Artificial Intelligence Adoption, Complementary Digital Capabilities, and Operational Resilience: A Comparative Analysis of Romania and the Euro Area (2020-2024)

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Abstract

This paper explores the relationship between Artificial Intelligence (AI) adoption, complementary digital capabilities, and operational resilience in enterprises, using Romania and the Euro Area as a comparative case study. Drawing on Eurostat data from 2020 to 2024, the analysis focuses on four indicators: AI adoption, cloud computing usage, the Digital Intensity Index (DII), and employment of ICT specialists. The findings reveal persistent structural gaps between Romania and the Euro Area across all dimensions, with Romanian firms – particularly SMEs – showing lower adoption rates and weaker digital integration. These differences are not only technological but also rooted in human capital disparities and infrastructural limitations. The results suggest that resilience-enhancing digital transformation in Romania requires coordinated interventions, including policy support for technology adoption, investment in cloud infrastructure, and expanded ICT education and training. By highlighting the complementary nature of digital capabilities, the study underlines that progress in one area (e.g., AI) depends on maturity in others (e.g., cloud or skills). This paper aims to provide insights into how less digitally advanced economies can accelerate transformation and strengthen enterprise resilience in an era marked by increasing technological disruption.

Keywords: *Artificial Intelligence, Digital Transformation, Operational Resilience, Technology Adoption*

JEL classification: O33, L86

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1. Introduction

In the current European economic context, digital transformation is increasingly recognised as a critical enabler of competitiveness and long-term sustainability for enterprises of all sizes. Within this transformation, the adoption of Artificial Intelligence (AI) plays a central role, providing firms with tools to improve efficiency, decision-making, and adaptability in the face of disruptions (Marchis et al., 2025). AI is rarely implemented in isolation; its impact is amplified when accompanied by complementary digital capabilities such as cloud computing, high levels of digital intensity, and a workforce with relevant ICT skills (OECD, 2021). These capabilities contribute to the operational resilience of organisations – the

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capacity to anticipate, absorb, and recover from shocks while maintaining core functions (OECD, 2014).

Comparing Romania with the Euro Area offers valuable insights for both policy-makers and business leaders. The Euro Area represents an advanced subset of the EU, with a generally higher level of economic integration, innovation, and productivity. Many Euro Area countries have reached or are approaching the *Digital Decade 2030* targets for digital skills, infrastructure, and technology adoption (European Commission, 2025). Romania, while making progress in several digital domains, continues to record lower adoption rates for advanced technologies such as AI and cloud computing (Eurostat, 2025), which may affect its convergence path with the Euro Area. Understanding these gaps is essential for designing targeted interventions that address structural deficiencies in digital readiness (Simut et al., 2025).

This paper analyses four key Eurostat indicators to assess the digital capacity and potential resilience of Romanian enterprises compared to their Euro Area counterparts:

- AI adoption rates (2021, 2023 and 2024);
- Cloud computing adoption (2021 and 2023);
- Employment of ICT specialists (2020, 2022 and 2024);
- Distribution across the Digital Intensity Index (DII v4) categories (2022 and 2024).

For all the indicators, a proxy total series was constructed from the unweighted average of small, medium and large enterprise classes due to the absence of a direct "all sizes" series in the data.

The decision to focus on 2021, 2023 and 2024 for AI reflects both data availability and the post-pandemic period, during which many European firms accelerated their digital transformation efforts (OECD, 2021). Similarly, the years 2021 and 2023 for cloud computing were dictated by the absence of 2024 data, while the DII analysis is limited to the years 2022 and 2024. The ICT specialist series includes 2020, 2022 and 2024, with 2021 and 2023 missing, allowing for contextualisation in relation to pre- and post-pandemic labour market conditions.

By comparing Romania's performance to that of the Euro Area, this study aims to identify persistent structural gaps, highlight areas where Romania lags in digital maturity, and derive implications for organizational resilience. The findings are relevant not only for Romania's policy agenda but also for understanding broader patterns of digital convergence and divergence within the EU.

2. Literature Review

2.1 Digital Transformation and Organizational Resilience

Digital transformation is broadly understood as the integration of digital technologies into all aspects of an organisation's operations, changing fundamentally how value is created, delivered, and perceived (Popescu-Zorica, 2025). Although the

concept is often associated with large corporations, recent research shows that small and medium-sized enterprises (SMEs) are equally affected by the pace and scope of this change (OECD, 2021). SMEs form the backbone of the European economy, accounting for the vast majority of the businesses in the EU (Nedef, 2024) and playing a critical role in innovation, employment, and regional development (European Commission, 2022). Yet, they typically face structural disadvantages compared to larger firms, including more limited financial resources, lower absorptive capacity for new technologies, and reduced access to skilled labour (Ferrari et al., 2022).

