DIH) as a means to provide access to latest digital technologies to businesses and notably SMEs was essential to take the first steps towards establishing and linking DIHs across the EU. To speed up the uptake of digital technologies across the EU and address issues of technological accessibility, there is a need to scale up the Digital Innovation Hubs and make them accessible for both private and public sectors. In view of the enormous potential of AI to benefit businesses and public administrations across the EU, DIHs should also be reinforced to provide access to AI capacities and help accelerate its take-up.

Lessons learned for advanced skills

The current MFF does not contain a dedicated budget for advanced digital skills development in particular in the key capacity areas identified above. Interventions in this domain are possible within the European Social Fund at national or regional level, at the behest of the competent authorities. However, only few examples are available in some Member States. The Digital Opportunity Traineeships pilot¹² which is financed by Horizon 2020 and implemented through Erasmus+, is the only example of targeted intervention on high-end digital skills. Due to its small scale and implementation modes, it lacks the capacity to meet the existing and projected demand for ICT specialists.¹³

No current programme focuses on reinforcing the essential digital capacities on which our economy and society increasingly depend such as capacities in computing and data handling, cybersecurity, the growing field of artificial intelligence and advanced digital skills. No existing programme provides the scale needed for their wide deployment in areas of public interest and industry.

1.3. Stakeholder consultations

The need to step up investments in digital capacities and in their broader use is widely supported by stakeholders¹⁴ and experts¹⁵ as well as at the highest political level.

A number of consultation activities have taken place in preparation to this Impact Assessment work to ensure stakeholder views are systematically accounted for in the process of formulating the post 2020 EU programmes. These consultation activities ranged from stakeholder conferences and events, to expert groups, an on-line consultation, workshops, meetings and seminars and analysis of the position papers. Results of the stakeholder consultations show support for a more efficient, less fragmented approach to maximise the benefits of digital transformation to all European citizens and businesses in the EU.

In HPC, AI and Cybersecurity, the Commission is engaged in continuous dialogue with stakeholders and Member States, notably under the Public Private Partnerships¹⁶ (HPC,

¹² To be implemented in 2018-2020

¹³ From 8.5 million in 2016 to at least 12.3 million in 2027.

¹⁴ See Annex 2 for details.

¹⁵ E.g., at a recent EPSC hearing on AI, the panel of experts recommended that Europe concentrates investments in AI adoption by public services such as health (ethical AI). The same approach has recently been proposed in the Villani report to the French Government on AI, *Donner un sens à l'intelligence artificielle*.

¹⁶ The PPP on robotics consists of around 300 partners including all Member States. The cPPP on cybersecurity consists of around 200 members including industry, academia and public authorities (at local, regional, national level) from 18 Member States. For cybersecurity as an example, in an online public consultation on ENISA evaluation which took place between 18 January and 12 April 2017, only 6% of respondents judged the current instruments and mechanisms at EU level (such as regulatory framework, cooperation mechanisms, funding programmes) to be “fully adequate” to promote and ensure cybersecurity. 83% of respondents regarded them as either “partially” or only “marginally adequate” and 5% found them “not at all adequate”. A subsequent stakeholder workshop on 23 February 2018 highlighted, inter alia, the need to address deployment challenges.

big data and robotics, cybersecurity), the public authority groups setup under the EuroHPC initiative, the cybersecurity coordination network and the AI group in the Digitising European Industry governance.

The strategic agendas of the PPPs, and reports from the various groups all point to the lack of investment in deploying capacities – particularly in comparison with the US and China where such investments are key parts of the relevant strategies and policy priorities.

Strong support for a strategic instrument was also expressed by the Digital Europe association, whose members include over 25,000 ICT Companies in Europe represented by 38 national trade associations¹⁷.

1.4. Member States engagement

Member States support and engagement to do more together, align strategies and co-invest in all strands of the Digital Europe Programme is also clear.

HPC

17 MSs have now joined the EuroHPC initiative and signed the EuroHPC Declaration and 4 more are planning to do so in the coming weeks. The Declaration is an agreement in which the signatory countries commit to work together and with the European Commission to acquire, build and deploy an integrated world-class High Performance Computing infrastructure that would rank among the world's top three by 2022-2023. The declaration foresees that such infrastructure will be made available across Europe for scientific communities as well as public and private partners, no matter where supercomputers are located. This integrated EuroHPC infrastructure will upraise Europe's scientific capabilities and industrial competitiveness and will ensure joint procuring and deploying of exascale supercomputers accessible from everywhere in Europe and based on competitive European technologies.

The declaration was signed on 23 March 2017 by seven Member States: France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain. Since then other countries have joined the initiative: Belgium in June 2017; Slovenia in July 2017; Bulgaria in October 2017; Switzerland in October 2017; Greece in November 2017; Croatia in November 2017; Czech Republic in January 2018; Cyprus in February 2018. Other countries such as Sweden and Poland are in the process of formalising their endorsement.

By signing the declaration, the above countries marked their intention to join the EuroHPC Joint Undertaking (JU), which has been proposed by the European Commission on 11 January 2018. The EuroHPC JU is a legal and funding entity which will enable pooling of the Union's and national resources on High-Performance Computer (HPC). The EU's contribution in EuroHPC will be around EUR 480 million under the current Multiannual Financial Framework, matched by a similar amount from Member States and associated countries. For the next MFF, the funding requirements to implement the full activities of the EuroHPC will increase significantly. The objective is to maintain the same level of co-funding with Member States.

¹⁷ DIGITALEUROPE calls for action on the Multiannual Financial Framework (MFF), Letter to Presidents Juncker, Tajani and Tusk on 9 April 2018.

Cybersecurity

Political commitment to an ambitious strategy in cybersecurity is clear from the November 2017 Council Conclusions on the Joint Communication to the European Parliament and the Council: "Resilience, Deterrence and Defence: Building strong cybersecurity for the EU". The Council underlined the need for the EU, its Member States and the private sector to ensure sufficient financing to support building cyber resilience and cybersecurity research and development efforts across the EU, as well as to strengthen cooperation to prevent, deter, detect and respond to cyber threats and to be able to respond jointly to large-scale cyber incidents and malicious cyber activities across the EU. The Council also invited all the relevant stakeholders to increase the investments in cybersecurity applications of new technologies in order to contribute to ensuring cybersecurity across all sectors of the European economy.

In a separate legislation, the Commission is now proposing a dedicated body that will facilitate co-financing and allow to pool contribution and resources from all involved actors including European Commission, Member States, private sector and academia. The implementation structure will create synergies and pool resources to invest in necessary capacities at the Member States' level and develop European shared assets (e.g. by jointly procuring necessary cybersecurity testing and experimentation infrastructure). In addition, national coordination centres will be financed by Member States and other public sources other than the Union budget.

Artificial Intelligence

On 10 April 2018, 24 Member States⁴ and Norway committed to working together on Artificial Intelligence. The signatories of the declaration¹⁸ are Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, UK, Norway. To build on the declaration, the Commission has committed to work with Member States on a coordinated plan to help align and step up investments. The Commission published a Communication on AI¹⁹ on April 25, 2018.

The discussion will take place in the framework of the existing European platform of national initiatives to digitize industry, with the view to agree a plan by the end of 2018. The objective will be to maximise the impact of investments at EU and national levels, encourage synergies and cooperation across the EU, exchange best practices and collectively define the way forward to ensure that the EU as a whole can compete globally.

Every Member State is encouraged to have an AI strategy, including on investment. Several Member States have developed or are working towards strategies to support AI. On 29 March 2018, France presented its national strategy for AI, building on the Villani report.⁶⁴ Germany, following the example of "Industrie 4.0", has set up a platform on learning systems to enable a strategic dialogue between academia, industry and the government. Finland has put forward its 'Tekoälyaika' strategy.

Digitisation of industry and digital innovation hubs

All Member States are today engaged in the digitisation of industry (DEI) initiative^{20, 21, 22} on which the Digital Europe Programme will build, with clear

¹⁸ <https://ec.europa.eu/digital-single-market/en/news/eu-member-states-sign-cooperate-artificial-intelligence>

¹⁹ http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=51625

²⁰ The Digitising European Industry initiative in a nutshell

commitment to further collaborate in making the best use of digital in businesses. Member States are joining forces in a common European platform, co-investing into further development of digital innovations and reinforcing EU competitiveness. Digitisation is a key element of national industrial policies. Some Member States are among the 'trend-setters' and many are 'fast-followers' in absorbing the emerging trends. Member States co-investment in Digitisation of Industry and in Digital Innovation Hubs is currently monitored on a yearly basis through a study. The findings are reported in the European Digital Progress Report²³.

In addition to the call for higher investment in digital at the Tallinn summit (October 2017), other examples of MS commitments include the following: organisations from 7 MS have endorsed the setting up of a European Lab for Learning and Intelligent Systems or 'EIIIS'²⁴; 16 MSs have committed to setup a genomic sequencing database for personalised medicine²⁵; All MS have voted for a €50 million investment under Horizon 2020 to support a pilot for the aggregation of competences in cybersecurity. European countries also committed to jointly develop advanced solutions for public services (e.g. through the development of a European blockchain service infrastructure²⁶).

Following the Tallinn summit, several Council formations have also discussed the issue of EU digital capacity building. In the MFF Communication²⁷, the Commission highlighted a scenario of doubling the investments in digital.

The willingness to act together is also clear from the strong engagement of MSs in CEF pilots under the current framework. This has also been reflected by the Council and European Parliament, which have repeatedly called for the urgent completion of the Digital Single Market and its individual files^{28 29 30 31}

The Parliament also expressed particular concerns that resources allocated to digital policies in the EU budget were insufficient to make a real impact and recognised the need to boost the European economy through productive investments.^{32 33}

2. CHALLENGES AND OBJECTIVES

2.1. Challenges for the programmes of the next MFF

2.1.1. Main challenges for the digital transformation

To fully benefit from the digital transformation, the EU needs to be equipped with state of the art digital capacity in critical areas such as advanced computing and data, artificial intelligence, cybersecurity and with the advanced digital skills related to these technologies. It must also ensure their optimal use in the private and public sectors. Yet, despite its strong position in science, research and innovation Europe lags behind when it

²¹ Brochure of the Digitising European Industry Initiative

²² Key pillars of the DEI initiative

²³ <https://ec.europa.eu/digital-single-market/en/news/europes-digital-progress-report-2017>

²⁴ <https://ellis-open-letter.eu/letter.pdf>.

²⁵ Signed by 16 European countries: http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=50964.

²⁶ Signed by 22 European countries: http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=50954.

²⁷ COM (2018)98: A new, modern Multiannual Financial Framework for a European Union that delivers efficiently on its priorities post-2020.

²⁸ Council conclusions May 2013 on the Cloud Communication, highlighting the role of HPC in the EU.

²⁹ Council conclusions May 2015 on the digital transformation of European industry (8993/15).

³⁰ Conclusions of the Council meeting 23 January 2018 (ECOFIN XX/18).

³¹ Council conclusions on health in the digital society – making progress in data-driven innovation in the field of health.

<http://data.consilium.europa.eu/doc/document/ST-14078-2017-INIT/en/pdf>.

³² Report on the European Cloud Initiative (A8-0183/2017).

³³ Parliament resolution on robotics and AI . (2015/2103 INL).

comes to investments in the deployment of digital capacities and take up of advanced digital technologies.

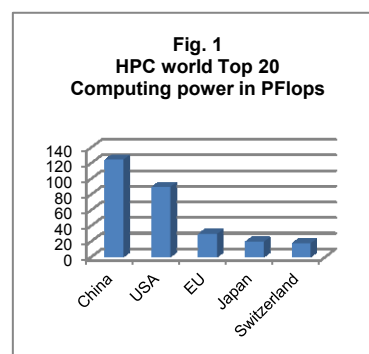
Europe is facing harsh global competition. The US and China both make huge injections of public capital³⁴ in advanced digital capacities to boost their competitiveness, modernise their public sector or protect their society and economy. The US publicly invests large sums in defence and security, enabling the private sector to develop its products and services on the back of these upstream investments.

Insufficient capacities in key digital technologies

Computing

Currently, Europe's scientific capabilities and industrial competitiveness critically depend on access to world-leading HPC computing and data infrastructures to keep pace with the growing demands and complexity of problems.

However, the EU HPC capacity is fragmented and underdeveloped, with no European HPC facilities in the global top 10 and with insufficient capacities to meet current demand (see Fig. 1).



At the same time there is strong demand, which is only likely to grow in the future. The EU currently consumes one third of HPC resources worldwide, but provides only around 5%.³⁵ This is primarily why, in 2017, the EU committed to procuring 2 world-leading computers (known as 'exascale'³⁶ computers) by 2023³⁷. In the meantime, the global supercomputer market is forecast to grow with estimates ranging from 4.3% to 7% compound annual growth rate.³⁸

A comparison between the USA (ASCR) and EU (PRACE) initiatives providing access to leading-edge HPC capacities indicates that European scientific and engineering communities obtain more support from US supercomputing facilities than from Europe, by a factor of more than 10.³⁹ The EU is dependent on processing power from third countries in respect of analysing important or sensitive data.

The lack of these advanced computing systems impedes Europe's success in the data economy.

Artificial Intelligence

The emergence of strong AI 'ecosystems' that unite AI developers, users and financiers is currently hampered by a lack of high-quality data, limited availability of AI capabilities and lack of AI competence centres that can ensure technology dissemination. There is also poor awareness of the opportunities that AI can bring to the real economy.

³⁴ China announced in October 2017 a 10 Billion USD investment in a Quantum Computing centre, while the US has a yearly budget of 1 Billion USD to acquire latest the High Performance Computing systems

³⁵ European Parliamentary Research Service (2017) Developing Supercomputers in Europe, p.3 [http://www.europarl.europa.eu/RegData/etudes/BRIE/2017/608789/EPRS_BRI\(2017\)608789_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2017/608789/EPRS_BRI(2017)608789_EN.pdf)

³⁶ Capable of 10¹⁸ calculations per second. A thousand-fold increase over current supercomputers

³⁷ Digital Single Market Mid-Term Review May, 2017

³⁸ Addison Snell, Christopher G. Willard, Ph.D., Laura Segervall, Intersect360 Research, Worldwide High Performance Computing 2016 Total Market Model and 2017–2021 Forecast, October 2017

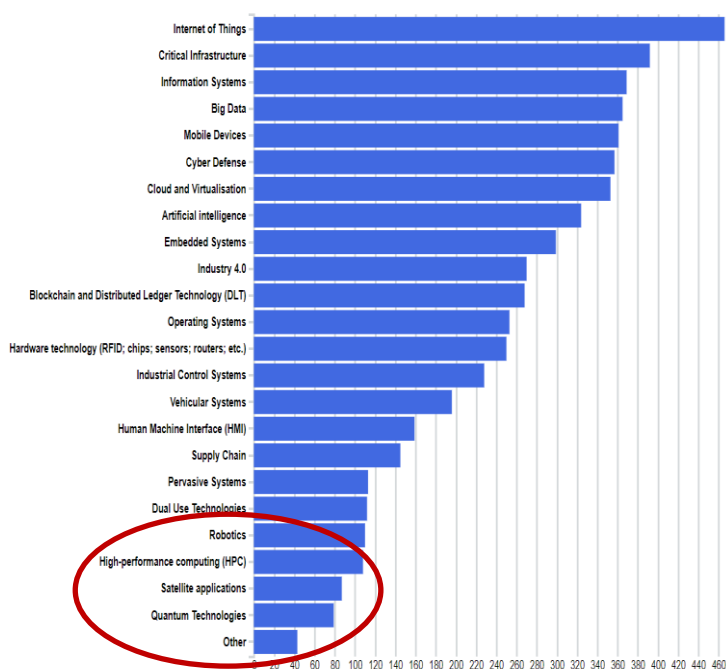
³⁹ Commission Staff Working Document Impact Assessment accompanying the proposal for a Council Regulation on a common European initiative on High Performance Computing

This contrasts with the importance placed on AI by scientists and opinion makers, who refer to AI as the next revolution in human history. The importance of AI for the future of Europe and our society has recently been highlighted in the Commission proposal of 25 April 2018 for an AI strategy for Europe⁴⁰ and by the EP report on AI and robotics⁴¹. It is also an important priority for several Member States as illustrated by the recently announced French strategy for AI. The Commission's proposed AI strategy underlines the gap in investment in AI between the EU and competing economies (above 10 Billion Euro per year) and puts forward a set of actions along three pillars: (i) reinforcing and investing in Europe's industrial and technological capacities in AI, (ii) addressing the ethical and legal issues related to AI and (iii) upskilling workforce and preparing for the new jobs and work environment.

Cybersecurity

A capacity to protect our critical infrastructures - and public services that depend on them - from potentially crippling forms of cyberattack is paramount. Currently, Europe is not adequately prepared to address this threat. Because of the fragmentation of resources and know-how across the EU, industry and the public sector struggle to secure the devices and infrastructures underpinning the DSM. Currently only two Member States are in the top 10 in the ITU Global Cybersecurity Index⁴². The same index rates a large majority of Member States with average to weak cybersecurity readiness.

Fig 2: Overall distribution of applications and technologies in cybersecurity competence centres in Europe



For cyber security, consultation with stakeholders and an analysis conducted by the JRC on the status of capacities in the EU highlighted clear weaknesses that need to be addressed urgently for the EU to remain "cyber-ready" in the next 5 to years. As shown in figure 2, it is mainly in the emerging and very advanced areas like Quantum technologies and high end computing that competences are less developed.

The reason is the high cost of the equipment and tools needed as well as the high level of expertise that is required. Such systems are becoming essential to shield our economy and society and an EU level investment together with MSs will be needed to ensure that these capacities not only exist in Europe but also are accessible for stakeholders, engineers, researchers and public authorities, all over Europe.

The illustrative example is indeed the emergence of quantum technologies such as dedicated quantum computers or key distribution that are technological game-changer

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COM(2018) 237 final: Artificial Intelligence for Europe

41

16/2/2017, EP Parliament report on robots and artificial intelligence

42

Global Cybersecurity Index 2017 https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2017-PDF-E.pdf

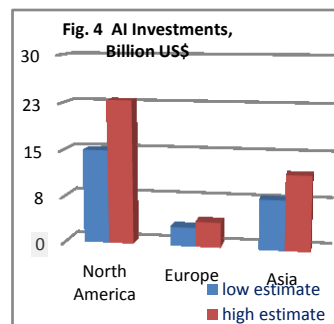
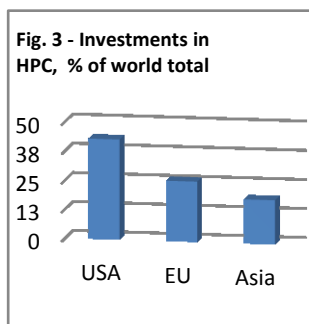
in cyber-security.⁴³ Today Europe is amongst the world leaders in quantum technologies research and innovation with a level of investment in R&D that is similar to the US. However the first deployment of technology developed in the EU and in EU programmes notably is not happening in Europe. First deployment of European Quantum key distribution is done in China and first quantum computers that can crack any existing encryption system is being done in the US.

All the above implementations are done in government-led programmes in cybersecurity. Europe cannot continue to be the generator of ideas and inventions that other regions deploy first through government programmes, and take full benefit of them across the economy and society.⁴⁴

Risks will also be amplified by the fact that cybersecurity and AI require computing power to function. The lack of HPC weakens our position in AI and exposes further our economy and society to cyber-threat. A position where data continues to flow out of the EU, and where latest data processing tools are scarce in Europe, will damage the sustainability and quality of public services, endanger our security and undermine our economic growth.

Fragmented and below critical investments to acquire core digital capacities

While China and the US, with ambitious government programmes, lead the race to acquire latest digital capacities that underpin digitisation, EU's investment remains fragmented and often insufficient. This has important socio-economic and geo-strategic implications.



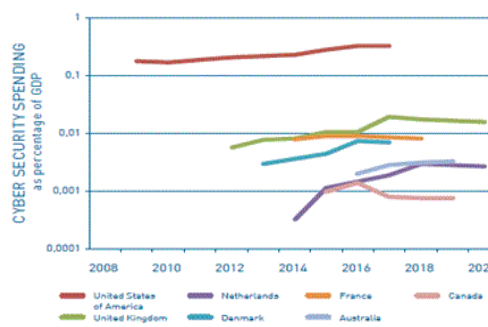
Despite the considerable efforts made to pool computing and data handling resources in the PRACE⁴⁵ and EuroHPC initiatives, HPC investments in the EU remain sub-critical. Total investment in HPC in the EU is at 60% of US level⁴⁶ (see Fig. 3).

