

The Digitalisation Dilemma In Romania's Challenges And Implications For Sustainable Development

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Abstract. This article explores the main obstacles to digitalisation in Romania by analysing data and examining digitalisation transformation processes. Despite the number of ITC graduates, Romania lags in corporate digital integration. The study examines statistical data, the role of universities as providers of knowledge, and essential digital skills for sustainable development. Main indicators analysed are entrepreneurs' demand for ITC specialists, university graduate statistics, access to necessary software, and internet accessibility for consumers. The research highlights Romania's "digitalisation dilemma" and provides insights into the factors hindering progress in the digital sector. The objectives of this article are to identify and rank the key barriers to digitalisation in Romania, analyse statistical data on digital transformation, assess the role of universities, evaluate the necessary essential digital skills, and examine factors like education, software access, and internet availability that hinder corporate digital integration. The authors highlight Romania's digitalisation challenges and emphasize the need for policy reforms. The findings present the primary obstacles impeding Romania's integration into the digital economy. This study aims to analyse and identify the key bottlenecks hindering digitalisation progress in Romania by utilizing the most recent and reliable sources. The authors systematically interpret the findings and establish correlations to generate well-founded insights, ensuring a comprehensive and meaningful contribution to the field.

Keywords: digitalisation, sustainability, barriers in digitalisation, management, IT, data model, ITC skills

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Introduction

Digitalisation integration refers to the process of transforming traditional systems, or parts of them, into virtual ones, serving as a fundamental pillar for future innovation. Although Romania has made some progress in this area in recent years, the Digital Economy and Society Index (DESI) consistently rank the country last in the Digital Intensity Score, which assesses the level of digitalisation across companies of all sizes—large, medium, and small.

Moreover, based on the available data, the authors have examined existing statistics related to this issue, particularly regarding the workforce required for digital transformation. Findings indicate that even if Romania ranks 6th in the European Union in terms of the number of Information and Communication Technology (ICT) graduates however it remains at the lower end of the spectrum in terms of overall digitalisation progress.

Furthermore, looking at the possible bottlenecks, besides the hypothetical lack of specialized human workforce in the field, there are other indicators that the authors focus on in this research, such as:

- ♦ Entrepreneurs demand a certain level of digitalisation. This indicator led to more reasons to be considered, such as: (1) entrepreneurs fear losing control of their business operations, (2) the challenge of accurately, realistically, and concretely identifying the digitalisation needs of one's own company, (3) difficulty in identifying digitalisation needs (especially for SMEs), (4) insufficient financial resources for implementing proper technical solutions.

- ♦ Essential skills to run through a digital world

What constitutes the optimal combination of hard and soft skills that employers seek? The successful implementation of a new process or the enhancement of an existing one necessitates the development of technical expertise, such as programming, software development, and edge computing, alongside an inclusive approach that ensures seamless integration and comprehension across all operational departments and employees involved. To facilitate smooth and sustainable implementation, both hard and soft skills are essential. These keys are closely linked to the role of education in fostering and delivering a highly skilled workforce equipped for the demands of a digitalized world.

- ♦ Level of inclusion of population (potential customers) in the digital word as the national study on digital inclusion and exclusion in Romania performed by Făgăraș Research Institute (FRI) reveals: *“Digital exclusion is not just about lack of access to the internet or digital skills training, but also about incomplete digital inclusion, which leaves various groups vulnerable and isolated”*. [2]

Summarizing, this article aims to analyse and explain the complexities surrounding Romania’s digitalisation dilemma.

Literature review

Digitalisation dilemma

The 2024 Digital Economy and Society Index (DESI) report data, where Romania ranks last in overall digitalisation progress, the authors start looking at the other indicators related to digitalisation to a better understanding of the identified dilemma, such as using cloud computing, data analytics and graduates’ numbers and statistics.

