

An Analysis of the Digital Resilience Challenge for Implementing EU Programs and Instruments

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Abstract. *One of the most acute challenges to which EU member countries urgently need to find solutions is related to digital resilience. Such a challenge must be addressed from both a temporal, spatial, and financial perspective. One of the areas where both problems and solutions to them must be placed is that of structural and investment funds. At the EU level, the new development model is feverishly sought, which must be green, digital, and resilient. The authors of this study explore how European Union funding programs and specifically the Recovery and Resilience Facility, influence the advancement of digital transition. It explores and quantifies the value added of using these programs to obtain more sustainable growth, societal inclusion, and global competitiveness through digital transformation. One of the most relevant hypothesis is that despite a growing interest in the impact of EU financial instruments on digitalisation, to different societal levels, lacks a comprehensive analysis that combines both the broad scope of EU initiatives and the specific impact of the RRF. Using qualitative methods, the authors investigated the main pitfalls and asymmetries of the allocative methods, the allocation, and impact of EU funding on digital transformation. The main focus of this paper is to answer the research questions regarding the connection between budget allocation for digital transformation and the position of digital transformation in EU priorities, while highlighting the changes that Recovery and Resilience Facility is bringing compared to other financial instruments for promoting digitalization in EU. Following this research route, we find indication that the budget allocations EU makes for digitalization, specifically through the Recovery and Resilience Facility demonstrate that digital transition is one of EU strategic priorities. The amounts and percentages made available through the Recovery and Resilience Facility which target to support in particular digital initiatives underline its key role in EU digital strategy. The clear comparison of EU financing programs that focus on digitalization, while providing a comprehensive literature review that gives a refined understanding of digitalization's impact will enable professionals and policy makers to analyze EU strategic objectives and identify key focus areas that require additional support, thus contributing to EU digitalization efforts.*

Keywords: green, digital and resilient development; challenges; economic, social and territorial cohesion; structural and investments funds; digital transition; Recovery and Resilience Facility, NextGenerationEU.

Introduction

The European Union is dealing with a kaleidoscope of crisis while targeting to obtain its best position towards the phenomena of hyper globalization, reduced globalization and deglobalization. A main tool visible on EU agenda to meet its objectives is digital transformation, which is planned

to be used for achieving sustainable growth, reaching improved global competitiveness, and obtaining societal inclusion. We notice a recent increase in EU's efforts towards digital transformation, highlighting its important role of providing the digital infrastructure which is the baseline of economic and social resilience. EU financing mechanisms play an important role for increasing the level of digitalization, particularly with its long-term financial perspective for 2021-2027 and NextGenerationEU initiative with a main role held by the Recovery and Resilience Facility (RRF) which has a high budget allocation.

EU is making significant financial commitments to support digital transformation; therefore, we are aiming to provide an overview of these budget allocations for digital initiatives found in NextGenerationEU with a dedicated focus on the Recovery and Resilience Facility (RRF) by analyzing policy documents, reports and digitalization actions.

Answering to the following question: How does the EU's financing strategy contribute through its long-term budget and NextGenerationEU, in particular through the RRF, to achieving digital transformation objectives? – the paper stress in special the strategic determinants of the EU's financial allocations toward digital transformation.

Literature review

Aspects related to digitization as desired but also as an adequate response to the challenges of modernity, have been addressed in the specialized literature from various analytical and methodological angles. Pinto, Nogueira, and Vieira (2023) analyze digitalization levels in different member countries of the European Union grouping these countries into several homogeneous and relevant clusters according to the digitization performance. One of the key objectives of this comparative analysis is to identify digitalization level achieved, categorize the policy measures taken to achieve the particular level and provide visibility to stakeholders and policy makers interested bringing additional progress in the digitalization field. The authors of the mentioned research uses Eurostat data in section Science, Technology, Digital Society identifying correlations between the indicators used and developing a data set of variables measured in percentage: share of individuals having at least basic digital skills, privacy and protection of personal data, employed Information and Communication Technologies (ICT) specialists, enterprises that provided training to develop/upgrade ICT skills of their personnel by size class of enterprise, level of internet access – households, individuals using mobile devices to access the internet on the move, overall fixed broadband take-up, fast broadband coverage, fiber to the Premises Coverage, cable modem DOCSIS 3.0, G Coverage, enterprises with high digital intensity index, enterprises use at least one of the AI technologies, e-government activities of individuals via websites, Internet use: obtaining information from public authorities' websites, internet purchases by individuals, e-commerce sales of enterprises by size class of enterprise, meetings via the internet by size class of enterprise. We considered that the structured way in which the factors that influence the digitalization process were identified and analyzed is also useful for us to make our own diagram of the influencing factors at the level of this process and to minimize the areas of complexity in terms of correlations and relationships of causality. Cluster analysis was used to group countries into groups according to their digital performance. Three major components were extracted with an impact of 74% of the total variance within the 16 set of variables.