Similarly, analysts are united in their view that Europe is currently underinvesting in AI compared to the US or China (see Fig. 4). Europe invested USD 3 to 4 billion in 2016, compared with USD 8 to 12 billion in Asia and USD 15 to 23 billion in North America.⁴⁷ A significant amount of current European AI investment is made in the United Kingdom (almost three times more than France in second place).^{48 49}

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The same is true of our investment in cybersecurity. While the cost of damage from cybersecurity attacks is expected to reach EUR 6 Tn. in

Figure 5: Government cybersecurity spending: a cross-country comparison over time (2008-2020)¹



43 As explained in Section 1.2 above, a quantum computer used for decryption in cybersecurity tools.

44 Quantum key distribution implements a cryptographic PRACE coordinates a pan-European HPC infrastructure of leading-class supercomputers

45 IDC study: HPC in the EU, SMART 2014/0021

46 Artificial intelligence the next digital frontier?, McKinsey Global Institute, 2017

47 The State of the European tech 2017, Atomico

48 The Battle for Digital Supremacy, March 15, 2018

49 The Economist in a recent article has crudely affirmed that the world digital race is a matter reserved to China and USA

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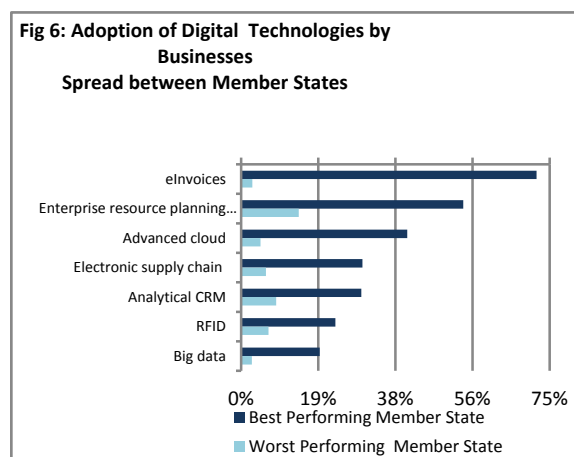
2021⁵¹, EU investment in advanced cybersecurity capacities remains modest (see Fig. 5). A recent study for the Dutch government⁵² estimates the total EU investment at close to 10 times less of the US investments. The figure is confirmed by announcements by MSs on their investments in cybersecurity.

The US invests USD 19 billion/year in cybersecurity capabilities, including USD 900 million for research and innovation alone. China announced a programme for deploying quantum technologies with a focus on cybersecurity in the order of USD 10 Bn⁵³. EU investment is not only low but also highly fragmented across Member States.

A recent report by the JRC on the status of cybersecurity competence centres in Europe⁵⁴ highlighted the large fragmentation of the investments, the high redundancies in expertise and the large gap in the essential areas requiring relatively high investments such as HPC or Quantum.

Inadequate uptake of digital solutions in areas of public interest

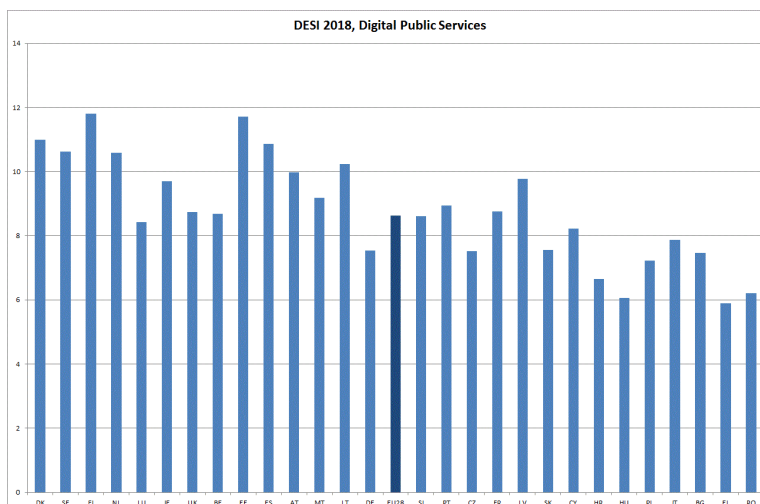
Business in Europe has been slow in adopting and diffusing digital innovations in areas of public interest. Adoption is also uneven between Member States (see Fig. 6). This has led to a further entrenchment of the European digital divide, and significant divergences in economic development paths. For example, in 2017, the availability of Austrian eGovernment services offered fully online was 89.7%, but the EU average was only 68.1%. The use of ICT in justice systems across Europe is similarly patchy.⁵⁵ This is documented in detail in the annual Digital Economy and Society Index (DESI) (see Fig. 7).



Wide adoption is further impeded by a lack of interoperability. Despite the creation of Digital Service Platforms and building blocks under the CEF programme, which laid the foundations for an interoperable public services environment (notably in the area of e-government and e-health), complete interoperability is far from being attained. Key technological enablers (e.g. electronic Identity eID, eDocuments, etc.) were only used in 54% of public administration cases.⁵⁶ In health, the IT systems in primary health care (such as general practitioners) are often not linked with those of specialist consultants or hospitals, even in the same city.

⁵¹ A 100% increase in comparison to 2015 (Cybersecurity Ventures Report: 2017)
⁵² Dutch investments in ICT and cybersecurity: putting it in perspective, *The Hague* Centre for Strategic Studies, Dec 2016
⁵³ Public cybersecurity spending is not easily discernible from overall government spending, but available data analysis show that its level (in terms of % of GDP) in Europe is much below what is spent by e.g. the US.
⁵⁴ JRC Technical Reports: European Cybersecurity Centres of Expertise, 2018
⁵⁵ The 2017 EU Justice Scoreboard includes several indicators showing the availability and use of ICT in the justice systems. It shows the level of use of digital technologies in Member States (e.g. the use of electronic signatures).
⁵⁶ eGovernment Benchmark report 2017

Fig. 7 DESI Index



Example of eIDAS: The entry into force of the eIDAS regulation on September 29 this year will project Europe in a new era for the public administration. Many Member States are late with the implementation of interoperable solutions for eIDAS (only 4 MS have so far notified the Commission) and, more worryingly, the services envisaged by the eIDAS regulation are ill developed. There is therefore a need to continue and scale up the support of the service element developed under CEF.

Equally, in the field of the judiciary, the lack of interoperable electronic communication between courts and legal authorities impedes seamless enforcement of civil and criminal law across the EU. Although the “European Single Procurement Document” simplified the process, the same problem occurs in public procurement, where buyers and suppliers have to gather certificates stored in several publicly owned, not interlinked, databases.

Solving the issue of access to advanced digital technologies only at national level would most likely lead to a fragmented approach due to the different starting points of Member States. If we do not act now, the gap between Member States risks widening, further entrenching a digital divide across the EU, slowing down the adoption of valuable digital innovations that are ready for use and missing important opportunities of (re)use of data provided when using public services or health and care services.

Slow and uneven adoption has also direct implications on the digital supply sector since a dynamic and high growth market attracts investment and drives innovation.

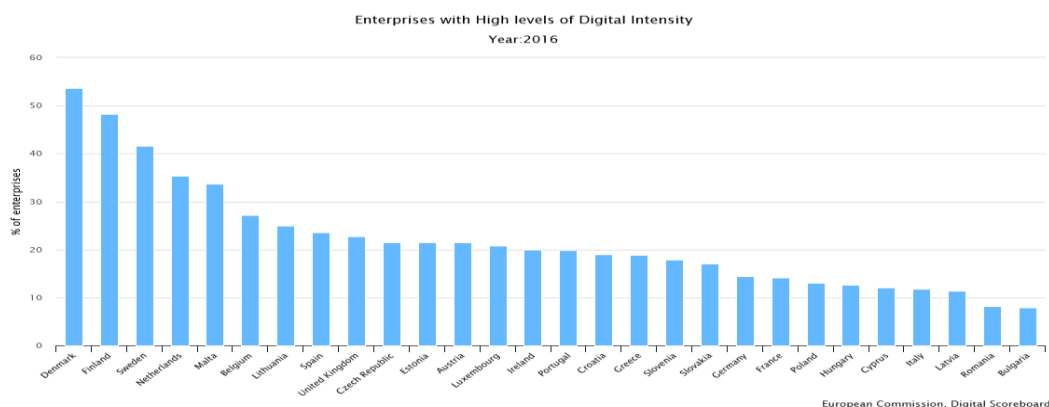
Inadequate uptake of digital solutions in businesses

As is the case for the public sector, uptake of digital solutions by businesses remains uneven between Member States, between sectors (particularly between high tech and traditional areas), and between large companies and SMEs. In the EU only 20 % of SMEs are highly digitised (compared to 58% of large enterprises).⁵⁷

Knowledge and finance gaps are impediments to business uptake of digital solutions, particularly for SMEs. Slow diffusion of digital technologies thus poses a significant risk to the EU's ability to compete on the world stage. Digitisation of businesses is also highly uneven across Member States as shown below. 53% of Danish companies are highly digitised vs 8% in Romania (see Fig. 8).

⁵⁷ ICT usage survey in enterprises/Digital Scoreboard (2017)

Fig. 8 Level of Digital Intensity



Shortage of advanced digital skills

Currently, the EU has a significant and systemic gap between market needs and what is offered in terms of skills related to advanced digital technologies. According to Cedefop (2016)⁵⁸, while ICT professionals are among the most in-demand workers, almost all Member States face shortages for both software and developer analysts and database and network professionals.⁵⁹ Skills availability is the most frequently cited obstacle to investment across the EU (expressed by 72% of firms), followed by “uncertainty about the future”.⁶⁰

High skilled technical experts jobs in areas such as AI, data analytics and cybersecurity go unfilled (there are currently more than 350,000 EU vacancies in this field)⁶¹. Finally, enterprises in all EU countries report difficulties in recruiting specialists, with 47.5% of companies experiencing difficulties in recruiting ICT specialists.⁶² According to the EIB, skills availability is now the most common obstacle to investment, with “lack of staff with the right skills” cited by 72% of firms. Filling the vacancy gap would boost the EU economy by around EUR 14Bn per year⁶³.

The uptake of HPC, AI and advanced cybersecurity tools across public and private sectors will require more experts in those fields.

Additionally, insufficient funding is allocated to the workforces' digital retraining.⁶⁴ About 77% of EU workplaces reporting digital skills gaps have not undertaken any actions, while only 12% have done so (mostly training) and 11% plan to do so. Cost is a key barrier to undertaking actions to deal with digital skills gaps.⁶⁵

⁵⁸ http://skillspanorama.cedefop.europa.eu/en/analytical_highlights/ict-professionals-skills-opportunities-and-challenges
⁵⁹ Estonia, Greece, Portugal, and Finland are the only Member States where the supply of ICT professionals almost equals their demand (Cedefop Skills Panorama 2016)

⁶⁰ ibid

⁶¹ This data is collected by Victory Database, analyzing vacancies in 7 EU Member States.

⁶² Eurostat 2017 survey on ICT usage and e-commerce in enterprises

⁶³ The vacancy rate of ICT specialists is 2.8%, compared to 2.1% for the overall business economy. Reducing the vacancy rate to the average would correspond to a reduction in vacancies from currently 560 000 (extrapolation to the whole EU based on the Victory database) to 420 000, i.e. by 140 000. With an average value added of 101 000 € per employee in ICT services, that would amount to € 14.1 bn.

⁶⁴ Different EU funds address workforce retraining. The European Globalisation Fund can, in certain limited circumstances, support digital skills training. Each case must be approved by the Council and Parliament. As a result, only 28 cases totaling EUR 114 Mn were financed. The ESF can also finance training for digital skills, however examples are rare and scattered across the EU.

⁶⁵ Ecorys (2016)

2.1.2. *Baseline: current EU framework for the financing of core elements relating to digital transformation*

The programmes currently supporting activities in the digital area under the current MFF are Horizon 2020 (Horizon 2020), CEF, ISA2, and partially, Creative Europe and ERDF, ESF and EAFRD..

Horizon 2020

Under Horizon 2020, research to discover radically new technological possibilities and ICT contributions to upstream research and innovation are addressed in the ‘excellent science’ part of Horizon 2020, in particular under ‘Future and Emerging Technologies’ and ‘European Research Infrastructures’ (‘eInfrastructures’). Research and innovation activities related to ICT technologies (driven by industrial roadmaps or through a bottom-up approach) are addressed in the ‘Leadership in Enabling and Industrial Technologies’ (LEIT) part of Horizon 2020. In addition, as essential EU policy objectives on health, ageing, climate, environment, energy, transport, public sector modernisation and security cannot be achieved without ICT innovation, multi-disciplinary application-driven research and innovation leveraging ICT to tackle societal challenges are addressed in the different ‘societal challenges’.

Overall, the support for digital available under Horizon 2020 is around EUR 13 Bn. This includes several partnerships with the public and the private sector for research and innovation covering digital technologies⁶⁶, including public-private partnerships on photonics, future internet, cybersecurity⁶⁷, HPC⁶⁸, 5G, electronics components and systems, and factories of the future as well as support to the integration of business, academia and education within the digital Knowledge and Innovation Community (KIC-Digital) of the European Institute of Innovation and Technology (EIT). Horizon 2020 also covers, to a certain extent, funding for research on technologies that support teaching and learning.

CEF

The Connecting Europe Facility supports trans-European networks and infrastructures in the transport, telecommunications and energy sectors. CEF Telecom facilitates cross-border interaction between public administrations, businesses and citizens, by deploying digital service infrastructures (DSIs)⁶⁹ and broadband networks. It also promotes free Wi-Fi connectivity in public spaces (WiFi4EU initiative). Investments in cybersecurity are limited to setting up the communication infrastructure for the CSIRT Network and supporting Member States for joining the network. Overall support for cybersecurity from CEF is limited to EUR 71m in 2014-2020. The total support for digital available under CEF amounts to EUR 1 Bn.

⁶⁶ For more details see Annex to the DSM Mid-term Review Staff Working Document SWD(2017) 155 final

⁶⁷ Funding to foster cooperation at early stages of the research and innovation process and to build cybersecurity solutions for various sectors, such as energy, health, transport and finance (support to R&I in Horizon 2020 in the field of cybersecurity is around 100 M€ per year – since 2016 in partnership with industry and academia under a contractual PPP – to which the private sector is adding an additional 300 M€ per year at least)

⁶⁸ The cPPP on HPC entered into force in January 2014 to develop an ambitious R&I strategy (the EC has pledged €700 million from Horizon 2020 and the cPPP is expected to leverage a similar amount of private resources)

⁶⁹ A wide range of cross-border digital services are facilitated by CEF including for example: (1) Europeana - the DSI for cultural heritage, which provides access to over 51 million items, (including image, text, sound, video and 3D material) from the collections of over 3,700 libraries, archives, museums, galleries and audio-visual collections across Europe, and (2) the CEF Automated Translation which has enabled the creation of a scalable platform for automated translation providing quality machine translation for specific domains

Creative Europe

The MEDIA sub-programme of Creative Europe supports initiatives that can generate a real impact for the sector across Europe, helping its adaptation to the digital transformation. These include supporting content creation and distribution, initiatives that promote new skills, and initiatives that promote international cooperation. MEDIA helps launching projects with a European dimension and nurtures new technologies; it enables European films and audiovisual works to find markets beyond national and European borders, and funds training and film development schemes. The support for digital available under the Creative Europe programme is EUR 1 Bn. The Culture sub-programme supports in particular cross-border co-operation projects but also platforms aiming at raising the visibility of emerging artists. Audience development and the testing of new business models using innovative technologies can be the object of grants both for partnership projects as for the business-to-consumer oriented platforms in the non-audiovisual creative sectors.

ERDF, ESF and EAFRD Digital Single Market related investments

ERDF, ESF and EAFRD funds are a catalyst for achieving the objectives of the Union Strategy for smart, sustainable and inclusive growth. They provide substantial support of over EUR 20 Bn in the current programming period making thus an important contribution to the implementation of the DSM and achieve local and regional ownership and engagement for the DSM. The European Regional Development Fund (ERDF) aims to foster the economic, social and territorial cohesion in all EU regions with a focus on less developed regions. It fosters innovation-led economic development involving the digitization of industry as set out in the smart specialization strategies (including investments in building up and improving Digital Innovation Hubs). The ERDF also supports the deployment of digital solutions, including cybersecurity, as part of the delivery on EU priorities in the area of modernization of public administrations, sustainable transport, improvement of the health and care systems, energy transition, circular economy and education. The ERDF and the European Agricultural Fund for Rural Development (EAFRD) also invest in broadband. The DEP will support the trans-national networking and mapping of digital capacities to make them accessible to SMEs and to make interoperable IT solutions accessible to all EU regions.

The European Social Fund in particular can support, if allocated by national and regional authorities, digital skills development at local level. Interventions vary to a large extent - from creating e-schools with digitally trained teachers, training unemployed people for all jobs, among which also ICT in, to supporting SMEs in the ICT sector, and providing basic digital skills to citizens to fully participate in society. Member States have allocated EUR 2.3 billion across all thematic objectives to ICT for 2014-2020⁷⁰; however, it is not possible to have a detailed view of interventions implemented at national level and to identify the interventions targeting advanced digital skills, such as those needed for HPC, quantum or cybersecurity, if present.

In the agricultural sector, 27 Member States programmed innovation projects under the EIP-AGRI funded by Rural Development Programmes. Available data show that around 1 in every 10 innovation projects work on precision farming or have a digital component.

⁷⁰ Interventions for digital skills are possible under the ERDF, within thematic objective 2 "Enhancing access to, and use and quality of, ICT", under ESF within thematic objective 8 "Promoting sustainable and quality employment and supporting labour mobility" and 10 "Investing in education, training and vocational training for skills and lifelong learning"

ISA²

Interoperability solutions for public administrations, businesses and citizens (ISA²) facilitate efficient and effective electronic interactions, cross-border or cross-sector, between European public administrations connecting them citizens and businesses. The Programme develops interoperability solutions autonomously or to complement and support other Union initiatives.

2.2. Objectives of the programmes of the next MFF

As illustrated above and under sections 1.2 and 2.1.2, current interventions are either limited in scale or scope and remain insufficient to support large-scale capacity building in the identified areas and roll-out in areas of public interest and business.

The new proposed Programme will focus on reinforcing Europe's digital capacities in High Performance Computing, Artificial Intelligence, Cybersecurity and advanced digital skills and ensuring their wide use across the economy and society.

In doing so it will build on existing structures and past achievements and bring key digital infrastructures and capacities to the next level. In High Performance Computing it will build on the EuroHPC initiative and remove the current limitations to implement a more strategic and efficient approach. In cybersecurity it will build on the contractual Public-Private Partnership created in 2016 and enable large-scale deployment of cybersecurity solutions. In AI, it will build on research and innovation achievements and support testing and experimentation of essential capacities such as large data sets or libraries of algorithms. For digital skills, it will build on the Digital Opportunity Traineeships pilot and provide the scale needed to respond to current demand. Finally, for the broader digital transformation of areas of public interest and of industry it will significantly build on the achievements of the CEF/Digital Service Infrastructures Programme, on the ISA Programme and on the existing network of Digital Innovation Hubs. In all cases, the novelty is the focus on deployment of digital technologies, the broader scope, the increased level of collaboration between stakeholders and the scale of intervention.

The Digital Programme will offer a spending instrument well-tailored to operational needs and capacity building in the areas identified by the European Council and will exploit synergies between those areas. Current interventions are not adequate to ensure the financing and roll-out of advanced digital technologies which are now mature enough to be deployed and scaled-up at European level. The programme will focus on the areas where no single Member State alone can ensure the level of investment required for digital success. It will also focus on the areas where public spending creates the maximum impact either because it is a topic in which there are massive public investments in competing regions or because public spending will accelerate the introduction of new services in areas of broad public interest. The components of the programme have been chosen because they are all prerequisite to the digital transformation of the economy and society and are key to the future prosperity of Europe. They are complementary and synergetic. Fostered simultaneously, these will lead to a thriving data economy, promote inclusiveness, catalyse innovative projects and ensure value creation. Ignoring or weakening one of the pillars will undermine the whole construction.

Starting from a blank sheet, a new Programme with specifically aligned objectives will simplify procedures, provide clarity for users, and maximise impact.

The general objective of the programme is to support the digital transformation of the European economy and bring its benefits to European citizens and businesses. The Specific objectives of the programme are:

- a) reinforcing Europe's digital capacities in key digital technology areas through large-scale deployment,
- b) widening the diffusion and uptake of digital technologies in areas of public interest and by businesses in private sector.

These objectives also derive directly from the Treaty on the Functioning of the European Union, notably Articles 172 and 173.

Cross-cutting objectives (flexibility, coherence, synergies, simplification and focus on performance)

The Programme is based on acquiring digital capacities that need EU level intervention and on delivering these capacities through Digital Innovation Hubs to ensure that they are accessible and used across the EU.

The modes of implementation will ensure that co-investment with MSs is achieved in the most flexible and simplest way. Coherence will be ensured through the use of the same model of delivery for the three capacities, relying on a wide network of Digital Innovation Hubs to provide access to technologies and advanced capacities. Synergies will therefore be intrinsically supported by the implementation mode. See further details on implementation modes under section 4.1.

2.3. EU Added Value

A guiding principle of the proposal is the added value of EU-level action. As shown in section 1.3, collectively, there is a new political will to cooperatively address what were previously domestic concerns. The EU is therefore in a unique position to plan, jointly finance, and coordinate actions on a scale capable of meeting these challenges, and ensure that the benefits of new digital technologies are fully shared - not reaped exclusively in a few Member States. Multi-lateral coordinated action can also avoid duplication, capitalise on synergies by linking funding with framework conditions, safeguard interoperability, and avoid blind spots or a major geographical digital divide. Given the urgency of the situation and the scale of the investment required, there is thus a very strong case for EU intervention.

Acting swiftly and at European scale is also necessary in the current international context. The US and China both make huge injections of public capital⁷¹ in advanced digital capacities to boost their competitiveness, modernise their public sector or protect their society and economy. The US publicly invests large sums in defence and security, enabling the private sector to develop its products and services on the back of these upstream investments.

In the areas of HPC, AI and cybersecurity, stakeholder consultations⁷² show that a set of critical investments are best done at EU level. Not only can the return on the high investment needed only be maximised by sharing the costs and the use, but also the high expertise required to specify and implement such technologies is not available in all MSs. A collective effort is the only way to bring their benefits to every business, public service

⁷¹ China announced in October 2017 a 10 Billion USD investment in a Quantum Computing centre, while the US has a yearly budget of 1 Billion USD to acquire latest the High Performance Computing systems

⁷² See annex 2

and citizen in Europe. These are also areas where scale is essential to succeed, be it for acquiring the necessary capacities⁷³ or for their wide use across the EU.