All the indicators consider companies with more than 10 employees, both in the public and private sectors. Using Cloud computing serves as a crucial metric for assessing the adoption of data-driven technologies. According to the Digital Economy and Society Index (DESI), 15.5% of Romanian enterprises utilise at least one intermediate or advanced cloud computing solution for functions such as finance, accounting, enterprise resource planning (ERP), customer relationship management (CRM), security, or hosting enterprise database applications. This percentage positions Romania among the lowest-ranking countries in the EU, closely followed by Bulgaria (14.2%), and significantly behind Finland (73%) and the EU average (38%).

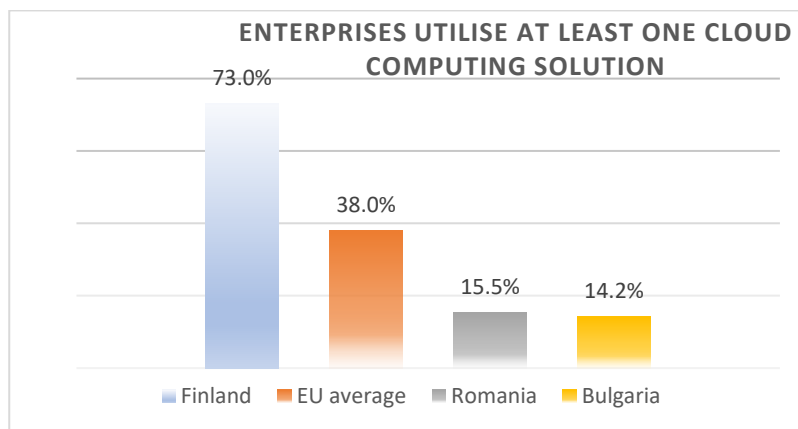


Figure 1: Enterprises utilise at least one intermediate or advanced cloud computing solution

Source: Authors’ contribution

The data analytics indicator, which assesses the utilisation of techniques and software tools for analysing data to identify patterns, trends, and insights aimed at enhancing decision-making and organizational performance, ranks Romania 24th out of 27 EU countries. 21.9% of Romanian enterprises implement data analytics practices, positioning the country ahead of Czechia, Poland, and Slovenia. [3]

Starting in 2020, most of the universities in Romania not directly related to the ITC field have incorporated several courses and programs focused on digitalisation into their curricula, preparing students for the challenges and opportunities of the digital era. Below are some notable examples: (1) University of Bucharest (UB): Through the EDIS project, UB has introduced training courses in emerging technologies, such as artificial intelligence, entrepreneurship in the Metaverse, and Web 3.0. These are integrated into micro-programs available as elective courses for students [4]; (2) Carol Davila University of Medicine and Pharmacy (UMFCD), Bucharest, has launched advanced digital competence courses, including "Health Education Using Artificial Intelligence Technologies" and "The Use of Artificial Intelligence in Scientific Writing", addressed to faculty members, researchers, and students [5]; (3) Politehnica University of

Timisoara (UPT): created its “Centre for Distance Learning and e-Learning (ID/IFR)”, UPT offers the online course "Using Digital Tools in Education" which focuses on developing digital competencies among educators and students [6]. Based on the previous information, it can be stated that graduates who have completed their higher education in the past four years possess competencies that can be effectively used in the digitalisation processes. Quantifying this assumption, in 2022 (the most recent available data), Romanian universities produced a total of 85,368 graduates across all fields, of whom 6.8% specialized in ICT, equating to approximately 5,800 students. This percentage positions Romania as the 6th -ranked country in the EU for ICT graduates, closely trailing leading nations in digitalisation, such as Finland (8.1%) and Ireland (8.2%).[7]

While Romania ranks among the top 10 European countries in terms of higher education in the ICT field, alongside the leaders in digitalisation, it occupies the last position in terms of corporate digitalisation according to the Digital Economy and Society Index (DESI).

Delving further into the complexities of the digitalisation dilemma, the authors examine additional key indicators outlined in the Introduction section.

Entrepreneurs demand a certain level of digitalisation

In the last study published by Digital Economy and Society Index (DESI), Enterprises that employ ICT specialists ^[1], Romania ranked as last European country with a percentage of 2.6%, far away from EU average of 4.8% and extremely behind the first ranked countries with a percentage of more than 8.7% in 2024.

