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DIGITAL EUROPE PROGRAM: NURTURING TECHNOLOGICAL SOVEREIGNTY FOR A RESILIENT EUROPEAN DIGITAL ECOSPHERE

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Research Article

Abstract

The Digital Europe Program (DIGITAL) is a European Union program aimed at accelerating the continent's digital transformation, increasing global digital competitiveness, and establishing technological sovereignty. It focuses on vital digital technologies such as HPC, broadband Internet access, Artificial Intelligence (AI), cloud services, cyber security, the digital single market, and advanced digital competencies. DIGITAL is regarded as critical for Europe's strategic autonomy in the digital sphere, and it is more than a project; it represents a massive transition that initiates socioeconomic change. The program develops a European data economy and a digital single market, influencing the EU's socioeconomic dynamics. The achievement of technical sovereignty is dependent on exemplary implementation, finance, and management initiatives.

Keywords: *Cyber Security, Artificial Intelligence, Digital Single Market, Technological Sovereignty, Semiconductors*

Dijital Avrupa Programı: Esnek-Dayanıklı Avrupa Dijital Ekosferi İçin Teknolojik Egemenliğin Geliştirilmesi

Dijital Avrupa Programı (DIGITAL), kıtanın dijital dönüşümünü hızlandırmayı, küresel dijital rekabeti artırmayı ve teknolojik egemenliği kurmayı amaçlayan bir Avrupa Birliği programıdır. Yüksek Performanslı Bilgi İşleme (HPC), Geniş Bant İnternet erişimi, Yapay Zekâ (AI), Bulut hizmetleri, siber güvenlik, Dijital Tek Pazar ve gelişmiş dijital yetkinlikler gibi hayati dijital teknolojilere odaklanmaktadır. DIGITAL, Avrupa'nın dijital alanındaki stratejik

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özerkliği için kritik olarak kabul edilmekte olup, sadece bir proje değil; aynı zamanda sosyoekonomik değişimi başlatan büyük bir geçişi temsil etmektedir. Program, Avrupa veri ekonomisi ve dijital tek pazarı geliştirmekte olup, AB'nin sosyoekonomik dinamiklerini etkilemektedir. Bu süreçte gözetilen teknolojik egemenliğin başarısı, iyi bir uygulamaya, finansa ve yönetim girişimlerine bağlıdır.

Anahtar Kelimeler: *Siber Güvenlik, Yapay Zeka, Dijital Tek Pazar, Teknolojik Egemenlik, Yarı iletkenler.*

Introduction

The Covid-19 pandemic underlined the essence of digital transformation to survive in extreme conditions. The pandemic highlighted the rising digitalization trend and added a remarkable load to digital services. Most countries have noticed that their infrastructure needs to be designed to meet the current demand. Even before the pandemic, the states appreciated the opportunities of globalism but felt threatened by increasing dependency in almost all fields. Friedman formulated this dualistic as "globalization is everything and its opposite[1]." Technology plays an essential role in promoting globalization on various levels. As Väyrynen highlighted,

> "Technology is a tool for collaboration and competition. The growth of 'techno-globalism' does not imply that collaboration between governments or corporations is without political repercussions, as demonstrated by the US' relations with Japan and China. For obvious reasons, technology tends to diffuse from the stronger to the weaker side, who benefits more from the relationship.[2]"

The utilization of technology and science to spread globalization also makes the techno-globalization concept emerge. The industrial revolutions and technological improvements expedited the process. With the end of the Cold War, the existing limitations regarding technology transfer have mostly disappeared. The foci mainly switched to inexpensive production and expanding market capacity. The fading political restraints on technology transfer also introduced Asian countries as promising candidates for lower

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[1] Thomas L Friedman, *The Lexus and the Olive Tree*, (New York SE -: Anchor Books, 2000), 406.

[2] Raimo Väyrynen, "Global Interdependence or the European Fortress? Technology Policies in Perspective," *Research Policy* 27, no. 6 (September 1998): 627–37, https://doi.org/10.1016/S0048-7333(98)00059-6.

labor costs. The erroneous idea in the production sector is that know-how is required to create certain technologies. Between 1995 and 2014, the US, Japan, Germany, France, and the UK accounted for three-quarters of all patented innovations worldwide. From 1995 to 2014, other large countries, most notably China and South Korea, started to significantly contribute to the global pool of knowledge, joining the top five leaders in several industries[3]. These countries are playing a more prominent role than before. The newcomer Asian countries' inexpensive and diligent production capacity also created a sweet spot for the technology-leading countries to make investments and carry their production line there. Meanwhile, technology's dissemination capacity has prepared the path for specialized forms of techno-nationalism, interdependence, and deglobalization.

The increasing logistics costs, technological copyright issues, and supply chain dependency make innovative countries contemplate possible outcomes. The EU countries are not representing a homogenous trend and are also concerned about the rise of Asian countries. The increasing dependency on the new global and inexpensive producers is also building a deep interdependency with the innovation-leading countries.

The expansion of globalization and deglobalization is also a repetitive trend. Prosperity promotes globalization in several ways. Globalization can also have complicated and uneven effects on wealth. Technology can potentially improve economic possibilities and growth, but it can also aggravate income inequality, disrupt existing sectors, and have negative social and environmental consequences. The deglobalization is partially observed during crisis times in several contexts[4]. The COVID-19 pandemic emerged when some EU bodies started to discuss technological power and sovereignty concepts in context to the converging normative approach of the EU with emerging technologies. Even in a deglobalized society, technological innovation is a potent force. Digital technologies and worldwide connectivity continue to transcend physical borders, facilitating global cooperation, driving economic opportunities, and stimulating innovation. However, the precise impact of technical innovation in a

[3] Aqib Aslam et al., "Globalization Helps Spread Knowledge and Technology Across Borders," *IMF*, 2018, accessed August 21, 2023, https://www.imf.org/en/Blogs/Articles/2018/04/09/globalization-helps-spread-knowledge-and-technology-across-borders.

[4] Douglas A. Irwin, "The Pandemic Adds Momentum to the Deglobalization Trend | PIIE," April 23, 2020, https://www.piie.com/blogs/realtime-economics/pandemic-adds-momentum-deglobalization-trend.

deglobalized world will be determined by several factors, including national policy, international relations, and the ability of enterprises and institutions to adapt to new circumstances. The value of DIGITAL has to be understood within this framework.

The rising AI trends also present a new benchmark for states to adopt and build a new type of consciousness regarding their data regime. Digital transformation is the new normal for staying competitive and innovative in the global digital landscape. Amid this, the EU invested in cutting-edge technology to empower citizens, businesses, and public institutions to fully realize the digital age's potential.

> "We do have in Europe a long history of technological success and innovation. We have big businesses; we have a robust industry. And in Europe, we are caring very much for individual rights and our values. And the digital strategy we put forward today is connecting all these dots and putting it into a concept. We want the digital transformation to power our economy and we want to find European solutions in the digital age." [5]

Digital transformation goals of the EU are summarized with these words by President von der Leyen to encapsulate the essence of the Digital Europe Program. As technology continues to shape how we live and work, this aspiring initiative promises to drive digital innovation, foster collaboration, and ultimately affect the daily lives of millions of Europeans. It is also vital to emphasize that the dynamics defining technology and innovation policy can thus be viewed as complementing features of European (or national) internal policies and foreign policy considerations, such as trade and economic competitiveness[6].

The EU is trying to leave no stone unturned to obtain technological sovereignty. Primarily to be superior in the technology competition to sustain its political position. Secondly, to build some degree of control and independence for technologies in the EU with consideration to the crisis times. Thirdly, building a socio-technical innovative ecosystem in the EU to

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[5] European Commission, "Press Remarks by President von Der Leyen on the Commission's New Strategy: Shaping Europe's Digital Future," February 19, 2020, accessed August 21, 2023, https://ec.europa.eu/commission/presscorner/detail/en/speech_20_294.

[6] Josephine Anne Stein, "Science, Technology and European Foreign Policy: European Integration, Global Interaction," *Science and Public Policy* 29, no. 6 (2002): 463–77.

sustain its production. Finally, to homogenize the innovation idea among all EU members to maintain the digital single market. The EU initiated the Digital Europe Program (DIGITAL) to achieve these goals.