From the perspective of resilience, digital transformation becomes more than a strategic choice; it is a necessity for survival and growth. Resilience refers to the ability of an organisation to withstand shocks, adapt to changing circumstances, and recover quickly from disruptions (Cristache & Cărăuș, 2024). It goes beyond returning to a pre-crisis state, encompassing the capability to evolve towards a "new normal" that may require different operational models or business offerings (Vial, 2019). The COVID-19 pandemic has been a critical test in this respect, revealing vulnerabilities in supply chains, workforce organisation, and customer relationships (Paschina & Hamza Benammi, 2024). Empirical evidence suggests that SMEs with higher levels of digital maturity – using cloud-based collaboration tools, e-commerce platforms, and data analytics – adapted more rapidly to lockdown conditions and maintained continuity of operations (OECD, 2014). These capabilities enabled them not only to maintain contact with customers but also to reconfigure business processes and, in some cases, enter new markets during a time of crisis (Paraschiv et al., 2024).

Several studies have confirmed a positive correlation between the adoption of advanced digital tools and faster recovery after disruptive events. Firms that had implemented AI-driven customer service chatbots, predictive maintenance systems, or integrated ERP-cloud platforms managed to reduce operational downtime and improve decision-making under uncertainty (Bai et al., 2021). Artificial Intelligence plays a particularly important role in this dynamic, providing predictive capabilities to forecast demand fluctuations, anticipate equipment failures, or detect cyber threats before they materialise (Brynjolfsson & McElheran, 2016). It also facilitates process automation, allowing services to continue even during workforce shortages or demand surges, and supports managerial decision-making through advanced analytics that assess trade-offs between speed, cost, and quality under uncertain conditions.

However, AI adoption among companies in the EU, especially SMEs, remains low, often below 15% even in more digitally advanced economies (Eurostat, 2025). The main barriers include high initial investment requirements, lack of professionals with AI expertise, and concerns related to data protection and regulatory compliance (European Commission, 2025). These barriers are particularly relevant in countries with lower overall digital readiness, where complementary technological capabilities are less widespread.

The benefits of AI for resilience are amplified when supported by complementary technologies. Cloud computing is a central example, as it offers scalability and flexibility to adapt IT resources to fluctuations in demand, enabling companies to remain operational under volatile market conditions (Marston et al., 2011). During the COVID-19 pandemic, cloud adoption was strongly associated with rapid migration to remote work, effective collaboration between geographically dispersed teams, and accelerated deployment of digital services (OECD, 2021). Another important complementary dimension is the level of digital intensity, captured by the Digital Intensity Index (DII), a indicator calculated by Eurostat which measures the use of a range of digital activities such as social media, CRM software, and e-commerce. High DII scores indicate that an enterprise has integrated digital tools across multiple functions, increasing its agility and capacity to respond to unexpected changes. Finally, the presence of ICT specialists within the workforce ensures that the necessary human capital exists to implement, maintain, and optimise these technologies (European Commission, 2023b).

When comparing Romania with the Euro Area, structural differences become apparent. SMEs in the Euro Area benefit from more developed digital infrastructure, higher broadband penetration, and stronger innovation ecosystems. EU-level programmes such as the Digital Europe Programme have provided access to funding, training, and pilot projects in advanced technologies including AI (European Commission, 2023b). Romania has made progress in broadband coverage and digital public services but continues to lag in AI and cloud adoption rates and in the proportion of enterprises employing ICT specialists (Eurostat, 2025). These differences have direct implications for resilience: limited adoption of complementary technologies leaves Romanian companies more exposed to operational risks such as supply chain interruptions, sudden shifts in demand, or cyber threats. Moreover, the persistent gap in digital skills — both technical and managerial — limits the ability to use AI and other tools for adaptive decision-making.

The policy implications of this relationship between digital transformation and resilience are significant (Cristache, et al, 2024). For Romania, aligning with the Euro Area's digital trajectory will require a mix of measures aimed at stimulating demand — including financial incentives and awareness campaigns — and measures to strengthen supply, such as targeted training programmes and support for ICT recruitment. For the Euro Area more broadly, the challenge is to reduce internal disparities between regions and sectors, ensuring that access to resilience-enhancing technologies is not concentrated in digitally advanced economies alone.