Given that knowledge and expertise in advanced digital fields is not available in all regions in Europe, EU-level action, notably through networking digital innovation hubs⁷⁴, can ensure that such expertise is made available in every region.

For example, the access to High Performance Computing and AI expertise currently provided through the EU I4MS initiative, enables SMEs in non tech sectors anywhere in Europe to get access to latest simulation, modelling and data analytics expertise that is available in only few excellence centres.

To sum up, although a large part of investment in the targeted capacities is done by the private sector and targets commercial and industrial purposes, coordinated public investments at the EU level are essential:

- to serve areas of public interest across the EU (from health to mobility and environment),
- for the public sector (over 50% of GDP) to act as first mover in acquiring latest digital technologies benefiting our citizens while reinforcing our industry and business sector.
- to provide access to such capacities for businesses, on a pay per use basis, notably SMEs, with focus on areas of market failure with high spill-over effect across the economy,

The proposed Digital Europe Programme addresses the above and targets areas where EU investment has clear added value based on three criteria:

- areas where the necessary funding is so significant that no Member State can do it, in a timely way, alone
- areas where there is a need to aggregate resources (computing power, data, expertise) that are scattered throughout Europe to ensure large-scale coordinated deployment, and
- areas where interoperability is important.

Finally, core concepts that define the European Union: trust, solidarity, cultural heritage, human dignity, rule of law, democratic participation and inclusiveness, must be preserved in the process of digital transformation of our society. There too, the added value of acting at the EU level is very clear.

3. PROGRAMME STRUCTURE AND PRIORITIES

3.1. Structure

The previous sections have highlighted the scale of the problem, the size of the funding gap, the urgency to act and the key role public investment at EU level could play, as a first mover to unlock the potential of the digital transformation.

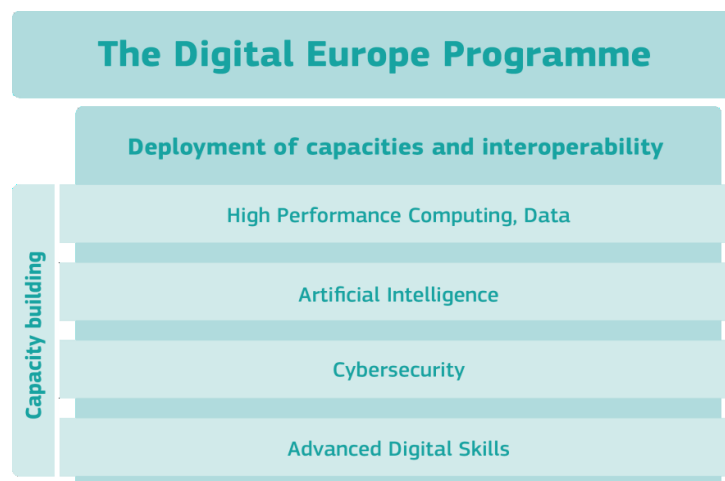
The proposed programme is structured around two main types of activities. To enable the digital transformation Europe must: first, reinforce its digital capacities in key digital technology areas (HPC and data, AI, cybersecurity and trust, and advanced digital skills),

⁷³ E.g. the critical mass of data required for AI applications in areas like health or cybersecurity can be only achieved at European scale

⁷⁴ Digital Innovation Hubs are explained in more detail in section 3.2.2. – *Digital transformation of industry*

and secondly, make available and deploy digital capacities across societies and economies. These activities will be implemented, preserving competition within the internal market, not fettering private investment and in a non-discriminatory and transparent manner. The programme would correspondingly be structured around five interdependent pillars.

Figure 9: Structure of the Digital Europe Programme



3.1.1. Capacity building

High Performance Computing and Data

Implementing the necessary step-change requires coordination and a level of investment that no one Member State can provide alone. Consequently the EU must embark on an ambitious strategy of co-investment with Member States to acquire and upgrade the technology.

The level and scale of this investment is significant. As an example, today, the cost of 2 exascale machines is close to €1B. The networking and upgrading of mid-range computers in MSs requires a similar investment. Meeting Europe's needs for deployment and capacity building in the area will require a commensurate co-investment over the next decade. The EU investment should draw at least the same level of investment from Member States.

High Performance Computing and data: *build up and strengthen the EU's high performance computing and data processing capacities, and ensure their wide use both in areas of public interest such as health, environment, security and by industry, notably SMEs.*

The Commission will implement the European strategy on HPC by supporting a full EU ecosystem that provides the necessary HPC and data capabilities for Europe to compete globally. The strategy aims to deploy a world-class HPC and data infrastructure with exascale capabilities by 2022/2023, and post exascale facilities by 2026/27, endowing the Union with its own independent and competitive HPC technology supply, achieving excellence in HPC applications and widening HPC availability and use.

Activities will cover:

- **A joint procurement framework** for an integrated network of world-class HPC including exascale supercomputing and data infrastructure. It will be accessible on a non-economic basis to public and private users and for publicly funded research purposes.
- **A joint procurement framework of a post-exascale supercomputing infrastructure**, including the integration with quantum computing technologies.

- **EU-level coordination and adequate financial resources** to support the development, procurement and operation of such infrastructure.
- **Networking of Member State HPC and data capacities and support for Member States** wishing to upgrade or acquire new HPC capacities.
- **Creation and networking of HPC Competence Centers**, one per Member State and associated with their national supercomputing centers to provide HPC services to industry (in particular SMEs), academia and public administrations.
- The **deployment of ready to use/operational technology: supercomputing as a service** resulting from R&I to build an integrated European HPC ecosystem, covering all scientific and industrial value chain segments (hardware, software, applications, services, interconnections and advanced digital skills).

Artificial Intelligence

The real value of the data economy⁷⁵ will be captured only if AI is widely adopted by both the public and the private sector. As highlighted by the recent Villani report to the French government⁷⁶, the EU needs first to significantly expand its pool of available data. Promoting open data principles, especially in the public sector, and creating EU-wide data spaces of open, accessible and interoperable data⁷⁷ will provide the engineers, innovators and researchers with the essential resource for wider application of AI in all sectors, from health, mobility and energy to manufacturing and agriculture. It will improve the effectiveness of public services with better decision-making, based on combined data sources and patterns.⁷⁸

Financing a large scale AI testing facility would require €300-400m. Making data sets interoperable and easy to access for AI use (e.g. health data) requires investment of several €100m. EU investment in the Programme should be sufficient to draw a significant investment from Member States and private sector with a direct contribution to the investment of at least the same amount. Overall, the total investment in AI in Europe should be brought closer to competing regions world-wide.

Artificial intelligence: *Build up and strengthen core Artificial Intelligence capacities in Europe including data resources and repositories of algorithms and making them accessible by all businesses, public administrations and researchers as well as reinforcement and networking of existing AI testing and experimentation facilities in Member States.*

Activities will include:

- Creation of **Common European Data spaces** that aggregate public information across Europe and become a data input source for AI solutions. The spaces would also be open to public and private sector. For increased usage, data within a space should be made interoperable as much as possible, both in the interactions between public and private sectors, within sectors and across sectors (semantic interoperability).
- Development of **common European libraries of algorithms** that would be accessible to all. Companies and public sector would be able to identify and acquire whichever solution would work best for their needs.

⁷⁵ AI is estimated to lift GDP growth by 1.2-1.5% until 2030. Source: ITIF (Nov28, 2016), Graetz & Michaels(2015), Evangelista et. al. (2014), McKinsey analysis

⁷⁶ Donner un sens à l'Intelligence Artificielle, Pour une stratégie nationale et européenne, rapport Villani Mars 2018
⁷⁷ in partnership also with the European Data Infrastructure and European Open Science Cloud supported under Horizon 2020

⁷⁸ For example, The INSPIRE Directive (2001/2/EC) obliges the Member States to assure interoperability of spatial data services on 34 themes by end of 2021.

- **Co-investment with Member States in world class reference sites for experimentation and testing in real setting focusing on the applications of AI in essential sectors such as health, mobility, security, manufacturing or finance.** The sites should be open to all actors across Europe and connected to the Network of Digital Innovation Hubs. They should be equipped with large computing and data handling facilities as well as **latest AI technologies** including emerging areas such as neuromorphic computing, deep learning and robotics.

Cybersecurity

The resilience of our financial markets, electric grids, transport, health and many other services depends on our capability to prevent attacks and protect the information. As cyberattacks are constantly growing more complex and incorporate the latest technology⁷⁹, we need to ensure that new cybersecurity tools are developed that match this level of sophistication. In its September 2017 Communication⁸⁰ the Commission stressed that it is in our strategic interest to ensure that the EU retains and develops the essential capacities to secure its digital economy, society and democracy, to protect critical hardware and software and to provide key cybersecurity services.

In order to achieve this, the Communication recognised that Europe needs to go beyond the existing Public-Private Partnership on cybersecurity, and to complement the financial support to research and innovation with support for large-scale deployment and uptake of the latest cybersecurity technology and know-how by the public sector and industry.

Here too the scale of the problem is so big that no Member State alone can develop the necessary response. As an example, establishing a quantum computing facility is a 500 M€ to €1B investment. The investment in the programme should be sufficient to draw a total investment in cybersecurity in the EU that is closer to the competing regions.

Cybersecurity and trust: *Stimulate the building of essential digital capacities to secure the EU's digital economy, society and democracy by reinforcing the EU's cybersecurity industrial potential and competitiveness, as well as improving capabilities of both private and public sectors to protect European citizens and businesses from cyber threats including supporting the implementation of the NIS Directive.*

Activities will include, among others:

- Co-investment with Member States in **advanced cybersecurity equipment**, infrastructures and know-how that are essential to protect critical infrastructures and the DSM at large. This could include investments in quantum facilities and data resources for cybersecurity as well as other tools to be made available to public and private sector across Europe.
- **Scaling up and networking of existing technological capacities** in the competence centers in Member States, and making sure that these capacities respond to public sector needs and industry, including in products and services that reinforce cybersecurity and trust within the DSM.
- **Ensuring wide deployment of the latest cybersecurity and trust solutions** across the Member states. This includes reinforcement of access to cybersecurity and trust technologies in the Digital Innovation Hubs, but also ensuring security and safety by design for products.

⁷⁹

<http://www.enca.com/technology/europol-says-fresh-cyberattacks-likely-sophisticated-than-wannary>

⁸⁰

JOIN(2017) 450 final: Resilience, Deterrence and Defence: Building strong cybersecurity for the EU

- Support to close the **cybersecurity skills** gap by e.g. aligning cybersecurity skills programmes, adapting them to specific sectorial needs and facilitating access to targeted specialised training courses.

Advanced digital skills

All the above gains from common EU investments in new technologies, such as HPC, AI, cybersecurity or blockchain, will only materialise if there are enough skilled people to develop, roll-out and use these new technologies. Advanced digital skills are a Europe-wide problem that needs a coordinated response.

Concrete actions are needed to close the advanced digital skills gap in line with the objectives of the Digital Skills and Jobs Coalition⁸¹, one of the key actions of the New Skills Agenda for Europe.

To fill the current gap, plus the additional demand created by faster growth and new investments in AI, HPC, cybersecurity and digital public services, the growth rate of ICT specialists employed would need to increase from 3.3% per year to 4.3% per year, resulting in an additional 1.3 million specialist ICT jobs by 2027.

Further actions should be stimulated at Member State level and by private sector actors, which would thus cover the entire demand. In order to ensure interventions reach a critical mass, the target should be no lower than the upskilling of 500,000 people.

In its Communication on "enabling the digital transformation of health and social care in the digital single market; empowering citizens and building a healthier society", the Commission proposes a plan to reach 1 Million genomes sequenced by 2023. At the Digital day in Brussels on 10 April 2018, 12 Member States engaged to work together to achieve that goal and linking it to existing Member States effort in this field. The US is planning a 3.8 B€ investment in order to reach 1 Million sequenced genomes.

Advanced Digital Skills: *Ensuring easy access to advanced digital skills, notably in HPC, AI and Cybersecurity for the current and future labour force by offering students, recent graduates, and existing workers, wherever they are situated, with the means to acquire and develop these skills.*

The pillar would offer the opportunity to:

- access on the job training by taking part in **traineeships in competence centres** and companies deploying advanced technologies (building on the Digital Opportunity pilot);
- access to **courses in advanced digital technologies** which will be offered by universities in cooperation with the bodies involved in the Programme (topics will include AI, cybersecurity, distributed ledgers (e.g. blockchain), HPC and quantum technologies);
- participate in short-term, specialised **professional training courses** that have been pre-certified for example in the area of cybersecurity.

Interventions will focus on high-end digital skills related to specific technologies and trainings will have a strong cross-border dimension aimed at high skilled workers mobility in the EU and attracting the world's best talent to work in the EU.

All interventions will be designed and implemented in close cooperation with Digital Innovation Hubs and other EU actions involved in the development and deployment of advanced digital technologies. In terms of delivery of advanced skills to SME's and other players, Digital

⁸¹ <https://ec.europa.eu/digital-single-market/en/digital-skills-jobs-coalition>

Innovation Hubs will play a key role. Their involvement will ensure that interventions are timely, relevant and consistent with the fast-changing needs of the labour market. Technologies such as HPC, Quantum, data analytics, AI, distributed ledger and cybersecurity are fast-developing, so advanced skills programmes and courses will need to reflect this, especially in higher education. Just as initiatives on HPC, AI and cybersecurity need a European response, so do the advanced digital skills linked to them.

3.1.2. *Deployment of Capacities and Interoperability*

Deployment and best use of digital capacities in areas of public interest and interoperability

There is high added value in engaging collectively in the deployment of digital solutions, notably in areas where scale and cross border access are essential success factors.

For areas of safety, security or justice and for administrations in general, the ‘User-Centricity principles’ of the ‘Tallinn Declaration’⁸² should be applied in all public services. For instance, simpler and interoperable administrative procedures such as the ‘once-only’ and ‘digital-by-default’ principles need to be systematically implemented across Europe. Interoperability of solutions will be essential.

A key asset for Europe would be a shared health data space where the data from the patients’ records, self-measured data including the genome data that can be made available in a secure and anonymised way. While the technology for genome sequencing already exists, we lack the actors and investment to use it.

The up-take of digital technologies in education and training systems needs to be scaled up across Europe⁸³ to trigger innovation in education and to support the development of digital skills.

The cost of deploying such technologies EU-wide will be high. Just in eHealth, the investment to digitise Finland’s health system was estimated to be EUR 2Bn. The co-investment envisaged should be significant and proportionate to the objectives under this pillar.

Digitization of areas of public interest with projects involving MSs ensures that public sector and areas of public interests (including but not limited to health and care, education, justice, culture) deliver the best public service, creating the minimum administrative burden on citizens and businesses based on a robust underlying infrastructure.

Work builds on results achieved in the current programming period under the CEF-Telecom and ISA programmes and will make use of the experience gained in those programmes to provide a wider reach and a wider impact in compliance with the European Interoperability Framework

Modernisation of administrations

- Support MSs in the implementation of the Principles of the Tallinn Declaration on e-Government in all policy domains, creating where necessary, the registries needed and interconnecting them in full respect of the General Data Protection Regulation. Provide a coherent eco-system of cross border digital services infrastructure and facilitate seamless end to end, secure, interoperable, cross-border, multi-lingual digital public services and procedures within public administrations.

⁸² http://ec.europa.eu/newsroom/document.cfm?doc_id=47559

⁸³ COM(2018) 22 final, Digital Education Action Plan

- Cooperate towards a European ecosystem for trusted infrastructures using Distributed Ledgers (eg. blockchain) services and applications, including support for interoperability and standardisation and fostering the deployment of EU cross-border applications.

Health

- Ensure that EU citizens can access, share, use, and manage their personal health data securely across borders irrespective of their location or the location of the data. Complete the eHealth Digital Service Infrastructure and extend it by new digital services, support deployment of the European exchange format for electronic health records.
- Make available better data for research, disease prevention and personalised health and care. Ensure that European health researchers and clinical practitioners have access to necessary scale of resources (shared data spaces, expertise and analytical capacities) to achieve breakthroughs in major as well as in rare diseases. The target is to ensure a population-based cohort of at least 10 million citizens. A milestone is 1 million of sequenced genome by 2022.
- Make digital tools available for citizen empowerment and for person-centred care by supporting the exchange of innovative and best practices in digital health, capacity building and technical assistance, in particular for cybersecurity, AI and HPC.

Judiciary

- Enable seamless and secure cross-border electronic communication within the judiciary and between the judiciary and other competent bodies in the area of civil and criminal justice. Improve access to justice and juridical information and procedures to citizens, businesses, legal practitioners and members of the judiciary with semantically interoperable interconnections to national databases and registers as well as facilitating the out-of-court dispute resolution online. Promote the development and implementation of innovative technologies for courts and legal practitioners based on artificial intelligence solutions which are likely to streamline and speed-up procedures (for example “legal tech” applications).

Smart cities, energy and environment

- Deploy decentralised solutions and infrastructures required for large-scale digital applications such as smart cities in support of transport, energy and environmental policies.

Culture and education

- Provide creators and creative industry in Europe with access to latest digital technologies from AI to advanced computing. Exploit the European cultural heritage as a vector to promote cultural diversity, social cohesion and European citizenship. Support the uptake of digital technologies in education.

Additionally a set of Digital Single Market support activities will be supported and will include a pan-European network of Safer Internet Centers to raise awareness and foster digital literacy among minors, parents and teachers, measures aimed at combatting intentional disinformation spread and an EU observatory for the digital platform economy as well as studies and outreach activities.

Digitisation of industry

To speed up the uptake of digital technologies across the EU and address issues of technological accessibility, there is a need to scale up the Digital Innovation Hubs (DIH) and make them accessible for both private and public sectors.

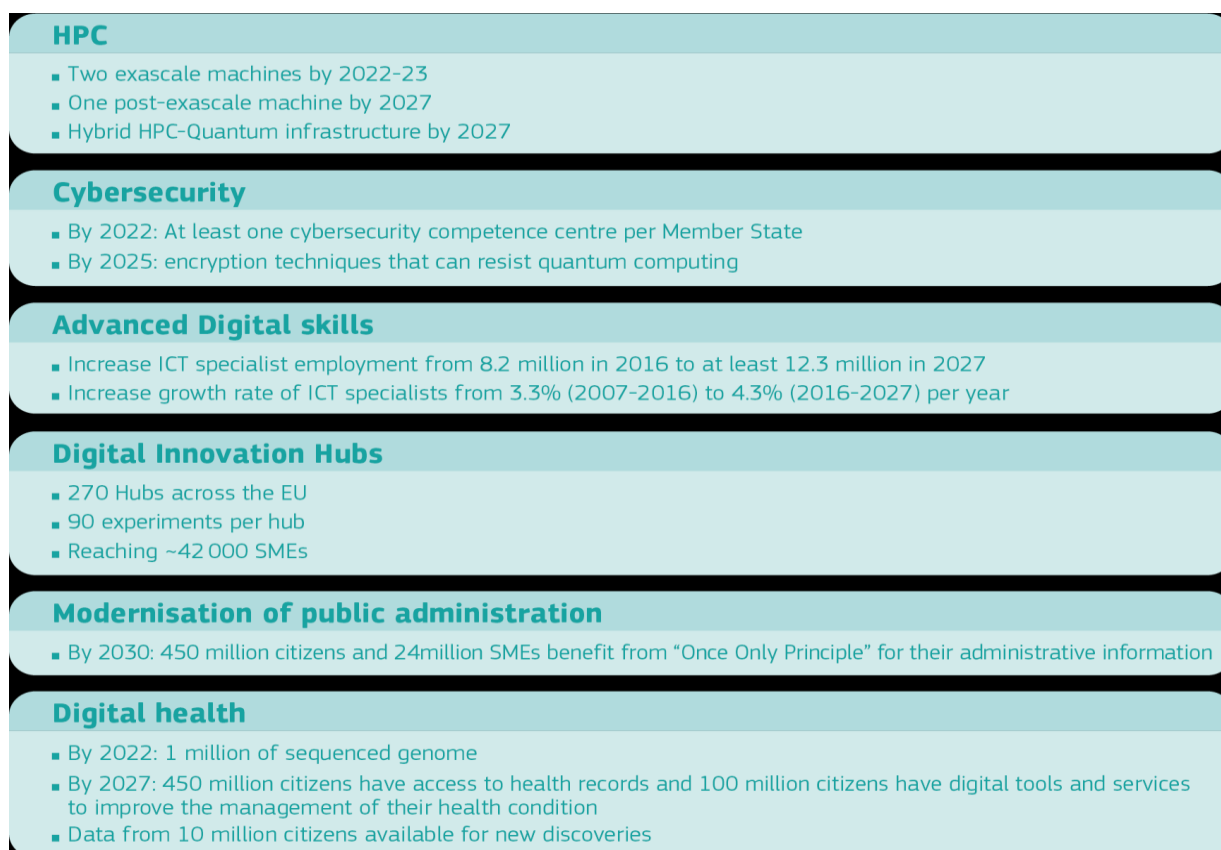
Networking the hubs will ensure that regional best practice can be exported to other regions, and missing expertise can be imported, ensuring an efficient innovation system. Additional help provided by the DIH in the form of grants to support SMEs and valuable information for access to finance, would be crucial to facilitate the digitisation of EU businesses in all sectors.

