



Cloud Computing in Europe

Appendix 2

The Policy Context

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ABSTRACT

The European Commission is actively setting priorities for the upcoming Multiannual Financial Framework of the European Union covering the 2021-2027 period. Among the different identified priorities, “A Europe fit for the digital age” explicitly supports digitalisation. Cloud computing, as a fundamental brick of a digital Europe, will play an even stronger role in European economy and society by embracing core European values, spanning fundamental individual rights to market openness and environmental friendliness.

This briefing note provide a summary of the current European Union strategies and policies linked to Cloud Computing in Europe.

The policy landscape is an important component to contextualise H-Cloud analysis within respect European priorities.

Important Notice: Working Document

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EXECUTIVE SUMMARY

In past years European Commission (EC) largely invested on Digital Single Market establishment, including a number of actions specific for Cloud computing. With the upcoming Multiannual Financial Framework (MFF) of the European Union covering the 2021-2027 period, the European Commission (EC) is setting new priorities and directions, that complement and expand strategies defined in the previous MFFs. EC announced that the focus will be on six key political guidelines¹:

- **A European Green Deal**, with the goal of “becoming the world’s first climate-neutral continent by 2050 is the greatest challenge and opportunity of our times”.
- **An economy that works for people**, under the ideal that “The EU’s unique social market economy allows economies to grow and to reduce poverty and inequality. With Europe on a stable footing, the economy can fully respond to the needs of the EU’s citizens.”
- **A Europe fit for the digital age**, by empowering people with a new generation of technologies and sustaining the Digital Single Market Strategy to create better and larger opportunities for European companies
- **Protecting our European way of life**, promoting a “vision for a Union of equality, tolerance and social fairness”.
- **A stronger Europe in the world**, to reinforce European role as responsible global leader working to ensure the highest standards of climate, environmental and labour protection.
- **A new push for European democracy** to ensure a stronger role of European citizens in the decision making process and in the setting of European priorities.

*Shaping Europe’s digital future*², provides the overall strategic plan to for the European digital agenda in the next years. In this new agenda, Cloud computing will continue to play a key role to tackle the Digital challenge in Europe, complementing and extending actions defined by previous strategies. The Cloud computing role is to unlock access to future and emerging technologies, such as 5G, artificial intelligence, high performance computing, the Internet of Things and distributed ledgers.

Cloud computing (and the digital technologies in general) will play even a stronger role in European economy and society by embracing core European values, spanning fundamental individual rights (e.g. security and data privacy), to market openness (e.g. interoperability and free flow of data) and to environmental friendliness (e.g. reduced carbon footprint and energy consumption) with the ambition to support the transition to a sustainable planet.

*A European strategy for data*³ and *A new Industrial Strategy for Europe*⁴ builds on the **High Impact Project on European data spaces and federated cloud infrastructures**, as a core European project to the unleash of the potential of data economy and digital single market in Europe.

Key instruments part of the new MFF 2021-2027 to support the digital transformation in Europe include:

- [Horizon Europe](#), the new research and innovation programme.
- [Digital Europe](#), a brand new programme focusing on building the strategic digital capacities of the EU.
- [Connecting Europe Facility 2](#), focusing on the creation of transnational digital infrastructures.

These three programmes are designed to complement each other and will play a key role in Europe’s digitalisation in connection with the Cloud Computing. In particular, the introduction of the Digital Europe programme may play a key role in supporting the deployment of mature research and innovation outcomes, bridging them between the Research and Market penetration phases, thus helping to overcome the so-called “Valley of Death”.

¹ EC. [6 Commission priorities for 2019-24](#). 2019

² EC. [Communication: Shaping the Europe’s digital future](#). 2020

³ EC. [Communication: A European strategy for data](#). 2020

⁴ EC. [A new Industrial Strategy for Europe](#). 2020

1 INTRODUCTION: KEY POLICIES AND STRATEGIES

Cloud Computing is a fundamental instrument to the success of European Economy. In the recent past the European Commission launched a number of initiatives and defined a number of policies that play a fundamental role to support and regulate the European Cloud ecosystem.

Up to 2020, the key EC strategy in this context was surely the Digital Single Market (DSM) strategy⁵ focusing on the establishment of a single market of digital services accessible by all citizens and business across Europe without barriers and under equal regulations. DSM has been supported and boosted by different actions before and following its announcement.