Overall, the literature indicates that digital transformation is a core driver of resilience in modern enterprises. AI adoption, reinforced by cloud computing, high digital intensity, and skilled human resources, can substantially enhance the ability of companies to navigate uncertain environments. The comparative perspective between Romania and the Euro Area provides a meaningful basis for assessing how differences in digital maturity influence resilience capacity.

2.2 Measurement of AI and Digital Capabilities

The measurement of AI adoption and related digital capabilities at the enterprise level is a complex task, requiring both consistent definitions and comparable statistical frameworks across countries. In the European context, the most comprehensive data source is the Eurostat survey on ICT usage in enterprises, conducted annually and covering firms with ten or more employees across all economic sectors except financial activities. This survey provides harmonised indicators for technology adoption, enabling meaningful cross-country comparisons and time-series analyses. The relevance of these indicators lies in their ability to capture not only the presence of specific technologies but also their integration into business processes, which is critical for assessing digital maturity and resilience potential (Eurostat, 2025).

Artificial Intelligence adoption is measured in the Eurostat framework as the percentage of enterprises using at least one AI technology from a predefined list. This list includes applications such as natural language processing, speech recognition, machine learning for big data analysis, and autonomous robots. The measure is self-reported by enterprises and is expressed as a share of all firms within a given size class and sector. While this approach allows for comparability across countries, it has inherent limitations. Self-reporting may lead to underestimation if respondents are unaware that a given tool in use qualifies as AI under the Eurostat definition. Conversely, overestimation may occur if firms conflate simpler automation tools with AI-driven systems (European Commission, 2025). Additionally, the indicator does not capture the intensity of AI usage or the scale of deployment within the enterprise, meaning that a firm using a single AI-based application and one with fully integrated AI systems are counted equally.

Cloud computing adoption is similarly measured as the share of enterprises purchasing cloud services used over the internet, with servers located in data centres operated by third parties. Eurostat distinguishes between various types of cloud services, including email hosting, file storage, database hosting, and computing power, but the headline indicator aggregates these categories. This aggregation provides a broad measure of cloud uptake but masks differences in sophistication; basic storage services do not offer the same transformative potential as infrastructure-as-a-service or platform-as-a-service solutions (Marston et al., 2011). Furthermore, the measurement reflects purchase or subscription, not actual utilisation or integration into critical processes.

The Digital Intensity Index (DII) represents a composite indicator designed to capture the breadth of digital adoption within an enterprise. In its version 4 (DII v4), the index is based on twelve selected digital technologies grouped into categories such as connectivity, human capital, use of internet for business, and integration of digital technology. Each technology is assigned a binary score depending on whether it is used by the enterprise, and the total score determines the digital intensity category: Very low, Low, High, or Very high. This categorical approach simplifies interpretation and allows for quick benchmarking. However, it

is inherently coarse, as it does not distinguish between firms at the lower and upper bounds of a category. Moreover, the equal weighting of technologies may not reflect their actual contribution to competitiveness or resilience.

The employment of ICT specialists is measured as the percentage of enterprises employing at least one person whose main job is to develop, operate, or maintain ICT systems. This measure captures an important dimension of digital readiness, as skilled personnel are essential for implementing and maintaining complex technologies (Popa et al., 2024) such as AI and advanced cloud solutions (European Commission, 2023a). However, the indicator does not capture the number of ICT specialists relative to enterprise size, nor their level of expertise or the scope of their responsibilities. A single ICT specialist in a large firm may be insufficient for comprehensive digital transformation, while in smaller firms, even part-time ICT support may represent significant capacity.

In the present study, these indicators are used to construct a comparative profile of Romania and the Euro Area in terms of AI adoption and complementary capabilities. Given differences in data availability across indicators, methodological adjustments were necessary. For AI adoption, data are available for the years 2021 to 2024, but the source dataset does not include a direct "total enterprises" series aggregating all size classes. To address this, a proxy series was constructed by taking the unweighted average of adoption rates for small (10–49 employees), medium (50–249 employees), and large (250+ employees) enterprises. This method ensures a consistent trend across years but has limitations, as it does not account for the actual distribution of enterprises by size within each country. Consequently, the resulting trend should be interpreted as indicative rather than definitive.

For cloud computing, data are available from 2021 to 2023, with 2024 values missing at the time of analysis. The absence of more recent data restricts the ability to assess whether Romania has narrowed or widened its adoption gap with the Euro Area in the last year. For the DII, only 2024 data are available, meaning that no trend analysis is possible; however, the snapshot provides valuable insight into the distribution of enterprises across digital intensity categories. For ICT specialists, data cover the years 2020 to 2024, with 2021 missing. This allows for some contextualisation, particularly in relation to pre- and post-pandemic changes in recruitment and retention of digital talent, although trend analysis is limited by the gap year.

