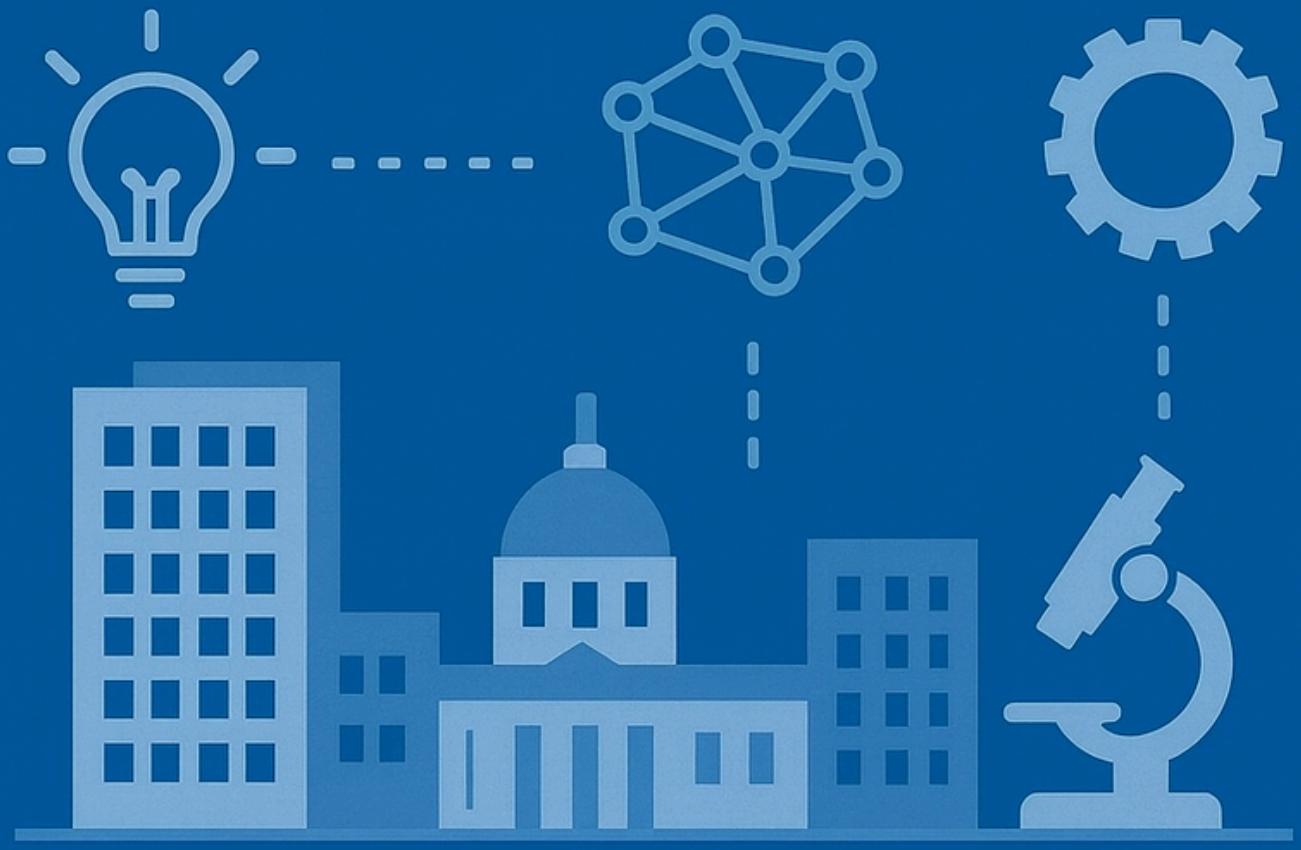
From Policy to Performance

The Evolution of the IT Sector in Romania the Context of Innovation and Digitalization Policies - Research report

Sapientia working papers IV.