A decade ago, the European Commission discussed the issue in a communication titled "A Digital Agenda for Europe," pointing to fragmented digital markets, a lack of interoperability, rising cyber-crime and the risk of low trust in networks, insufficient research and innovation efforts, a lack of digital literacy and skills, and missed opportunities in addressing societal changes[7].

To overcome such problems, the EU initiated the DIGITAL as part of the EU's grand strategy to create a digital single market, which seeks to enhance Europe's competitiveness and foster innovation and growth[8]. The DIGITAL has several goals, including promoting digital infrastructure, developing digital skills and competencies, deploying digital technologies in key sectors such as healthcare, transport, and energy, and enhancing digital public services. Such loaded goals prove that the DIGITAL intends to do a paradigm shift, which also brings doubts and fears when the capacity of the EU is considered. Furthermore, the DIGITAL aims to promote ethical and trustworthy AI, improve cyber security, and foster digital inclusion, ensuring that all citizens have access to the benefits of digital transformation while strengthening Europe's digital sovereignty by supporting the development of European digital capabilities and technologies, reducing reliance on foreign providers, and ensuring that European values and standards are incorporated into developing and deploying digital technologies. The EU tries to minimize its interdependence on foreign providers regarding energy, digital, cyber security, semiconductors, and industrial policy related to the supply chain[9]. The recent supply chain attack (e.g., the SolarWinds incident[10]) in the cyber security sector also underlined the EU's policies and actions.

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[7] European Commission, "A European Strategy for Data' (2020) COM/2020/66 Final", accessed August 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0066&from=EN.

[8] European Commission, "A Digital Single Market Strategy for Europe," in *A Digital Single Market Strategy for Europe* (Oxford: Oxford University Press, 2015), 1–20.

[9] Sabrina Korreck, "Exploring Prospects for Digital Europe in the Age of the US-China Technology Race," *ORF Occasional Paper*, 159, (2021), accessed August 21, 2023, https://www.orfonline.org/wp-content/uploads/2021/03/ORF_ Occasional Paper_303_DigitalEurope.pdf.

Technological sovereignty is the critical concept primarily depicting the EU's current stance on digital technology. "Technological sovereignty can be defined as the ability of a country (or a group of countries) to generate autonomously technological and scientific knowledge to use technological capabilities developed outside or through the activation of reliable partnerships"[11]; conceptualization is underlying the approach that the EU considers its international partners considerably less dependable for various reasons. It is also vital to underline possible friction between technological sovereignty and globalization in the age of neoliberalism.

After the pandemic, the EU allocated approximately €7.5 billion for the DIGITAL in 2021-2027, and it is part of the EU's broader multiannual financial framework. It seeks to create a more competitive and inclusive European digital economy and society by supporting various initiatives and investments.

In this essay, I will explore the DIGITAL program in depth, including its aims, focus, pillars, efforts, realization, and the institutions it establishes concurrently. Given the program's complexity, including the concurrent development of various entities and processes, capturing it within a single article is a daunting endeavor. Nonetheless, we hope to present an enlightened viewpoint. I will also address two critical issues: Has the EU met its DIGITAL program objectives, and what constraints have surfaced during implementation?

I. Conspectus of DIGITAL

The roots of the digital agenda of the EU go back to 2010[12]. Later, the European Commission launched the Digital Single Market Strategy in 2015, the Digital Skills and Jobs Coalition in 2016, and the Digital Education Action Plan in 2018[13]. These steps are forming the background of such

[10] Sean Peisert et al., "Perspectives on the SolarWinds Incident," *IEEE Security & Privacy* 19, no. 2 (March 2021): 7–13, https://doi.org/10.1109/MSEC.2021.3051235.

[11] Francesco Crespi et al., "European Technological Sovereignty: An Emerging Framework for Policy Strategy," *Intereconomics* 56, no. 6 (2021): 348–54, https://doi.org/10.1007/s10272-021-1013-6.

[12] European Commission, "A Digital Agenda for Europe," *Communication*, vol. 5, 2010, accessed August 21, 2023, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF.

[13] Steph Hazlegreaves, "Building a Digital Future for All in Europe," *Open Access Government* (blog), September 11, 2018, accessed August 21, 2023, https://www.openaccessgovernment.org/digital-future/51932/ .

massive planning. The increasing data usage and GDPR accelerated the EU to understand the demands of the technology, data market, and data brokers. The program also demonstrates the shift in the EU's broader strategy to promote digital transformation, which has several effects on the European economy and society[14].

A. Objectives of the Digital Europe Program

The DIGITAL has several critical goals for realizing the program:

- Promoting the digital infrastructure is foundational to building other stages. The DIGITAL initiative seeks to strengthen Europe's digital infrastructure by fostering the development of high-speed broadband and 5G networks. The connectivity improvement also underpins advanced technologies such as AI, cloud computing, and cyber security.

- The program focuses on developing individuals' digital competencies, notably within the EU. The DIGITAL project aims to improve EU citizens' digital literacy, entrepreneurship, and workforce skills. Notably, there is a substantial skill shortage in cybersecurity and coding. According to LinkedIn, demand for cybersecurity knowledge has increased by an average of 22% in the last year across 12 European regions, with Poland (36%), Germany (32%), and Romania (31%) leading the way. To meet demand next year, at least 60,000 additional cyber experts are needed across all 12 European countries[15]. At the 2022 Munich Cyber Security Conference, European Commission Vice President Schinas stated:

> "As Vice-President responsible for coordinating the EU's work both in the areas of skills and security, I see the urgent need to boost the number of specialists in cyber security in Europe. For this reason, I call on all of you to join forces and make concrete pledges to train professionals on cybersecurity skills. Time is of the essence[16]."

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[14] European Commission, "Decision (EU) 2015/2240 - Establishing the Digital Europe Programme and Repealing," *Official Journal of the European Union* L 166, no. March (2021): 1–34.

[15] Microsoft, "The Urgency of Tackling Europe' s Cybersecurity Skills Shortage," 2022, accessed August 21, 2023, https://blogs.microsoft.com/eupolicy/2022/03/23/the-urgency-of-tackling-europes-cybersecurity-skills-shortage/.

[16] Margaritis Schinas, "Keynote Speech by Vice-President Schinas at the Munich Cyber Security Conference (MCSC) 2022," accessed August 21, 2023 https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_22_1163.

Coding skills, particularly in the cybersecurity industry, are critical in the EU. This phase of the DIGITAL program needs more time and effort, but it is critical to fulfilling other program goals. The digital competencies program aims to enable all EU citizens to participate in and realize the benefits of digital transformation.

- The DIGITAL aims to promote the deployment of digital technologies in key sectors, such as healthcare, transport, and energy, to improve efficiency, reduce costs, and enhance the quality of services. The program also seeks to promote the development of digital public services that are accessible, user-friendly, and secure.

- The rise of AI implementation in several products and services also forms a concern point for the EU. In addition to the AI competition between several states, the EU AI patent filings are less than those of China and the US[17]. The DIGITAL is designed to support innovation and research in AI technologies to increase the presence of the EU in the AI competition. Another concern for the EU is tackling biases and ethics in AI technologies. The DIGITAL seeks to promote the development of AI technologies that are ethical, trustworthy, and respect fundamental rights and values. The program aims to ensure that the development and deployment of AI technologies are transparent, explainable, and subject to human oversight.

- Cyber security is essential to European security and the DIGITAL. The EU's Cybersecurity Strategy for the Digital Decade has underlined that EU citizens have the right to use or visit connected devices, electricity grids, banks, aircraft, public administrations, or hospitals with the assurance that they will be protected from cyber threats. The strategy also emphasized how the EU's economy, democracy, and society rely more on secure and dependable digital tools and connectivity than ever[18]. Within this context, the DIGITAL aims to strengthen the cybersecurity of EU institutions, businesses, and citizens by promoting cybersecurity research, developing cybersecurity capabilities, and supporting the development of cybersecurity standards and certification schemes.

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[17] Daniel Zhang et al., "The AI Index Report 2022," (Stanford Institute for Human-Centered Artificial Intelligence (HAI), 2022), 230.

[18] European Commission, "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of The Regions Digital Education Action Plan 2021-2027 Resetting Education and Training for the Digital Age," September 30, 2020, accessed August 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT /PDF/?uri =CELEX :52020DC0624.

- The DIGITAL program seeks to promote inclusive digital transformation, particularly among vulnerable communities. It supports projects that increase digital literacy, access to services, and skill development. This entails installing digital services and improving citizens' digital competencies to fully utilize services.