Digital empowerment accounting for 35% of the total variance, is a factor which is focusing on improving digital skills in individuals, access to internet and using technology for different purposes. Enterprise digitalization makes up to 27% of variance and is concerning the digital transformation of companies willing to provide IT training, using latest technology infrastructure,

adopting AI tools and hosting internet-based meetings with their employees. Broadband accessibility explains 12% of the variance in the data, concerning broadband, fiber coverage and mobile network coverage. Using the parameters listed above, the study is categorizing EU member states in four groups: the digital access leaders formed by Belgium, Denmark, Germany, Ireland, Malta, the Netherlands, Finland and Sweden, managing to have highest percentages for digital empowerment, digital transformation, enterprise digitalization and broadband accessibility. The second group identified is the digital transformation champions, formed by Bulgaria, Poland, Portugal and Romania, as they had a significant increase in the past years making notable progress in their digitalisation efforts. Digital empowerment laggards is the third group of countries formed by Czech Republic, Greece, Croatia, Italy, Cyprus and Austria where the progress towards digitalization is rather slow, the countries reaching a point where additional efforts are needed but the interest level of implementation is low. The last group of countries named empowerment driven disparities is formed by Estonia, Spain, France, Latvia, Lithuania, Luxembourg, Hungary, Slovenia and Slovakia identifying as countries where part of the parameters is high compared to other where they register low percentage levels.

The split of EU countries in above groups brings additional level of understanding of the gaps between each country and between each group, thus identifying the strong need to manage the differences and disparities targeting to achieve a balanced level of development and advancement of digital transformation across EU member states, using a common strategy. Also, the differences observed and their diversity shows the need for customized approach ensure the digital divide is mitigated where there are significant differences between the digitalization levels at county or regional level. This gained understanding of the correlation between digital empowerment, innovation and technology development can help EU leaders and stakeholders to direct their efforts towards standardization of access to digitalization to each individual, community and country to increase its overall benefits.

They proved useful for our research identification of the positive link between broadband accessibility and innovation performance is highlighting the urgent need to improve infrastructure in order to address infrastructure gaps and allow similar access to technology thus increasing the potential for innovation. Differences between innovation performance and digital empowerment status show the need to improve digital skills and access so that human resources can use technology advancement to its maximum potential targeting to achieve innovation. Also, disparities in enterprise digitalization among digital access leaders indicate the need for further prioritization of digital initiatives in countries not benefiting enough from digitalization at enterprise levels. Digital transformation champions managed to use the advanced technologies clearly showing their interest and work towards innovation. Eliminating the digital gap needs strategic actions and integrated approach to secure the access to digital benefits will be uniform for all member states. Broadband infrastructure upgrades must be prioritized as it will provide digital access which is vital for improving digital empowerment and promoting innovation. Increasing enterprise digitalization will lead to quantifiable and equal access to digitalization resources, thus supporting digitalization strategies and should be a focus also for the countries positioned as digital access leaders. Digital development can be inclusive and sustainable if properly sustained by effective public policies, thus driving economic growth and social progress for EU citizens.

We found useful analytical openings at Pellegrin and Colnot (2023) who asserts that ICT has a strong influence on economic and social dynamics through internet and digital devices, effects visible especially during the COVID-19 pandemic when companies extended the work from home granted one day per week to a new 100% teleworking concept which showed increased

productivity levels and maintained connectivity between employees even without physical work presence. ICT helped employees maintain their job and lifestyle during the pandemic, as they could perform their tasks from home using the same devices they would typically use at work, leading to an accelerated development of certain digital platforms that offer conferencing and video conferencing. The educational scenario was also impacted as students and teachers met in virtual classrooms to go through the regular lesson. Interestingly all the progress and adaptations done to unprecedented challenges were kept to some level even after the pandemic, as multiple companies transitioned to hybrid or full remote employment program, while universities and teaching platforms created a new product of online courses only to facilitate students' attendance from various regions and work schedules. ICT was also used for medical purposes, in cases where doctor's advice online could be sufficient, patients scheduled for virtual consultations, while in more complex cases a specialist not available physically could advise during a surgery the medical team onsite, being connected to a video platform.

This complex topic was also on the agendas of international organizations (OECD) that emphasized the fact that ICT is driving a major impact on economic growth and productivity. Several interest groups including academics, business leaders and stakeholders together with policy makers sustain the importance of ICT in future development, businesses using ICT to optimize operations with automation and digitalization, eliminating manual and redundant tasks and improving efficiency. ICT is enabling companies to penetrate new markets and increase their customer portfolio globally using e-commerce and digital marketing. The benefits of ICT can be also accompanied by challenges benefits of ICT with the development of advanced digital technologies like AI that increase the complexity of this tool management. AI is raising ethical questions when used in decision-making purpose like recruitment or safety algorithms. Also, AI introduces the opportunity to replace traditional human jobs, thus raising the concern of workforce displacement in the automatization process, human employees needing continuous, training and perfecting their skills while being flexible to make a change of career path. At the moment there are efforts to put in place adapted legislation to address AI usage and development, showing the need of a regulatory framework to master this concept ensuring accountability, transparency and equality while it is being deployed in various sectors. It is essential to have therefore in place a balanced approach between the promotion of digital technologies and the risk mitigation activities that need to be undertaken to secure a safe implementation.