Even if the employment of already skilled people is not taken seriously into account, Romanian enterprises do not report difficulties in filling ICT job vacancies or prioritising the upskilling of their workforce either. According to the Digital Economy and Society Index (DESI), national companies largely fail to provide training programs aimed at developing or enhancing employees' ICT and digital competencies, resulting in Romania once again ranking last in this indicator.

Using that information, it can be inferred that Romanian entrepreneurs are not actively pursuing digitalisation to the extent expected when compared to other European countries. This raises the questions: *What factors are causing Romanian entrepreneurs to hesitate and refrain from fully embracing the digital landscape? What kind of employees are they searching for?* *What factors are causing Romanian entrepreneurs to hesitate and refrain from fully embracing the digital landscape?* Based on the available information (following OECD Eurostat defines ICT specialists as "workers who have the ability to develop, operate and maintain ICT systems, and for whom ICT constitute the main part of their job"), the main reasons for entrepreneurs' hesitation to embrace digital transformation are: (1) financial constraints: limited financial resources are a primary barrier, with one-third of small and medium-sized enterprises (SMEs - 99.7% % of the total number of active companies, approximately 521.000 SMEs) citing this as a major impediment to digitalisation efforts, according to Statista, [8] (2) access to financing: securing capital remains a significant challenge, with entrepreneurs facing difficulties in obtaining the necessary funds to invest in digital transformation, [9] (3) limited digital skills: there is a notable gap in digital literacy among entrepreneurs and their workforce, making it challenging to implement and utilise digital tools effectively, [10] (4) entrepreneurs' level of study - according to the last report of Global Entrepreneurship Monitor (GEM), 58.8% of established entrepreneurs in Romania have higher education. This is an important factor in understanding the needs of digitalisation and directly affects the demand for skilled people in this field.[11]

What kind of employees are they searching for? According to EUROSTAT 2024 data, which includes all economic activities (except agriculture, forestry and fishing, and mining and quarrying), without the financial sector, the proportion of employees in Romania using computers and the internet is 44.13%. This figure is substantially lower than the European Union average of 62.88%, and it represents nearly half the usage levels reported in the leading Nordic countries—Norway (87.93%), Sweden (87.9%), and Finland (86.9%).[12]

Although the share of employees utilizing computers and the internet in their daily work activities has shown a steady increase over the past four years, as illustrated in Figure 2, Romania's progress in the digitalisation sector remains insufficient to align with EU benchmarks and expectations.

Use of computers and the internet by employees in Romania (%)

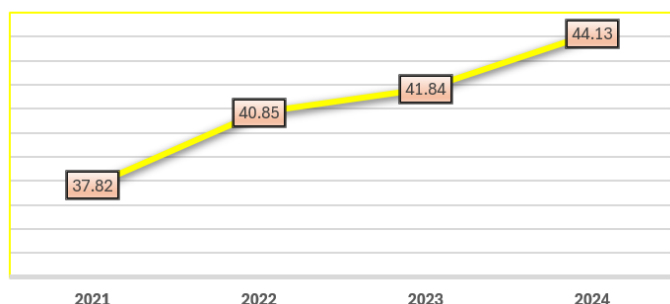


Figure 3: The evolution of computer usage between 2021-2024

Source: Authors' own contribution

Although digitalisation is a key objective across EU member states and is driving the transition toward a digitally-oriented environment, Romania appears to exhibit a degree of reluctance in embracing the associated changes. Following OECD Eurostat defines ICT specialists as "workers who have the ability to develop, operate and maintain ICT systems, and for whom ICT constitute the main part of their job".

Romanian entrepreneurs often perceive digitalisation as merely another requirement for survival in an increasingly competitive market, rather than as a progressive standard that fosters a more advanced and sustainable business landscape.

Taking into consideration the information analysed thus far, it can be asserted that the Romanian business sector is not actively pursuing digital integration, primarily due to a lack of strong market demand, which remains below current expectations.