- The DIGITAL initiative seeks to strengthen Europe's digital sovereignty by fostering the development of European digital capabilities and technologies. From the standpoint of technological sovereignty, the EU wishes to reduce its reliance on foreign providers, critical suppliers for several European digital infrastructures. The chip and semiconductor industries are global market choke points and critical dependencies[19]. The more advanced chips are made in Taiwan and South Korea. The US' intellectual property in chip design automation, Japanese wafers, and Chinese chip assembly is also a source of dependence for various sectors of the EU industrial production. Europe has extensive research and manufacturing capabilities and some capacity for producing (less advanced) chips with larger transistors, frequently destined for the automotive industry and (chemical) inputs[20]. The semiconductor supply shortages that emerged during the pandemic are unlikely to disappear anytime soon because surging production requires massive amounts of capital and knowledge. Another challenge for the EU is maintaining the European values and standards incorporated into developing and deploying these digital technologies.

B. Emphasis of the Digital Europe Program

The primary goal of the DIGITAL is promoting the digital transformation of the EU economy and society. On the one hand, the DIGITAL program seeks to encourage the advancement of digital technologies and infrastructure within the EU to increase the EU economy's competitiveness. HPC (Supercomputing), AI, cyber security, and the development of digital skills are significant areas of attention. Through several projects, the DIGITAL strives to foster innovation, productivity, and growth in the EU's digital economy. On the other hand, the DIGITAL aims to ensure that the benefits of digital transformation are felt by all citizens, regardless of their socioeconomic background or geographic location. It seeks to promote the development of digital public services, such as e-

[19] For further details, see; Chris Miller, *Chip War: The Fight for the World's Most Critical Technology*, First Scribner hardcover edition (New York: Scribner, an imprint of Simon & Schuster, 2022).

[20] See, the Chips Act section.

government, e-health, and e-learning, to make these services more accessible and user-friendly. This move also supports the governance stance of the EU countries in the neoliberal age. Additionally, the use of these platforms could produce several data points that could be utilized for further automatization.

At the root of its spirit, the DIGITAL is more than a project; a monumental shift that will initiate a socioeconomic change by altering the *habitus* and interaction of European society. Since production technologies are rooted in social systems, introducing new technologies will first encounter resistance from the existing organizational structures, cultural attitudes, vested interests, and institutional settings (consistent with the pre-existing production technologies). When the resistance has ended, these same structures, interests, and institutions can underpin the spread and further development of these introduced new technologies.

The DIGITAL invests in HPC to assist researchers and businesses in more efficiently tackling complex scientific and engineering problems. It also supports the development and deployment of AI to assist businesses and government agencies in making more data-driven decisions, improve operations, and provide better services to customers and citizens. Parallel to this understanding, HPC has been identified as a strategic investment priority by the European Commission, underpinning its entire digital strategy, from big data analytics and AI to cloud technologies and cybersecurity. These infrastructural preparations strategically build necessary environments to boost innovation, productivity, and accelerated communication.

Furthermore, the DIGITAL emphasizes cybersecurity investments to protect these processes, recognizing that digital technologies are vulnerable to cyber-attacks. The program encourages adopting best practices and standards to improve cybersecurity across the EU and invests in cybersecurity research and innovation. The evolution of the EU's digital economy methodology may have specific consequences for European society's daily practices and interactions with states. The DIGITAL also ensures that all citizens, regardless of socioeconomic status or geographical location, reap the benefits of digital transformation. To that end, the program emphasizes the importance of digital inclusion, particularly for underserved populations such as the elderly, people with disabilities, and those living in rural areas. Improving digital competencies is also considered within this framework. But demographic statistics present a particular challenge that the EU administration should have to address. The population of those 65 and older in the EU will grow significantly, from 90.5 million at the beginning of 2019 to 129.8 million by 2050. The number of people in the EU aged 75-84 years is expected to increase by 56.1% during this period, while the number

of people aged 65-74 years is expected to increase by 16.6%. According to the most recent projections, the EU will have 13.5% fewer people under 55 by 2050[21]. With these aging population figures, the EU should develop other projects to support the human component within the DIGITAL.

II. DIGITAL Pillars and Initiatives

The DIGITAL has four pillars: Digital skills, digital infrastructure, digital public services, and digital single market. Each of these pillars is crucial to the DIGITAL's overall goal of promoting the digital transformation of the EU economy and society.

The *first pillar*, digital skills, ensures that all EU citizens have the necessary digital skills to participate fully in the digital economy. This includes promoting digital literacy and providing training and education programs to help individuals acquire digital skills. The need to address the digital skills gap by improving the quality and relevance of digital skills education and training programs across the EU is eminent. The human component is very critical in digitalization projects. In the global market, there is a remarkable talent gap in the digital market, from software development to cyber security experts. Therefore, the human component comes first in the achievement of such a project. However, since the local sources of the EU are not enough to fill the gap, a comprehensive talent visa program and a new migration process for the EU is needed. Germany's recent talent visa program is becoming a forerunner to this understanding.

The *second pillar*, digital infrastructure, is focused on improving the quality and accessibility of digital infrastructure across the EU including investment in high-speed broadband and 5G networks and development of a pan-European network of supercomputers. Improving the cybersecurity of EU institutions, businesses, and citizens by promoting the adoption of best practices and standards for cybersecurity is also part of the program.

The *third pillar*, digital public services, focuses on developing digital public services that are user-centric, secure, and accessible to all EU citizens. This includes promoting the development and deployment of AI technologies that are ethical and trustworthy, as well as the use of digital technologies in key sectors such as healthcare, transport, and energy.

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[21] Eurostat, "Ageing Europe - Statistics on Population Developments," 2022, accessed August 21, 2023, https://ec.europa.eu/eurostat/statisticsexplained/.

The *fourth pillar* is the digital single market. Previous pillars are preparing the necessary infrastructure to operate the DIGITAL; the digital single market is building its content. It focuses on innovation and productivity, aiming to increase efficiency and form an innovative ecosystem in the EU. To sustain innovation, the digital single market is promoting digital entrepreneurship to boost the number of startup companies in the EU. The principal idea behind this step is to produce the necessary hardware and software to compete with leading market countries. On the other hand, this approach also intends to decrease dependency and build a robust structure that could be affected less by global uncertainties. It hopes to achieve this by creating a more competitive and innovative EU better prepared to face the challenges of the digital age.

III. Major Initiatives and Their Process

The program has a budget of €7.5 billion for 2021-2027, supporting various initiatives to accelerate Europe's digital transformation. The EU's Multiannual Financial Framework (MFF), which establishes the EU's long-term budget for the seven-year period from 2021 to 2027, funds the Digital Europe program including research and innovation, infrastructure, and social policies[22].

A. Digital Skills

The main programs under this pillar provide young people with digital skills training and work experience. The EU has allocated €700 million for the digital skills chapter and started three significant initiatives to achieve these goals.

1- The Digital Skills and Jobs Coalition[23]

This is an EU initiative that promotes digital skill development and employment throughout Europe bringing together diverse stakeholders,

[22] European Commission "Regulation of the European Parliament and of the Council Establishing the Strategic Technologies for Europe Platform ('STEP') and Amending Directive 2003/87/EC, Regulations (EU) 2021/1058, (EU) 2021/1056, (EU) 2021/1057, (EU) No 1303/2013, (EU) No 223/2014, (EU) 2021/1060, (EU) 2021/523, (EU) 2021/695, (EU) 2021/697 and (EU) 2021/241," June 20, 2023, accessed August 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023PC0335 .

[23] European Commission, "Digital skills and jobs coalition", accessed August 21, 2023, https://digital-strategy.ec.europa.eu/en/policies/digital-skills-coalition

including businesses, industry associations, educational institutions, and government agencies, to work toward improving digital skills and closing the digital skills gap in Europe. It was established in 2016 as part of the New Skills Agenda for Europe[24] and it operates at the EU and national levels, with member organizations collaborating to identify and address their respective countries' and regions' digital skills needs.

Its ambitious targets for digital skills development in Europe, include:

-Training 1 million Europeans in coding and other digital skills by 2020. The COVID-19 pandemic hindered its realization. "The Digital Economy and Society Index (DESI) 2021 published by the Commission states that even before the COVID-19 pandemic Union businesses, in particular small and medium-sized enterprises (SMEs), struggled to find information and communications technology (ICT) professionals in sufficient numbers25."