These methodological considerations highlight the importance of transparency in cross-country comparisons of digital capabilities. Differences in data coverage, indicator design, and interpretation can significantly affect conclusions about relative performance. Nevertheless, the harmonised nature of the Eurostat survey provides a robust basis for comparison, and the selected indicators collectively capture key dimensions of digital maturity relevant to resilience. AI adoption reflects the integration of advanced analytics and automation, cloud computing indicates the scalability and flexibility of digital infrastructure, DII summarises the breadth of digital integration, and ICT specialist employment signals the availability of human capital to sustain and expand these capabilities.

In comparative analyses such as the one undertaken here, the value of combining these indicators lies in their complementarity. A high rate of AI adoption without adequate cloud infrastructure may limit scalability, while a large ICT workforce without strategic integration of digital tools may lead to underutilised human capital. The combined perspective offered by these measures provides a more holistic understanding of digital readiness and its implications for resilience in the face of economic and operational shocks. This integrated measurement approach forms the empirical backbone of the analysis in the following sections, where Romania's position relative to the Euro Area is examined in detail.

3. Methodology

The analysis presented in this paper is based on harmonised statistical data from Eurostat's data browser on four key indicators: adoption of Artificial Intelligence, use of cloud computing, distribution of the Digital Intensity Index (DII v4), and employment of ICT specialists. These variables capture both the presence of advanced technologies and the underlying human and infrastructural capabilities necessary for their effective use.

The comparison focuses on Romania and the Euro Area, as defined in Eurostat's datasets, which includes the EU countries that have adopted the euro as their official currency. The Euro Area is used as a benchmark because it represents a more digitally advanced subset of EU economies, with higher average productivity, more developed innovation ecosystems, and stronger integration of digital technologies into business operations (European Commission, 2023a). Comparing Romania with this group allows for the identification of structural gaps in digital maturity and resilience potential, offering relevant insights for policy-making and business strategy.

The period of analysis varies depending on data availability for each indicator. AI adoption data are available for the years 2021, 2023 and 2024. The choice of this interval reflects both the constraints of the dataset — there are no AI adoption data for 2020 — and the analytical relevance of focusing on the post-pandemic period, during which many European enterprises accelerated their digital transformation (OECD, 2021). For cloud computing, data are available for 2021 and 2023, with no observations for 2022 and 2024 at the time of writing. This means that trends in cloud adoption can be assessed only up to 2023, and conclusions regarding 2024 are necessarily limited. The DII v4 distribution is available only for the years 2022 and 2024, precluding any trend analysis but offering a valuable snapshot of digital maturity in the most recent period. The employment of ICT specialists is documented for 2020, 2022 and 2024, with the exceptions of 2021 and 2023, which was not collected or published, allowing for partial assessment of pre- and post-pandemic developments.

For all the indicators, a proxy total series was constructed from the unweighted average of small, medium and large enterprise classes due to the absence of a direct "all sizes" series in the data.

An important methodological consideration relates to the measurement of the indicators in aggregate form. The source datasets report the rates separately for three enterprise size classes: small (10-49 employees), medium (50-249 employees), and large (250 or more employees). However, it does not provide a "total"/ "all sizes" series aggregating all size classes for the selected years. To construct proxies for the indicators, it was used the unweighted average of small, medium and large enterprise. The proxies provide a consistent trend series but does not reflect the actual distribution of enterprises by size within each economy. Since smaller enterprises are more numerous in all EU countries, a weighted average could yield different values. Therefore, the proxy should be interpreted as indicative, capturing the relative evolution of adoption rates rather than their exact aggregate level.

All indicators are expressed as the percentage of enterprises in the relevant population that exhibit the characteristic being measured. For AI and cloud computing, the numerator is the number of enterprises using at least one form of the technology, while the denominator is the total number of enterprises in the size class. For the DII, enterprises are classified into four categories of digital intensity — Very low, Low, High, and Very high — based on the number of digital technologies they use, and the percentages across categories sum to 100%. For ICT specialists, the numerator counts enterprises employing at least one person whose main role is to develop, manage, or maintain ICT systems.

Given the comparative nature of the analysis, the focus is on relative differences between Romania and the Euro Area rather than on absolute levels in isolation. This approach controls for the fact that structural characteristics such as industrial composition or firm size distribution can influence adoption rates. Nonetheless, it is recognised that these structural factors themselves are part of the explanation for observed differences and will be addressed in the discussion section.