Essential skills to run through a digital world

Several types of skills are needed to run through a digital world: both technical and professional skills, including:

(1) ICT specialist skills for workers who drive innovation and to support digital infrastructures and the functioning of the digital eco-system, (2) ICT generic skills for workers and citizens alike to be able to use digital technologies, (3) ICT complementary "soft" skills, such as leadership, communication and teamwork skills, are required for the expanding number of opportunities for ICT-enabled collaborative work. [13]

Table 1: Required hard & soft skills combination to run a digital business

Skill type	Skills	Indicators	Key indicators
Hard	Technical expertise	Knowledges in: ◦ programming ◦ web development ◦ database management ◦ cloud computing ◦ system administration ◦ network configuration	Programming and process automation knowledge Experience with digital tools (ERP, CRM, etc.) Flow automatization
	Data Analytics and Interpretation	Knowledges in: ◦ data analysis ◦ statistical modelling ◦ machine learning ◦ user testing	Ability to use data to inform decisions and optimize processes Experience with analytical tools (Power BI, Tableau, etc.) Quality assurance expertise
	Project Management	Knowledges in: ◦ project management ◦ simulation tools	Digital project management tools (Agile, Scrum, Jira) System integration management (API)
Soft	Change Management	Knowledges in: ◦ simulation tools ◦ compliance and risk management Strategic thinking oriented Leadership and influence capabilities	Ability to navigate and support others through digital change Openness to learning new technologies and rethinking traditional processes
	Cross-Functional Collaboration	Knowledges in: ◦ communication ◦ team alignment ◦ emotional intelligence ◦ coordination and execution of cross-functional projects	Working across IT, operations, and business units Translating complex digital topics for non-technical stakeholders
	Customer-Centric Thinking	Result-oriented focus Customer profile orientated	Focusing digital transformation efforts on improving customer/end user experience Tracks and reports on cross-functional project outcomes

Skill type	Skills	Indicators	Key indicators
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Source: Authors' own research

Table's notes:

ERP = Enterprise Resource Planning

CRM = Customer Relationship Management

API = Application Programming Interface

While Romania continues to perform very well in training ICT specialists, the proportion of ICT specialists in its workforce is relatively low, partly due to difficulties in retaining them in the country. [14]

The requisite combination of hard and soft skills for digitalisation processes encompasses both the technical competencies necessary to implement and manage digital transformation, as well as the interpersonal and adaptive capacities required to navigate and respond to digital change at the human level. The authors identify and present a set of key indicators essential for operating effectively in the digital business environment, as outlined in Table 1.

To navigate the digital landscape—particularly within the business domain—it is essential to emphasize capabilities such as technology adoption, process transformation, data utilization, and change management. A deficiency in any of the skills outlined in Table 1 may hinder the overall success of a business's digital transformation, potentially resulting in unsustainable change and preventing the digitalisation process from achieving its full potential.

Level of inclusion of the population

In the 2024 edition of the Digital Decade Report, 59% of Romania's population considers that the digitalisation of daily public and private services makes their life easier. This is one of the lowest scores in the EU, much below the EU average of 73%.

Romania has achieved 27.7% basic digital skills coverage, compared to the EU average of 55.6%. The score in Romania has slightly decreased compared to the 2023 results (27.8%), Figure 3.