-Facilitating recognizing and validating digital skills acquired through non-formal and informal learning.

-Supporting the development of digital skills for all citizens, including the elderly, the unemployed, and those in low-skilled jobs.

-Promoting the uptake of digital skills in all sectors and industries, including the public sector, healthcare, and education.

To realize these goals, the Coalition offers resources and support services, such as training materials, networking opportunities, and funding for digital skills projects and initiatives. The coalition aims to create new job opportunities across Europe to drive economic growth by bringing together key stakeholders from across Europe.

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[24] European Commission, "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions A new Skills Agenda for Europe", October 6, 2016, accessed August 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT /PDF/?uri=CELEX:52016DC0381 .

[25] European Commission, "Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030 (Text with EEA relevance)" , December 14, 2022, accessed August 21, 2023 https://eur-lex.europa.eu/eli/dec/2022/2481/oj

2- EU Digital Competence Framework (DigComp)[26]

DigComp is a framework in Europe that promotes digital skills and competencies establishing a common reference framework for describing and assessing European digital skills and competencies. It was created in collaboration with experts from across Europe by the European Commission's Joint Research Centre. DigComp and updated version DigComp 2.2 can continue to play a critical role toward achieving determined EU goals for digital upskilling of the entire population - 80% of the population to have basic digital skills by 2030, which is also supported by the European Pillar of Social Rights Action Plan. The update considers developing technologies such as AI, the Internet of Things information literacy, datafication, and new phenomena such as new teleworking conditions, which have resulted in new and increasing digital competence needs for citizens[27]. The framework comprises five critical digital competencies: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving.

3- The Digital Education Action Plan[28]

The action plan contributes to the EU's goal of promoting economic growth and social inclusion by developing a digital economy and society since it is a comprehensive harmonization strategy designed to improve digital skills and competencies in education across Europe. The plan was launched in January 2018 to improve the quality and accessibility of digital education, promoting the use of digital technologies in teaching and learning and is constructed on three main priorities:

The *first priority* is creating a framework for digital education that supports the development of high-quality digital skills and competencies among learners and educators. This priority aims to create a framework for digital education that supports the development of high-quality digital

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[26] European Commission "DigComp Framework", accessed August 21, 2023, https://joint-research-centre.ec.europa.eu/digcomp/digcomp-framework_en

[27] Riina Vuorikari, Stefano Kluzer, and Yves Punie, *DigComp 2.2 - The Digital Competence Framework for Citizens* (Publications Office of the European Union, 2022), accessed August 21, 2023, https://publications.jrc.ec.europa.eu/repository/handle/JRC128415.

[28] European Commission, Digital Education Action Plan (2021 – 2027), accessed August 21, 2023, https://education.ec.europa.eu/focus-topics/digital-education/action-plan

abilities and skills among learners and educators. It includes initiatives to promote the use of digital technologies in education, as well as to support the development of digital pedagogy and the use of open educational resources.

The *second priority* aims to ensure that all Europeans have the digital competencies and skills necessary to participate in the digital economy and society. It emphasizes the DIGITAL's human component including includes initiatives to promote digital literacy and skills among students and educators and to encourage the development of new digital skills to meet the digital economy's demands.

The *third priority* encourages the use of digital education technologies for innovation and creativity including initiatives to encourage the creation of new digital tools and resources for teaching and learning and to improve digital technologies for collaborative learning and co-creation[29].

B- Digital Infrastructure

The specific highlight of the DIGITAL is to improve European infrastructure by enlarging the coverage of broadband Internet access in cities and rural areas. The broadband concept includes several technological categories. Most of the EU's Internet infrastructure is formed by Digital Subscription Lines (DSL), which provide Internet connections over traditional telephone lines. The EU tries to develop better connection technologies with the support of DIGITAL. The Internet coverage with DSL technology was 89.9 % in 2020. Another technology is Fiber to the Premises (FTTP), which utilizes fiber optic cables for Internet access. That was 42.5% in 2020. Up to the final report on Broadband Internet access, at the end of June 2020, 56.1% of EU households had access to Fixed Wireless Access (Wi-Fi, WiMAX, 4G LTE-TDD, and 5G FWA)[30]

[29] European Commission "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Digital Education Action Plan 2021-2027 Resetting Education and Training for the Digital Age," September 30, 2020, accessed August 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/ ?uri= CELEX:52020DC0624.

[30] European Commission, "Digital Single Market Broadband Coverage in Europe: Final Report", 2021, accessed August 21, 2023, https://doi.org/10.2759/27414.

-The European Gigabit Society[31] is based on the idea that digital connectivity is critical for economic growth, social cohesion, and innovation in the digital age and it aims to provide reliable universal access to gigabit connectivity capable of up to 1 gigabit per second. This necessitates the construction of new, high-speed networks, such as fiber-optic broadband and 5G wireless networks, capable of providing the bandwidth required to support advanced digital services and applications. To achieve this goal, the EU also has pledged to invest in deploying high-speed networks such as fiber-optic broadband, 5G wireless networks, and other advanced technologies. For 2025, the EU has set high connectivity goals (by 2025) such as all European households having access to 100 Mbps networks, with the option of upgrading to much faster speeds, gigabit broadband being available to all major socio-economic drivers, uninterrupted 5G coverage being accessible in all urban areas and key terrestrial transportation corridors connecting people and objects, mobile data access being available including places where people live, work, travel, and congregate[32].

The EU tries to eliminate several bureaucratic and administrative hurdles to realize these high-speed networks while coordinating between public and private entities, especially bringing broadband Internet connection to rural and remote areas.

-The Connecting Europe Facility (CEF)[33] is a funding program designed to assist in developing trans-European infrastructure networks in the transportation, energy, and digital sectors. The initiative, which began in 2014, set aside €1.05 billion for trans-European networks in the telecommunications industry between 2014 and 2020. The recent budget for 2021-2027 is approximately €30 billion. The CEF seeks to promote sustainable and inclusive growth in Europe by financing cross-border infrastructure projects that improve connectivity, increase efficiency, and reduce carbon emissions. The initiative will also help the EU achieve its broader policy goals, such as the Digital Single Market, Energy Union, and

[31] European Commission, "Connectivity for a European Gigabit Society – Brochure", accessed August 21, 2023, https://digital-strategy.ec.europa.eu/en/library/connectivity-european-gigabit-society-brochure

[32] European Commission, "EU 2025 Connectivity Objectives", accessed August 21, 2023, https://digital-strategy.ec.europa.eu/en/library/connectivity-european-gigabit-society-brochure

[33] European Commission, "Connecting Europe Facility", accessed August 21, 2023, https://cinea.ec.europa.eu/programmes/connecting-europe-facility_en

Trans-European Transport Network. The Innovation and Networks Executive Agency (INEA) was under the authority of the CEF, which ceased its operations on 31 March 2021. To replace the similar functionality, The European Climate, Infrastructure, and Environment Executive Agency[34] was established on 1 April 2021 to inherit the INEA's functionality. The CEF has three main areas of interest: Transportation, Energy, and Telecom. Also, the CEF Telecom legacy portfolio and additional EU funding program were taken over by the European Health and Digital Executive Agency (HaDEA)[35]. The CEF in Telecom is a key EU instrument to facilitate cross-border interaction between public administrations, businesses, and citizens by deploying digital service infrastructures (DSIs) and broadband networks. The CEF also supports several projects to create a European ecosystem of interoperable and interconnected digital services that sustain the Digital Single Market.

-European Alliance for Industrial Data, Edge, and Cloud[36] The Commission proposed a Regulation on harmonized regulations on fair access to and use of data (Data Act) on February 23, 2022 which is an essential component of the European data strategy. Its primary goal is to position Europe as a leader in the data economy by leveraging the potential of the ever-increasing volume of industrial data to benefit the European economy and society. The Data Act is positioned at the core of this alliance[37]. The Digitizing European Industry initiative of the European Commission, which aims to assist European industry in entirely using the advantages of digital technologies, included the Alliance in its debut in 2019. is a critical initiative for advancing the European digital economy. By encouraging collaboration between industry, academia, and policymakers, the Alliance targets to create a solid and innovative industrial ecosystem that can support the needs of European businesses by considering European citizens' benefits. The data

[34] Commission, "Connecting Europe Facility"

[35] European Commission, "European Health and Digital Executive Agency (HaDEA)", accessed August 21, 2023, https://hadea.ec.europa.eu/programmes/connecting-europe-facility_en

[36] European Commission, "European Alliance for Industrial Data, Edge and Cloud", accessed August 21, 2023 https://digital-strategy.ec.europa.eu/en/policies/cloud-alliance

[37] European Commission, "Regulation of the European Parliament and of the Council on Harmonised Rules on Fair Access to and Use of Data (Data Act)" February 23, 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022PC0068.

edge and cloud technologies are also assisting the green economy targets. The Alliance intends to accelerate the development and adoption of industrial data, edge, and cloud technologies in Europe by constructing common architectures and standards, investing in research and innovation, cultivating skills and talents, and forming partnerships among various stakeholders. In contrast, the alliance empowers private and public partnerships and prepares SMEs for industry 4.0 standards. It is also critical to note that the alliance is arranging the necessary background for the digital single market concept.