Economic growth is a topic and a target that has evolved over time, in its beginnings focusing on capital accumulation and workforce occupancy growth while technological progress was viewed as external factor, Panteleeva (2023). Additional research showed that technological change and advancement needs to be analysed as an internal element that has the ability to increase the role of human employees through automation, increasing capital returns while achieving efficiency and additional workforce specialisation. For example, if 4000 people needed in a plant, introducing robot lines could decrease the number to 1500 people, but they would however need to become more specialised into managing the robots and performing more high-level tasks, this sustaining the important role research and development, human capital and innovation have in identifying the opportunities to implement technological advancements.

Access to information is also an important premises to secure digital development is achieved. Nikolov (2023) highlights the challenges faced by companies in regards to sustainability reporting. The issue is not a quantitative one as more a qualitative one, as most of the companies are disclosing non-financial information – especially big size companies, however there are concerns regarding the information quality and its delivery methods. A positive correlation was

identified between enterprise size and reporting quality, as smaller companies seem to be struggling with challenges when reporting information due to their undeveloped infrastructure, lack of skill or high-speed broadband availability access. Implementing software systems adjusted to the company needs is often requiring additional resources not always prioritized into digitalization direction especially for small and medium sized companies.

Decker (2023) deduced that the future of the European Union faces significant challenges, such as tensions on formal systems and difficulties in accessing appropriate resources, especially for vulnerable groups. Challenges identified could be both mitigated and increased with digitalization as it can have a both positive and negative effect – while offering additional options to access improved efficiency in service delivery, it is also raising obstacles for the population who is lacking digital literacy. As gaining digital literacy is a second step to formal education, populations with deficits in education will struggle to align their human resource to the new technologies and skill set needed to manage them, therefore, it is very important to address in the EU policy digital solution topic as corner stone needed to overcome the identified challenges and continue the path towards future benefits brought by digitalisation - leveraging the usage of digital technologies EU decision makers could improve employees efficiency, provide faster and leaner access to resources, thus responding to each particular group needs.

Gaiani and Ala-Karvia (2023) proved through a comprehensive case study that digital economy is playing a significant role in current economic landscape. Even if the term is often used in the present, researchers show that its core is not only in the increase of high-tech industries but also in the impact that ICT could have in all sectors of economic and social life. Traditional firms and industries not highly digitalized need to leverage digital technologies and learn how to increase their efficiency and competitiveness, keeping the pace of their competitors and their country development status. Digitalization landscape was studied at EU level using Digital Economy and Society Index, DESI and it shows that despite the spike in digitalization, COVID-19 pandemic brought also unimagined challenges. EU member states are working on improving digital skills, improve digital transformation to medium and small size enterprises and upgrading the network to robust 5G access. Even if progress is noticed regarding the points above, there is a big delay in implementing AI and Big Data, showing that customized policies are mandatory to uniformize the disparities and accelerate digital adoption and promote inclusive digitalization across EU.

Boly et al. (2024) is focusing on analyzing the ecosystems that aid digital evolution at regional level, showing how the actions taken by territorial ecosystems including financial procedures and political strategies impact the increase of digital maturity of the respective regions. Where there is noticed a sustainable effort by local stakeholders, individually and collectively there is a positive relation to digitalisation increase in the particular area.

Based on this brief radiography of the specialized literature, the conclusion can be drawn that the EU's Cohesion Policy is central component aimed to sustain economic growth and social development and enhance the advancement of digitalization in Europe. If we consider the Cohesion Policy within the EU Policy, its role it is very important as it is sustaining economic growth and promoting social cohesion by identifying and supporting the regions and member states that require significant assistance to enhance their development.

Digitalization has become top priority in the past years for EU as it is expected to facilitate increase in innovation and competitiveness. Due to these expected benefits that support achieving EU important goals, in order to secure the target is achieved, EU put in place programs, policies and strategies to foster digital transformation in multiple sectors. Cohesion Policy funds are not spread evenly across all regions of the EU, as the policy is prioritizing the regions that are facing

economic challenges and need significant development, such as regions with low GDP or high unemployment rate which benefit of higher allocations to meet their specific needs.

Investments in digitalisation projects within the Cohesion Policy are therefore targeting less developed regions, to improve their digital infrastructure, provide high speed internet connection and train human resource to enhance their digital skills. This can be explained by EU strategy to work towards reducing the differences in digital competence and securing that all EU citizens have access and use the opportunities made available by the digital economy.

Methodology

A qualitative approach was the authors' option regarding the research methodology. More precisely, the most relevant facets of integrative landscape were explained using a descriptive method. The descriptive research design was performed in order to provide a systematic, objective and exhaustive description of the European Union's funding programs allocated for the digital transition. Aiming to provide a description of the European Union's financing programs for the digital transition, the research design is structured to capture the EU financial mechanisms, with a focus on the support of the digital transition efforts in Member States. Secondary data, collected from the EU policy documents, reports, and program descriptions relevant to the research theme were used, aligning with documentary research. The method of analysis was applied using features of the financing programs in terms of the type of management, the major digital actions, the total budget, and the budget for actions estimated to be related to digitalization. A comprehensive understanding of the EU funding strategies to support the digital transition could be ensured by the tailored research design.

The first major assumption of the authors is that *the EU's strategic priority is reflected in the substantial resources allocated to digital transition initiatives within the EU long-term budget and NextGenerationEU*. A second assumption clarified during the research carried out considered the fact that the *Recovery and Resilience Facility (RRF) receives the most significant budget allocation to facilitate the digital transition, compared to other EU financial instruments, reflecting its central role in the EU's strategy for post-pandemic recovery and digital transformation*.