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SAPIENTIA
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CATALYSING SCIENCE DIPLOMACY: NEW CAREER PERSPECTIVES, CURRICULA AND INTERNATIONAL PARTNERSHIPS

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The Evolution of the IT Sector in Romania the Context of Innovation and Digitalization Policies Research report

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INTRODUCTION

Romania ranks last among EU member states in terms of research, development and innovation spending and has one of the lowest percentage of people involved in research activities. The country is not considered an innovation leader but rather a moderate innovator. At the same time, Romania recognizes the importance of science and technology for both its economic development and foreign policy making significant efforts to improve its position. It the last couple of years it developed several strategies on innovation and digitalization. Despite these efforts, Romania presents an interesting case in terms of digital transformation. Although it holds a leading position in the EU in internet access and digital infrastructure, with major improvements in broadband coverage and mobile device ownership over the past decade, the effective and productive use of the internet among citizens and businesses remains limited.

Information and communication technology (ICT) is widely seen as one of the main drivers of competitiveness and innovation, as it enables the creation of new products, services, and business models (Săvulescu, 2015). When describing the ICT sector, most authors include software, hardware, digital transactions, communication technologies, data processing, internet access, and cloud computing (Kirvan et al., 2025).

The appearance of the first computers and the internet, followed by their rapid spread, the rise of mobile applications, and the development of cloud-based technologies, has radically shaped everyday life. ICT influences how people access information, how they learn, spend their free time, and carry out their daily work. It also reshapes how companies and public institutions operate. At the same time, new "e-" concepts such as e-health, e-learning, and e-government continue to emerge and are seen as key areas of future development (Săvulescu, 2015). Săvulescu interprets the ICT revolution through three main dimensions: (1) productivity, meaning increased efficiency in industry and services, (2) knowledge, referring to how ICT helps people access and share information, and (3) learning, meaning that ICT supports continuous education and lifelong learning.

Over the past two decades, Romania's information technology (IT) sector has become one of the key engines of economic modernization and integration into the European digital economy. The rapid growth of IT services, outsourcing, and software development, along with the growing international presence of Romanian technology firms, has attracted increasing attention from policymakers and researchers alike. The sector is often described as one of Romania's great success stories and even as the most dynamic branch of the national economy (Veith, 2018). However, despite its remarkable growth, there is still limited research on how the IT sector is connected to the rest of the domestic

economy, how it interacts with other industries, and how digitalization and innovation policies influence its development.

The main goal of this report is to critically analyze Romania's policies in the fields of research, development, innovation, and digitalization, and to examine how these contribute to the growth of the IT sector. A further aim is to investigate the structural role of the IT industry within the Romanian economy. The study looks at how the sector has evolved over time, how it connects to other branches of production and services, and how changes in IT demand or supply affect the broader economy. It seeks to determine whether Romania's IT sector acts as a driver of innovation and technological diffusion, or rather as an export-oriented enclave with limited connections to domestic industries.

This research was carried out within the framework of the *CatalySD: Catalysing Science Diplomacy – New Career Perspectives, Curricula and International Partnerships* project (Project No. 2023-1-HU01-KA220-HED-000165139), funded by the Erasmus+ program. The project brings together universities, NGOs, and research institutes across Europe to foster long-term cooperation between Central and Western European educational and research institutions. It contributes to the development of science diplomacy in Central and Eastern Europe, promoting its visibility. Within this project, the partners have developed new courses and teaching materials designed to help students and lecturers understand how diplomacy shapes science and international collaboration.

This study adds to the existing literature in several ways. First, it brings together a wide range of information about innovation and the IT sector in Romania, from policy analysis to longitudinal and comparative statistical data. These are rarely presented together in a structured way. Second, it fills an important research gap, since most studies focus on the IT sector's growth and export performance, but pay little attention to its structural role and connections with other industries. Third, by linking macro-level findings with insights from innovation policy and firm-level analysis, the paper provides a more complete picture of Romania's digital transformation.

The report is organized as follows. Chapter 1 discusses the policy environment in which the IT sector operates. It examines the institutional framework and the discursive approaches to research, development, innovation, and digitalization in Romania. Chapter 2 presents statistical data on the innovation activities of Romanian enterprises and describes how innovation has evolved over time. Chapter 3 focuses on the IT sector itself, summarizing the main findings from the existing literature and outlining key contextual trends. Chapter 4 applies an input–output (I-O) analysis to assess the IT sector's linkages and multiplier effects in Romania. Also, by comparing these results to trends in Hungary, it explores whether the observed patterns are unique or are more broadly regional. Chapter 5 adopts a firm-level perspective, analyzing the performance and structural

characteristics of Romanian IT companies between 2008 and 2023. Finally, the conclusion summarizes the main findings, highlights policy implications, and offers suggestions for future research.