EU investment should ensure a sufficient leverage factor for the programme to upscale and network DIHs and provide a meaningful contribution to the current gap in private investment in digitisation that is several tens of billion Euros.⁸⁴

Digitisation of industry: *ensuring businesses, notably SMEs, have access to state of the art digital technologies, in particular HPC, AI and cybersecurity, and finance for adapting to digital change. Access to private sector would be done largely on pay per use basis.*

- Contribution to the **upscaling of the infrastructure and technology facilities (equipment, software and tools) of the network of Digital Innovation Hubs** to ensure access to digital capacities to any business, notably SMEs in any region across the EU. This includes notably:
 - Access to Common European Data space and AI platforms and European HPC facilities for data analytics and compute intensive applications
 - Access to AI large scale testing facilities and to advanced cybersecurity tools
 - Access to advanced skills
- Activities will be coordinated with, and will **reinforce the innovation actions supported notably under the Horizon Europe** Programme as well as investments in Digital Innovation Hubs supported under the European Regional and Development Funds. Grants for market replication would also be provided from the Digital Europe Programme in line with state aid rules. Support for access to finance further steps in their digital transformation will be achieved with financial instruments making use of the InvestEU scheme.

Figure 10: Illustrating the level of ambition



⁸⁴

The European Investment Bank estimates that the EU suffers a gap of EUR 90 Bn. a year just to keep up with advanced manufacturing technologies - Restoring EU competitiveness, European Investment Bank, January 2016

3.2. Complementarities and synergies with other programmes

The Digital Europe programme has complementarities and synergies with a number of other proposed instruments in the post-2020 MFF, notably Horizon Europe, Connecting Europe Facility (CEF2), EU Values Fund (MEDIA programme), InvestEU Fund, COSME, European Regional Development Fund, European Social Fund (including Youth Employment Initiative and basic digital skills), Erasmus +, European Globalisation Adjustment Fund (basic and advanced digital skills), Defence Fund, Internal Security Fund, Internal Border Management Fund, Environment and Climate Action (including Energy Efficiency) and European Agricultural Fund for Rural Development.

The section below presents in brief the main complementarities and synergies between the DEP and the most relevant instruments in the digital context. A detailed description of the complementarities and synergies with these – and all other – instruments can be found in annex 3 to this document.

Complementarities and synergies with Horizon Europe

Although several thematic areas are addressed by both Horizon Europe and DEP, the type of actions to be supported, their expected outputs and their intervention logic are different and complementary.

Horizon Europe will provide extensive support to research, technological development, demonstration, piloting, proof-of-concept, testing and innovation including pre-commercial deployment of innovative digital technologies, in particular:

- a dedicated budget in the Global Challenges pillar for "Digital and industry" to develop next generation enabling technologies (Artificial Intelligence and Robotics, Next Generation Internet, High Performance Computing and Big Data, Key Digital Technologies, combining digital with other technologies);
- support to e-Infrastructures under the Open Science pillar;
- the integration of digital across all the Global Challenges (health, security, energy and mobility, climate, etc.); and
- support for breakthrough innovations under the Open Innovation pillar (many of which will combine digital and physical technologies).

Horizon Europe will be the sole centrally-managed EU programme supporting research and technological development and the main programme for demonstration, piloting, proof-of-concept, testing and innovation including pre-commercial deployment. Horizon Europe will cover the innovation chain from basic research to applied research, to prototyping, piloting, demonstration and pre-commercial deployment accelerating wider market uptake. Horizon Europe will not, in general, support deployment at wide scale, infrastructure costs or provide institutional funding (for example the support to research infrastructures is for cross-border access to and integration of research infrastructures and the development of ESFRI pan-European research infrastructures, but not the construction or operational costs).

The DEP, on the other hand, will invest in:

- digital capacity building in High Performance Computing, Artificial Intelligence, Cybersecurity and advanced digital skills; and
- national and regional deployment within an EU framework of digital capacities and latest digital technologies in areas of public interest (such as health, public

administration, justice and education) or market failure (such as the digitisation of businesses, notably small and medium enterprises).

DEP will focus on large-scale digital capacity and infrastructure building. These capacities and infrastructures will support the wide uptake and deployment across Europe of critical existing or tested innovative digital solutions. This will mainly be implemented through coordinated and strategic investments with Member States, notably through joint public procurement, in digital capacities to be shared across Europe and in EU-wide actions that support interoperability and standardisation as part of developing a Digital Single Market.

Synergies between the two programmes will be exploited. As an example, novel digital technologies developed by Horizon Europe will progressively be taken up and deployed by DEP. By the same token, capacities and infrastructures under the DEP will be made available to the R&I community, including for activities supported through Horizon Europe.

DEP and Horizon Europe will align their strategic programming. Their governance structures will involve the respective DGs as well as others concerned by the different parts of the respective programmes.

For their implementation, Horizon Europe and DEP will align operating procedures (e.g. common processes, IT tools, etc.), inter alia using the services provided by the Horizon Europe Common Support Centre.

Horizon Europe initiatives for the development of skills and competencies curricula, including those delivered at the co-location centres of the European Institute of Innovation and Technology's KIC-Digital, will be complemented by DEP-supported capacity-building in advanced digital skills.

Complementarities and synergies with CEF2 and other programmes

CEF2 will provide the trans-European networks supporting high capacity broadband and 5G corridors necessary to enable the deployment of digital services and technologies proposed in the DEP. At the same time the critical infrastructures across sectors - supported by CEF2 – will need the appropriate level of cybersecurity and will thus rely on the deployments made under DEP. In the future only DEP will provide support to the deployment of digital services in areas of public interest.

Clear synergies with the DEP can be found in the 'MEDIA' strand of the EU Values Fund. 'MEDIA' supports targeted actions (e.g. access to content, promotion and audience development) in the digital transformation of the cultural and creative sectors as a whole. The DEP will also support these sectors by providing wide access and adoption of cutting-edge technologies, standards (where needed) and infrastructure necessary for the capacity-building.

With regard to cybersecurity, synergies will be established between the Internal Security Fund, Horizon Europe, the Defence Fund and DEP, supporting a future European Cybersecurity Research and Competence Centre. Synergies may involve the inclusion of civilian, law enforcement and military cyber defence research entities in an EU network to jointly carry out research, solving law enforcement challenges and possibly creating a cluster of expertise involving law enforcement actors.

Complementarities and synergies with the shared managed EU funds

Investments from DEP, ERDF and ESF need to be complementary and mutually reinforcing. Most of the national and regional smart specialization strategies either include ICT research and innovation or the adoption of digital solutions for other fields

of innovation. Given the importance of digitisation for innovation and industrial transition, this should be reinforced. The DEP and Horizon Europe can facilitate cooperation and synergies between the countries and regions and complementarities in the implementation of those programmes at regional, national and European level in a manner which does not distort competition.

At least four of the areas addressed by the DEP (cybersecurity, digital transformation of industry, digital transformation of Services of Public Interest and advanced digital skills) have a clear regional impact but the scope and scale is completely different. DEP aims at building and federating excellence. This is done through procurement and capacity building of facilities which have a European dimension.

The Digital Innovation Hubs will support faster adoption of the latest digital technologies, notably by SMEs. The Hubs are very effective in helping companies with their digital transformation, especially in regions where there is a high industrial activity and an under-investment in digital technologies. At the same time, Local and Regional Administrations (LRAs) have an important role in modernising administrations and services and enabling smart, digital transformations of their territories.

Through the Digital Hubs and the excellence networks the actions supported by the DEP offer clear opportunities for collaboration and coordination with the operational programmes under ERDF policy objective "Smarter Europe".

The DEP will build on and complement other efforts financed among others by the ERDF. For example, the DIHs will be scaled up and networked to allow them to work in partnership with those in other Member States, inter alia by sharing human and technical expertise.

As a further example, the focus on HPC in the DEP is on co-investment (through procurement) in latest supercomputers, the networking of supercomputing centres and the development of application which have an EU interest notably in areas of public interest (health, public administration, climate, etc.). Therefore, programme synergies, attentive to preserving competition within the internal market, could cover the deployment and innovation actions funded through DEP which have a common European Interest or projects with regional relevance jointly funded by DEP and ERDF (e.g. National HPC competence centres) for example addressing the use of HPC in 3D high resolution mapping and analysis of the territory.

Complementarities and synergies with the Erasmus+

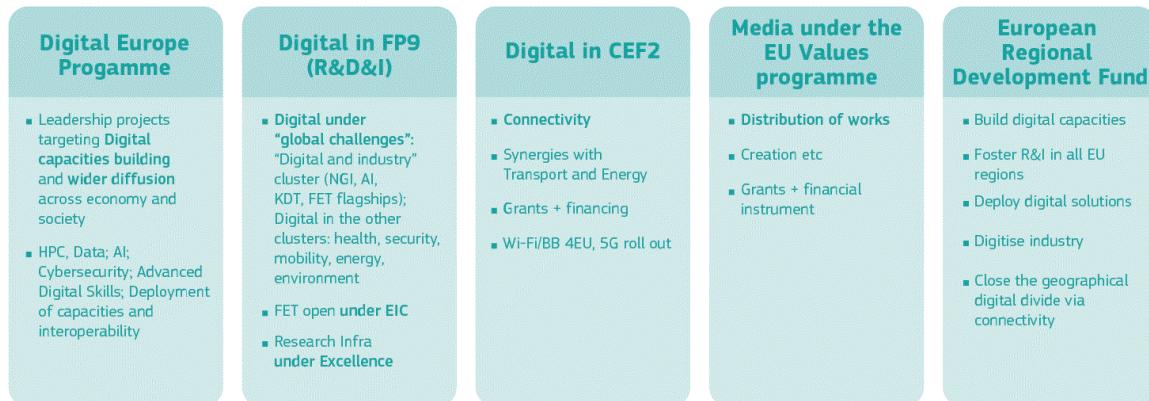
The Action Plan (Digital Education Action Plan (COM(2018) 22 final)) of January 2018 sets out how the Commission, over the coming three years, will support Member States in ensuring that education systems make good use of digital technologies and are prepared for future change. It will also set out measures to support teachers and learners in developing the competences they need to live, work and thrive in the digital age. In particular, one of the priorities of the Digital Education Action Plan is to support the development of digital skills and competences.

The renewed EU agenda for Higher Education (COM(2017) 247 final) address four main challenges by focusing on four corresponding priorities for action, supported by EU-level activities:

- Tackling future skills mismatches and promoting excellence in skills development;
- Building inclusive and connected higher education systems;

- Ensuring higher education institutions contribute to innovation;
- Supporting effective and efficient higher education systems.

Figure 11: Digital in next MFF: Five main complementary blocks



4. DELIVERY MECHANISMS OF THE INTENDED FUNDING

This section will consider delivery mechanisms at various interlinked levels. There are: implementation modes, the specific instruments used, and programming and priority-setting.

4.1. Implementation modes

Given the nature of the activities to be covered under each programme pillar, a one-size-fits-all mechanism should be avoided. The Programme will be implemented directly as provided for by the Financial Regulation or indirectly with the appropriate entities or bodies referred to in Article 58(1)(c) [new 61(1)(c)] of the Financial Regulation.

Without prejudice to the possibility to provide funding in any of the forms laid down in the Financial Regulation the intention is to implement the programme as described below:

- For HPC, the continuation of the EuroHPC joint undertaking which is currently under discussion with the Council is deemed to be the most effective and efficient instrument to implement the HPC strategy, in particular to coordinate national and Union strategies and investments in HPC infrastructure and Research and Innovation, pooling resources from public and private funds, and safeguarding the economic and strategic interests of the Union⁸⁵. The Joint Undertaking is expected to draw budget from both DEP and Horizon Europe.
- Grants relating to AI activities would be awarded directly by the Commission or through an existing agency.
- Most of the cybersecurity related activities would be implemented through the creation of a cybersecurity network and competence centre, as proposed in a separate impact assessment⁸⁶. The cybersecurity activities related to the

⁸⁵ Impact Assessment accompanying the document "Proposal for a Council Regulation on establishing the EuroHPC Joint Undertaking" (<https://ec.europa.eu/digital-single-market/en/news/proposal-council-regulation-establishing-eurohpc-joint-undertaking-impact-assessment>)

⁸⁶ The Impact Assessment on the network of cybersecurity competence centers with a European Cybersecurity Research and Competence Centre is forthcoming.

implementation of the NIS Directive would be managed through an Executive Agency as is currently done, to a limited extent, under CEF.

- Funding relating to the promotion of advanced digital skills would be implemented primarily through the Digital Innovation Hubs. The work programme will be drafted by the Commission in collaboration with the above-mentioned relevant cross-European networks, which would be able in this way to provide the inputs needed to ensure consistency of interventions in the field of advanced digital skills with the latest technological developments. The aim is thus to provide a swift response to the fast-changing needs of the labour market.
- As is currently the case under CEF, funding relating to digitisation of areas of public interest would continue to be managed by an executive agency. European Commission management will continue to be used for development of solutions to ensure common design and architectural interoperability, while the most standardised, mature and non-sensitive services could be delegated to an existing regulatory or executive agency. Whether such an agency could also take over the management of grants, and any modalities for such a transition, would still need to be considered.

The management of specific sectorial core service platforms could potentially be transferred to the operational management of already existing agencies, if this possibility is already provided for in their remit. In the context of the e-CODEX core service platform for example, a potential transfer to the eu-LISA agency is one of the options being explored⁸⁷.

- The digitisation of industry will also be implemented through the Digital Innovation Hubs via an existing executive agency. During the first year of the implementation of the Programme, an initial network of Digital Innovation Hubs shall be established. This initial network shall consist of entities which shall be nominated by each Member State subject to the Commission's approval. Additional Digital Innovation Hubs shall be selected on the basis of an open and competitive process, in such a way to ensure the widest geographical coverage across Europe.

The implementation modes will seek to develop strong synergies between the various components of the Programme and with other programmes at European, national and regional level. These are further described in annex 4 to this document as concerns HPC, AI and cybersecurity.

The sections below provide more details on the implementation modes for each area of intervention along three strands of investment:

4.1.1. Co-investing with MSs in high-cost infrastructure accessible across the EU

For HPC, the intervention will cover the acquisition of machines and equipment for Exascale and post-Exascale. It will also cover the operation of exascale and post-exascale supercomputers and the interconnection of supercomputers across the EU. It will be implemented through EuroHPC Joint Undertaking (which will also implement Horizon Europe supported activities in HPC). There will be co-investment with MSs (MS entrust the JU with their funding) implemented through procurement only (JU procurement). The ownership of the machines will be with the JU and the governance as well.

⁸⁷

Inception Impact Assessment on Cross-border e-Justice in Europe (e-CODEX) (https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-3600084_en)

For Cybersecurity, the intervention will cover the acquisition of advanced cybersecurity equipment and tools. It will be implemented through the Cybersecurity competence network with a European Cybersecurity Industrial, Technology and Research Competence Centre (which will be open to the Defence Fund supported activities in cybersecurity). There will be co-investment with MSs and facilities can be owned, governed and used by members of the network and it will be implemented through procurement only.

For Artificial Intelligence, the intervention will support the establishment of high-cost infrastructures accessible across the EU supporting common data spaces, AI-platform (incl. software tools – European libraries of algorithms) and large scale testing facilities for AI. These will be shared facilities, possibly setup from the ground up, accessible throughout the EU which could involve a subset of “first movers” Member States that are ready to share facilities. The intervention will be supported through Grants implemented under direct management by agency and/or Commission (agency is default) in co-investment with MSs (details to be defined).

4.1.2. Reinforcing existing MS capacities, networking and aggregating - making them available to users across the EU

For HPC the intervention will cover the upgrade or acquisition of MS computing facilities below exascale performance level as well as interconnecting and federating national supercomputers and making them accessible across the EU (super-computing as a service). This will also be implemented by the EuroHPC JU through calls for expression of interest for potential hosting entities, followed by call for tender. There will be joint procurement by JU and MS. The EU financial contribution will be subject to the selected hosting entity allocating access time available EU-wide equivalent to the EU's contribution. The ownership of the equipment will be shared between hosting entity and JU. The governance will be with the JU.

For cybersecurity, the intervention will cover scaling up of existing technological capacities in cybersecurity in MSs, networking them and making them accessible across the EU. This will be implemented through a Cybersecurity competence network with a European Cybersecurity Industrial, Technology and Research Competence Centre mainly through procurement. Selected capacity owners will procure upgrading equipment. EU support will be conditioned on making available a certain percentage of the capacity EU wide, with consideration of the national security conditionings. The ownership will be with the capacity owner. The governance will be entrusted to the Cybersecurity competence network with a European Cybersecurity Industrial, Technology and Research Competence Centre.

For AI, the intervention will focus on reinforcing and connecting Artificial Intelligence capacities in the MS to form an AI hub in Europe in partnership with the European Data Infrastructure and European Open Science Cloud supported under Horizon Europe. This could also address capacities such as datasets and large scale testing facilities that would not necessarily be available EU-wide (eg. could be large scale pilot in AI and Robotics for health involving several sites). This will be implemented through grants under direct management by agency and/or Commission (agency is default). There will be co-investment with MSs.

For skills, the intervention will target the reinforcement of advanced skills capacity building in MS through Traineeships, Bootcamps and Master/specialised Courses where needed. This will be supported through grants implemented under direct management by EU Agency (AI) and JU (HPC) or Cybersecurity specific body. For traineeships, an executive agency will publish a call for Digital Innovation Hubs

willing to provide traineeships in enterprises (or directly through the Digital Innovation Hubs). For Master/specialised courses and bootcamps: the EU Agency, JU HPC or Cybersecurity body will publish calls for education providers willing to design and provide Master/specialised courses and bootcamps.

4.1.3. Ensuring best use of capacities in areas of public interest and industry

Digital Innovation Hubs

Digital Innovation Hubs will be involved in the implementation of the Programme by:

- providing digital transformation services - including testing and experimentation facilities - targeted towards SMEs and midcaps, also in sectors that are slow in the uptake of digital and related technologies.
- transferring expertise and know-how between regions, in particular by networking SMEs and midcaps established in one region with Digital Innovation Hubs established in other regions which are best suited to provide relevant services;
- providing thematic services, including services related to artificial intelligence, high performance computing and cybersecurity and trust to the administrations, public sector organisations, SMEs and midcaps.;
- managing grants, in particular as regards provision of financial support to third parties, in the areas of advanced digital skills and the digitisation of industry.

The Digital Innovation Hubs will receive funding in the form of grants.

Supporting broad use of capacities in areas of public interest and in industry

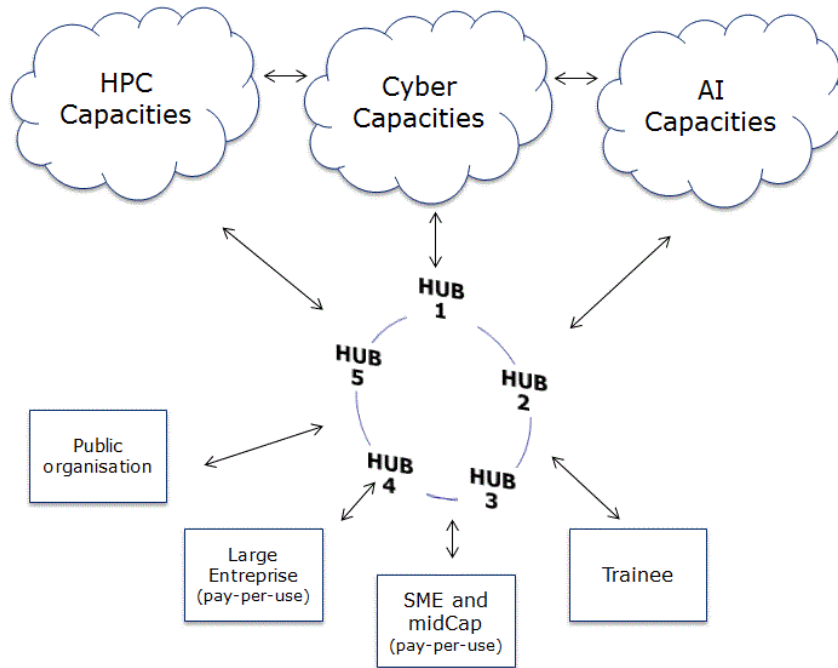
This intervention will be covered by grants implemented under direct management by agency and/or Commission. Procurement can also be used for elements where ownership by the commission (or agency) is required, like e.g. under the current CEF programme.

For industry, this intervention will be covered to a large extent by financial instruments under InvestEU or by grants for market replication activities. Access to capacities will be on pay-per-use basis.

For the example of HPC capacities, the Governing Board of the EuroHPC Joint Undertaking shall define the access rights to the Union's share of access time to the pre-exascale supercomputers and petascale supercomputers in accordance with the following guiding principles:

- Allocation of access time for publicly funded research and innovation activities for any user of a Member State or country associated to Horizon 2020 should be based on a fair and transparent peer review process.
- Access time may be granted without a call for expressions of interest in certain strategic scientific European research initiatives or in emergency and crisis management situations. Up to 20% of the Union's share of access time may be allocated to commercial services on a pay-per-use basis.
- Use of the Union's share of access time shall be free of charge for applications related to publicly funded research and innovation activities. The Governing Board shall regularly monitor granted access per Member State and country associated to Horizon 2020 and per user category.

Figure 12: Overview of main implementation mechanisms



4.2. Instruments

The programme will be implemented through a toolkit of available instruments that would be used depending on the policy need to be addressed and favoring those having the least distorting effect on the market. So as to ensure the achievement of objectives and maximum flexibility throughout the lifetime of the programme, each of the pillars should have the capacity to use the instruments offered by the Financial Regulation.

4.2.1. Use of procurement

Procurement in its various forms will play a prominent role in the implementation of the Digital Europe Programme. In contrast to the USA, China and Japan, innovation procurement instruments have not been used extensively so far by Member States in areas such as HPC or cybersecurity. The procurement of systems is still done by Member States in an uncoordinated way.