During the process of establishing the foundation of the EU funding programs contribution to digital transformation, the authors identified and used the most appropriate tools to clarify connections, explain correlations and draw conclusions. The analysis was based on data collection and identifying digitally relevant EU programs and instruments financed from the EU budget and NextGenerationEU for 2021-2027, to map the landscape of EU funding for digital initiatives. With a specific focus on the digital dimension, an analysis of the selected EU programs was performed, covering their types of management, key digital actions, and budget allocations. Special attention was given to the Recovery and Resilience Facility (RRF), recognized for its relevant budget allocated to digital transition. In this respect, its digital aspect was underlined, in terms of strategic importance and possible impacts on boosting the speed of digital transformation within the EU.

Results and discussions

The digital transformation represents the commitment of the European Union transposed in its programs and financial instruments for 2021-2027, according to the European Commission (n.d.). Aiming to accelerate digital innovation and infrastructure, these initiatives ensure that the digital transformation is inclusive and covers all the sectors of society and economy. This is an important argument in favor of starting a process of understanding the truth that digitalization is a key factor for sustainable economic growth, new model of competitiveness, and improved social

cohesion, The EU digital agenda encompasses various financing programs, allocating substantial resources for digitalization, as illustrated by its programs such as Digital Europe, Horizon Europe, Connecting Europe Facility, and others (Figure 1). Different areas are covered, such as research and innovation, market deployment of digital technologies, digital skills.

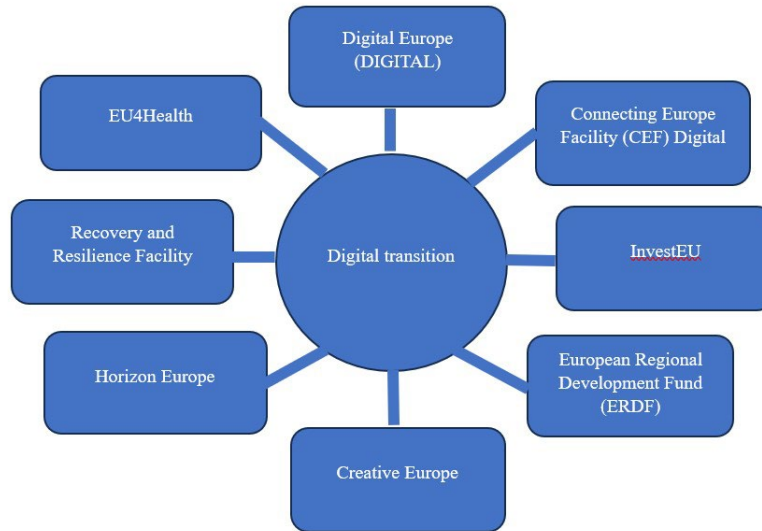


Figure 1. EU funding opportunities available for the 2021-2027 fostering digital transformation

Source: Authors' own research.

The *Digital Europe* program represents the main initiative for digital efforts under the MFF, with the aim of accelerating the economic recovery and driving Europe's digital evolution, as described by the European Commission (n.d.). Digital transformation of the European economy, industry and society, strengthened and accelerated, represents the objective of the program. The program envisaged to narrow the digital gap in EU and strengthen the strategic autonomy through increased competitiveness on the global digital scene. Investment in various domains will be accelerated, the use of digital technologies will be optimized across the society and economy and digitalization efforts in public and private sectors will be supported. The transition of digital technologies from research to market deployment will be envisaged with benefits in particular to small and medium enterprises.

According to the European Commission (n.d.), the seven-year *Horizon Europe* program serves as a funding initiative for research and innovation, expanding the efforts of Horizon 2020. Promoting scientific excellence, new knowledge, technologies, research and innovation activities and the products and services resulted represents the objective of Horizon Europe. A sustainable economic growth will be generated and job creation and positive results for growth, trade, and investment will be ensured. Health, resilience, and green and digital transformations are the main field where resources were allocated. Horizon Europe has a designated budget for Digital, Industry, and Space to promote advanced research and innovation in key enabling technologies. Horizon Europe initiatives are implemented in addition to Digital Europe.

The European Commission (n.d.) describes that the aim of *Connecting Europe Facility* (CEF) is to support the development of trans-European networks and infrastructure projects, covering transport, telecommunication, and energy sectors. Investment in broadband networks is guided in this program and refers to the wider EU initiative regarding infrastructure capable of

hosting emerging, and future technologies and applications. The Digital component of the Connecting Europe Facility (CEF Digital) aims to facilitate and stimulate public and private investment in digital connectivity infrastructure in the period 2021-2027. Promoting projects of mutual interest linked to the establishment of reliable and secure high-capacity networks, encompassing 5G systems and ensuring accessibility represents the objective of CEF Digital. Strengthening the resilience and capacity of the core digital networks across EU, promoting their alignment with neighboring regions, and digitalization of transport and energy networks.