The functionality of the alliance focused on four key areas; to develop common architectures and standards for the industrial Internet of Things (IIoT), edge computing, and cloud computing to ensure interoperability and compatibility across various systems and technologies, to foster technological advancement in industrial data, edge, and cloud technologies to create a European-wide innovation environment, to develop training programs and educational initiatives to support the development of industrial data, edge, and cloud technologies and to foster collaboration and partnerships between industry, academia, and policymakers to drive innovation.

- The European High-Performance Computing Joint Undertaking (EuroHPC JU)[38] is responsible for selecting and deploying HPC systems, creating applications, and providing user training and support. It was established in 2018 as a joint venture between the European Union (EU), European countries, and private stakeholders to make Europe a world leader in HPC technologies and applications. The Commission framed the role of the EuroHPC Joint Undertaking as to develop, deploy, extend, and maintain a world-class supercomputing and data infrastructure in the Union. The Commission also underlined the importance of a new mission and objectives for the EuroHPCJU to ensure its continuation concerning the analysis of the critical socioeconomic and technological drivers affecting the future evolution of HPC and data infrastructures, technologies, and applications in the Union and globally, as well as the lessons learned from the EuroHPC Joint Undertaking's current activities[39].

[38] EuroHPC, "The European High Performance Computing Joint Undertaking (EuroHPC JU)", accessed August 21, 2023, https://eurohpc-ju.europa.eu/index_en

[39] Official Journal of the European Union, "Council Regulation (EU) on Establishing the European High Performance Computing Joint Undertaking and

The EuroHPC Joint Undertaking is a public-private collaboration that funds and resources the development of a pan-European HPC infrastructure, including the deployment of pre-exascale and petascale supercomputers. Now, the EuroHPCJU has acquired eight supercomputers spread across Europe[40]. The first of these systems, "Leonardo," was installed in Italy in 2020. The Joint Undertaking also funds research and innovation projects that use HPC technology to address scientific and societal concerns and training and education programs that help people learn how to use and manage HPC equipment. The EuroHPC Joint Undertaking also assists in developing HPC applications in various fields, including climate modeling, drug discovery, and engineering simulations.

-The European Processor Initiative (EPI)[41] is a project currently being carried out to design and implement a roadmap for a new family of low-power European processors for extreme-scale computing, high-performance big data, and various emerging applications. The effort was initiated in 2018 as part of the Horizon 2020 research and innovation program to design a new processor architecture to assist Europe in reclaiming its leadership in HPC. The EPI hopes to strengthen Europe's position in HPC and lessen its reliance on non-European technology suppliers. The goals of the EPI include creating a new processor design and the related software tools and programming models needed for the effective use and programming of the new processors in partnership with various European institutions, including research institutes, universities, and technology firms. Building a competitive and innovative ecosystem for HPC customized to the requirements of European applications and industries, is crucial for the growth of the European digital economy.

-The Chips Act Semiconductors are at the heart of any digital device and the digital transition of the Union, from smartphones and cars to vital applications and infrastructures in health, energy, communications, and automation, as well as most other industry areas. The COVID-19 pandemic also underlined semiconductor production and obtaining difficulty. The EU has seen unprecedented supply disruptions with major implications. The

Repealing Regulation (EU) 2018/1488", accessed August 21, 2023, https://eurohpc-ju.europa.eu/system/ files/2022-03/uriserv_OJ.L_.2021.256.01.0003.01.ENG_EN_TXT.pdf.

[40] EuroHPC

[41] "European Processor Initiative", accessed August 21, 2023, https://www.european-processor-initiative.eu

present interruptions have exposed long-standing vulnerabilities in this regard, particularly a substantial reliance on third-country manufacturing and chip design. In the mid-2000s, corporations began relocating their supply chains to East Asia in search of increasing investment prospects and reduced labor costs. Now, China, Taiwan, South Korea, Singapore, and Japan are the leading countries in the production of these products. The EU also sees semiconductors as tremendous enablers of sustainability and the green transition. Additionally, semiconductor production is also perceived as the principally responsibility for the EU's solid industrial, competitive, and sustainable foundation and for supporting innovation across a broad range of chips. Semiconductor production is also emerging as a prerequisite for the success of the DIGITAL.

To create a joint European chip ecosystem, including production, the EU focused on the Chips Act, which "aims at reaching the strategic objective of increasing the resilience of Europe's semiconductor ecosystem and increasing its global market share"[42] and to facilitate the early adoption of new chips by European industry and increase its competitiveness within the framework of DIGITAL.Up to the Chips Act, the European Chips Strategy is basically organized around five major strategic goals:

-Europe should strengthen its research and technology leadership.

-Europe should build and reinforce its own capacity to innovate in the design, manufacturing, and packaging of advanced chips and turn them into commercial products.

-Europe should put in place an adequate framework to substantially increase its production capacity by 2030.

- Europe should address the acute skills shortage, attract new talent, and support the emergence of a skilled workforce[43].

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[42] European Commission, "Proposal for a Council Regulation Amending Regulation (EU) 2021/2085 Establishing the Joint Undertakings under Horizon Europe, as Regards the Chips Joint Undertaking," 2021/2085 § (2022), accessed August 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/ PDF/?uri =CELEX :52022PC0047.

[43] European Commission, "Establishing a Framework of Measures for Strengthening Europe's Semiconductor Ecosystem and Amending Regulation (EU) 2021/694 (Chips Act)" (2023), accessed September 19, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1781.

However, such production ambition also requires high investment in research and development, a qualified human workforce, logistics, and sustainability. The EU reserved €45 billion for the Chips Act project[44]. While the EU member countries are in dire need of a skilled workforce, how will the EU realize such a goal and be able to compete with lower labor costs in emerging markets[45]. Germany is receiving the major share from the semiconductor support of the EU, which also forms another monopoly and creates another dependency within the union. It remains to be seen whether these investments will put an end to Europe's appetite for foreign chips, which was forming 20% of the global production. It is also critical to note that the success of the Chips Act also depends on its cooperation with the US Chips Act (2022)[46]. The experts in a report also highlighted that despite the EU Chips Act's best efforts, Europe could be a net importer of semiconductors by 2030[47].

-The European AI Alliance was established in 2018 to exchange ideas, promote best practices, and create a shared vision for the future of AI in Europe. The Alliance wants to gather diverse professionals from academia, industry, civil society, and other pertinent groups on legislative efforts relating to AI and share their knowledge and expertise on AI development. It aims to promote the development and uptake of trustworthy AI, defined as AI developed and used safely and transparently, and respects fundamental rights and values such as privacy, non-discrimination, and human autonomy. With the context of the digital Europe program, the Alliance also promotes education and training in AI and supports the development of a diverse and inclusive AI workforce. From the technological sovereignty perspective, the

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[44] Foo Yun Chee, "EU Countries Back Billion-Euro Chip Plan Ahead of Talks with Lawmakers," *Reuters*, November 23, 2022, sec. Technology, https://www.reuters.com/technology/eu-countries-back-billion-euro-chip-plan-ahead-talks-with-lawmakers-2022-11-23/.

[45] Afiq Fitri, "The European Chips Act Has Already Failed," *Tech Monitor* (blog), November 28, 2022, https://techmonitor.ai/technology/silicon/the-european-chips-act-will-not-restore-the-continents-semiconductor-industry-to-its-former-glory.

[46] US Congress, "US Chips and Science Act," Pub. L. No. H. R. 4346 (2022), August 21, 2023, https://www.congress.gov/117/bills/hr4346/BILLS-117hr4346enr.pdf.