In 2012 the European Commission, announced the creation of the European Cloud Partnership⁶. The European Cloud Partnership concluded its activities in 2014 with a set of policy recommendations⁷ that were key to the definition of the Digital Single Market strategy. With the establishment of the Digital Single Market strategy, Cloud related activities focused on increasing trust when using cloud services and at establishing a European open science cloud through accompanying implementation activities: particular the Cloud-for-Europe (C4E)⁸ initiative for the public sector and the HNSciCloud⁹ initiative for public research and innovation.

The different initiatives leveraging Cloud as a key enabler for the Digital Single Market in Europe, have been complemented by policies and regulations supporting the EU Citizens rights when using Cloud services. Such policies include:

- General Data Protection Regulation¹⁰ defining EU-wide regulations to protect EU citizen data, with a special focus on digitalised data hosted in the Cloud in Europe and globally.
- European Union (EU) Free Flow of non-personal Data Regulation aiming to “achieve a more competitive and integrated EU market for data storage and/or processing services and activities.”¹¹
- European Cybersecurity Act (EUCA), which aims to set the grounds to establish an EU-wide framework for cybersecurity certification of ICT services, products and processes, including those services provisioned by Cloud Service Providers (CSP)¹²

With the upcoming Multiannual Financial Framework (MFF) of the European Union covering the 2021-2027 period, the European Commission (EC) is very active in setting new priorities and directions, that complement and expand strategies defined in the previous MFFs. Under the current commission lifetime, the focus will be on six key political guidelines¹³ that will shape Europe over the next five years and well beyond:

- **A European Green Deal**, with the goal of “becoming the world’s first climate-neutral continent by 2050 is the greatest challenge and opportunity of our times”.
- **An economy that works for people**, under the ideal that “The EU’s unique social market economy allows economies to grow and to reduce poverty and inequality. With Europe on a stable footing, the economy can fully respond to the needs of the EU’s citizens.”

⁵ EC. [A Digital Single Market Strategy for Europe](#). 2015

⁶ EC. [The European Cloud Partnership](#). 2012

⁷ EC. [Establishing a trusted cloud Europe](#). 2014.

⁸ Cloud-for-Europe. <https://ega.ee/project/cloud-for-europe/>

⁹ Helix Nebula. <http://www.helix-nebula.eu/>

¹⁰ EC. [General Data Protection Regulation](#) (EU) 2016/679 (GDPR). 2016

¹¹ EC. [Regulation on a framework for the free flow of non-personal data in the European Union](#). (EU) 2018/1807. 2018

¹² EC. Regulation on ENISA (the European Union Agency for Cybersecurity) and on information and communications technology cybersecurity certification. (EU) 2019/881 (EUCA). 2019.

¹³ EC. [6 Commission priorities for 2019-24](#). 2019

- **A Europe fit for the digital age**, by empowering people with a new generation of technologies and sustaining the Digital Single Market Strategy to create better and larger opportunities for European companies
- **Protecting our European way of life**, promoting a “vision for a Union of equality, tolerance and social fairness”.
- **A stronger Europe in the world**, to reinforce European role as responsible global leader working to ensure the highest standards of climate, environmental and labour protection.
- **A new push for European democracy** to ensure a stronger role of European citizens in the decision making process and in the setting of European priorities.

In line with the above political guidelines, EC is defining and releasing a whole new set of strategies. On 19th February 2020 Ursula von der Leyen announced¹⁴:

“Today we are presenting our ambition to shape Europe's digital future. It covers everything from cybersecurity to critical infrastructures, digital education to skills, democracy to media. I want that digital Europe reflects the best of Europe – open, fair, diverse, democratic, and confident.”

Shaping Europe's digital future¹⁵, provides the overall strategic plan to implement through different actions the “Europe fit for the digital age” political guideline. This strategy pushes three key objectives to promote technological solutions that will help Europe pursue its own way towards a digital transformation that works for the benefit of people and respects our fundamental values:

- 1) Technology that works for people;
- 2) A fair and competitive economy; and
- 3) An open, democratic and sustainable society.