The European Commission (n.d.) outlines that the objective of the *Creative Europe* is protecting and promoting the diversity of European cultures and languages and their rich heritage. Increasing the competitiveness in the cultural and creative field also stands as objective of this program. It encompasses the Creative Europe MEDIA subprogram and provides financial support for the promotion, marketing, and dissemination of European work, namely from European cinema and other audiovisual sectors, at European and international level.

EU4Health is a new program that aims to bolster health security and address future health crises from a preventive perspective - European Commission (n.d.). Public health, reduction of diseases incident, promoting health and prevention of diseases and also countering the health inequalities are also addressed. Furthermore, protection of the citizens against the cross-border health threats, facilitating the access to the medicines and medical devices and encouraging the innovation for the essential products in crisis management are subjects of interests. Strengthening the health systems by improving resilience and optimizing resource efficiency in all Member States represents also an aim of EU4Health.

According to the European Commission (n.d.), *the Recovery and Resilience Facility* is a temporary instrument located in the center of NextGenerationEU, represents the EU's strategy to emerge stronger and more resilient from the current crisis. The RRF allocates funds to Member States which consist in grants and loans and offer support for ambitious reforms and investments. More specifically, the RRF envisages sustainability and resilience, preparing the countries for the green and digital transition according to the UE's priorities. In this way, the RRF should tackle those challenges outlined in the country-specific recommendations of the European Semester for economic and social policy coordination.

The *InvestEU* program, an integral component of NextGenerationEU and the EU's multiannual budget, operates under the general objective of addressing the immediate economic and social repercussions of the coronavirus pandemic, as the European Commission (n.d.) emphasizes. InvestEU, significant source of long-term financing for Europe's sustainable recovery efforts, operates with both private and public funds. The main policy priorities of EU, such as green and digital transitions, innovation, social investments, and skills are also supported by this program. InvestEU simplifies access of the enterprises and projects to EU funding. Invest EU Fund, InvestEU Advisory Hub, and InvestEU Portal represent the components of the program.

The *European Regional Development Fund* intends to reduce the disparities between regions, as the European Commission (n.d.) outlines. Strengthen economic, social, and territorial cohesion within the EU represents ERDF objective. For 2021-2027, ERDF sustains five policy objectives for promoting a more competitive and smarter Europe, a greener and low-carbon, and also a more connected and social inclusive Europe. ERDF is operated under shared management where the Commission adopts programs upon submission by the Member States, which are responsible for their implementation. It is the Member States responsibility to establish the form of the support to beneficiaries, namely grants, financial instruments, prizes, or a combination of the previous mentioned.

Table 1. Digitally relevant EU programs

EU program	Management type	Key Digital Actions	Budget	Estimated digital-related budget
Digital Europe (DIGITAL)	direct management	Five key investment areas: - supercomputing; - AI; - cybersecurity; - advanced digital skills - deployment activities for the best use of digital technologies across the economy and society	€7.6 billion	100% of DIGITAL will support the digital transition
Horizon Europe	direct management	Research and high-end innovation in enabling technologies, such as: - artificial intelligence and robotics - next generation Internet - high performance computing - big data - key digital technologies - 6G - digital solutions for health and care - digitalization of biodiversity services, agriculture, and digitalization solutions to support the Green Deal - digital infrastructures in the energy and mobility field	€95.5 billion	around 35% of Horizon Europe will support the digital transition.
Connecting Europe Facility (CEF) - Digital	direct management	Actions foreseen include: - deployment of/access to very high-capacity networks including 5 G systems, - uninterrupted coverage with 5 G systems on all major transport paths - deployment of new or upgrade of existing backbone networks - implementation of digital connectivity infrastructures related to cross border transport and energy projects	€2.07 billion	100% of CEF for Digital will support the digital transition
Creative Europe Media	direct management	Creative Europe Media is contributing to the digital shift of the cultural and creative sectors in line with the Commission's Digital Decade policy program: - support to the digitization of the audiovisual and news media industries. - digital skills, - digital platforms - innovative technologies - creative innovation labs	€1.4 billion	around 20% will support the digital transition
EU4Health	direct management	EU4Health supports digital transformation of healthcare through: - creating the digital infrastructure needed for digital health - improving digital skills of healthcare professionals - digital and innovative tools and technologies such as artificial intelligence	€5.3 billion	approximately 10% of EU4Health will be used for digital transformation of the health sector.

EU program	Management type	Key Digital Actions	Budget	Estimated digital-related budget
Recovery and Resilience Facility (RRF)	direct management	Each recovery and resilience plan include a minimum level of 20% of expenditure related to digital.	€723.8 billion	minimum 20% of the national recovery and resilience plans for digital actions
InvestEU	direct management	It supports investments for: - sustainable infrastructure - digital connectivity - research innovation and digitalization - demonstration and deployment of innovative solutions to scale up innovative companies as well as digitalization of businesses (artificial intelligence; quantum technology; cybersecurity and network protection infrastructures; the internet of things; blockchain and other distributed ledger technologies; advanced digital skills; robotics and automatization; photonics).	EU Budget guarantee of €26.2 billion with the aim of mobilizing more than €372 billion in public and private investment.	at least 10% of InvestEU will feed into digital goals.
European Regional Development Fund (ERDF)	shared management	Policy objective 1 (P01) - a more competitive and smarter Europe promotes innovative and smart economic transformation and regional ICT connectivity	€226.05 billion	€20 billion from European Regional Development Fund (ERDF), focusing on digital cohesion across the EU

Source: Authors' own research, based on EU data retrieved from <https://digital-strategy.ec.europa.eu/en>.