[47] "A New Dawn for European Chips," *Deloitte Insights*, accessed August 21, 2023, https://www2.deloitte.com/uk/en/insights/industry/technology/semiconductor-chip-shortage-supply-chain.html .

European AI Alliance aims to ensure that Europe remains at the forefront of AI innovation while protecting the rights and values of its citizens. This includes ensuring that AI is developed and deployed to benefit society. The European AI Alliance is welcoming any interested parties for participation. Members are encouraged to participate in Alliance events and support the organization's objectives by contributing their perspectives on AI-related issues. The Alliance also presents platforms for its members to interact with legislators and other key players in the European AI ecosystem.

C. Digital Public Services

The EU Commission has facilitated the DIGITAL with several services in the field of Digital Public Services. These services focus on increasing efficiency, speeding up public services, and improving the quality of management. It is also critical to note that the EU is using these services to regulate the data flow and benefit from the platforms to build a digital single market.

1. Single Digital Gateway and Your Europe Portal[48]

The single digital gateway offers online access to information, administrative processes, and help services that people and businesses of the EU may require when residing or conducting business in another EU Member State.

The Internal Market, Industry, Entrepreneurship, and SMEs Commissioner Elbieta Biekowska summarized the essence of the service: "Today, persons and businesses desiring to relocate, work, or do business throughout Europe encounter a maze of perplexing regulations and interminable paperwork. That takes up a lot of time and money for our people. According to the promises made in the Digital Single Market Strategy, the single digital gateway would alter, simplify, improve, and speed up administrative procedures. Beginning in 2020, the Your Europe portal will direct EU people and enterprises to all the information they require regarding EU or national rules relating to employment, healthcare, education, and business setup[49]."

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[48] "Your Europe", accessed August 21, 2023, https://europa.eu/youreurope/index_en.htm

[49] European Commission, "Commission Welcomes Adoption of the Regulation for a Single Digital Gateway," accessed August 21, 2023,

A single digital entry point supplies faster access to high-quality information, online administrative procedures, and assistance services in the future. The multilingual platform now supports 13 basic administrative processes, such as obtaining a birth certificate, registering a car, building a business, or filing for social security benefits. The gateway ensures that there will be a quick rise in the number of services for the most critical procedures. The Single Digital Gateway works with a "once-only" principle; relevant data gathered by national authorities should only be submitted once and then made available for reuse in the most critical cross-border operations activities. The Single Digital Gateway satisfies users' digital age needs. The calculation of the relevant bodies demonstrates that it has the potential to save businesses more than EUR 11 billion per year and EU residents up to 855,000 hours of work each year. The gateway will also ease the process for those relocating to or doing business in another EU country and the single digital gateway will evolve, making administrative operations easier, better, and faster[50]. The gateway also highlights and encourages Member States to develop and implement e-government programs to provide contemporary and efficient public services.

2. The European Interoperability Network

The European Interoperability Network was established to define interoperability norms and guidance among the member states to develop a European public services ecosystem[51]. Within the DIGITAL context, Member States focused on modernizing their public administrations by adopting digital public services to make the interactions more efficient, effective, timely, and of high quality, as well as to help remove barriers and minimize the cost and effort required. The major problem will emerge when each member state creates its digital public services platform. These isolated digital environments could prevent public administrations from connecting with one another and citizens and businesses from identifying and using available digital public services in countries other than their own. Kouroubali also focused on the effectiveness of such a network for the

https://www.pubaffairsbruxelles.eu/eu-institution-news/commission-welcomes-adoption-of-the-regulation-for-a-single-digital-gateway/.

[50] European Commission, "Daily News 03 / 10 / 2018," 2018, accessed August 21, 2023, https://ec.europa.eu/commission/presscorner/detail/en/MEX_18_6002 .

[51] European Commission, Directorate General for Informatics, *New European Interoperability Framework: Promoting Seamless Services and Data Flows for European Public Administrations.* (LU: Publications Office, 2017).

healthcare ecosystem just before the COVID-19 pandemic[52]. Therefore, the digitalization efforts of the public sector should be meticulously coordinated at the regional and national levels to minimize digital fragmentation of services and data and ensure the seamless operation of the EU's digital single market. The network published and disseminated these guiding principles:

-Subsidiarity and proportionality, which aims to give certain freedom to the members and prioritize the national specificities.

-Openness marks all public data should be freely available for use and reuse by others unless restrictions apply. The concept also promotes the use of open-source technologies and software.

-Transparency enables other government agencies, individuals, and businesses to view and comprehend administrative rules, processes, data, services, and decision-making. There is a particular emphasis on the interoperability of the data and services.

-Reusability mitigates redundancy of IT solutions. The repetitive creation of information and data is costly because information and data enable interoperability and increase quality by extending operational use while saving money and time.

-Technological neutrality and data portability focus on functionality and warning about technology dependency. The member states should prioritize functional needs and postpone technological decisions for as long as possible to reduce technological dependencies, avoid imposing specific technical implementations or products on their constituents, and be able to adapt to a rapidly changing technological environment to protect the reusability of data.

-User-centricity focuses on prioritizing the needs and feedback of the users.

-Inclusion and accessibility recommend an inclusive stance for the users. The concept also puts people with disabilities, the elderly, and other disadvantaged groups into the spotlight to make them access public services at comparable levels to other citizens.

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[52] Angelina Kouroubali and Dimitrios G. Katehakis, "The New European Interoperability Framework as a Facilitator of Digital Transformation for Citizen Empowerment," *Journal of Biomedical Informatics* 94 (June 2019): 103166, https://doi.org/10.1016/j.jbi.2019.103166.

-Security and privacy consistent with cyber security guidelines and GDPR rules.

-Multilingualism observes expected end-user languages for seamless operation.

-Administrative simplification has two points: digital-by-default encourages accessibility of at least one digital channel and utilizing a specific European public service. The second point is digital-first, which prioritizes using public services through digital media.

-The presentation of information provides a baseline for public agencies to transform their records and electronic information into new media when old media becomes obsolete.

-Assessment of effectiveness and efficiency advice to consider investment, the total cost of ownership, level of flexibility and adaptability, administrative burden reduction, efficiency, risk reduction, transparency, simplification, enhanced working techniques, and user satisfaction for building a digital public service[53].

To empower interoperability, the EU has established a legal framework for electronic identification, authentication, and signature systems, known as the eIDAS Regulation[54], which is crucial for digital public services.

D. Digital Single Market (DSM)

The market is positioned in the background of all services and underlines the socioeconomic importance of other initiatives. The EU built up the DSM to ensure the free movement of digital goods, services, and data across national borders. The market was designed to sustain the EU's leadership in the digital economy and expand the capability of European businesses. The Commission defined the DSM as "one in which the free movement of goods, persons, services, and capital is ensured and where individuals and businesses, regardless of nationality or place of residence, can seamlessly access and exercise online activities under conditions of fair competition and a high level of consumer and personal data protection[55]."

[53] EIF, *European Interoperability Framework, White Pages*, 2017, 2.

[54] European Commission, "eIDAS Regulation", accessed August 21, 2023, https://digital-strategy.ec.europa.eu/en/policies/eidas-regulation

[55] Commission, "A Digital Single Market Strategy for Europe."

The DSM has several goals and interacts with other digital services to achieve such goals. It emphasizes several points, but mainly:

- Promotion of free cross-border data flows by removing barriers and restrictions that impede digital trade as much as possible. Under the GDPR jurisdiction, the data flow, even within the EU, requires attention to data privacy, cybersecurity, and intellectual property rights. Protecting intellectual property rights and blueprints is critical to sustaining the EU's advantage in the digital market.

-Harmonization of laws, regulations, and practices in digital trade since each member state has distinguishing practices at specific points for digital trade. It is critical to underline that several MNCs function in the EU, and their practices should also be harmonized with the laws and regulations. The principal approach is building European standards and technical specifications to promote interoperability, EU citizens' safety, and protection of the environment. Accessibility, chemicals, construction, conformity assessment, measuring technologies, and services[56] are listed in the harmonization criteria. The standardization strategy, published in 2022, emphasizes a resilient, green, and digital EU single market and the standards are considered as a driver of European competitiveness and resilience, supporting investments in green and digital transitions, and embedding democratic values in technology applications[57]. A lucid example of such friction between the European Commission is on Apple products. The Commission decided to standardize smartphone wired charging ports as the universal USB-C port by the fall of 2024. Apple uses its own designed lightning power connector in all its products. As the media channel clarified, other electronic devices, such as tablets, digital cameras, headphones, handheld video game consoles, and e-readers, will also be subject to the rule[58].