These objectives will be pursued by a number of key actions, some of which have been already started or announced:

- **A European strategy for data**¹⁶ through which the “EU can become a leading role model for a society empowered by data to make better decisions – in business and the public sector”. To this aim, the strategy pushes the creation of a single market for data within Europe supported by a **High Impact Project on European data spaces and federated cloud infrastructures**.
- **An Industrial Strategy package** focusing on EU industry transition toward climate neutrality and digital leadership as way to promote EU global leadership. The package includes different documents, most relevant ones for cloud and digital services are:
 - **A new Industrial Strategy for Europe**¹⁷: setting the lines for an industrial strategy aligned with core European societal and market values, including the investments on sustainable digital infrastructure needed to ensure EU digital sovereignty.
 - **An SME Strategy for a sustainable and digital Europe**¹⁸: focusing on concrete actions to support SMEs (as the heart of EU industry) toward a sustainable digital transition.
- **A White Paper on Artificial Intelligence**¹⁹, promoting a European approach to artificial intelligence putting upfront key European values such as excellence and trust.
- A new set of policies²⁰ to ensure the sustainability of the EU economy linked to the **Green Deal**. In these landscape, one of the key goal is to “make data centres and ICT infrastructures climate-neutral by 2030”.

¹⁴ EC. [Shaping the Europe's digital future](#). 2020

¹⁵ EC. [Communication: Shaping the Europe's digital future](#). 2020

¹⁶ EC. [Communication: A European strategy for data](#). 2020

¹⁷ EC. [A new Industrial Strategy for Europe](#). 2020

¹⁸ EC. [An SME Strategy for a sustainable and digital Europe](#). 2020

¹⁹ EC. [White Paper on Artificial Intelligence: a European approach to excellence and trust](#). 2020

²⁰ EC. [Supporting the green transition](#). 2020

- **A new agenda for the European strategic autonomy**²¹ that encompasses the changes brought by the digital technologies and underlines the need for Europe to support its capacity to act independently and defend its sovereignty in the Digital Age;

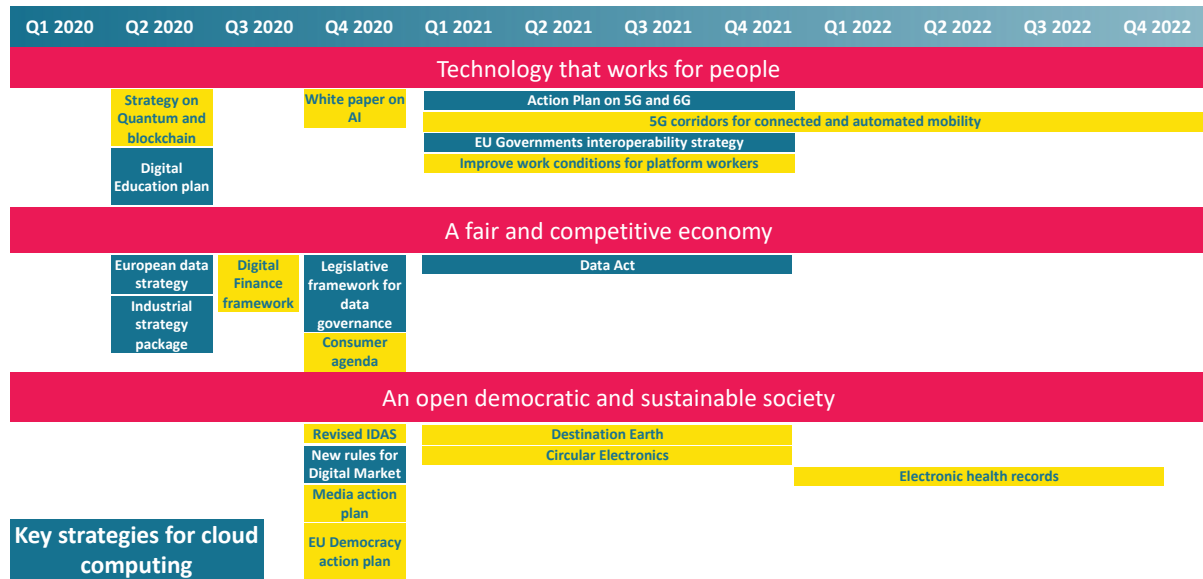


Figure 1. Roadmap of key EC strategies, the ones with blue background are highly relevant to cloud computing industry.

1.1 Strategy Summary

In this section, we take a look at some of the key strategies connected to cloud computing, and summarise some of the key actions.