The methodological choices made in this study balance the need for comparability with the constraints of available data. The reliance on harmonised Eurostat indicators ensures a high degree of validity for cross-country comparisons, but the interpretation of results must take into account the differences in measurement scope and data availability across indicators. The use of a proxies for the indicators is a practical solution to a data gap, but it introduces an additional source of uncertainty.

Overall, this methodology provides a robust basis for assessing the digital readiness and resilience potential of enterprises in Romania relative to the Euro Area. By combining multiple indicators that reflect both technological adoption and human capital, and by situating them within a consistent comparative framework, the analysis captures the multidimensional nature of digital resilience.

4. Results and Discussion

The comparative analysis of Romania and the Euro Area across the four selected indicators provides a comprehensive view of the digital readiness of enterprises and its implications for resilience. Artificial Intelligence adoption, cloud computing usage, digital intensity, and employment of ICT specialists together

outline the technological and human capital foundations upon which operational adaptability depends. The differences observed between the two economies are consistent across most measures, confirming previous literature which showed that Romania's digital transformation is progressing but remains at a lower level of maturity relative to the Euro Area benchmark (Sitnikov, 2024).

In terms of AI adoption, data for the years 2021, 2023 and 2024 show that Romanian enterprises in all size categories report lower usage rates than their Euro Area counterparts. According to Figure 1, the adoption rate for small enterprises in Romania range between 1.06% to 2.57%, compared to the adoption rates in Euro Area, which range from 6.73% to 12%. Medium-sized enterprises range from 1.9% to 3.88% in Romania, in the selected period, ones in the Euro Area, which range from 13.86% to 22.59%. Large enterprises record rates between 7.13% and 11.26% in Romania and between 30.73% and 43.43% in the Euro Area. The proxy total AI adoption rate, calculated as the unweighted average of the three size classes, ranges between 3.36% and 5.9% for Romania and between 17.1% and 26% for the Euro Area. These figures reveal steady growth in both economies, with the gap remaining important, which indicates that Romania's adoption is not catching up in relative terms despite overall progress. This persistence suggests that, as it was already observed in the literature, the factors inhibiting adoption — such as costs, skills shortages, and awareness — are systemic rather than temporary (Ioan-Franc & Gâf-Deac, 2024).

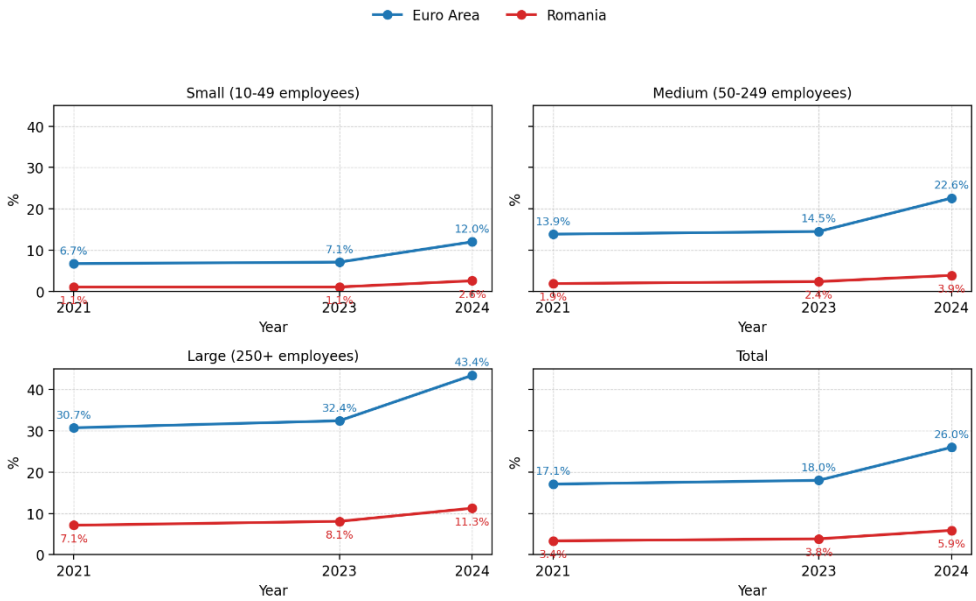

Figure 1. Artificial Intelligence by size class of enterprise (isoc_eb_ai) – Euro Area vs Romania