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[56] European Commission, "Harmonised Standards", accessed August 21, 2023, https://single-market-economy.ec.europa.eu/single-market/european-standards/harmonised-standards_en

[57] European Commission, "Communication from the Commission to the European Parliament, the European Economic and Social Committee and the Committee of the Regions: An EU Strategy on Standardisation, Setting Global Standards in Support of a Resilient, Green and Digital" 2022, accessed August 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022DC0031

[58] Jon Porter and James Vincent, "EU sets December 28th, 2024, deadline for all new phones to use USB-C for wired charging", *The Verge*, December 8, 2022,

- Investment in digital infrastructure to provide high-speed broadband networks to all citizens and building up innovation and startup ecosystems to increase employment and growth. This is essential not only sustaining entrepreneurship culture but also for poverty reduction. In the EU context, there are still two major valid questions: why do so few people in Europe start a business, although many individuals are interested in doing so? And why do European enterprises grow at a generally modest rate [59]. Entrepreneurship is nourished by research and innovation, which require a continuous and independent research environment to sustain it. In the EU, since the entrepreneurship emerges as an SME and their competitiveness is critical in the global market, the EU tries to protect their outputs with intellectual copyright regulations.

To sustain the necessary support to the innovation and startup ecosystem, the European Commission funds the European Digital Innovation Hubs (EDIHs)as part of the DIGITAL program, which provides funding and support for digital transformation across the EU. The goal of EDIHs is to assist businesses, particularly SMEs, in becoming more competitive through digital innovation while offering advisory services, testing, and experimentation environments for technology, funding assistance, collaboration, networking, and skill development.

-Use of data and its protection. The EU builds adequate protection with the GDPR implementation. In DSM, the EU tries to reinforce regulations on topics such as online privacy, data protection, and consumer rights.

E. Digital Services and their Protection

Certain domains are not presented as a component of the DIGITAL, but they strengthen its outputs, such as cyber security and blockchain. Cyber security is essential for several digital services' sustainability and cyber security products and solutions present an economic opportunity for the DSM, which is an indispensable part of technological sovereignty. The digital competencies and infrastructures are also associated with cyber security to sustain their services. The EU tries to maintain a value-based cyber security strategy for a digital single market. To realize this goal, the

https://www.theverge.com/2022/12/8/23499754/usb-c-iphone-european-union-legislation-charger-lightning-enforcement-date.

[59] European Union, *Entrepreneurship Determinants: Culture and Capabilities.*, 2012, accessed August 21, 2023, https://ec.europa.eu/eurostat/documents/3217494/5748437/KS-31-12-758-EN.PDF.

GDPR, the new version of the Network and Information Systems Security Directive (NIS), and the Digital Services and Digital Markets Acts are working together to support the security of the cyber domain. The achievement of the DIGITAL depends on the availability, confidentiality, and integrity of communications, networks, and data infrastructure. The cutting-edge cyber security technology and trained human component could help to realize this goal. The resilience of EU infrastructure is also related to the cyber security crisis management capacities. Recent incidents demonstrated that supply chain attacks could easily compromise the infrastructure and profoundly affect the socioeconomic order.

The cyber security section of the DIGITAL will be managed by the future European Cybersecurity Industrial, Technology, and Research Competence Centre in Bucharest. The European Cybersecurity Competence Centre (ECCC) and the Network of National Coordination Centers (NCCs) reinforce the cyber security technology and the EU's capabilities, protect socioeconomic order from cyber-attacks, maintain research excellence, and boost the EU industry's competitiveness.

The DIGITAL has set the operational objective to have an effective cyber security stance within the EU:

- to obtain advanced cybersecurity equipment, solutions, and data infrastructures developed in collaboration with the Member States.

- to build cyber security knowledge, capacity, and skills; to collect best practices; widespread deployment of effective cutting-edge cybersecurity solutions,

-to put the light on public authorities and SMEs, capabilities within Member States and the private sector to support the NIS Directive,

-to develop resilience and risk awareness approaches, and at least to synchronize the member states in fundamental levels of cyber security.

-to improve synergies and coordination between the civilian and defense cyber security spheres by facilitating knowledge exchange.

Similarly, the European Blockchain Partnership[60] was launched in 2018 to promote blockchain technology throughout the EU. The partnership comprises 27 member countries, including Norway and Liechtenstein, and promotes interoperability and the widespread adoption of blockchain-based

[60] European Commission, "European Blockchain Partnership", accessed August 21, 2023, https://digital-strategy.ec.europa.eu/en/policies/blockchain-partnership

services. It has successfully developed a European Blockchain Services Infrastructure (EBSI)[61] to provide a secure and trustworthy method of exchanging data and transactions. The partnership delivers a regulatory-compliant infrastructure consistent with EU rules, transparent governance structures, and models to help blockchain expand and flourish across Europe.

IV. The Impact of DIGITAL

The DIGITAL is an evolving process with several projects and many stakeholders, so it is premature to evaluate the impact. From the sense of temporality, the DIGITAL has more than four years to be completed. The program's impact also depends on the number and quality of proposals and support of the European people instead of allocating the funding. Several potential challenges and possible implementation problems will change the program's impact. The successful development and deployment of new digital technologies, the expansion of digital infrastructure, and the promotion of digital skills training may result in positive social and economic outcomes. The program, in principle, promotes a gigantic transformation in the EU economy and societal dynamics. However, the DIGITAL raises concerns about implementation, funding, and management.

A. Implementation

Since the program is formed by several initiatives and projects, a careful planning process, meticulous assessment, and agile management are required for a successful implementation. The successful implementation of DIGITAL-funded projects will be a crucial challenge. Complexity is the major problem of the process. Project management theories define complexity as a characteristic of tasks that involve multiple interconnected factors that are difficult to understand, predict, or control[62]. The complex and interdisciplinary nature of many digital technologies, such as AI and cyber security, may pose challenges in coordinating projects and ensuring successful outcomes. From the structural point of view, each member state has a particular stance about its level of digital infrastructure, which also defines the budget and time frame of the implementation. To initiate

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[61] European Commission, "EBSI", accessed August 21, 2023 https://ec.europa.eu/digital-building-blocks/wikis/display/ebsi

[62] Michael T. Pich, Christoph H. Loch, and Arnoud De Meyer, "On Uncertainty, Ambiguity, and Complexity in Project Management," *Management Science*, August 1, 2002, https://doi.org/10.1287/mnsc.48.8.1008.163.

infrastructural investments in several countries with diverse expertise and geographical conditions is challenging for planning and implementation. The complexity also continues with the number of stakeholders involved in the DIGITAL. Many stakeholders are involved in the program, including government agencies, private sector organizations, research institutions, and civil society organizations. Each of them had specific organizational structures and communication cultures. Effective stakeholder communication, including the DIGITAL, is critical for a successful implementation. The first step is to align with all stakeholders' needs and priorities, and all stakeholders support the program. Throughout the program, effective stakeholder communication necessitates a two-way exchange of information, ideas, and feedback. It demands that the program leads should listen to various stakeholders' concerns and perspectives throughout the implementation phase.

Organizational and sectoral dissimilarities and cultural contrasts also form barriers throughout the implementation process. One could not be able to find specific sources to assess such conditions among the publication and the Commission reports. The final problem worth emphasizing would be the interdependency between the projects and the centrality of certain actors. The DIGITAL facilitates several human groups, infrastructure, organizational, and legislative processes. For example, broadband Internet infrastructure is necessary to construct the DSM and is crucial for HPC, AI, and cloud connectivity. Raising digital competencies and skills also demands a certain degree of connectivity to access online learning platforms. Therefore, handling complexity and interdependency requires more agile and flexible implementation strategies, which will test the EU's organizational capacity limits.

B. Funding

DIGITAL has made substantial investments in digital transformation. However, ensuring that funding is distributed equitably across sectors and countries and accessible to various organizations, including SMEs and non-profits, may pose challenges. While the DIGITAL has been given a substantial budget, it may not be enough to meet its lofty objectives. The level of investment required to develop digital technologies and infrastructure across Europe and whether the program's funding is commensurate with this need is a critical consideration. One of the most challenging aspects of the Digital Europe project is obtaining the necessary financing. The project aims to invest €9.2 billion in digital innovation,

infrastructure, and skills development, but this amount may not address all the EU's digital challenges.