The analysis performed reveals that the listed EU programs present a variety of types of management philosophies, indicating a multidimensional approach to the implementation of the appropriate digital initiatives. Programs such as Digital Europe (DIGITAL) and Horizon Europe are managed at the EU level, directly by the Commission. Other programs, such as ERDF, are managed by the Commission and national authorities from the Member States, thus offering a regional flexibility that permits the implementation of digital improvements according to the specific local needs. Considering the fact that under these programs, the main digital actions encompass a wide range of activities, from innovation and digital research under Horizon Europe to the deployment of the research results into market solutions under Digital Europe, the analysis indicates that EU strategy suggests a holistic approach to digital transformation. Moreover, the actions focus on the development of infrastructure under the Connecting Europe Facility (CEF) – Digital, digitalization of health (EU4Health), media (Creative Europe) and digital cohesion across the EU (ERDF). Ranging from health to creative industries, the programs include various sectors, taken into consideration the cross-cutting impact of digitalization. The estimated digital budget for each program underlines the commitment of the EU to digital transformation and the dimension of the overall EU budget committed to this goal. The Recovery and Resilience Facility and Horizon Europe have high allocations suggesting that the European economy and society are considered to be transformed, with digitalization playing a leading role in adapting it to future challenges.

The presentation of EU's programs and its budget allocation in long-term budget and NextGenerationEU initiative, and the key digital action, shown in Table 1, substantiate hypothesis 1, i.e., considerable commitment towards digital transition initiatives. The priorities that focus on

building digital infrastructure, skill development and innovation projects to foster sustainable growth, societal inclusion, and ensuring international competitiveness are clearly shown this intention. The strategic allocation aligns with the broader objectives of the EU; that is, mobilizing digital transformation as a booster to the development of the socio-economy.

The Recovery and Resilience Facility (RRF), as part of the NextGenerationEU initiative, has an unprecedented budget to foster the recovery of the EU from the COVID-19 pandemic, with a significant emphasis on digital transformation, according to the European Commission (n.d.). The available RRF funds represent € 723.8 billion (Figure 2) and aim to provide financial support to EU Member States in implementing reforms and investments aligned with EU priorities, including the Digital Agenda. The EU's strategic priority is to mobilize digitalization as a catalyst for recovery and resilience and the allocation of digital transition under the RRF is evidence of this priority.

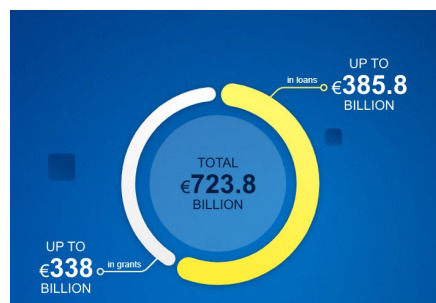


Figure 2. Total available RRF funds

Source: https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/.

The broad initiatives of RRF are clearly shown in Figure 3. In order to ensure a wide digital transformation, these initiatives support economic recovery, digital public services, competitiveness through digitalization of enterprises, digital skills, connectivity, digital capacities and innovation across the EU.

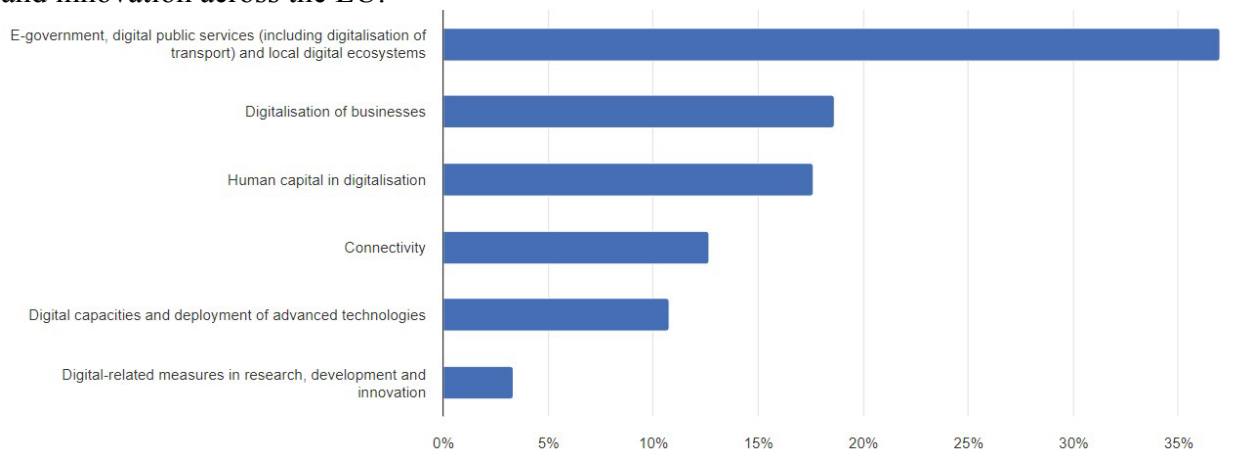


Figure 3. Digital tagging: Breakdown of expenditure towards digital objectives per policy area

Source: https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/.