1.1.1 A European strategy for data

The European Commission is convinced of the importance of data to make better decisions in public and private sector, to this aim “A European strategy for data” envisions a set of actions to support the uptake of data economy in Europe. The strategy tackles the following key problems linked to data economy:

- Scarce availability of data
- Imbalance in cloud service market power
- Limited data interoperability and quality
- Weak data governance
- Limited availability and uptake of data infrastructure and technologies
- Complexity of empowering digital rights
- Lack of skills and data literacy
- New challenges linked to cybersecurity

To tackle such problems, EC proposes a strategy that focus on:

- a set of data governance policies;
- investments to support the creation of data infrastructures;
- development of competences; and,
- promotion of common European data spaces in key sectors.

²¹ EC. [Rethinking Strategic Autonomy in the Digital Age](#). 2019

All these actions are clearly connect to the European cloud computing ecosystem, and requires its involvement and support. In particular, the public-private investment of €4-6 billions targets a **High Impact Project on European data spaces and federated cloud infrastructures** with a first implementation by 2022.

Such a project clearly requires the identification of organisational and technological requirements that cloud industry and linked ecosystem should put in place to support its realisation. This effort, to ensure the support to data spaces in the key sector, should probably start from exploring the different requirements and identify commonalities. Key sectors listed in the strategy include:

- manufacturing
- green economy
- mobility
- health
- finance
- energy
- agriculture
- public administration
- education

The high impact project will be supported and driven by a set of actions aimed at harmonising data governance policies (Data Act, Act on high-value data sets, EU data spaces Governance) and access to cloud services (MoU members states, Cloud rulebook, Cloud services market place).

1.1.2 A new Industrial Strategy for Europe

Europe Commission, in “A new Industrial Strategy for Europe”, discuss its vision of an European industry, that while looking toward its future challenges, adhere and promote European key values, including:

- Market openness and fairness
- Social fairness
- Environmental friendliness

To achieve its vision, the strategies relies on three drivers that should guide the transformation of EU industry:

- Making EU industry competitive at global level through the leverage on the single market
- Supporting the EU industry transition toward climate-neutrality
- Ensuring the digitalisation of EU industry and the availability of core digital infrastructures in Europe

Cloud and other digital technologies play and essential role in the strategy. In particular:

- Strategy relies on data spaces in key sectors, such as Energy, Mobility and Circular economy, as a way to **increase digitalisation of industries, increasing their capacity of innovation based on data, and thus supporting their role in creation of EU single market.**
- Strategic digital infrastructures, such as 5G networks, will be key enabler for the EU industry transformation, and it is key that they are under EC governance and respectful of EU policies. This also means that such **digital infrastructures need to embrace climate-neutrality principles.**
- New principles for Electronics industry, including servers and other digital enabling hardware, will be promoted. According to such principles electronics will need to carry more information facilitating their recycling and repairing. This will **reduce the environmental impact of electronics life-cycle.**
- Investments on digital education are seen as a priority of the upskilling and reskilling actions to **support filling the gap of 1 million digital workers in the current market and future demands.**

1.1.3 An SME Strategy for a sustainable and digital Europe

European Commission dedicates specific measures to support SMEs within the Industrial Strategy package, as the vital role of SMEs in European economy demands for. The ultimate objective of this strategy is to increase the number of SMEs engaged in sustainable business practises as well as their adoption of digital technologies. To this aim, the strategy builds on three pillars:

- Investments to support the transition toward sustainable and digital business.
- Reducing regulatory barriers limiting SMEs access to single market (digital one as well).
- Improving access to finance to facilitate SMEs transition toward sustainable and digital business.

The three pillars contain key actions linked to cloud and other digital technologies:

- Support SMEs (digital) innovation in support of Green Deal vision: €300 millions are already allocated in 2020 by the European Innovation Council to allow SMEs to pilot such solutions.
- Increase EU network of Digital Innovation Hubs to support the uptake of digital technologies by SMEs.
- Simplify access to IP registration procedures by SMEs.
- Develop courses and curricula for digital upskilling by SMEs.
- Create a guarantee facility for high risk SMEs adopting digital business practises.
- Co-fund tech due diligence services facilitating the evaluation of investor of high-tech start-ups.