Another problematic strategy would be examining the degree of funding coordination between the Digital Europe Program and other EU funding initiatives like Horizon Europe and the European Structural and Investment Funds. This would entail evaluating if the funding stream for the program is compatible with other funding programs and whether there are chances for cooperation and synergies with other funding streams. However, redundant, and repetitive investments in the different chapters would also shake the funding streams and goals of the program.

The balance of public and private sector investment is another point of contention in the DIGITAL. One should oversee whether the program's funding strategy is overly dependent on private sector investment, which could limit public sector influence and control over digital technologies and infrastructure development. Some member states could use this advantage to reinforce their position rather than supporting the SMEs or private actors. The DIGITAL also provides support to SMEs. This would entail determining whether the program's funding measures are aimed at removing financial barriers that SMEs face in the digital economy and allowing them to compete with larger firms. Returning the investment and building a platform to compete with more prominent companies are additional delicate issues that can be seen in the upcoming years. The increasing inflation in the EU, political uncertainties, and energy crises could also affect the funding or slow down the process, which might cause delays in the time frame.

C. Management

The primary discussion point in the management category is building a zero-sum game with stakeholders from diverse cultural backgrounds and different interests and specifications. Throughout the process, the DIGITAL needs a very qualified orchestration to manage the program and a sophisticated toolbox to deal with uncertainties that might appear in different stages. From this perspective, another research could answer whether this orchestration requires a vertical or horizontal hierarchy to touch its stakeholders.

The balance between encouraging innovation and ensuring that digital technologies are used for the good of society is a critical challenge in this category. The EU can contribute to ensuring that the advantages of digital technologies are realized while reducing the possible risks and negative impacts by encouraging clear and consistent laws and regulations. However,

ensuring that technologies developed with DIGITAL funding adhere to ethical and legal standards (such as do not harm citizens or the environment) may present challenges.

The EU member states have different digital strategies and priorities; some may not quickly align with the DIGITAL objectives which may hinder DIGITAL's goal of standardization. Complying with complicated standards can be difficult for businesses, especially smaller ones with fewer resources. This can push up business expenses and obstruct the creation and uptake of new digital technology. These standards could also affect the cooperation of EU corporations with their non-EU partners, which could require substantial changes in their business practices. Some contend that companies operating in the EU may be at a competitive disadvantage compared to businesses operating in other regions with less onerous laws. This might inhibit investment in digital innovation in the EU or cause a brain drain of companies and individuals from the EU to other areas. The Digital Europe project must navigate challenging regulatory landscapes, especially cyber security and data protection. Implementing some program components can be challenging because of potential conflicts between EU legislation and those of other jurisdictions. While the program supports innovation and business competitiveness, it is critical to emphasize that consumer trust is crucial for the digital sector's long-term growth.

Conclusion

The DIGITAL is an ongoing initiative with the possibility of future developments, alterations, and initiatives which will likely continue prioritizing emerging technologies, partnerships, digital skills, cyber security, green initiatives, and digital regulation to promote digital innovation, infrastructure, and skills development in the EU. It demonstrates the EU's unwavering commitment to defining its own path in an increasingly digitalized world. Recognizing and effectively minimizing its possible flaws are essential preconditions for maintaining its status as an expression of innovation, wealth, and inclusivity for every European citizen in an ever-changing digital context. The DIGITAL's goals are critical to Europe's future and achieving them will be a significant challenge for policymakers and stakeholders.

The implementation of DIGITAL is inextricably linked to the EU's reliance on foreign technologies and providers. The program's ambition to position Europe as a digital powerhouse requires it to negotiate delicate international ties and dynamic economic landscapes deftly in the face of severe global competition. Diplomatic savvy and adaptable policies will be

critical in sustaining Europe's competitiveness in the global digital sphere. The program performs a sophisticated dance of collaboration and rivalry, establishing alliances while protecting its strategic interests. To achieve technological sovereignty, Europe must reduce its dependence on foreign providers and invest in critical areas such as cyber security, cloud computing, AI, chips, and semiconductors.

The DIGITAL is also responsible for promoting the adoption of European standards and norms and supporting the development of European technologies and infrastructure. Ethical quandaries emerge as the curriculum grapples with challenges such as data ownership, algorithmic transparency, and protecting vulnerable populations in the digital age. Striking an appropriate balance is a continuing ethical dilemma that necessitates constant awareness and adaptation in the face of changing technological paradigms. The need to constantly improve legal frameworks, as exemplified by the GDPR, emphasizes the commitment to competently handling evolving ethical challenges. Aside from legislative compliance, the EU's moral compass directs its efforts to guarantee that digital advancements are founded on principles of fairness, transparency, and respect for individual rights. This ethical foundation serves as a beacon, guiding the program's way across the digital age's complicated moral terrain.

Furthermore, the initiative works in tandem to further the goals of the EU's ambitious Green Deal. As the EU seeks for a more sustainable future, the DIGITAL's initiatives are inextricably linked to environmental concerns. Utilizing digital technologies for sustainable practices, such as energy-efficient solutions and smart infrastructure, is critical to meeting the ecological aims of the Green Deal. The fusion of digital innovation and environmental sustainability constitutes a harmonious combination that strengthens the EU's commitment to responsible and ethical progress. Expectations for a rapid result would almost certainly fall short.

The DIGITAL covers a wide range of technology applications and ensuring that the program's objectives align with broader national and regional policy objectives will be critical. In most cases, the magnitude of the implementation increases the risk of fragmentation. This size of undertaking, in most cases, increases the risk of fragmentation. Fragmentation may occur if stakeholders pursue different priorities or the program's objectives are unclear or poorly communicated. To avoid fragmentation, policymakers should collaborate with stakeholders to ensure that the program's goals are aligned with broader policy objectives and that the program's implementation is coherent and integrated.

The program’s skill gap and human component are also critical issues. The effectiveness of education and training efforts emerges as a critical tool for preparing the workforce with the essential skills required to thrive in the digital age. Europe must develop a highly skilled workforce capable of developing and implementing cutting-edge technologies to achieve technological sovereignty. However, there is a risk of a skilled worker shortage to meet the digital economy’s demands. The Commission is developing several programs to address this challenge, but the population’s interests and demographic conditions significantly impact the process. Rapidly changing working conditions and an effort-reward imbalance, particularly after the pandemic, are unappealing to the next generation.

Understanding the program's inherent potential weak points, including coordination issues, bureaucratic complexities, economic allocation, and technical adaptability, is critical for the program’s success. To resolve these complications, persistent vigilance, administrative flexibility, resilient governance, and active participation of stakeholders at all levels are required. Navigating this complex landscape necessitates constant monitoring, adaptive strategies, and smart governance. Financial sustainability, situated against the backdrop of post-pandemic political uncertainty and economic weaknesses, emphasizes the program's multidimensional challenge. Overcoming these external limits needs strategic forethought and the ability to change quickly. The persistence of policy objectives will determine the program's success, the prudent measurement of progress, the creation of a dynamic innovation ecosystem, and active worldwide engagement.

Furthermore, resilience and adaptation to the ever-changing technology landscape, active citizen involvement, solid cyber security provisions, and the promotion of digital inclusion are critical components of the program's journey. Furthermore, the initiative has transformative power within technological marketplaces. Its initiatives can change digital marketplaces, encouraging innovation and the expansion of European technology firms. This effect, however, raises serious concerns about market competitiveness, regulatory monitoring, and the convergence of state-driven initiatives with free-market ideals. A significant problem is striking a harmonic balance between promoting local innovation and sustaining a competitive technological sector.

Despite these obstacles, the DIGITAL has the potential to advance Europe’s technological sovereignty significantly. The DIGITAL will necessitate extensive coordination and collaboration among various stakeholders to achieve its goals. Policymakers should collaborate closely

with businesses, research institutions, and civil society to ensure that the program's objectives are aligned with broader policy objectives and that the program's implementation is coherent and integrated. The DIGITAL management's hierarchical design and agility are critical success factors for the program. The political uncertainties in Europe, post-pandemic economic fragility, and energy crises are changing most of the calculations. To fund the programs and dividing the steps into projects is naturally the most striving phase of the program, but these are not enough for the achievement. The coming years will show us if the DIGITAL is categorized as a failure or success story of the century.

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