The impact assessment for the EuroHPC Joint Undertaking⁸⁸ has highlighted that more joint procurement by Member States could allow Europe to take advantage of efficiency gains. It points to the initiatives of global competitors providing critical mass for procurement, obtaining better value for money in acquisitions, and the link to technology supply, ensuring national suppliers remain at the forefront of technology advancements.

For cybersecurity, there is no common European strategy to develop and acquire costly cybersecurity infrastructures. The specifications and procurement of the necessary equipment are done in an uncoordinated way and are mainly guided by own or national interests without incentive to align with other Member States. Due to limited resources and fragmentation of efforts, this neither guarantees optimal coverage nor constitutes an economically viable solution both in terms of acquisition and optimal exploitation.

⁸⁸ Impact Assessment accompanying the document "Proposal for a Council Regulation on establishing the EuroHPC Joint Undertaking" (<https://ec.europa.eu/digital-single-market/en/news/proposal-council-regulation-establishing-eurohpc-joint-undertaking-impact-assessment>)

The Programme will induce a critical mass for procurement, obtaining better value for money in acquisitions. It will also ensure a tighter link to the technology supply, guaranteeing that national suppliers stay at the forefront of technology advancements.

4.2.2. Use of grants

The new programme will make use of grants notably in the context of the Digital Innovation Hubs⁸⁹ and Artificial Intelligence capacities, in a manner which does not distort competition and threaten to crowd out private investment.

4.2.3. Use of Financial Instruments / budgetary guarantees

As mentioned in section 3, the use of financial instruments is envisaged in particular as regards achieving the objectives relating to private sector digitisation/AI. Financial instruments in the area of Artificial Intelligence aim to address the finance gap and insufficient funding volume dedicated to the uptake of digital technologies and AI in Europe. The use of financial instruments in parallel and/or in combination with grants is critical to maximise the efficiency of the intervention. In order to achieve full integration and coherence with InvestEU and to benefit from the benefits of the scale it offers, financial instruments for AI would be delivered making use of the budgetary guarantee to be proposed in the framework of InvestEU. It would be structured as dedicated financing products supporting digitisation of industry/AI, with a significant budget addressing projects with a higher risk profile and more intensive capital use.

Equity-type investments are required to support the growth of innovative firms proposing AI solutions or the more risky uptake, for example a traditional company that has developed new products and services based on AI. On the other hand, a large group of companies would prefer loans instead of equity in order to remain in full control. The InvestEU Fund would support intermediated loans, to be provided by banks and funds at local and regional level. These financial intermediaries would make use of specifically designed financial products consisting of guarantees or risk sharing for loans. The products can be blended with grants provided directly under DEP.

To accomplish the objectives of the intervention, it is also essential to ensure financing assistance with knowledge, expertise and assurance to respond to business's needs provided by the Digital Innovation Hubs under the DEP programme.

4.2.4. Use of blending

The legal provisions of the DEP will allow for blending of funds. The provision of grants in combination with financial instruments, whenever appropriate through EU-backed financial instruments, National Promotional Banks or private finance to projects aligned with EU high value objectives may be an appropriate support mechanism for projects on the margins of financial viability, where support solely through EU-backed financial instruments, including "InvestEU" backed financial products, would not be sufficient to deliver financial viability. The blending approach might improve the quality of the projects and their efficient delivery.

4.3. Cost/Benefit of a new Programme

The Digital Europe Programme structure and implementation are aimed at minimising the cost of setting up a new programme. The Programme will use existing (or currently

⁸⁹ One could envisage a two-stage process whereby one Digital Innovation Hub per region is selected, which then cascades grants to SMEs and public organisations to experiment and test AI technologies.

being set up) implementation mechanisms including the Joint Undertaking (JU) for HPC, a specific body for Cybersecurity and the network of Digital Innovation Hubs.

It will also use existing delivery systems including the Common Support Centre and executive agencies. The target for administrative costs of the programme will be below 4%, in line with existing programmes.

The overheads introduced by new elements such as the cybersecurity center will be limited since it will be a small entity as relying for the expertise on existing network of national centers.

The benefits will be fit-for-purpose financing instruments (e.g. joint public procurement, support to the reinforcement of MS capacities), clear and visible targets to be achieved while addressing a constituency that is different from e.g. Horizon Europe and CEF2. The governance will also ensure the engagement of all relevant stakeholders.

4.4. Programming and priority setting

DEP is a new instrument designed to cover digital aspects in areas such as AI in which innovation moves extremely fast. In addition, digitisation affects every sector of the economy and society therefore there will be areas of complementarity between DEP and other Commission programmes that need proactive management. For this reason, beyond the initial key concrete objectives identified in this impact assessment and in the legal instrument, it is necessary to have a system of priority setting and programming that adapts with time.

The programme will use either multiannual or annual work programmes. For the purposes of drawing up work programmes, it is envisaged that the Commission may be assisted by a high-level group with representatives of participating states, which may meet in different configurations depending on the area to be discussed. In addition, wide and open consultation will be utilised and an industrial and multi-stakeholder advisory group will be set up on an ad hoc basis.

The Digital Europe Programme will be implemented through ambitious large-scale projects reinforcing the digital capacities and integrating them into solutions with clear targets. This will involve co-investments with Member States and, when needed, the private sector. Involvement of all relevant services of the European Commission is key and therefore an internal coordination mechanism will be set up in order to help DG CONNECT manage the programme and ensure that the maximum level of synergies can be guaranteed. Involvement of DGs will in addition be ensured in the management of specific actions on a variable geometry basis; it is envisaged that DGs other than DG CONNECT would take a leading role on certain projects.

4.5. Competition rules and market distortion aspects

The activities and actions financed under the DEP will not duplicate or crowd-out market-led activities. First of all, as outlined in the previous chapters, the underlying rationale of the programme is to support activities with common good characteristics⁹⁰, These activities are actually not provided by the market or not provided to a sufficient degree, to enable all undertakings and public organisations to make the most of digital technology.

⁹⁰ "Common good" is a well-established concept in contemporary economics. For such goods, consumption is rivalrous yet non-excludable. Positive externalities (for example for society) created by these goods cannot be fully internalized by the provider, leading to non- or undersupply by the market.

Centrally-managed EU funds are not subject to State aid control because the EU budget is not imputable to a Member State and therefore one of the core conditions of State aid, the presence of national State resources, is not met. Moreover, a number of safeguards will be put in place to avoid distortions of competition. The public funding will be allocated through mechanisms (i.e. procurements or open calls for proposals) which exclude any undue selective advantage which could lead to a distortion of competition.

Regarding HPC, there will be no economic advantage at the level of the owner/developer or of the operator. The Joint Undertaking and the HPC competence centres will be acting as a mere intermediary and any actions (acquisition of machines and equipment) will be implemented through procurement only. HPC services including upgrading of MS mid-range facilities, grants to companies, academia and public administrations will be provided on a transparent and non-discriminatory basis and will be made accessible to all entities across the EU.

The cybersecurity-related activities under the DEP would be implemented through the creation of a cybersecurity network and competence centre. There will be no economic advantage at the level of the owner/developer or of the operator. The Cybersecurity competence centre will be acting as a mere intermediary and actions (acquisition of machines and equipment) will be implemented through procurement only. Cybersecurity-related services under DEP, including scaling up existing technological capacities in cybersecurity in MSs, grants to companies, academia and public administrations, will be provided on a transparent and non-discriminatory basis and will be made accessible across the EU.

Grants relating to AI activities would be awarded directly by the Commission or through an existing European Union agency. As regards the involvement of Digital Innovation Hubs, one Hub would be selected per region through an open and non-discriminatory process. There will be no economic advantage at the level of the owner/developer or of the operator of the Innovation Hub. The Innovation Hub will be acting as a mere intermediary.

As regards training and the provision of advanced digital skills, there is no State aid at the level of the individual trained nor at the level of training providers/innovation hubs as these grants are allocated for the provision of a service through an open and non-discriminatory process.

If, under specific and very limited circumstances, the presence of State aid could not be excluded, for example in the case of co-investments by Member States, such aid would fall under the provisions of the General Block Exemption Regulation⁹¹, and other provisions of European law⁹².

⁹¹ Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty

⁹² Small aid amounts would fall under the rules for *de minimis* aid (Commission Regulation 1407/2013 of 18 December 2013 on the application of Articles 107 and 108 of the Treaty on the Functioning of the European Union to *de minimis* aid). Possible aid involved in activities related to HPC, cyber, artificial intelligence or training would be deemed compatible on the basis of the GBER and in particular articles 14, 17-24, 25- 29 and 31. In specific cases, the Communication from the Commission - Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest (2014/C 188/02) may also be relevant.

5. HOW WILL PERFORMANCE BE MONITORED AND EVALUATED?

The Digital Economy and Society Index (DESI) is established as a reference instrument to measure the progress of digitisation in the EU. The DESI instrument has been refined over time and is based on a number of indicators which are derived from rigorous statistical analysis, including indicators to compare the EU with the rest of the world.

Since the Digital Europe Programme focuses on the diffusion and uptake of digital technologies already identified in the DESI: digitisation of industry (AI and HPC), of digital public services (public services), human capital (digital skills) and cybersecurity, which covers both digitisation of industry and public services, many of the existing indicators are relevant. However, in some cases new indicators will need to be developed in order to have detailed feedback on the impact of DEP, e.g. the use of HPC by SMEs.

Thus, it is possible to rapidly and progressively set up a fully dedicated set of indicators for DEP which will monitor the effective progress and impact of the programme. To do so, the existing data collection will need to be amended (e.g. the choice of technologies considered "advanced" could be regularly updated). It is important to set up some new indicators already in 2019 in order to start measuring the effects of the introduction of DEP from the beginning of the programme.

The data collection of the DESI, which captures dissemination effects by surveying the relevant target groups (citizens, (small) businesses) would be complemented by information generated by the programme itself (such as HPC time booking system or DIH's activity reports).

The data collection would also take advantage of the Horizon Europe Common Support Centre and the National Interoperability Framework Observatory wherever synergies are possible. The advantage of using a well proven mechanism that measures the progress of the digital economy is to enable a swift and direct measurement of the impact of DEP in the development of the digital economy and society. The feedback from yearly monitoring will thus allow to adapt the programme management and structure depending on the results obtained.

Specific *impact* indicators will be collected and may in the future be adapted to increase the focus on specific sectors. Existing indicators can be used from annual ICT surveys, and from the labour force survey. Special surveys may be carried out. For *output* indicators, data collection will be systematically part of requirements for programme participants. The data from all participants will be computed and indicators will be reported annually by pillar.

Success would be defined for each of the indicators as reaching a predefined minimum or maximum level. For impact indicators, the appropriate level would be the sum of current trends and additional impacts expected from the programme. Levels would depend on the amount of funding allocated to each sub-programme.

Of course, this monitoring needs to be complemented with specific evaluation tools of the effectiveness of the programme, which includes systematically assessing data and information needs for monitoring and evaluation purposes. Ex-post evaluation arrangements will draw, to the extent possible, on counterfactual impact evaluation techniques. Mid-term evaluation shall be submitted by the end of 2024 to allow three years' operational data. The final evaluation shall be submitted by the end of 2028, at pillar and programme level.

The table below presents some examples of particularly relevant indicators from the set described above, including the key performance indicators coordinated across all Commission services.

	Output		Impact		Data collection
	Indicator	Success	Indicator	Success	
HPC	a) # exascale computers b) # post exascale computers c) Development/Acquisition of hybrid HPC/Quantum Infrastructure	a) 2 exascale computers by 2023 b) 1 post exascale computers by 2027 c) 1 hybrid HPC/ /Quantum Infrastructure	d) Usage of the exascale computers in total and by various stakeholder groups (universities, SMEs etc.)	d) Usage of at least x% of capacity; at least y% by group z	a, b, c) DESI / Commission services/Joint Undertaking/PRACE d) Computer administrator, real time data
AI	a) # data sets in EU data spaces b) % of data sets checked for quality c) # of algorithms developed to use data and made available in libraries d) Total amount co-invested in sites for experimentation and testing e) # of DIHs in network with AI competences	a) > x% increase in # of data sets b) > x% of sufficient quality c) > x% increase in # of algorithms d) > x% increase in investment e) at least one hub per region with AI competences	f) AI indicator (from DESI) - # of companies using AI	f) Increase by x% in # of companies using AI	a), b), c), d) , e), f) DESI / Commission services / JU / surveys / open data portal / European Open Science Cloud support structure
Cyber-security	a) Reinforced network of cybersecurity competence centres. b) # quantum facilities c) Investment level in cybersecurity	a) Network of national cybersecurity competence centres fully operational by 2022 b) Availability of x quantum facilities by 2025 c) Investments above 0.1 % of GDP	d) Level of security of areas of public interest and critical infrastructure in the EU e) Market share of EU industry in cybersecurity	d) Increased level of cybersecurity in the EU e) % of increase of market share of European cybersecurity suppliers	a), b), c) DESI/ Commission Services, Competence centers / ENISA d) Crime statistics ESTAT e) Economic analysis/survey/ study

	Output		Impact		Data collection
	Indicator	Success	Indicator	Success	
Advanced digital skills	a) # participants in financed master courses b) # participants in financed training courses c) # traineeships completed	a) > xx,000 participants in financed master courses b) > xxx,000 participants in financed training courses c) > xxx,000 traineeships completed	d) # ICT specialists employed e) Share of enterprises having difficulty recruiting ICT specialists	d) Increase of annual growth rate of employed ICT specialists from 3.3% to 4.3% e) less than 20% enterprises with difficulty by 2027	a, b, c) programme management d) labour force survey e) DESI/ ICT usage survey of enterprises
Digitization of areas of public interest	a) # of interoperable cross border digital public services delivered across all areas of public sector responsibility (eg. Once-Only principle, Health records, judiciary, safer internet...) b) # of health data sets and analytical capacities available for research	a) > x # of available services delivered b) data from 10 million citizens	c) Take-up of digital public services across all areas of public sector responsibility and the judiciary d) # citizens' data available for research	c) Share of citizens, institutions and companies using digital public services d) # of genomes sequenced	a), b) and c) DESI / ICT usage survey of citizens (annual) c) Justice Scoreboard d) study benchmarking the uptake of innovation procurement of ICT solutions in the EU across different types of public services (annual or bi-annual)
Digitization of industry	e) Reinforced network of Digital Hubs f) # experiments carried out by hubs g) # of SMEs supported by hubs for market replication.	e) One DIH per region across the EU f) xx experiments per hub per year g) xx 000 SMEs reached	h) # Enterprises with high digital intensity score	h) share of enterprises with high digital intensity score above x	e), f), g) DIH accounting h) DESI / Modified ICT usage survey of enterprises (annual)

ANNEX

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Annex 1: Procedural information

1. LEAD DG(S), DeCIDE PLANNING/CWP REFERENCES

This impact assessment report was prepared by Directorate General Communications Networks, Content and Technology (DG CONNECT). The initiative on establishing the Digital Europe Programme (DEP) under the next MFF was included in the Commission proposal for MFF beyond 2020.

The Decide Planning reference of the initiative "Proposal for a Regulation of the European Parliament and Council establishing Digital Europe Programme" is PLAN/2018/[tbc].

2. ORGANISATION AND TIMING

Several services of the Commission with an interest in the assessment of the initiative have been associated in the development of this analysis.

An inter-service steering group (ISSG), consisting of representatives from various Directorates-General of the Commission, was set up in 2018 to steer the evaluation during the key phases.

In 2018, two meetings of the ISSG on establishing the Digital Europe Programme were held.

The first meeting took place on 1 March 2018, attended by DG BUDG, DG DIGIT, DG GROW, DG HOME, DG ECFIN, DG ENER, DG JRC, DG JUST, DG LS, DG MOVE, DG REGIO, DG RTD, DG SANTE, and the Secretariat General (SG).

The second meeting was held on 23 March 2018. The representatives from DG BUDG, DG COMP, DG DIGIT, DG EAC, DG GROW, DG HOME, DG ECFIN, DG EMPL, DG ENER, DG ENV, DG JRC, DG JUST, DG LS, DG MOVE, DG REGIO, DG RTD, DG SANTE, and the Secretariat General (SG) were present. This was the last meeting of the ISSG before the submission to the Regulatory Scrutiny Board on 28 March 2018. The meeting was chaired by SG. Taking these comments from these ISSG meeting into account, DG CNECT updated the impact assessment report.

3. CONSULTATION OF THE RSB

An informal upstream meeting was held on 16 February 2018 with RSB representatives and the participation of SG, DG BUDG and JRC. During this discussion Board members and representatives of the horizontal Services provided early feedback and advice on the basis of a discussion paper. Board members' feedback did not prejudice in any way the subsequent formal deliberations of the RSB.

The impact assessment report was examined by the Regulatory Scrutiny Board on April 25 2018. The Board gave a negative opinion. A revised Impact Assessment was resubmitted on 5 May 2018.

An overview of the comments of the RSB and how they were considered in preparing the revised report is given below.

RSB comments	Changes to IA report
<p>1/ The report does not describe how the proposed spending programme builds on experience to date, both in terms of existing programmes covering digital aspects and examples of similar interventions that proved successful. It also does not demonstrate a clear delineation with the future Research Framework Programme (Horizon Europe).</p>	<p>The section "Lessons Learned" has been revised and describes how the proposed programme builds on existing programmes related to Digital. Several examples of similar interventions in third countries or in MSs have been given in section 1. The delineation with other programmes as agreed with DG RTD is detailed under section 3.2 and in Annex 3. Details on the delineation with Horizon Europe have been brought back from the Annex to clarify this aspect.</p>
<p>2/ The report does not show what market failures the programme responds to in each of the five problem areas, or how it would fill a gap left by other spending programmes.</p>	<p>Section 2 "Challenges and Objectives" has been revamped and describes in detail the market failures and upstream investment gap in the various areas. Section 1.1 has also been completely revised to clarify the logic of intervention.</p>
<p>3/ The report does not explain the delivery mechanisms for each of the five pillars. It is silent on cost coverage of publicly provided infrastructure and services, and potential conflicts with state aid rules. It does not give a clear picture of Member States' commitments to provide financial support.</p>	<p>Section 4.1 "Delivery Modes" has been revised to include more detail on delivery modes for each of the proposed actions. Section 4.5 "Competition rules and market distortion aspects" has been introduced to clarify that the proposed intervention will not duplicate or crowd-out market-led activities. Member' states' commitments have been detailed and clarified under section 1.3 "Stakeholder Consultation".</p>
<p>4/ The report should explain what the proposed new programme could achieve that an increase of the volume of spending programmes that currently fund digitisation activities could not. The report should refer to examples where similar "industrial policy" interventions succeeded in improving competitiveness. It needs to show why European public investment and coordination is necessary, and where the other spending programmes leave a gap.</p>	<p>Section 2 "Challenges and Objectives" and Section 3 "Programme Structure and Priorities" explain in detail what is to be achieved with an increase in funding that cannot be achieved with current intervention mechanisms in the various pillars. Some examples of similar successful policies in the US and in Europe are given in section 1. The gap left by current policies is demonstrated under sections 1.2 "Lessons Learned", 2 "Challenges and Objectives", 2.1.2 "Baseline" and to some extent 2.3 "EU Added Value".</p>
<p>Other issues</p>	
<ul style="list-style-type: none"> • Which proportion of the Fund would be spent on each respective problem and action area • What will not be supported in case the volume of funding falls short 	<p>The report does not provide detailed allocation of budget per area. However, section 3.1 "Structure" provides an indication of the order of magnitude of funding necessary to respond to the needs in each of the areas. The available budget as proposed on 2 May will allow covering all areas proposed in the Digital Europe</p>

	Programme in an impactful and meaningful way. No further prioritisation is needed at this stage but further detail will appear in the Legal and Financial Fiche to be annexed to the legal act.
<ul style="list-style-type: none"> • How the spending programme would be carried out • Delivery mechanism 	Section 4.1 "Delivery Modes" includes a detailed presentation of the common model proposed for delivery articulated along three axes (large shared infrastructure, upgrade and networking of MS capacities and use of capacities). Digital Innovation Hubs are the central element for delivery of expertise to users in the public and private sectors.
How the programme will interact with the existing programmes	Section 3.2 "Complementarities and synergies with other Programmes" has been revised to cover these aspects. See also Annex 3 for details.
Monitoring needs to measure the use of the acquisitions and the success of the policy as a whole	Section 5 "How will performance be monitored and evaluated" has been revised to clarify how the DSM DESI (Digital Economy and Society Index) monitoring tool will be extended to monitor the progress of the Digital Europe Programme.
Report could be more neutral and even-handed	The report was extensively revised to adapt language and make it more neutral and factual throughout.

Following resubmission, the Regulatory Scrutiny Board gave a positive opinion (with reservations) on 8 May 2018 on the understanding that the impact assessment report would be revised to take into account the Board's recommendations.

The report has been revised accordingly: the text has been reviewed to clarify what the proposal builds on and what is new and to better explain why the Digital Europe Programme is a better channel to support the proposed measures; a new section on Member States engagement has been added to better describe the political endorsement of proposed measures and commitment of Member States; the section related to competition rules and market distortion has been reinforced; a new section has been introduced to provide an example of the envisaged pay per use mechanism. In addition, the text now takes into account the comments from other services received during the interservice consultation.

4. EVIDENCE, SOURCES AND QUALITY

Key evidence and sources

- European Digital Progress Report (EPDR)⁹³, European Commission: combines the quantitative evidence from DESI (Digital Economy and Society Index) with country-specific policy insights.