1.1.4 A new agenda for the European strategic autonomy

The European Political Strategy Centre (EPSC) released a strategy node that focus on the importance of controlling digital infrastructures to ensure ability to promote European interests and values in the global economy. Having a strategic autonomy boils down to three major dimension:

- Industrial autonomy: the capacity to independently fulfil Europe own digital infrastructure needs
- Operational autonomy: the resiliency of European digital infrastructure, especially to cyberattacks.
- Political autonomy: the ability to make well-informed decisions freely and independently, which clearly largely depends on the two previous dimensions.

While the note from EPSC does not yet define a concrete set of actions to increase EU autonomy, it analyses in detail the current status, and provides a set of relevant evidences:

- The IT supply chain of Europe is largely dependents from other states at all levels: from hardware to software, from telco infrastructure to cloud services.
- Global supply chains make less transparent the enforcement of security standards, and are not resilient to geo-political tensions, which may compromise operational capacity.
- Digital technologies have been lately exploited to steer elections and other voting procedures, clearly undermining democracy.
- The more Europe falls behind on digital technologies, the less chances Europe will have to shape new technologies to be compliant with its core values and interest. Cloud is one of the core technologies where Europe is late and less autonomous.
- Compared to other players EU is not investing enough on R&D of digital technologies, beyond that, there is also a lack of scale-up funding, thus limiting the success of European start-ups.

As outcome, EPSC urges Europe to adopt an holistic strategic approach that leverage different policy instruments to ensure the proper level of digital sovereignty, starting from a closer collaboration among member states to i) complement strategic supply chains; ii) realise priorities in term of digital technologies; iii) increase investments on critical digital technologies.

1.2 The role of H-CLOUD

H-CLOUD is a Coordination and Support Action that supports the European Cloud Community by providing recommendations and strategies to guide the future of European Cloud services and their market regulations.

To fulfil this challenge H-CLOUD is working on different actions, such as:

- Increasing awareness of barriers, benefits, needs, research & innovation, and pre-standardization opportunities;
- Creating and operating the H-CLOUD Forum community to facilitate coordination, collaboration, knowledge sharing and innovation;
- Developing the European Cloud Computing research and innovation strategy and its implementation plan
- Ensuring the sustainability of the H-CLOUD Forum activities.

The above actions have the role of contributing to identify challenges and priorities at different layers, that future actions and programmes of the European Commission should tackle to achieve its broader vision with the help and support of the different stakeholders of the European Cloud Computing ecosystem.

2 THE DIGITAL CHALLENGE IN EUROPE

Europe since 2014 is focusing a number of actions on the creation of a Digital Single Market with the aim of enabling the best possible access to the online world for individuals and businesses. “A Digital Single Market (DSM) is one in which the free movement of persons, services and capital is ensured and where the individuals and businesses can seamlessly access and engage in online activities under conditions of fair competition, and a high level of consumer and personal data protection, irrespective of their nationality or place of residence.”²² The creation of a digital single market accessible to 500 millions of people and more than 27 million enterprises is a fundamental step to create a better future for European society and economy.

In line with the Digital Single Market Strategy and the new Shaping Europe’s digital future Strategy, Cloud computing plays a key role to tackle the Digital challenge in Europe. The Cloud computing role is to unlock access to future and emerging technologies, such as artificial intelligence, high performance computing, the Internet of Things and blockchain. In the strategies defined by the European Commission one of the key objectives is to ensure that cloud services offered in Europe are secure and that they comply with key European values and rules in fundamental rights, cybersecurity, interoperability, portability and market behaviour.

While enabling new technology to support the digital transition, the European cloud computing vision needs to contribute as well to the transition to a sustainable planet, in alignment with core Europe values. “Europe must lead the transition to a healthy planet and a new digital world”, as stated by Ursula von der Leyen. The European Commission committed to achieve climate neutrality by 2050 as part of the strategy towards achieving the SDGs by 2030. Following the announcement on the European Green Deal, Europe committed to key actions such as energy decarbonisation, circular economy, and sustainable land use and food systems and to sustaining them by investing in education, promoting innovation, and harnessing the potential of digital technologies for Europe’s sustainable development. Cloud Computing and Edge computing, in combination with other digital technologies will play a fundamental role in shaping a sustainable Europe.

To sustain these ambitions, as discussed in the next sections, EU is rolling out an ambitious set of programmes, covering Research, Innovation, and market deployment.