Source: Eurostat

The adoption of cloud computing exhibits a similar pattern. Figure 2 shows that in 2021 and 2023, Romanian small enterprises had a cloud adoption rate of 12.61% and respectively 16.31% compared to 39.62% and 41.42% in the Euro Area. Medium-sized enterprises report rates of 18.37% and 24.23% in Romania versus 55.29% and 58.68% in the Euro Area. For the large enterprises, the rates are 32.92% and 42.95% in Romania and 74.06% and 77.75% in the Euro Area. The proxy total cloud computing adoption rate, calculated as the unweighted average of the three size classes, ranges between 21.3% and 27.83% for Romania and between 56.32% and 59.28% for the Euro Area The role of cloud infrastructure as a facilitator for AI and other advanced digital tools implies that Romania's lower cloud uptake may indirectly constrain the scaling of AI solutions. Furthermore, the trend for these two years indicates that while Romania's growth rate in cloud adoption is comparable to that of the Euro Area, the starting point was significantly lower, and the absolute gap remains largely unchanged. The absence of 2024 data prevents a definitive statement on whether this trajectory has improved recently, but given the relative stability of the gap over the observed period, major changes are unlikely without targeted interventions.

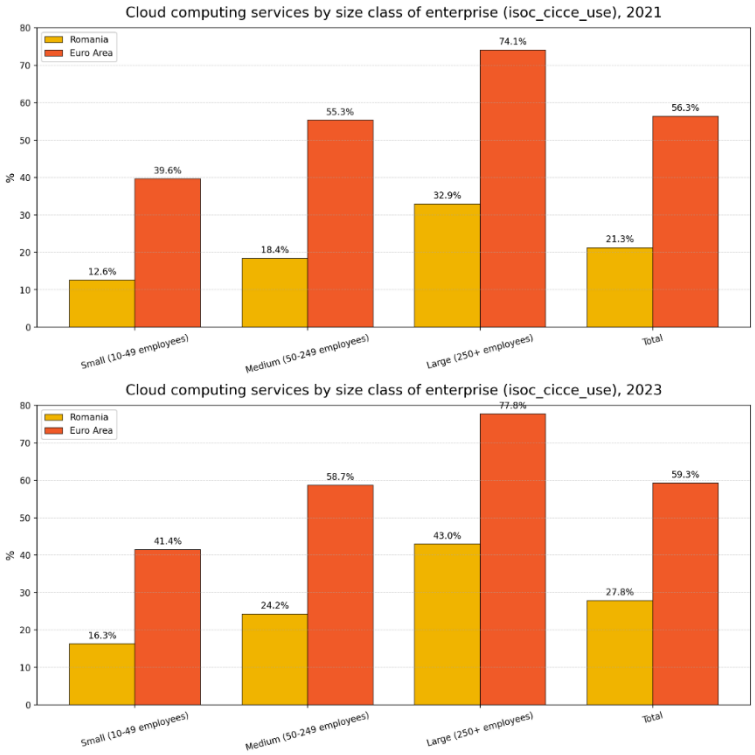

Figure 2. Cloud computing services by size class of enterprise (isoc_cicce_use), 2021
Source: Eurostat

The Digital Intensity Index (DII) provides a broader perspective on digital maturity, capturing the extent to which multiple technologies are integrated into enterprise operations. In both 2022 and 2024, Romania exhibits a higher concentration of enterprises in the Very low and Low categories, while the Euro Area has a greater proportion in the High and Very high categories. According to Figure 3, 32.93% (2022) and 21.17% (2024) of Romanian enterprises fall into the Very low category compared to 15.09% (2022) and 13.48% (2024) in the Euro Area, while only 3.3% (2022) and 5.61% (2024) of Romanian enterprises are in the Very high category versus 13.85% (2022) and 20.92% (2024) in the Euro Area. This distribution suggests that many Romanian enterprises have not yet embedded digital tools across multiple functional areas, which limits their agility and capacity for rapid adaptation to disruptions. The higher share of Euro Area enterprises in the upper categories reflects not only greater adoption of individual technologies but also more widespread integration of digital practices throughout the organisation.