⁹³ <https://ec.europa.eu/digital-single-market/en/desi>

- EPSC Strategic Notes - Back in the Game Reclaiming Europe's Digital Leadership - 28 September 2017. EPSC Strategic Notes are analytical papers on topics chosen by the President of the European Commission.
- Digital Europe: Pushing the Frontier, Capturing the Benefits, McKinsey&Company, June 2016.
- Digital Europe: Realizing the continent's potential, McKinsey Global Institute, June 2016.
- PREDICT (Prospective Insights on R&D in ICT) 2017 data and report⁹⁴ which provides analyses on the supply of ICT and the investments in Research and Development (R&D) in ICT in Europe, with comparison to major competitors worldwide.
- Digital Single Market Mid-Term Review May, 2017⁹⁵
- Van Ark and Van Welsum, Unlocking the ICT growth potential in Europe (a study prepared for the European Commission), 2013.
- OECD Science, Technology and Industry Scoreboard which draws on some 200 indicators drawing on the latest internationally comparable data. The 2017 edition of the OECD Science, Technology and Industry (STI) Scoreboard shows how the digital transformation affects science, innovation, the economy, and the way people work and live. It aims to help governments design more effective science, innovation and industry policies in the fast-changing digital era.
- Report on The Economic Rationale for Public R&I Funding and Its Impact, DG RTD, Policy Brief Series, March 2017.
- Transitions at the Horizon: Perspectives for the European Union's future research- and innovation-related policies. Final report of project BOHEMIA (Beyond the horizon: Foresight in support of the EU's future research and innovation policy), 2018).

All evidence and sources cited above are from trusted quality sources.

Further Sources

- Impact Assessment accompanying the document "Proposal for a Council Regulation on establishing the EuroHPC Joint Undertaking"⁹⁶
- Commission Staff Working Document Impact Assessment accompanying the Proposal for a Council Regulation on a common European initiative on High Performance Computing⁹⁷
- COM 2018 [to be adopted] eHealth. Enabling the digital transformation of health and care in the Digital Single Market; empowering citizens and building a healthier society

⁹⁴ <https://ec.europa.eu/jrc/en/identities/predict-prospective-insights-rd-ict>

⁹⁵ <https://ec.europa.eu/digital-single-market/en/news/digital-single-market-mid-term-review>

⁹⁶ <https://ec.europa.eu/digital-single-market/en/news/proposal-council-regulation-establishing-eurohpc-joint-undertaking-impact-assessment>

⁹⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018SC0006>

- EC study: Survey on the access to finance of enterprises (SAFE)⁹⁸, Analytical Report 2016
- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions on the Mid-Term Review on the implementation of the Digital Single Market Strategy - A Connected Digital Single Market for All⁹⁹
- Council conclusions May 2013 on the Cloud Communication, highlighting the role of HPC in the EU's innovation capacity and stressing its strategic importance to the EU's industrial and scientific capabilities as well as to its citizens
- Council conclusions on cultural and creative crossovers to stimulate innovation, economic sustainability and social inclusion (2015/C 172/04).
- Council conclusions May 2015 on the digital transformation of European industry (8993/15)
- Conclusions of the European Council meeting 19 October 2017 (EUCO 14/17)
- Conclusions of the European Council meeting 14 December 2017 (EUCO 19/1/17 REV 1)
- Conclusions of the Council meeting 23 January 2018 (ECOFIN XX/18)
- Proposal for a Council Regulation on establishing the European High Performance Computing Joint Undertaking¹⁰⁰
- Digital Agenda key indicators, Latest data available (2016 and 2017)¹⁰¹
- Digital Transformation Market Analysis, 2014 – 2025, Grand View Research, 2017
- ICT for work: Digital skills in the workplace. Final report, Ecorys (2016), Study prepared for the European Commission, DG Communications Networks, Content & Technology.
- Restoring EU competitiveness, European Investment Bank, January 2016
- Investment Report 2017/2018: from recovery to sustainable growth, Key findings, European Investment Bank, 2018¹⁰²
- eGovernment Action Plan 2016-2020¹⁰³
- eGovernment Benchmark report 2017¹⁰⁴
- Motion for a European Parliament Resolution with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103 INL)

⁹⁸ https://www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html

⁹⁹ <http://eur-lex.europa.eu/legal-content/EN/TXT/DOC/?uri=CELEX:52017DC0228&from=EN>

¹⁰⁰ <https://ec.europa.eu/transparency/regdoc/rep/1/2018/EN/COM-2018-8-F1-EN-MAIN-PART-1.PDF>

¹⁰¹ https://digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators/visualizations

¹⁰² http://www.eib.org/attachments/efs/economic_investment_report_2017_key_findings_en.pdf

¹⁰³ <https://ec.europa.eu/digital-single-market/en/news/communication-eu-egovernment-action-plan-2016-2020-accelerating-digital-transformation>

¹⁰⁴ <https://www.capgemini.com/consulting/resources/egovernment-benchmark-2017-report/>

- Net losses: Estimating the Global Cost of Cybercrime, McAfee & Centre for Strategic and International Studies, 2014
- ITIF (Nov28, 2016), Graetz & Michaels (2015), Evangelista et. al. (2014), McKinsey analysis
- Artificial intelligence the next digital frontier?, McKinsey Global Institute, 2017
- Final report on study "Long-term sustainability of digital service infrastructures"¹⁰⁵
- Report on the European Cloud Initiative (A8-0183/2017)¹⁰⁶
- State of Health in the EU "Companion Report 2017"¹⁰⁷
- The State of the European tech 2017¹⁰⁸, Atomico
- Tallinn Digital Summit, Conclusions of the Prime Minister of Estonia, Juri Ratas¹⁰⁹
- 2017 Special Eurobarometer 460¹¹⁰

¹⁰⁵ <https://publications.europa.eu/en/publication-detail/-/publication/ed6ddbc9-c8f2-11e7-9b01-01aa75ed71a1/language-en>
¹⁰⁶ <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2017-0183+0+DOC+XML+V0//EN>
¹⁰⁷ https://ec.europa.eu/health/state/summary_en
¹⁰⁸ <https://2017.stateofeuropantech.com/>
¹⁰⁹ <https://www.eu2017.ee/news/insights/conclusions-after-tallinn-digital-summit>
¹¹⁰ https://data.europa.eu/euodp/data/dataset/S2160_87_1_460_ENG

Annex 2: Stakeholder consultation

Stakeholder consultation and engagement to inform this proposal have been a continuous process. Overall, the proposed structure of the Digital Europe Programme responds directly to the needs identified by stakeholders. The top structure of the Programme stems directly from the EU leaders summit and the Programme captures the issues identified by the leaders, by the Competitiveness Council and several other Council formations. As developed in previous sections, the readiness of Member States to deepen their cooperation in areas proposed in this Programme has been tested in various ways including round tables, Digital Day conferences and council conclusions.

In addition, a formal stakeholder consultation (public consultation) complemented the Commission's broader interaction with stakeholders (such as meetings or workshops). In the outline below, the views of stakeholders, across the board, who stand to benefit from Digital transformation in Europe, are explained. Stakeholders include political decision makers, industry and research representatives, technical experts as well as end-users and the broader public.

Following up on both quantitative and qualitative assessment of the collected feedback, the results of the stakeholder consultation, especially the stakeholder views related to the digital transformation, feed into the Impact Assessment for the programme and help to shape the draft of the legal text.

Consultations methods and tools

A mix of consultation activities have been run to ensure stakeholder views are systematically accounted for in the process of formulating the post 2020 EU programme for the Digital Europe Programme.

To tailor for different information needs, consultation activities range from stakeholder conferences and events, to expert groups, an on-line consultation, workshops, meetings and seminars and analysis of the position papers. The following categories of sources were considered:

- Open Public Consultations for the MFF (10/1 - 9/3 2018) in the areas of:
 - Strategic infrastructure; Cohesion; Migration; MFF Post 2020 Investment, MFF Post 2020 Values; Security
- On-line consultations on the Digital Single Market website of the European Commission in 2017¹¹¹.
- Position of the Member States
- Broad range of workshops and meetings with relevant stakeholders, such as the Tallinn Digital Summit and the Expo (attended by 4000 people) illustrating the impact that digital developments has on society in support of European competitiveness¹¹² (September 2017) and others (see details in relevant section below)
- Other sectoral Public Consultations such as e.g. the consultation on health and care in the Digital Single Market (1400 respondents) and third party surveys -

¹¹¹ <https://ec.europa.eu/eusurvey/runner/Eurohpc>

¹¹² https://www.eu2017.ee/sites/default/files/inline-files/TallinnDigitalSummit_Conclusions_0.pdf

The 2017 Eurobarometer survey (Standard Eurobarometer 87, 27,901 consulted)¹¹³

Target groups

Views were sought from the following type of stakeholders relevant to the Digital Europe Programme:

- scientific communities and associations, scientific users (e.g. HPC infrastructures - the 29 large ESFRI research infrastructures and the PRACE scientific users, each reaching hundreds of actors, EUDAT, EGI, etc.).
- Member State & governmental institutions.
- Participants in national and EU-funded projects
- Public-private partnerships (e.g. on HPC and Big Data PPPs)
- Other intermediaries (e.g. Centres of excellence for supercomputing applications, cybersecurity, IA, service providers, access providers(s))
- Industry associations

Relevant workshops and meetings with a wide range of relevant stakeholders

<i>Stakeholder engagement activity</i>	<i>Scientific/expert Users</i>	<i>EU Member States</i>	<i>Projects</i>	<i>PPPs</i>	<i>Intermediaries</i>	<i>Associations</i>
Tallinn Summit and exhibition Tallinn Digital Summit and the Expo (attended by 4000 people) illustrating the impact that digital developments has on society in support of European competitiveness (September 2017)						
HPC						
Digital Day of 23 March 2017 in Rome in the presence of 250 HPC stakeholders						
Workshop on EuroHPC governance in Rome with 50 participants. (23 March 2017)						
Eleven meetings with the Sherpas of the EU Member States on HPC						
European Open Science Cloud summit on 12 June 2017 in Brussels						

¹¹³ <http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/Survey/getSurveyDetail/instruments/STANDARD/surveyKy/2143>

Workshop on the European micro-processor in Brussels (18 January 2017)						
Multiple meetings with key stakeholders (PRACE, ETP4HPC, visits to supercomputing centres, international conferences) 2017						
General assembly of ETP4HPC in Munich (21 March 2017)						
PRACE days in Barcelona, gathering the whole HPC community (15-18 May 2017)						
Cyber						
High Level Roundtable chaired by Vice President Ansip on the creation of Cybersecurity Network and Competence Centre (5 December 2017)						
Meetings of the Council Horizontal Working Party on Cybersecurity (2017)						
Draft Cybersecurity Market Study conducted by PwC (October 2017)						
In 2018, a targeted online public survey was launched for the self-registration of cybersecurity centres of expertise. The consultation included questions on the different domains of expertise of each self-registered body						
A 12-week online public consultation launched in 2017 to seek views of the wider public (approx. 90 respondents) on ENISA evaluation and review.						
A 12-week online public consultation that was carried out in 2016 at the occasion of the launch of the contractual public-private partnership on cybersecurity (approx. 240 respondents). Survey of the network of national Computer Security Incident Response Teams (CSIRTs) set up by the NIS Directive.						
A general open public consultation carried out in 2018 on the topic of security in relation to the next MFF. (10 January to 9 March 2018)						
A general open public consultation carried out in 2018 on the topic of investment, research & innovation, SMEs and the single market. (10 January to 9 March 2018)						
Two Workshops on the future Network and Centre's governance model (23 February and 22 March 2018)						

Artificial Intelligence & Digitising European Industry						
Stakeholder Forum, in Essen with 500 stakeholders (January 2017)						
Digital Day in Rome in the presence of 100 participants: The launch of European Platform of national initiatives on Digitising European Industry. (23 March 2017)						
Roundtables of the European Platform of national initiatives with 200 participants (November 2017, September 2016)						
Working group meetings of Digital Innovation Hubs (100 participants), (5 times in 2017 and 2018)						
Public Services						
Tallinn Ministerial eGovernment declaration with ~250 delegates (including the 32 ministers) (5-6 October 2017)						
Connecting Europe with Building Blocks with 400 participants (7 December 2017)						
Online consultation on Public consultation on health and care in the Digital Single Market. (20 July to 12 October 2017)						
2017 EU Justice Scoreboard						
Advanced Skills						
Digital Day Rome (23 March 2017)						
European Week of Region and cities dedicated workshop – investing in digital skills for youth						
Gotheborg Summit November 2017						
Digital Skills and Jobs Coalition annual conferences (8 December 2017) gathering 400 stakeholders.						

Open Public Consultations

The aim of an online public consultation is to gather inputs from a broad range of stakeholders. The consultation gave unlimited access to anyone who wished to contribute, experts and the public alike. The list contains information on the nature of the consultation, the date and summary reports.

Overall, results of the online stakeholder consultations show the extent of support for a more efficient, less fragmented approach to maximise the benefits of digital transformation to all European citizens and businesses in the EU. This is particularly

pertinent for the key domains of the Digital Europe Programme, i.e. HPC, Cybersecurity and Artificial Intelligence as well as advanced skills and digitisation of areas of public interest.

Open Public Consultations - highlights

This section presents the results of the online public consultations on the post-2020 Multiannual Financial Framework which took place between 10th January 2018 and 9th March 2018. It should be noted that the on line consultation did not address new programmes such as the Digital Europe Programme. It only addressed the future of established programme. Nevertheless approximately 14% of responses addressed issues related to the Digital Europe Programme. The example responses below give a flavour of the nature of the comments related to the Digital Europe Programme¹¹⁴.

- *"Pooling of funds at a European level has much more impact especially in regards to digital economy."*
- *"Promote and ensure digital sovereignty (only with its own competences and capacities in strategic important areas of ICT, Europe can drive the digital transition and is able to compete globally)"*
- *"Integrated care is partially addressed by: - Horizon 2020, incl. SCI-Health and IMI2, LEIT-ICT - Digital Single Market strategy. However digital health still faces significant challenges as yet unsolved "*
- *"Ensure Cybersecurity is and has to be a factor that's crucial to the success of the digital economy, guaranteeing trust in digital technologies - Maintain and improve competitiveness of EU industry."*
- *"ERC grants National funders do not fund the kind of innovative large-scale projects funded by this program, which is essential to go beyond the frontier of research."*
- *"Can be improved by better aligning legislation, funding opportunities, large-scale deployment, smart procurement at regional, national, EU level".*

Regarding the specific online public consultation on 'Strategic Infrastructure' which include 'CEF – Digital', results indicate that stakeholders from the Digital sector support an increased EU investment in the state-of-the-art digital infrastructure seeing it as a catalyst to all other economic sectors' growth.

Connectivity is seen as central to participation in the economy and society, and they pinpoint that a proper infrastructure including broadband and 5G will set up Europe as a serious player in the global digital economy.

Other stakeholders highlighted the need to increase competitiveness of the EU through connectivity across the EU with strong a focus on rural areas. Connectivity, 5G and interventions in these fields are seen as the key factor in improving economic performance, promoting qualitative leaps and generating jobs in the EU.

Position of the Member States

¹¹⁴ In adherence to data protection rules (Regulation (EC) 45/2001), reference to all sources have been removed.

Most Member States positions on the scope of the Digital Europe Programme have been expressed in European Council conclusions or European Parliament resolutions:

- The recent (12.3.2018) Council of the European Union ministerial discussion on the digitalisation of the EU economy (in the context of the European semester cycle) reiterated that a fully functioning internal market in the digital age is a fundamental pillar for strengthening industrial competitiveness.
- The Tallinn Digital Summit of September 2017 and the Conclusions of the European Council of 19 October 2017 indicated the need for Europe to invest in digitising our economies and addressing the skills gap to maintain and enhance European competitiveness, our quality of life and social fabric.
- The European Council meeting on 19 October 2017 (EUCO 14/17) conclusions state: that Digitalisation offers immense opportunities for innovation, growth and jobs, will contribute to our global competitiveness, and enhance creative and cultural diversity. Seizing these opportunities requires collectively tackling some of the challenges posed by the digital transformation and reviewing policies affected by digitalisation.
- The support to the Union's intervention in the area of HPC was expressed by the Council and, by the European Parliament. Moreover, in 2017 nine Member States signed the EuroHPC Declaration, a multi-government agreement where they commit to collaborate with the Commission to build and deploy state-of-the-art HPC and data infrastructures in Europe that would be available across the EU for scientific communities, public and private partners.
- In its resolution of 1 June 2017 on digitising European industry the European Parliament highlighted the importance of a common European cybersecurity approach, recognising the need to raise awareness and considers cyber-resilience as a crucial responsibility for business leaders and national and European industrial security policymakers.
- The European Council in its conclusions of 19 October 2017 stressed that to successfully build a Digital Europe, the EU needs in particular labour markets, training and education systems fit for the digital age and that there is a need to invest in digital skills, to empower and enable all Europeans;
- The European Council in its conclusions of 14 December 2017 called on Member States, the Council and the Commission to take forward the agenda of the Gothenburg Social Summit of November 2017 regarding education and training. The European Council also asked the Commission, the Council and the Member States to examine possible measures addressing the skills challenges linked to digitalisation, cybersecurity, media literacy and artificial intelligence and the need for an inclusive, lifelong-learning-based and innovation-driven approach to education and training.
- European Parliament resolution of 1 June 2017 on digitising European industry stresses the importance of unlocking sufficient public and private finance for the digitisation of Europe's industry.
- In its Tallinn Declaration on eGovernment at the ministerial meeting during Estonian Presidency of The Council of the EU in its Tallin declaration of 6 October 2017: concluded that digital progress is transforming our societies and

economies to the core, challenging the effectiveness of previously developed policies in a broad range of areas as well as the role and function of the public administration overall. It is our duty to anticipate and manage these challenges to meet the needs and expectations of citizens and businesses.

- The platform of National Initiatives on Digitisation of European Industry concluded on 17 November 2017 that there is a significant added value in EU-wide actions to support the digitalisation of i.a. through co-investment and access to finance.
- The Council Conclusions on 7 December 2017 on health in the digital society called for making progress in data-driven innovation in the field of health. The Council emphasised that it is important to embrace the possibilities of the digital society, to enable people to better understand and manage their own health with easier access to information and digital tools.
- At the European Council meeting on 19 October 2017 Member States concluded the Union needs a sense of urgency to address emerging trends: this includes issues such as artificial intelligence and blockchain technologies, while at the same time ensuring a high level of data protection, digital rights and ethical standards. The European Council invited the Commission to put forward a European approach to artificial intelligence by early 2018 and called on the Commission to put forward the necessary initiatives for strengthening the framework conditions with a view to enable the EU to explore new markets through risk-based radical innovations and to reaffirm the leading role of its industry.

Sector specific stakeholder workshops

The results of the workshop with national cybersecurity competence centres confirmed the need to build digital capacities in Europe and provide access to testing and experimentation infrastructure. The examples included access to hardware (e.g. access to HPC), software (e.g. access to AI, creation of software testing platforms) or real time data sets. This was supported by a comparison with the opportunities available in the US, where stakeholders have access to very large scale real time data and laboratories where these can be tested helping them to advance their projects and get them to the market. Participants warned about the current state-of-play where innovation is led by the development by large private companies from outside Europe. Participants encouraged collaborative co-investing in large scale experimentation, which could be then used by researchers from across Europe.

Stakeholders frequently refer to the advanced digital skills gap and the need to increase the number of engineers and other profiles specialised in HPC, cybersecurity and AI. 63% of all respondent to the public consultation on EU funds in the area of investment, research & innovation, SMEs and single market find very important that EU funds support education and training policies (another 37% finds it important).

Other sectoral Public Consultations

Findings from online consultations and surveys carried out by other policy areas also show the extent of demand for digital transformations of our economy and society in the public sector (e.g. health, legal services).

For example, the main findings of the public consultation on health and care in the Digital Single Market show that over 93% of over 1400 respondents to an online questionnaire believe that “Citizens should be able to manage their own health data”. Furthermore, 83% of all respondents either agree or strongly agree with the statement that “Sharing of health data could be beneficial to improve treatment, diagnosis and prevention of diseases across the EU”. The overwhelming majority of all respondents (73.6%) identify improved possibilities for medical research as a reason for supporting cross border transfer of medical data, which was higher than for their purpose of their own treatment (67.8%).

Risks of privacy breaches and of cybersecurity are on the top of the lists among the major barriers identified to the cross-border transfer of medical data. Other than these, the current lack of infrastructure (51%) and the heterogeneity of electronic health records (58.2%) also scored high on the lists. To overcome these barriers, the following activities for the EU were strongly supported: developing standards for data quality and reliability (59.6%), standardizing electronic health records (56.8%), proposing health-related cybersecurity standards (54.4%) and supporting interoperability with open exchange formats (53.4%). To propose legislation setting the technical standards enabling citizen access and exchange of Electronic Health Records across the EU was supported by nearly 40% of respondents.

These findings are endorsed by the results of the Eurobarometer findings (27,901 consulted). The majority of European citizens (52 per cent) would like to have online access to medical or health records. 70 per cent of European citizens would be ready to share personal health and wellbeing data (medical and care data, lifestyle, physical activity, nutrition, etc.). 18 per cent of European citizens have accessed health and care services online (remotely) at least once over the last 12 months.

Similar findings are available in other domains, for example the 2017 EU Justice Scoreboard¹¹⁵ provides an overview of the efficiency, quality and independence of justice systems in the EU. Effective justice systems are essential to build trust in the single market and create a business and investment-friendly environment. ICT systems in courts play an increasingly important role in cross-border cooperation between judicial authorities and also ease the implementation of EU legislation. Key findings of the 2017 edition shows limited use of digital technologies in some countries (e.g. the use of electronic signatures is very limited in over half of EU countries), while new data underlines the importance of digital technologies for well-functioning justice systems.