2.1 Emerging applications, services & technology

As discussed above, Cloud computing is a key enabler to several digital technologies that are opening new scenarios for European citizens and business very day life. Such innovative (and in some cases disruptive) technologies include:

- **Edge Computing:** increasingly, over the last few years, different scenarios show the limitations of a pure cloud-centric approach to service delivery platforms. For different reasons (e.g. latency, privacy, reliability), platforms and solutions enabling the processing of data at the edge of the network (where the data is generated) are arising on the market, although different challenges are still to be solved in relation to edge computing. It is no mystery that several innovative application scenarios are pushing and demanding for the adoption of Edge Computing (also in combination with distributed ledgers, making data computation distributed, and data governance decentralised). The ability of taking decisions ‘locally’ and in reliable way (i.e. regardless of connectivity with the cloud), is the main driver for the adoption of edge computing within different solutions.
- **5G:** cheap, reliable and scalable internet connectivity is a key requirement for several distributed and mobile applications relying on cloud services. 5G, the new evolution of mobile internet technologies spanning from radio access to backbone management, aims to provide low latency and high-bandwidth access in a capillary way. Beyond that, 5G introduces novel means to

²² EC. [Shaping the digital single market](#). 2019

deliver virtual infrastructures and explores novel mechanisms to virtualise traditional hardware resources. The virtualisation of mobile infrastructure will fuse connectivity and edge computing infrastructures. These infrastructure-related innovations are driven by successful concepts established by Cloud computing.

- **Artificial Intelligence and analytics:** albeit Artificial Intelligence has been around for many years, the recent evolutions in terms of AI software platforms and hardware platforms and the availability of massive data sets to test and apply AI combined with increasing computing capability (e.g., HPC, etc.), enabled its wide adoption in several real-life scenarios. This new wave of Artificial Intelligence research and application is showing a great potential to bring automating in several application domain from the automotive one (e.g., self-driving cars) to healthcare one (e.g., ai-based diagnostics). Cloud Computing is nowadays providing the computing capacity required to create AI models and automate systems. More and more, in the next several scenarios, will require such intelligence to be applied at the edge, to ensure a low latency loop.
- **Internet of Things:** IoT, and its linked paradigms such as Digital Twin and Tactile Internet, are becoming central to the digital revolution. IoT platforms are today mostly centralised and cloud-based, research trends expect that platforms will move rapidly and with big steps to the next level with the emerging 'Tactile Internet and the intelligence at the edge, creating interactive, conversational IoT platforms with new user interfaces to engage with things and humans'²³, adding the human-centred perspective and sensing/actuating capabilities in the human-objects-systems interaction²⁴.
- **Distributed Ledgers:** most of the digital platforms dominating today's market relies on centralised data management. The advent of distributed ledgers, following the hype of bitcoin derived technologies, advocates for novel approaches for data management. These approaches enable for a decentralised governance, where all the actors in the ecosystem play a role in the validation and acceptance of the data entering the ecosystem, and data owners can have direct control over who in the network can access their data. In the context of the Cloud computing this facilitates a distributed data governance across multiple clouds and the ability to ensure truthfulness of the data and authorising data access in a distributed way are interesting concepts.

2.2 The research response: Evolution of the Research programmes

The upcoming programmes need to support the novel direction pushed by the European Commission. As part of the new MFF 2021-2027, the European Commission is currently working on three key pillars to support the digital transformation in Europe:

- [Horizon Europe](#), the new research and innovation programme to succeed Horizon 2020 with a proposed € 100 billion budget, including € 15 billion on the 'Digital, Industry and Space' cluster.
- [Digital Europe](#), a brand new programme focusing on building the strategic digital capacities of the EU and on facilitating the wide deployment of digital technologies, with a proposed € 9.2 billion budget.
- [Connecting Europe Facility 2](#), the follow-up of the current CEF programme, focusing on the creation of transnational digital infrastructures with a proposed € 3 billion budget.