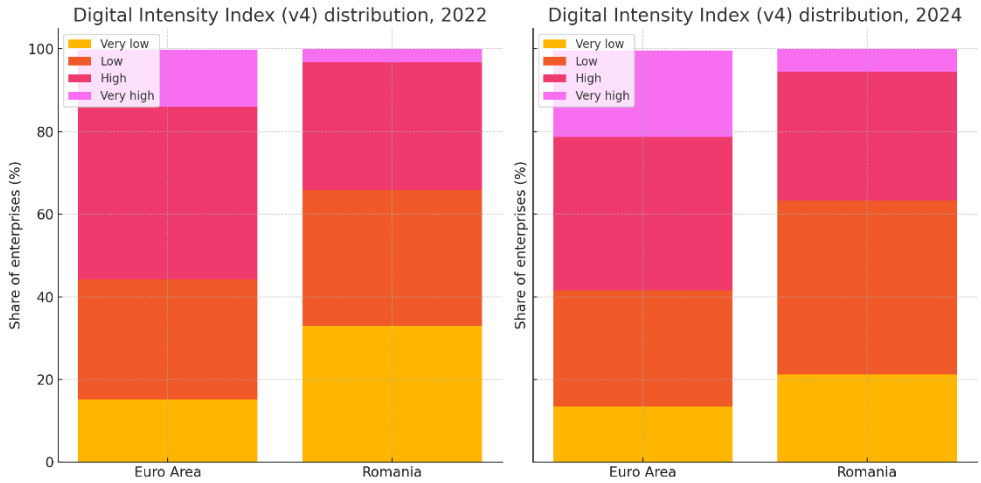

Figure 3. Digital Intensity Index (DII) of Enterprises in Romania and the Euro Area, 2022 and 2024

Source: Eurostat

The employment of ICT specialists is another critical dimension, reflecting the human capital available to implement and sustain digital technologies. In the selected years (2020, 2022 and 2024), the rate of Romanian enterprises which employ ICT specialists (Total proxy) ranges between 27.17% and 28.63%, compared to rates which range between 43.73% and 45% for the Euro Area, as shown in Figure 4. The gap is relatively consistent across size classes, indicating that the shortage is not confined to smaller firms. The temporal perspective reveals that Romania's share increased modestly from 2020, but the pace of growth has been slow, and the gap with the Euro Area has narrowed only marginally. The absence of 2021 data makes it difficult to assess the immediate post-pandemic dynamics, but the broader pattern suggests that increasing the supply of ICT professionals – through education,

training, and retention policies – is a necessary condition for accelerating digital transformation.