The impact of the Recovery and Resilience Facility on the digital transition can be expected to be substantial taken into consideration the significant funding allocation and strategic focus on digital initiatives, as described by the European Commission (n.d.). The Recovery and Resilience Facility will accelerate the digital transformation offering financial support for the development of

digital infrastructure, digital skills and digital public services in all EU Member States. Furthermore, we can affirm that all stakeholders can benefit from an increase of economic resilience, from the boost innovation, and EU will remain competitive on the global stage. However, the success of the RRF in accelerating digital transformation will also depend on the implementation of funded projects and initiatives in EU Member States. In the Recovery and Resilience Plan each Member State has to allocate a minimum of 20% of its total funding to initiatives that contribute directly or address the challenges arising from the digital transition. To this end, the plans had to detail and support the extent to which each measure completely (100%), partly (40%), or does not contribute at all (0%) to the digital targets. It becomes possible to assess the overall contribution of the plan to the digital targets and verify compliance with the 20% threshold by integrating these coefficients into the estimated costs of each measure (Figure 4).

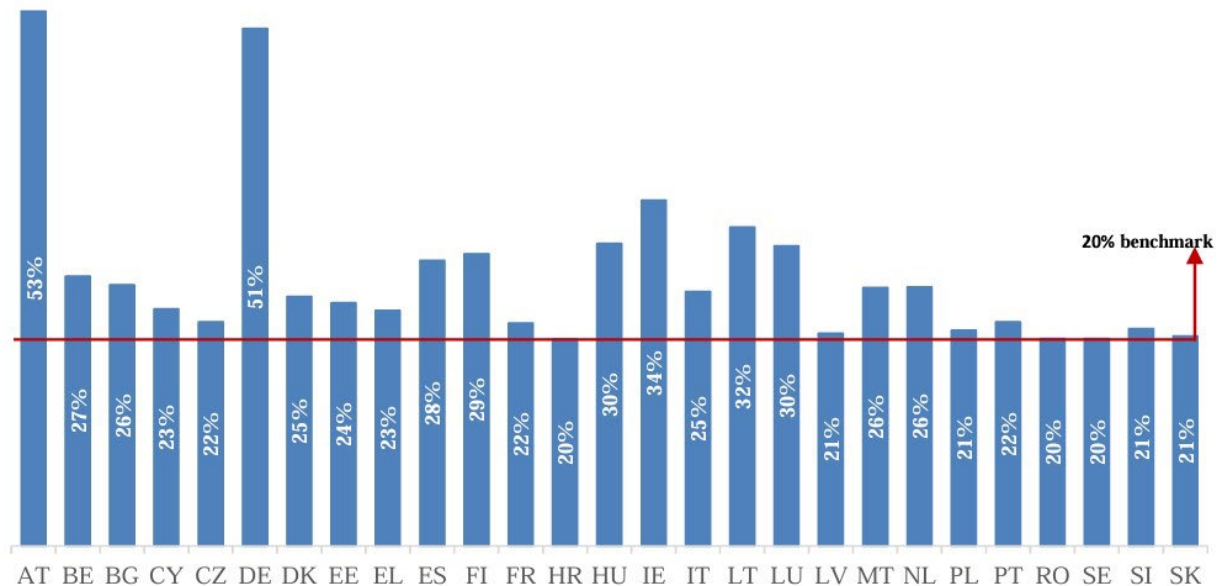


Figure 4. Share of RRFs estimated expenditure towards digital objective

Source: https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/.

The results obtained sustain the idea that the Recovery and Resilience Facility indeed receives the most important budget allocation to facilitate the digital transition within the EU programs and financial instruments. The significant role of the RRF in the recovery strategy, and the recognition of digitalization as a key component of resilient recovery are underlined by this financial allocation. The efficiency of RRF in sustaining digital transformation is essential for the EU capacity of facing the post pandemic challenges. Therefore, the essential role of the strategic investment in digital projects for an increased resilience and sustainable growth is highlighted.

The recognition of digitalization as a foundation of the present socio-economic strategy is underlined by the validation of these hypotheses, and the substantial allocation in digital transition initiatives signifies firm commitment. The financial allocation related to the digital actions of the programs are presented, giving nuanced understandings of the role of EU financial mechanisms. From the findings, one can appreciate that the strategic EU investment in digital transition, for example, via the RRF, is far from being only economic recovery; it lays the base for inclusive, competitive, and sustainable futures. Also, the investments in digitalization must be strategic, substantial, and linked to wider socio-economic objectives in order to be effective, can be drawn.

Conclusion

Digitalization is a constant concept met in modern civilizations who are considering the advantages of technological advancements on social and economic landscape. Its increase facilitated connectivity and enhanced technological progress. In the present time, digitalization has become a new driving force reaching over societies and changing fundamentally our lives, work, and interact. Leading this transformational change are more powerful computing, increasing high-speed internet connection to almost everyone, and the omnipresence of smartphones and other digital gadgets. Citizens, businesses and governments experiment the use of digital tools as a core necessity together with the increased evolution and adoption worldwide of policies and actions focused towards easy access to information and digital resources.