²³https://aioti.eu/wp-content/uploads/2018/09/AIOTI_IoT-Research_Innovation_Priorities_2018_for_publishing.pdf

²⁴ Petar Popovski (2018), "The Supernatural Touch of Tactile Internet, Big Data, AI, and Blockchain", https://medium.com/@petarpopovski_51271/the-supernatural-touch-of-tactile-internet-big-data-ai-and-blockchain-e05f93a198d6

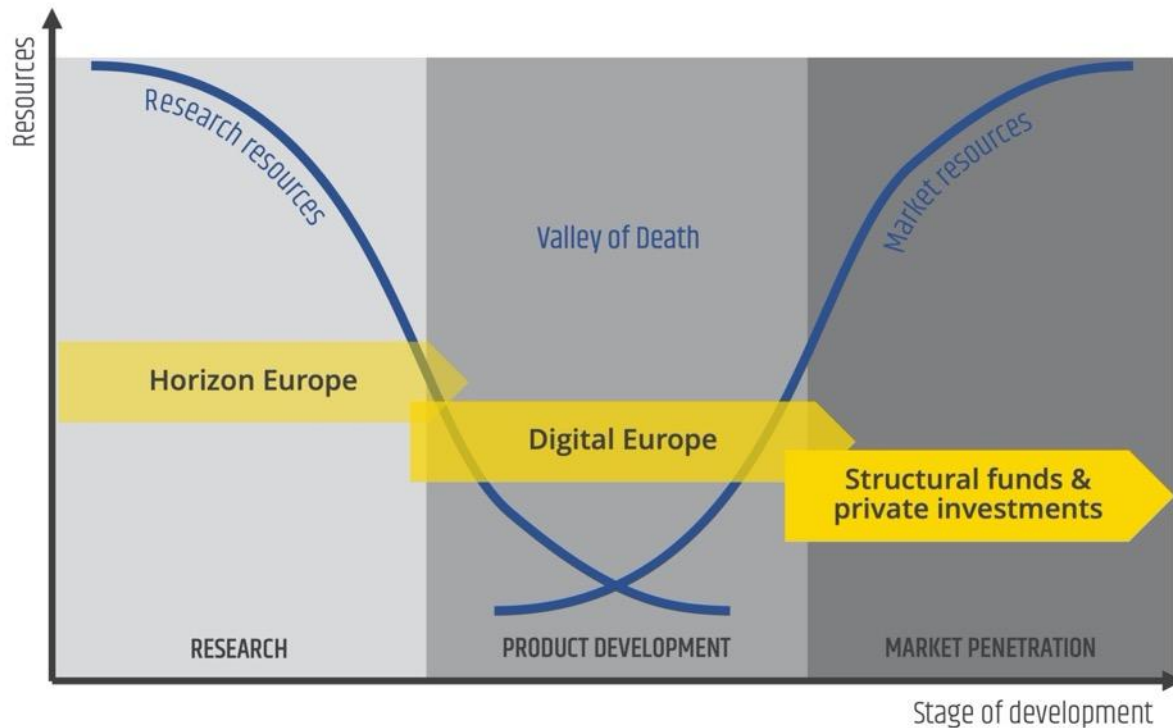


Figure 2. From Research to Market Penetration leveraging EU work programmes

These three programmes are meant to complement each other and will play a key role in Europe's digitalisation in connection with the Cloud Computing. While Horizon Europe will provide future outlook by supporting cutting edge research and innovation, Digital Europe and Connecting Europe Facility will foster the market deployment of mature technologies (including those that proved maturity and business viability from Horizon 2020 and, in future, Horizon Europe). The introduction of the Digital Europe programme may play a key role in supporting the deployment of mature research and innovation outcomes, bridging them between the Research and Market penetration phases, thus helping to overcome the so-called "Valley of Death".

The European Commission already released draft orientations for Digital Europe²⁵ and Connecting Europe Facility²⁶. Within these orientation it is clear the impulse and support to realise the strategies outlined in "A European strategy for data" and "An Industrial Strategy package".

In particular, Digital Europe draft orientations promote it as the instrument to pilot the High Impact Project on European data spaces and federated cloud infrastructures and the and the to support the establishment of the new Digital Innovation Hubs. At the same time, CEF-2 draft orientations promote the usage of the programme to support role out of backbone networks capable to support pan-European sustainable cloud federations.

²⁵ EC. [Digital Europe Draft Orientations for the preparation of the work programme\(s\) 2021-2022](#). 2019.

²⁶ EC. [Draft Orientations towards an implementation roadmap - Connecting Europe Facility \(CEF2\) digital](#). 2019.