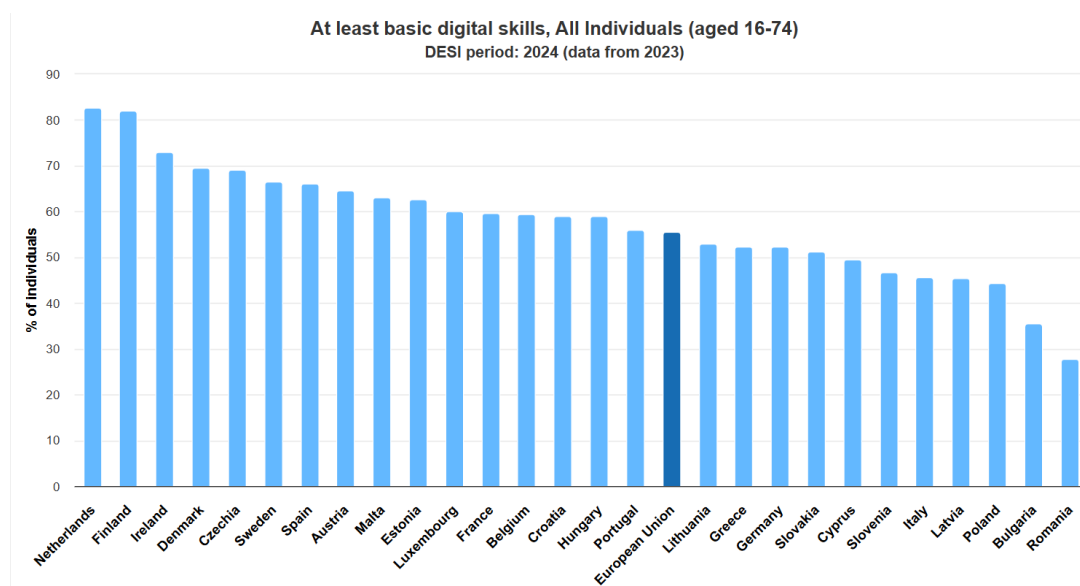


Figure 3: Percentage of individuals with at least basic digital skills

Source: Digital Economy and Society Index 2024

The situation about the percentage of individuals with at least basic digital skills does not show any kind of progress, even though the connectivity infrastructure has exceeded EU targets.

With 95% coverage of households with very high-capacity networks (VHCN), which equals Fibre-to-the-Premise (FTTP), Romania brings a very strong contribution to the Digital Decade Gigabit connectivity target. These values are significantly above the EU averages of 79% (for VHCN) and 64% (for FTTP), but their overall dynamic during 2023 was very limited. However, it is worth noting that FTTP coverage of rural areas went up from 90% to 92.5% during 2023, continuing the strong growth observed during the previous 5 years and reaching the highest FTTP rural coverage in the EU, as shown in Figure 4.

Connectivity infrastructure (Gigabit)



Figure 4: Coverage of households with access to the internet and its evolution in Romania
Source: Digital Decade Report 2024

Methodology

This study employs a qualitative and quantitative secondary research approach, relying on the analysis of existing literature to explore the research topic. A comprehensive review of scholarly articles, reports, and relevant publications was conducted to identify and examine both qualitative insights and quantitative data presented in previous studies. The sources underpinning this report consist of Eurostat and DESI reports, complemented by research conducted by Cult Research and EY Romania. The authors integrated the data published in these reports with relevant studies and information from trusted sources to construct a comprehensive framework illustrating the broader context of Romania's digitalization dilemma.

By synthesizing findings from diverse sources, this methodology allows for a multi-dimensional understanding of the subject and supports the development of well-grounded conclusions. The dual focus on qualitative and quantitative perspectives enhances the depth and reliability of the analysis.

Results and further discussion

Based on the previously stated facts, the key bottleneck appears to be the disconnect between the information and communications technology (ICT) sector and the business environment. Bridging this gap will likely require professionals with both digital competencies and business acumen, capable of guiding business owners through the process of digital transformation.

Looking forward to achieve the EU target regarding digital transformation for 2030 (in the Table 2), the Digital Skills and Jobs Romania website offers a list of events on digital skills, various resources and training opportunities, a collection of good practices showcasing successful strategies, initiatives and projects with a strong local impact and potential, and a news section which shared the latest initiatives, projects, innovations and job offers related to digital skills at local and international level. The platform serves as a hub for information resources from Romania and the European Union, aimed at enhancing the digital skills of Romanian citizens. It also promotes career training opportunities in the ITC sector, scholarships, project financing, and spreads awareness about cybersecurity measures. The platform further encourages collaboration between the academic environment and the ITC industry in Romania.