This paper is analyzing EU financial mechanisms validating the importance of its financial promises to support digital transformation, with the Recovery and Resilience Facility being differentiated as a major pillar of its initiatives. The results found after testing the hypotheses sustain that the considerable budget allocation in the long-term budget and in NextGenerationEU through the Recovery and Resilience Facility is reflecting EU strategic priority of stimulating digitalization, having as objective sustainable growth, societal inclusion an increasing its global competitiveness. The study is concentrated on EU programs linked to digitalization within the financial mechanisms allocated for digital transition. Particularly, it helps understand the role of EU funding in shaping of a digital economy and society and also provides information to policymakers, researchers, and practitioners dealing with the dynamics of funding dedicated to digital transitions.

Regarding the potential limitation, the research is primarily based on the most relevant EU programs; thus, there is a digital component in almost all programs available for the 2021-2027 period. Other EU programs and instruments, in addition to those examined in our research, may also be relevant to the digital transition and have not been included in our analysis. Furthermore, synergies between funding programs are not analyzed.

This will be a research input not only to the overview of financial mechanisms but will open new perspectives of research in the very dynamic field of financing the digital transition. Future research may consider these results to analyze the long-term effects of RRF and other financial tools on the outcomes of digitalization in Member States. Furthermore, the most significant projects in the digital field, implemented at national or European level could also be explored.

References

- Boly, V., Morel, L., Marche, B., Monticolo, D., Camargo, M., & Hörlesberger, M. (2024). Ecosystem Practices for Regional Digitalization: Lessons from Three European Provinces. In *European Perspectives on Innovation Management* (pp. 315-341). Cham: *Springer International Publishing*. Retrieved from https://link.springer.com/chapter/10.1007/978-3-031-41796-2_12.
- Dekker, L. H., & Hilderink, H. B. M. (2023). The future of care in the Netherlands: application of foresight to explore challenges towards 2050. *European Journal of Public Health*, 33(Supplement_2), ckad160-1712.
- European Commission (n.d.). Shaping Europe's digital future. Retrieved from <https://digital-strategy.ec.europa.eu/en>
- European Commission (n.d.). Digital Europe Programme. Retrieved from <https://digital-strategy.ec.europa.eu/en/activities/digital-programme>
- European Commission (n.d.). Connecting Europe Facility. Retrieved from <https://digital-strategy.ec.europa.eu/en/activities/connecting-europe-facility>

- European Commission (n.d.). Horizon Europe. Retrieved from https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en
- European Commission (n.d.). InvestEU. Retrieved from https://europa.eu/investeu/home_en
- European Commission (n.d.). Creative Europe. Retrieved from <https://digital-strategy.ec.europa.eu/en/policies/creative-europe>
- European Commission (n.d.). EU4Health. Retrieved from https://ec.europa.eu/health/funding/eu4health_en
- European Commission (n.d.). Recovery and Resilience Facility. Retrieved from https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en
- European Commission (n.d.). European Regional Development Fund. Retrieved from https://ec.europa.eu/regional_policy/en/policy/themes/ict/
- European Commission (n.d.). Recovery and Resilience Scoreboard. Retrieved from https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/.
- Gaiani, S., & Ala-Karvia, U. (2023). The European Digital Economy: Drivers of Digital Transition and Economic Recovery. Retrieved from https://books.google.ro/books?hl=ro&lr=&id=EujoEAAAQBAJ&oi=fnd&pg=PA63&dq=European+Financing+programs+that+support+digitalisation&ots=AGAtfG_tVl&sig=bF0aI_czRlxgvJWWZSj0p6uh5nA&redir_esc=y.
- Nikolov, E. (2023) Assessing the Quality of Sustainability Reporting: A Case Study of Bulgarian Sofix Companies, *100th International Scientific Conference on Economic and Social Development*, Retrieved from https://www.researchgate.net/profile/Emil-Nikolov-3/publication/375228510_ASSESSING_THE_QUALITY_OF_SUSTAINABILITY_REPORTING_A_CASE_STUDY_OF_BULGARIAN_SOFIX_COMPANIES/links/6543bd07bb8314438dbf0e2f/ASSESSING-THE-QUALITY-OF-SUSTAINABILITY-REPORTING-A-CASE-STUDY-OF-BULGARIAN-SOFIX-COMPANIES.pdf#page=68
- Panteleeva, I. (2023). Opportunities for Increasing Economic Growth Through Entrepreneurship Based on Business Innovation, *100th International Scientific Conference on Economic and Social Development*.
- Pellegrin, J., & Colnot, L. (2023). Digitalisation in a Multilevel Governance Context: The Case of Cohesion Policy. In *Territorial Innovation in Less Developed Regions: Governance, Technologies, and Sustainability* (pp. 141-161). Cham: *Springer International Publishing*. Retrieved from https://books.google.ro/books?hl=ro&lr=&id=yFazEAAAQBAJ&oi=fnd&pg=PA139&ots=7g1ynrsIgw&sig=anMBWdqi57hwKeB9VogYVxEORBQ&redir_esc=y.
- Pinto, H., Nogueira, C., & Vieira, G. (2023). Digitalisation landscape in the European Union: Statistical insights for a Digital Transformation. *European Public & Social Innovation Review*, 8(1), 20-38.