Thus, there is strong support among respondents for European Union action at an appropriate scale on privacy, security and interoperability, as well as for training of a skilled workforce with the necessary IT skills and competences to deliver improved public services.

Methodology and tools used to process the data

Information collected during the consultation were analysed according to the consultation methodology. Reports from conferences, workshops and expert groups were prepared and published. The results of the on-line consultations as well as the position paper were carefully analysed against the key issues identified in the process of the impact assessment preparations.

¹¹⁵ https://ec.europa.eu/commission/news/commission-publishes-2017-eu-justice-scoreboard-2017-apr-10_en

Annex 3: Complementarities and synergies with other programmes

Complementary to section 3.3. of the impact assessment, this annex looks at the main complementarities and synergies between the Digital Europe programme (DEP) and other proposed instruments in the post-2020 MFF.

Overall, the sub-headings under the next multiannual budget must be closely aligned, be compatible and avoid any duplication of funding. This can best be achieved through ensuring a common vision at EU level and remaining focused on the desired outcomes and impact.

Synergies between the programmes will make investments more effective and provide better value for citizens. They will amplify the impact of EU-level digital investments on the ground, while national and regional digital investment will be able to better complement the EU programmes.

By increasing the impact and efficiency of public funds through practical linkages between the different programmes, the EU will tackle digital challenges in a more targeted and streamlined way; creating more jobs, increasing growth and boosting competitiveness. In the implementation of DEP, attention will be paid to preserving competition within the internal market.

The end result is a set of future EU funding programmes that are simple, relate better to each other and are straightforward for applicants and citizens to engage with.

It is structured around the most relevant groupings of instruments:

- Strategic Infrastructure
 - CEF2
 - InvestEU Fund
- Single Market
 - Digital services for the Single Market
 - COSME
- Economic, Social and Territorial Cohesion
 - European Regional Development Fund (ERDF) and European Social Fund (ESF)
- Investing in People and European Values
 - European Social Fund, including Youth Employment Initiative, Basic digital skills
 - Erasmus +
 - EU Values Fund (Justice, Rights Equality and Citizenship, Consumers), including European Culture, Rights and Values (including MEDIA)
- European Globalisation Adjustment Fund (basic and advanced digital skills)
- Border Management and Security
 - Internal Security Fund

- Environment
 - Environment and Climate Action, including Energy Efficiency
- Agriculture and Fisheries
 - European Agricultural Fund for Rural Development
- Research and Innovation
 - Framework Programme 9 (Horizon Europe)

Strategic Infrastructure

Complementarities and synergies with CEF2

The investments planned in the CEF2 programme for the digital sector will cover the needs of the physical infrastructure supporting high capacity broadband networks, from backbone to access networks, in view of ensuring coverage to specific communities/areas and socio-economic drivers, as well as coverage along major terrestrial transport paths. CEF2 will thus provide the infrastructure necessary to support the digital transformation of industry, economy, public administration and society at large. Contrary to what is done in the current MFF, CEF2 will not provide support to the deployment of digital services in areas of public interest, as this will be done within the scope of the new Digital Europe Programme.

Clear synergies exist: on the one hand without the infrastructure provided by CEF2 Digital, the services and technology proposed in the Digital Europe Programme will not be possible, on the other the critical infrastructures supported by CEF2 in all sectors will need the appropriate level of cybersecurity and will rely on the deployments done in DEP. As the programme develops synergies will be exploited taking into account specific areas needs and timeline alignment.

Complementarities and synergies with InvestEU Fund

The implementation of the InvestEU Fund involves the use of financial products, predominantly in the area of the support to the digitisation of industry, including SMEs, and on the deployment of sustainable infrastructure. The synergies with the InvestEU Fund will be ensured by making use for the digital projects of the financial possibilities offered by the InvestEU Fund and by establishing blending facilities supporting the combination of DEP grants and financial products under the InvestEU Fund. In addition, access to financial instruments by companies will be facilitated by the support provided by Digital Innovation Hubs.

Single Market

Complementarities and synergies with the Single Market Programme (SMP)

The activities under SMP will ensure the sufficient design, piloting and uptake of digital solutions that are fit-for-purpose to the Single Market. It will ensure that generic digital services are adapted to the specific needs of the Internal/Single Market while securing compliance with mainstream digital policies and IT corporate standards. Generic digital building blocks made available through DEP might be combined to offer fit-for-purpose Internal Market solutions. Solutions deployed to serve the SMP needs will be complementary to those developed in DEP and interoperability will be ensured.

Complementarities and synergies with COSME

The future COSME programme will address the market failures which affect all SMEs, and will promote entrepreneurship and the creation and growth of companies. Thus it will focus on generating growth opportunities for mainstream enterprises. Under the Framework programme 9 (Horizon Europe), the European Innovation Council (EIC) will support the scale-up of innovative start-ups, SMEs and mid-cap firms, while a Guarantee scheme will focus on R&I-driven innovative companies.

The Digital Europe Programme will provide for the wide deployment of essential digital capacities, including their uptake by all industry and public organisations attentive to preserving competition within the internal market. SMEs in particular will be supported by Digital Innovation Hubs to overcome their knowledge gap regarding digital transformation. After experiencing how beneficial the new digital technologies such as AI can be for their business, SMEs will have the possibility to access financial intermediaries for growth finance. Full complementarity will be ensured between the DEP and the scaling-up instrument under the future COSME, including support services for SMEs.

For the implementation of programmes (COSME+, and DEP), it will be important to continue using the existing SME support structures put in place by the Commission, notably the Enterprise Europe Network (EEN), the Digital Innovation Hubs and also to complement them for more specific support, which is expected by EU firms for digitisation attentive to preserving competition within the internal market, including not crowding-out private investment. It should also allow for both economies of scale and a more efficient implementation of policy objectives.

The Digital Innovation Hubs will provide specific support in a manner which does not distort competition between competitors for the uptake of digital technologies, which also require a technological expertise. EEN should be used for reaching out to new markets, and newly designed services. It is important to mainstream support for digitisation through dedicated instruments at relevant scale.

Economic, Social and Territorial Cohesion

Complementarities and synergies with the Union funds under shared management

The digital transformation in Europe needs the joint effort of all interested parties to succeed. Investments from DEP, ERDF and ESF need to be complementary and mutually reinforcing. Most of the national and regional smart specialisation strategies either include ICT research and innovation or the adoption of digital solutions for other fields of innovation. Given the importance of digitisation for innovation and industrial transition, this will be further strengthened. The DEP and Horizon Europe can facilitate cooperation and synergies between the countries and regions and complementarities in the implementation of both programmes at regional, national and European level in a manner which does not distort competition.

At least four of the areas addressed by the DEP (cybersecurity, digital transformation of industry, digital transformation of Services of Public Interest and advanced digital skills) have a clear regional impact but the scope and scale is completely different. DEP aims at building and federating excellence. This is done through procurement and capacity building which have a European dimension. For example a national or regional supercomputing center being part of a federated cluster will develop skills and applications that can be utilized all over Europe including, in the case of the outermost regions which are remote from the European continent, in neighbouring Overseas Countries and Territories and associated countries. DEP will use the digital innovation

hubs as the catalyst for innovation at regional level. The establishment of digital innovation hubs in each region is a specific target of DEP.

The Digital Innovation Hubs will support faster adoption of the latest digital technologies, notably by SMEs. The Hubs are very effective in helping companies with their digital transformation, especially in regions where there is a high industrial activity and an under-investment in digital technologies. At the same time, Local and Regional Administrations (LRAs) have an important role in modernising administrations and services and enabling smart, digital transformations of their territories.

Through the Digital Hubs and the excellence networks the actions supported by the DEP offer clear opportunities for collaboration and coordination with the regional operational programmes under ERDF policy objective "Smarter Europe".

The DEP will build on and complement other efforts financed by ERDF and ESF. For example, the DIHs will be scaled up and networked to allow them to work in partnership with those in other Member States, inter alia by sharing human and technical expertise.

As a further example, the focus on HPC in the DEP is on co-investment (through procurement) in latest supercomputers, the networking of supercomputing centres and the development of application which have an EU interest notably in areas of public interest (health, public administration, climate, etc.). Therefore, programme synergies, attentive to preserving competition within the internal market, could cover the following aspects:

- Deployment and innovation actions funded through DEP which have a common European Interest.
- Projects with regional relevance jointly funded by DEP and ERDF (e.g. National HPC competence centres) for example addressing the use of HPC in 3D high resolution mapping and analysis of the territory.

Investing in People and European Values

Complementarities and synergies with European Social Fund (ESF), including Youth Employment Initiative, Basic digital skills and Erasmus +:

The ESF, has a very wide scope, ranging from employment, education, social policies and public administration, with a particular attention to – although not limited to - the most disadvantaged target groups. Currently the ESF support digital skills at all levels: from creating e-schools with digitally trained teachers, training unemployed people, also for ICT jobs, to supporting SMEs in the ICT sector, and providing basic digital skills to citizens to fully participate in society. The ESF will continue to support these actions in the next programming period as they are in line with the Fund's missions.

These interventions do not overlap with those foreseen in the Digital Europe Programme, as the latter will target only very specific advanced digital skills needs related to the deployment of cutting edge technologies that need a common EU wide response. Interventions in DEP will be designed and implemented as integral part of the actions that will support HPC, AI and cybersecurity. The network of Digital Innovation Hubs will make sure that offer and demand for advanced digital skills linked to the above-mentioned technologies can be efficiently met. The programme will support workers and graduates anywhere in Europe to acquire the latest digital skills wherever they may be located in Europe.

In this way they are different from the measures developed to make sure that a large part of the active and non-active population acquires basic digital skills. There is complementarity with the Youth Employment initiative that has a narrow target population – targeting NEETs (young people not in employment, education or training) which is implemented only in some eligible EU regions. Here, interventions could help NEETs acquire digital skills for business which could improve their employability.

The future Erasmus+ Programme will continue to support mobility, cooperation and policy development in the field of education, training, youth, and sport. The advanced training facilities developed in DEP will be available beyond the participating partners to a larger population through the Erasmus + programme.

The European Institute of Innovation and Technology (EIT) supports the participation to Master courses for different target groups. The DEP legal instrument will allow for cooperation between EIT communities and the excellence networks in AI, cyber and HPC.

Complementarities and synergies with the European Globalisation Adjustment Fund (EGF):

The EGF provides upon the request of Member States a package of personalised services to displaced workers following mass redundancies events aiming at their quick reintegration into the labour market. Each case must be approved by the Council and Parliament. The scale of these interventions is limited, 28 cases totalling EUR 114 Mn were financed.

Acknowledging the importance of digital skills in the future, under the post-2020 EGF Regulation there will be a mandatory requirement for digital skills training adjusted the needs of the displaced workers targeted in the EGF intervention. This is likely to be directed in the majority of cases to basic skills but it cannot be excluded that in certain cases the use of the advanced training facility developed in DEP can be made available for retraining.

Complementarities and synergies with EU Values Fund:

The new EU Values Fund will include two main programmes: the Justice programme and the Rights, Equality and Culture programme. The latter, in turn, includes four strands:

- Empowering people: This features existing programmes such as Europe for Citizens; Rights, Equality & Citizenship; and the Consumer programmes. Actions currently run by DG CONNECT – primarily through pilot projects and preparatory actions – will be included in this strand, in particular in fields such media freedom and pluralism, quality journalism, and media literacy and misinformation.
- MEDIA: The current MEDIA sub-programme of Creative Europe will be included in this strand, together with policy support actions (including those related to the implementation of the AVMSD, such as the activities of the European Audiovisual Regulators' Group ERGA).
- Culture: This strand will include primarily the current Culture sub-programme of Creative Europe.

- Cross-sectoral strand: This will include the current Creative Europe cross-sectoral strand (including the guarantee facility fund) broadened to the other parts of the programme and strengthened with innovation and creativity labs.

The EU Values Cluster includes therefore a number of actions in which the digital component is essential. In particular, synergies with the DEP can be found in the "Empowering people" strand, some of the actions of which aim at a better understanding of the dynamics of digital media – social media, in particular –, and at the adaptation of the European news media sector to the digital shift.

The "MEDIA" strand also presents clear synergies with DEP. DEP will support targeted actions in the digital transformation of the Cultural and Creative sectors as one of the most important sectors of our society and economy. For instance, as it is today the case in the current CEF, the DEP will support a wide access and adoption of cutting-edge technologies, standards (where needed) and infrastructure needed for the capacity building of these cultural and creative sectors, while the new MEDIA strand will aim at encouraging the use of digital tools for content creation, access to content, promotion and audience development, and for the training of media professionals.

Defence

Complementarities and synergies with European Defence Fund:

The EU civilian and defence cybersecurity markets share common challenges¹¹⁶ and dual-use technology that call for close collaboration in critical areas. The cybersecurity competence network, including the Research and Competence Centre, will draw resources from the DEP and could also be open to the European Defence Fund in the future.

As announced in a recent policy Communication¹¹⁷ a cyber defence dimension of the Competence network and Centre could "contribute to the cooperation between Member States in the area of cyber defence, including sharing of information, situational awareness, building expertise and coordinated reactions, and supporting Member States' development of common capabilities. It could also act as a platform, enabling Member States to identify the priorities for the EU's cyber defence, investigating common solutions, contributing to the development of common strategies, facilitating joint cyber defence training, exercises and testing at European level, and supporting work on cyber defence taxonomies and standards, with the Centre having a supporting and advisory role."

Border Management & Security

Complementarities and synergies with the Internal Security Fund (ISF):

The policy objective of the ISF will be to contribute to ensuring a high level of security in the Union by tackling terrorism and radicalisation, organised crime and cybercrime (including child sexual exploitation) and by assisting and protecting victims of crime. Actions targeted to the prevention of cybercrime are also eligible under the fund. Such actions include in particular support and assistance to (potential) victims of crime, a limited cybersecurity component in the protection and resilience of critical infrastructure and public spaces, investments in interoperable secure IT-systems and information

¹¹⁶ "Study on synergies between the civilian and the defence cybersecurity markets"(Optimity; SMART 2014-0059).

¹¹⁷ Joint Communication "Resilience, Deterrence and Defence: Building strong cybersecurity for the EU" JOIN (2017) 450

exchange tools as well as measures to support Member State authorities in criminal investigations (training on how to deal with encryption in criminal investigations, collaboration in view of cross-border access to e-evidence).

The fund specifically aims at objectives which are complementary with DEP by increasing information exchange and operational cooperation between law enforcement and with other authorities within the EU, including with Europol and other relevant Union bodies, third countries and international organisations in relation to the prevention, detection and investigation of serious and organised crime with a cross-border dimension. It also aims at ensuring collective responses to security threats by increasing capacities and enhancing EU preparedness and resilience, including by increasing cooperation among public authorities, civil actors and private partners from across EU Member States and third countries, including EU agencies and international organisations.

Environment

Complementarities and synergies with the Environment and Climate Action, including Energy Efficiency programme:

The digital transformation is an important enabler for the transition to low-carbon, circular economy and society. The provision of large scale capacities in HPC and AI for instance will offer new opportunities to help reduce CO₂. The provision of such capacity will benefit many sectors seeking to reduce CO₂ emission.

At the same time, digital technologies are an important source of energy consumption and CO₂ emissions. In this respect, the energy efficiency component of the future Environment and Climate Action programme would be beneficial in identifying ways to make EU computing activities more environmentally friendly.

The future LIFE programme will continue to act as a catalyst for a better implementation of EU environment and climate policy and legislation. To that end, it supports innovative pilot projects with significant direct environmental impact, which occasionally base themselves on advanced technologies (including for planning purposes) – these projects could serve as showcases for the hubs. LIFE's 'Strategic integrated projects' support Member States or regions in planning and fund mobilisation for investments and a better governance for a better implementation of environmental legislation.

By cooperating with the *Strategic Integrated Projects* the Digital Innovation Hubs could ideally help to leapfrog technical implementation of environmental legislation by relying on digital technologies. Anticipating, by the use of AI, habitat changes (induced by invasive species, high nutrient load or climate) in nature-protected areas and recommending management interventions would be one example of strong synergies to be realised between the programmes. Examples related the circular economy are numerous.

Agriculture and Rural Development

The Communication on "The Future of Food and Farming" acknowledges the huge potential of technological development and digitisation "making possible big leaps in resource efficiency enhancing a climate smart agriculture, which reduces the environment-/climate impact of farming, increase resilience and soil productivity and decrease costs for farmers. However, it also recognises that the uptake of new technologies in farming remains below expectations and unevenly spread throughout the

EU, and there is a particular need to address small and medium-sized farms' access to technology. The Digital Europe Programme will offer new solutions to:

- Support the uptake of digital technologies in the agriculture sector and rural areas.
- Explore the potential of new technologies such as AI in developing smart farming solutions.
- Improve the coordination and cooperation with Member States and regions in both: the modernisation of CAP monitoring and controls, and the modernisation of the agri-food sector.

Research and Innovation

Both the DEP and Horizon Europe will provide EU level public support in the field of digital technologies:

- **Horizon Europe** will provide extensive support to research, technological development, demonstration, piloting, proof-of-concept, testing and innovation including precommercial deployment of innovative digital technologies, in particular through (i) a dedicated budget in the Global Challenges pillar for "Digital and industry" to develop enabling technologies (Artificial Intelligence and Robotics, Next Generation Internet, High Performance Computing and Big Data, Key Digital Technologies, combining digital with other technologies); (ii) support to e-Infrastructures under the Open Science pillar; (iii) the integration of digital across all the Global Challenges (health, security, energy and mobility, climate, etc.); and (iv) support for scale-up breakthrough innovations under the Open Innovation pillar (many of which will combine digital and physical technologies).
- **DEP** will invest in (i) digital capacity building in High Performance Computing, Artificial Intelligence, Cybersecurity and advanced digital skills; and (ii) national and regional deployment within an EU framework of digital capacities and latest digital technologies in areas of public interest (such as health, public administration, justice and education) or market failure (such as the digitisation of businesses, notably small and medium enterprises).

Ensuring complementarity between both programmes

While several thematic areas addressed by Horizon Europe and DEP coincide (e.g. both will cover High Performance Computing, Artificial Intelligence, Cybersecurity), the type of actions to be supported, their expected outputs and their intervention logic are different and complementary, as explained below.

Two programmes with a different scope...

- **Horizon Europe will be the sole centrally-managed EU programme supporting research and technological development and the main programme for demonstration, piloting, proof-of-concept, testing and innovation including precommercial deployment.** Horizon Europe will cover the innovation chain from basic research to applied research, to prototyping, piloting, demonstration and precommercial deployment accelerating wider market uptake and deployment. Horizon Europe will not, in general, support deployment at wide scale, infrastructure costs or provide institutional funding (for example the support to research infrastructures is for cross-border access to and integration of research infrastructures and the

development of ESFRI pan-European research infrastructures, but not the construction or operational costs).

- **DEP will focus on large-scale digital capacity and infrastructure building.** These capacities and infrastructures will support the **wide uptake and deployment across Europe of critical existing or tested innovative digital solutions.** This will mainly be implemented through coordinated and strategic investments with Member States, notably through joint public procurement, in digital capacities to be shared across Europe and in EU-wide actions that support interoperability and standardisation as part of developing a Digital Single Market.

... exploiting synergies ...

- As the development of novel digital technologies matures through Horizon Europe, these will progressively be taken up and deployed by DEP.
- DEP capacities and infrastructures will be made available to the R&I community, including for activities supported through Horizon Europe.
- Horizon Europe initiatives for the development of skills and competencies curricula, including those delivered at the co-location centres of the European Institute of Innovation and Technology's KIC-Digital, will be complemented by DEP -supported capacity-building in advanced digital skills.

... with strong coordination mechanisms for programming and implementation

- DEP and Horizon Europe will align their strategic programming. Their governance structures will involve the respective DGs as well as others concerned by the different parts of the respective programmes.
- For their implementation, Horizon Europe and DEP will align operating procedures (e.g. common processes, IT tools, etc.), inter alia using the services provided by the Horizon Europe Common Support Centre.

Hereunder an overview of how programmes are complementary.

Figure 1 Complementarities between Horizon Europe and DEP at the strategic level

Horizon Europe	DEP
Development of technological and non-technological solutions, including digital content	Large scale deployment of digital capacity and existing digital technologies in areas of public interest or market failure
Research, technological development, demonstration, piloting, proof-of-concept, testing and innovation including pre-commercial deployment	Capacity and infrastructure building on HPC, AI, Cybersecurity and advanced digital skills
Research and innovation on digital technologies	Making the best use of digital capacities in areas such as health, public administration, justice and education
Selection through EU level competition and support for cross-border collaboration	Large-scale deployment of digital capacities, infrastructures and solutions within Member States as part of an overall EU strategy or policy
EU-level calls for proposals: grants, public procurement, financial instruments and budgetary guarantees (*).	An important part will be strategic co-investment with Member States through public procurement. Funding also to be provided through procurement grants,

Horizon Europe	DEP
	financial instruments and budgetary guarantees(*).
Networking at EU level of research & innovation actors	Promotion of interoperability of digitised public services
Support to cross-border access to and integration of research infrastructures	Construction, maintenance, upgrade and use of digital capacities and infrastructures in computing, AI and cybersecurity.
Development of skills and competencies curricula	Support for capacity building on advanced digital skills
Supporting EU-wide research databases	Building of shared digital capacities including "common data spaces" of public sector data and other publicly available data

(*) To be implemented under the InvestEU programme.