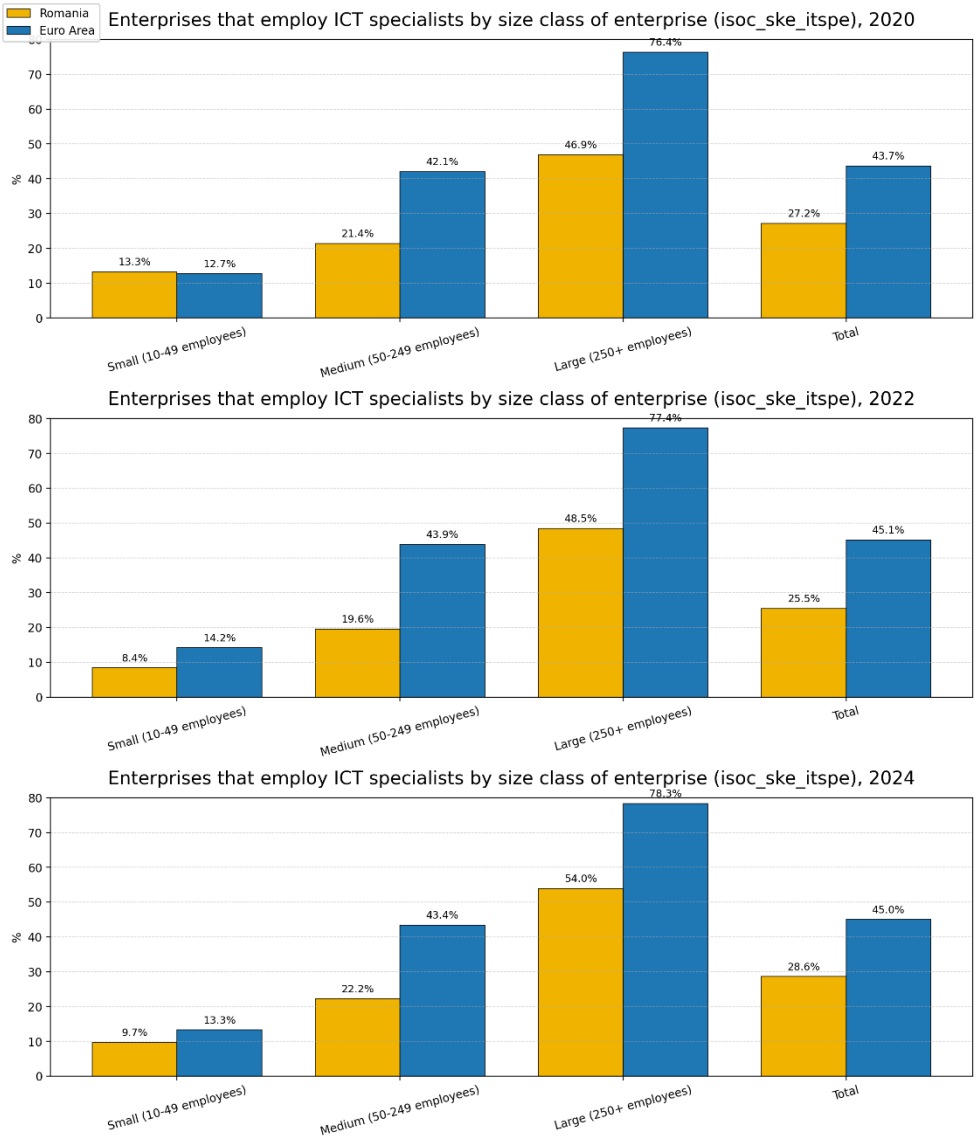

Figure 4. Enterprises Employing ICT Specialists in Romania and the Euro Area, 2020, 2022 and 2024
Source: Eurostat

The implications of these findings are substantial. The consistent gaps across AI, cloud, DII, and ICT specialists suggest that Romania's digital readiness deficit is multidimensional, involving both technological and human capital components.

Addressing one dimension in isolation is unlikely to close the gap; rather, a coordinated approach is needed. For example, policies aimed at subsidising AI adoption will have limited impact if enterprises lack the cloud infrastructure to support AI applications or the skilled personnel to operate them. Conversely, training more ICT specialists will yield suboptimal returns if enterprises are not incentivised to invest in complementary technologies.

From a resilience perspective, the observed disparities imply that Romanian enterprises, particularly SMEs, may be more vulnerable to operational disruptions. Lower AI adoption reduces predictive and adaptive capabilities, while limited cloud uptake constrains flexibility in scaling operations and accessing digital services remotely. Low digital intensity indicates that digital tools are not embedded across multiple business functions, reducing organisational agility. Finally, a smaller pool of ICT specialists limits the ability to respond quickly to technical challenges or to integrate new technologies effectively. These vulnerabilities could manifest in slower recovery from crises, reduced competitiveness in dynamic markets, and greater susceptibility to supply chain or cybersecurity shocks.

The Euro Area's stronger performance across all indicators reflects a more mature digital ecosystem in which technologies and skills are mutually reinforcing. Higher AI and cloud adoption rates are supported by greater digital intensity and a larger ICT-skilled workforce, creating a virtuous cycle of innovation and adaptability. For Romania, the challenge is to initiate a similar cycle, which requires not only investment but also cultural and organisational change. Awareness campaigns, targeted subsidies, and public-private partnerships could play a role in accelerating adoption, but these must be complemented by long-term investments in education and skills development.

In conclusion, the comparative analysis demonstrates that Romania's enterprises lag behind the Euro Area in digital readiness across multiple dimensions. While progress has been made in recent years, the relative gaps have not significantly narrowed, suggesting that structural barriers persist.

5. Conclusions

The comparative analysis of Romania and the Euro Area highlights persistent structural gaps in digital capabilities across enterprises of all sizes. The results show a gap, which has been underlined in the specific literature for a long time (Popa et al., 2018), which makes Romanian enterprises record significantly lower adoption rates of Artificial Intelligence and cloud computing, as well as weaker performance on the Digital Intensity Index. In parallel, the share of firms employing ICT specialists is also considerably lower than the Euro Area average, limiting the ability to implement and scale digital tools effectively.

The findings confirm previous studies showing that digital transformation and resilience are closely interconnected (OECD, 2014). Low levels of AI and cloud adoption in Romania suggest a limited capacity to anticipate and adapt to disruptions, which may increase operational vulnerability. As shown in the literature, AI adoption

alone is insufficient—its benefits are amplified when complemented by cloud infrastructure, integrated digital systems, and specialised human capital (Bai et al., 2021; Brynjolfsson & McElheran, 2016).

The gaps identified are not narrowing at a significant rate, despite some recent improvements. This indicates that barriers such as limited financial resources, lack of skilled personnel, and low organisational digital maturity are still prevalent (Ferrari et al., 2022). The evidence suggests the need for coordinated interventions, combining technology investment support with education and training initiatives.

In conclusion, Romanian enterprises – especially SMEs – remain less digitally resilient than their Euro Area counterparts. The low adoption of advanced technologies and the underdevelopment of complementary capabilities reduce their ability to respond to economic shocks (Năstase, M., et al, 2024). A comprehensive and systemic approach is required to strengthen digital readiness and reduce the risk of divergence within the EU's digital economy (Rădulescu et al., 2025).

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