Table 2: Comparison of key performance indicators of digitalisation between Romania and the EU average, and the target for 2030

Digital Decade KPI ⁽¹⁾	Romania			EU		Digital Decade target by 2030	
	DESI 2023	DESI 2024	Annual progress	DESI 2024 (year 2023)	Annual progress	RO	EU
Fixed Very High-Capacity Network (VHCN)	95.6%	95.0%	-0.6%	78.8%	7.4%	99%	100%
Fibre to the Premises (FTTP) coverage	95.6%	95.0%	-0.6%	64.0%	13.5%	99%	-
Overall 5G coverage	26.8%	32.8%	22.4%	89.3%	9.8%	62%	100%
Semiconductors		NA					
Edge Nodes		5		1 186		113	10 000
SMEs with at least a basic level of digital intensity	22.2%	26.8%	9.9%	57.7%	2.6%	75%	90%
Cloud	11.3%	15.5%	17.1%	38.9%	7.0%	40%	75%
Artificial Intelligence	1.4%	1.5%	3.5%	8.0%	2.6%	10%	75%
Data analytics	NA	21.9%	NA	33.2%	NA	15%	75%
AI or Cloud or Data analytics	NA	28.7%	NA	54.6%	NA		75%
Unicorns		0		263		x	500
At least basic digital skills	27.8%	27.7%	-0.2%	55.6%	1.5%	50%	80%
ICT specialists	2.8%	2.6%	-7.1%	4.8%	4.3%	4%	~10%
e ID scheme notification		No					
Digital public services for citizens	47.6	52.2	9.7%	79.4	3.1%	100	100
Digital public services for businesses	44.6	50.0	12.1%	85.4	2.0%	100	100
Access to e-Health records	57.1	58.6	2.7%	79.1	10.6%	x	100

Source: Digital Decade Report 2024

Moreover, Romania has developed a Recovery and Resilience Plan (RRP) aimed at facilitating a robust recovery and preparing the country for the future. The RRP consists of 177 investment measures and 66 reforms, which will help Romania become more sustainable, resilient, and adaptable to the challenges and opportunities posed by the green and digital transitions. The plan is supported by an estimated €13.6 billion in grants and €14.94 billion in loans. 41% of the plan will contribute to the green transition, while 21.8% of it will support the digital transition.

Conclusion

Based on both quantitative and qualitative data, the authors rank key barriers for Romania's digitalisation progress in Table 3.

Table 3: Key barriers ranking for digitalisation progress in Romania

Rank	Barrier	Barrier's explanation
1	Lack of entrepreneurs' demand for digitalisation	Romanian entrepreneurs are not proactively engaging in digital integration, primarily due to their limited ability to identify technological needs and to recognize the potential benefits such integration can offer in terms of business sustainability
2	A disconnect between the information and communications technology (ICT) sector and the business environment	Universities are not in close collaboration with the business sector to develop academic programs that are aligned with the needs of enterprises, particularly concerning the implementation of digitalisation across companies of all sizes
3	The resistance to change exhibited by individuals, including potential consumers	Despite the availability of adequate internet infrastructure to support digital engagement, a substantial proportion of the Romanian population remains reluctant to adopt new technologies, continuing to prefer a traditional, non-digital environment

Source: Authors' own research

Summarising the information gathered, the authors can draw the following conclusions: (1) the digitalisation dilemma is a tangible issue in Romania, primarily reflecting the gap between entrepreneurs' understanding of digital integration and the availability of a skilled workforce capable of demonstrating their competencies and the added value they can contribute to the business field; (2) digital exclusion extends beyond limited access to the internet or digital skills education. It also encompasses substantial shortcomings in the digital inclusion process. This suggests the emergence of a phenomenon akin to functional digital illiteracy, wherein individuals possess basic digital competencies but lack a sufficient understanding of the digital processes they engage with. This situation highlights significant deficiencies in digital education programs within formal educational institutions, as well as limited access to

complementary initiatives aimed at enhancing digital literacy; (3) although the situation appears to be improving, Romania must still overcome significant barriers that hinder its ability to achieve the desired progress in integrating digitalisation within the business sector.

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