Complementarities in specific thematic priorities

High Performance Computing (HPC)

=> **DEP** will focus on co-investment (through joint procurement with Member States) in the latest supercomputers, the networking of supercomputing facilities and the use of these in areas of public interest, e.g. health, public administration, climate, etc. Supercomputing capacity will be also available to the scientific community and industry, notably SMEs. The budget will be used: (i) to procure together with Member States two top-range exa-scale super computers by 2022-23; (ii) to provide an EU coordinated framework for Member States wishing to upgrade and share their mid-range supercomputing facilities across Europe; (iii) to facilitate the networking and use of the supercomputing facilities.

=> **Horizon Europe** will support research and innovation underpinned by HPC infrastructures and facilities, including testing, experimentation and demonstration across all sectors and disciplines. On HPC specifically, Horizon Europe funding will cover research and innovation for next generation computing paradigms, architectures and programming environments, like cognitive computing, neuromorphic systems, multi-purpose quantum computing and codes for post-exascale performance. It will explore features like extreme low-power and large-scale distributed data processing.

Cybersecurity

=> The DEP will focus on:

- Investments in advanced cybersecurity equipment and infrastructures that are essential to protect critical infrastructures and the DSM at large. This could include investments in quantum facilities for cybersecurity (e.g. Quantum key distribution and facilities for post quantum cryptography) and other tools to be made available to public and private sector across Europe.
- **Scaling up existing technological capacities in the Competence Centers** in Member States and **ensuring wide deployment of the latest cybersecurity solutions** across the economy;
- **Networking of Cybersecurity Competence Centres in the Member States** with leading technology capacity able to support the digital economy. This should also include aligning and enhancing cybersecurity skills.

=> **Horizon Europe** will provide support for research and innovation underpinned by cybersecurity infrastructures and facilities, including testing, experimentation and demonstration across all sectors and disciplines impacted by cybersecurity. In addition Horizon Europe will support research and innovation on cyber-secure components and software relevant for areas such as protection of infrastructure or privacy and data protection. These novel approaches include, e.g. new paradigms for safety- and security-by-design, for cryptography, for self-healing systems and for cyberattack monitoring and rebuttal.

Artificial Intelligence (AI)

=> **DEP** will focus on common capacity building to ensure the wide deployment of AI in Europe including, e.g. (i) the provision of an "AI on demand" based on open source software, algorithms, tools and equipment, and on a "common data space" containing public sector data and other publicly available data. The platform will be made available widely across Europe (notably through the Digital Innovation Hubs) to actors in all sectors; (ii) the set up and reinforcement of the network of Digital Innovation Hubs to cover all regions in Europe with AI expertise and facilities. Support will go both, to the reinforcement of existing competence centres (at the core of the Digital Innovation Hubs) and to building up of new ones where needed.

=> **Horizon Europe** will support for research and innovation underpinned by AI infrastructures and facilities, including testing, experimentation and demonstration across all sectors and disciplines that are influenced by Artificial Intelligence. Horizon Europe will also support research and innovation in advanced AI technologies including explainable AI, unsupervised machine learning and data efficiency. Horizon Europe will support the networking and EU-wide access to specialised innovation hubs and innovation infrastructures for research and innovation performing activities.

Digitisation of areas of public interest and of industry

=> **DEP** will support the Europe-wide transformation of areas of public interest and of industry. This will be done through co-investment with Member States and, where relevant, the private sector in leadership deployment projects making the best use of digital capacities and latest digital technologies in areas of public interest or market failure. The added value of DEP will be in ensuring interoperability of solutions, suitable regulatory frameworks and standards across the EU, as well as higher impact through EU-wide actions avoiding digital divide and fragmentation, and with significant economies of scale. An important component of DEP will be the access to and availability of advanced digital skills. This action will complement the training activities performed in the KIC-Digital of the EIT under Horizon Europe.

=> Under **Horizon Europe** a dedicated budget will be allocated to support research and innovation dedicated to "digital and industry" and digital aspects will be behind almost every research, including health, transport, environment, energy, etc.

Annex 4: Convergence and synergies in AI, HPC and Cybersecurity

The purpose of this annex is to highlight the convergences of HPC – AI – Cybersecurity and how dedicated competence centres and Digital Innovation Hubs will be developed and mutually reinforce their synergies, in the context of DEP.

With a view of exploiting this convergence and synergies, **several HPC competence centres are expected to be created in the Member States** – one HPC competence centre per Member State associated with the national Supercomputing tier-1 national centres). They will provide **HPC services to industry, academia and public administrations**. The activities include on site evaluation of new technologies, experimenting, proof of concept, **facilitating access to the HPC ecosystem** including hands-on sessions on HPC and, HPC application tuning and scaling in a number of fields. In addition they will undertake **awareness raising and outreach and training activities** of the benefits of HPC for SMEs in particular, which can ease the transition towards HPC.

Similarly, in parallel to DEP, the Commission will propose the establishment of a **Cybersecurity Competence Network with a European Cybersecurity Research and Competence Centre** as the cybersecurity-specific delivery mechanism for the programme. The **key objectives will be to pool resources, overcome fragmentation of efforts across the EU and stimulate the development and deployment of technology in cybersecurity**. The intention is also to take advantage of the synergies between EU civilian and defence cybersecurity markets, which share common challenges and to create an effective mechanism of close collaboration between both communities. Attacks on ICT systems are facilitated by the advent on ever more powerful computing capabilities (HPC and quantum). **In order to assess and validate the robustness of existing or future ICT systems** and their fundamental cryptographic security components **will require testing these solutions against attacks run on HPC machines**. In this context, the existence of an HPC competence centre can provide the necessary skills and competences, in conjunction with access to ad hoc computing capacity, to support critical systems/infrastructures subject of an attack, whilst at the same time running the malware codes in its systems so that it can be reversed engineered and neutralised. For this kind of problems, dedicated HPC machines may have to be used. A further step would be the later access to and use of a hybrid HPC / quantum computer infrastructure, which could be made accessible through the Competence Centre itself.

Furthermore, a series of **Digital Innovation Hubs will be reinforced** (one per region). Their purpose is to **stimulate the broad adoption of Artificial Intelligence and other advanced digital technologies by industry and by public organisations**. They offer possibilities for testing and experimenting with Artificial Intelligence, and support for further investments after an experiment was considered to be a success. **The complementarity of the Digital Innovation Hubs with HPC competence Centres and the Cybersecurity competence network is critical**. Adopting an AI solution means that an AI system needs to be trained with a large set of data ("deep learning"). Access to high performance computing capabilities will be key in order to support this learning. Also, modelling and simulation may play an important role, which can only be done using HPC capabilities. Therefore, **HPC competence centres will collaborate with the DIH, or even form part of a DIH in some cases**. We already see this happening: some

HPC competence centres are teaming up with other actors to become a Digital Innovation Hub.

The AI solution also needs to be secure. The Digital Innovation Hub will normally have expertise around "mainstream" cybersecurity. However, it should constantly update its information around this and for that it can rely on the Cybersecurity Competence Network. They will distribute best practices and give advice on what should be done in case of cyber-attacks. Different entities could even be members of more than one of the discussed networks, thereby creating structural linkages. Concluding, the **Digital Innovation Hubs can be one access point to both HPC competence centres and the Cybersecurity competence centres which mutually reinforce each other.**

Annex 5: Digital and the added value for society

This section aims to put forward the added value and opportunities as well as the risks linked to the transformational power that digitisation has on the economy and society. Digitisation enables higher productivity across the economy, consequently leading to lower price while facilitating the creation of new and better products and services with fewer resources. For those embracing this revolution with technological know-how, the digital economy offers plenty of opportunities¹¹⁸.

At the same time, digitisation, like previous technological advances, will also have repercussions on labour markets. Some jobs will be replaced, some jobs will be created, and many jobs will be transformed. It is impossible to estimate the job replacement and job creation effects with any degree of certainty for the moment. Moreover, new jobs may not go to the same people as the old ones, and may not go to the same geographic areas.

In any case, there will be a significant adaptation process. The EU's main objective is to manage the changes well and turn ongoing digital developments into real opportunities, while assisting the Member States wherever it is appropriate.

Digitisation constitutes a transformative shift in technology across industry and society in general. It changes the way people live, work and communicate. It changes the way companies are run, how customers are acquired and enterprises do business. All sectors (energy, mobility, financial, agriculture, health, logistics, etc.) are being radically reshaped. The pace of change is very rapid.

However, it is also expected to lead to significant labour market adjustments as it reshapes the range of skills demanded by employers.

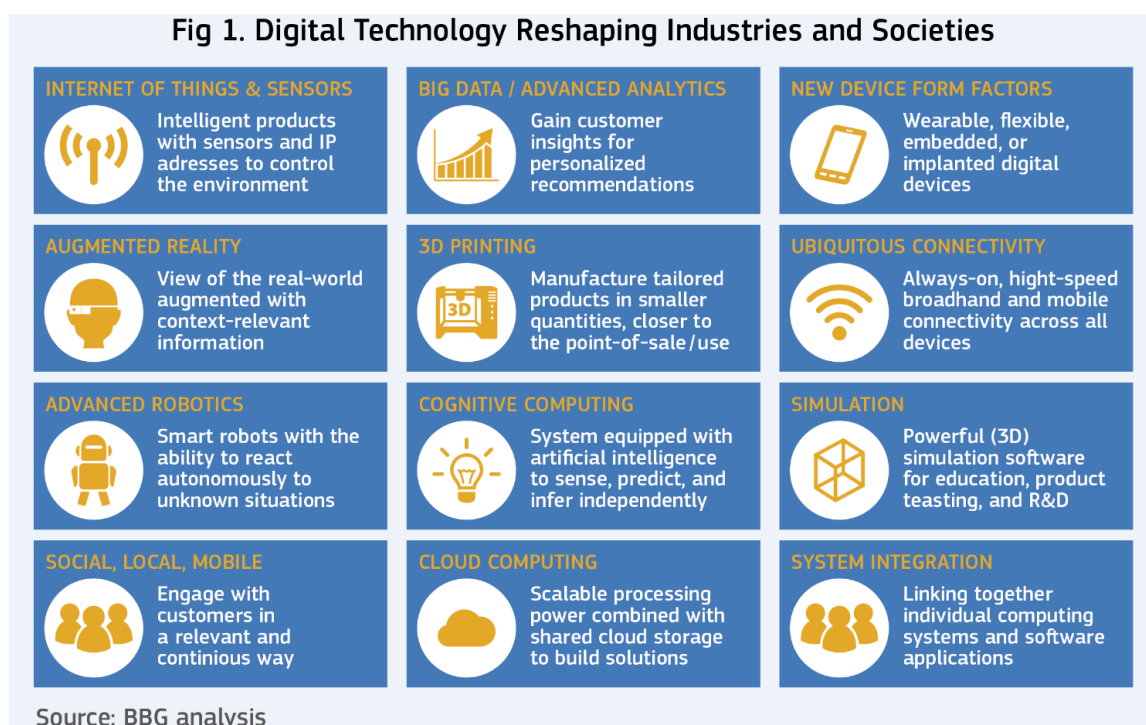
Digitising society involves most industries and sectors. Major investments in technological shifts which are driving digitisation such as High Performance Computing (HPC), Artificial intelligence (AI) and cybersecurity, IoT and connectivity, big data, monitoring and control through online platforms, etc. are needed to keep the EU at the forefront of innovation, to spur societal breakthroughs and for the EU businesses to remain competitive. A fully digitised Europe is expected to add €415 billion in annual GDP. According to estimates, digitization will increase average GDP growth rate by 40% while capturing the benefits from emerging high tech markets would place the most digitised nations among the fastest growing in the world (expected annual growth of 3.9%)¹¹⁹.

However, the gains from these common EU investments will only materialise if there are appropriate infrastructure and a sufficient number of skilled staff to develop, roll-out and use these new technologies. Substantial investments in high speed broadband and advanced digital skills are therefore necessary and must go hand-in-hand with investments in technologies.

¹¹⁸ A concept paper on digitisation, employability and inclusiveness – the role of Europe; DG Connect, May 2017

¹¹⁹ Digitizing Europe - Why Northern European frontrunners must drive digitization of the EU Economy. BCG; May 2016

Fig 1. Digital Technology Reshaping Industries and Societies



Digital creates value for individuals, corporations and the society. Digitalisation can foster innovation and competition in the EU market. Moreover, the trained and talented could access and fill the net difference of 1.6 to 2.3 million digital jobs which will have been created until 2020. A recent report¹²⁰ estimates that the adoption of AI could boost labour productivity by up to 40% in 2035.

In terms of impact on business growth, corporations might expand to reachable markets and increase therefore their sales potential (The report mentioned above estimates that the market for AI solutions will grow to USD 153 billion by 2020.). Companies might benefit from increased productivity through digitised supply chain, automated production lines, digital distribution systems (ex: EU manufacturing could grow by 15-20% by 2030 if fully digitised¹²¹). This will in turn benefit citizens by creating other jobs as well as more efficient and tailor made products and services.

Going digital will benefit society also by strengthening the efficiency of the public administration through eGovernment (ex: a digitally powered government could reduce public admin costs across the EU by 1.7€ billion by 2020¹²²). Big data availability increases the opportunities for analysing societal trends and fostering the innovation in the private sector.

¹²⁰ Robot revolution – global robot & AI primer; Bank of America, 2015.

¹²¹ Digitizing Europe - Why Northern European frontrunners must drive digitization of the EU Economy. BCG; May 2016

¹²² Back in the Game – Reclaiming Europe's Digital Leadership; EPSC; 2017

Fig 2. How Digitization Drives Value for Countries, Companies and Citizens Alike

Values for nations		
Digitization is a key driver for GDP growth		
Digitization has a positive net impact on job creation		
Values for government	Values for companies	Values for citizens
Increasing productivity in government operations such as tax collection and data management	Access to bigger market - increasing sales	Increased competition - consumers can find the best products at the lowest price-point
Potential to identify and reduce fraud and misuse of public services	Increased productivity potential through digitization of business processes and business models	Access to new types of products and services (e.g. sharing economy)
Identify and analyze societal trends with big data tools	Better access to talent thanks to better reach of digital channels	Better employment possibilities through facilitated access to available job positions
More efficient communication with citizens and businesses	Open access to government data can spur innovation and new uses of available data	Facilitated access to government services through e-government services

Source: BBG analysis

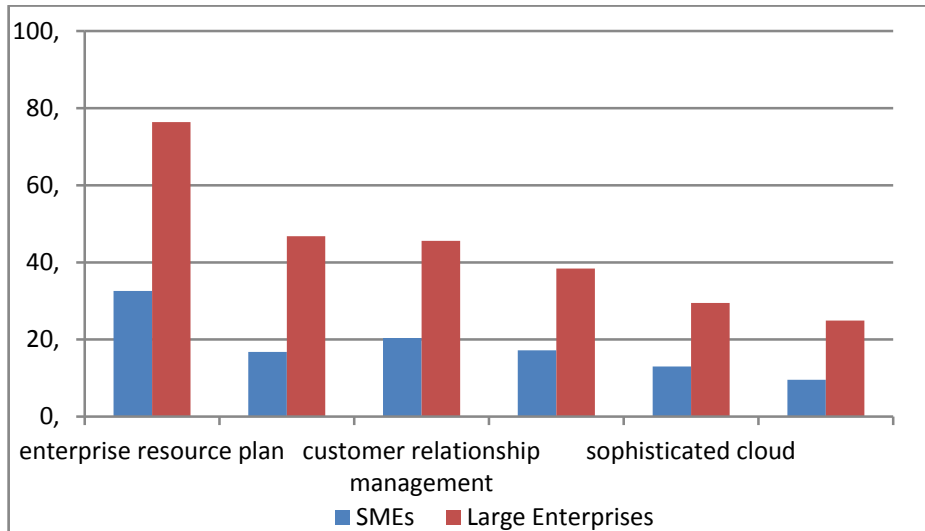
Europe is lagging behind

The slow pace of digital adoption and diffusion across the European public sector and the industry undermines our current and future competitiveness.

Despite being a leader in research and development with more than 3€ billion in digital research and innovation under Horizon 2020 for 2016-2017 to develop key digital technologies (including nano-electronics, photonics, robotics, 5G, high-performance computing, big data, cloud computing, and Artificial Intelligence), Europe has found itself struggling to transform inventions into genuine innovations and commercial products as it fails to create sufficient critical mass for new technologies to take off.

Moreover, European public sector and companies –SMEs in particular – have remained far too slow at taking up even basic digital technologies aimed at boosting productivity and improving internal processes. The most important issues put forward were the discouragement by initial investment costs, cross-border barriers that limit market potential, and, increasingly, concerns about cybersecurity. To date, only one in five European companies trades over the internet or uses cloud computing services while fewer than 2% of European companies use advanced digital technologies to innovate in products or processes. European firms must understand that digital technologies are one of the key drivers of transformative new business models that are rapidly replacing those of the past.

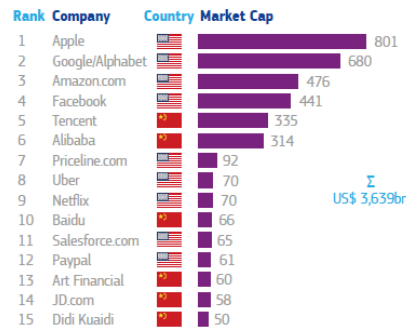
Fig 3. Integration of digital technology by SMEs and large enterprises



ERP, ESCM and CRM data refer to 2017; eInvoices, cloud and big data refer to 2016

As the digital revolution enters a new phase and new digital applications transform traditional strong companies, Europe risks falling even further behind. The emerging champions of this new phase tend not to be Europeans. The biggest and most powerful Internet companies are American and Chinese and this is also the case in emerging sectors, such as fintech, where China looks set to dominate.

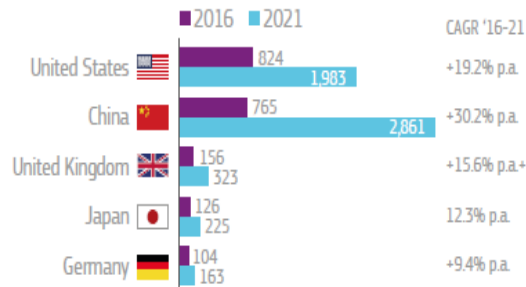
Fig 4. Global Digital Companies



Source: Statista, 2017

Fig 5. Fintech Transactions by Regions

Total fintech transactions on value by region (billion US dollars)



Source: Statista, 2017

A recent study concludes that European companies operating at the digital frontier reach only a digitisation level of 60% compared to their peers in the US. As a result, the digital

share of the economy represents only 5% in the EU compared to 8% in the US.¹²³ The European Investment Bank estimates that the EU suffers a gap of €35 billion a year to match US venture capital financing and a staggering €90 billion a year to keep up with advanced manufacturing technologies¹²⁴.

A study conducted for the EC in 2015 on the progress of the implementation of the European HPC strategy concluded that the present pace of growth of European investment in HPC will not be enough to attain and maintain leadership, meaning at minimum parity with best-in-class HPC resources in the USA, Japan, or China. When compared to current investments of the EU and Member States, the gap with the USA can be estimated at least at EUR 700 million per year.

In cybersecurity, the efforts in terms of investment are still far below what is needed to keep up with other global players (e.g. US or Israel), who have a clear and significant cybersecurity investment strategy designed to increase technological and operational capabilities. For example, federal funding in the US has increased to 19 billion US dollars in 2017 – a 35% increase compared to 2016.

Swim or sink: EU must go digital at scale

Given the rapid changes taking place in the economy, labour markets and society-at-large, digital technologies can contribute to offer higher-quality, efficient tailor-made services that better respond to businesses and citizens' needs.

This will only be overcome by creating a genuine and seamlessly-operating digital single market. A single regulatory framework is crucial for businesses. So is a concerted effort by Member States to support important initiatives that would create the necessary scale for Europe's digital economy to thrive.

EU must upgrade to take full advantage of the digital transition while addressing the varying digital performance across Europe. All sectors of economy need to have access to digital technologies. Barriers to adoption for SMEs need to be removed. A study for the German Government on digital readiness of industry shows that around 60% of large industries feel lagging behind in digital innovation and the same for more than 90% of SME.

About 15% of EU workplaces report the existence of digital skill gaps among their workforce¹²⁵. In the same vein, between 2016 and 2017, the number of ICT specialists working in the EU grew by 2 million to reach 8.2 million, thus increasing its share in total employment from 2.8 to 3.7%¹²⁶. Yet the number of new graduates has been roughly stagnating since 2006¹²⁷. As a result, there is a lack of ICT specialists available in the labour market. In 2016, 48% of companies trying to recruit ICT specialists have problems doing so across the EU¹²⁸. Companies everywhere complain of shortages: Germany and France both report shortages of ICT specialists to fill existing jobs in ICT producing companies.^{129 130}

¹²³ Digital Europe: Pushing the frontier, capturing the benefits, McKinsey Global Institute, June 2016.

¹²⁴ Restoring EU competitiveness, European Investment Bank, January 2016.

¹²⁵ Ecorys (2016): ICT for work: Digital skills in the workplace. Final report. Study prepared for the European Commission, DG Communications Networks, Content & Technology.

¹²⁶ Eurostat Press Release 114/2017 - 18 July 2017

¹²⁷ Reference Eurostat

¹²⁸ Reference Eurostat

¹²⁹ <https://www.bitkom.org/Presse/Presseinformation/55000-Jobs-fuer-IT-Spezialisten-sind-unbesetzt.html>

¹³⁰ Estimate by Direction de l'animation de la recherche, des études et des statistiques, quoted in "Etat des lieux numérique de la France, Google/Roland Berger January 2017"