1. THE POLICY ENVIRONMENT OF RESEARCH, DEVELOPMENT, INNOVATION AND DIGITALIZATION

In the following chapter, we outline the main legal resolutions and strategies that shape research, development, and innovation (RDI) and digitalization, and the governmental institutional system that supports them. This approach enables us to identify the dominant discourses surrounding RDI, to determine its primary beneficiaries, and assess how the information technology (IT) sector is perceived from a governmental perspective.

The chapter begins by examining the evolution of the legal context, followed by a discussion of the main features of the institutional system that governs this field. The chapter concludes with an analysis of the existing strategies, and how they changed over time

1.1. THE EVOLUTION OF LEGAL REGULATIONS RELATED TO RESEARCH, DEVELOPMENT AND INNOVATION

Following the collapse of state socialism, three distinct waves of legislation shaped the organization and financing of research, development, and innovation (RDI). The first regulatory framework was introduced in 1995, followed by revisions in 1997, while the current system—adopted in 2002—remains in force, with minor amendments between 2011 and 2018.

ORDINANCE NO. 25/1995

The first post-socialist regulation, *Ordinance No. 25/1995*, adopted a linear model of research and development (on theoretical aspects of the model, see: Godin, 2006), dividing it into three sequentially linked activities: fundamental research, applied research, and technological development (Art. 2). The ordinance defined research and development as activities of national interest but did not yet include innovation as an integral component.

To understand the rationale of the law, it is useful to examine how research and development were defined. *Fundamental research* was described as work "primarily to gain new knowledge about phenomena and processes, as well as for the formulation and verification of hypotheses and theories," while *applied research* focused on "the use of scientific knowledge to develop new systems, products, technologies, and services." In contrast, *technological development* introduced an explicitly economic and social dimension, involving the application and transfer of research results to economic actors

and the wider society, with the goal of introducing new technologies, products, and systems or improving existing ones.

This non-economic orientation of the regulation was reinforced by its vision of the research environment and funding mechanisms. Most of the institutions authorized to conduct research were public entities, including state research institutes, university research centers, and museums (Art. 3). Although private institutions and authorized individuals were recognized as potential participants, funding was directed primarily toward fundamental research (Art. 12(2)).

This approach proved short-lived. The 1996 amendments redefined *applied research* as an activity "intended mainly for the use of scientific knowledge in the economy and society," and described *technological development* as "an activity of system engineering, technological design, technology transfer, and exploitation of inventions." The revised version thus explicitly identified economic agents as the main beneficiaries of applied research and reframed technological development around commercialization and economic exploitation.

ORDINANCE NO. 8/1997

Ordinance No. 8/1997 marked a turning point in the post-socialist regulation of research, development, and innovation (RDI). It explicitly designated innovation—alongside research and development—as a national priority (Art. 1) and redefined the role of the state as a catalyst for creating "an economic environment favorable to the diffusion, absorption, and capitalization" of RDI results. In doing so, the ordinance repositioned RDI as an instrument of economic growth, designed to support sustainable development, increased welfare, and the expansion of the national knowledge base (Art. 2).

The legislation refined the earlier linear model by subdividing *technological development* into two stages: *precompetitive* and *competitive research*. The first concerned the transformation of applied research results into prototypes and design documentation not yet intended for commercial use, while the second focused on converting these prototypes into marketable products, processes, or services (Art. 6). This revision introduced clearer progression from scientific discovery to market application.

The ordinance also provided an explicit definition of *innovation*, conceptualizing it both as a product and a process. As a *product*, innovation referred to a new or improved function of an existing product, process, or service that could meet or create market demand. As a *process*, it described the set of creative and dynamic activities—individual, social, or corporate—that enable the emergence of innovative products, encompassing research and development itself.

These definitions collectively reframe research and development as activities oriented toward the generation and exploitation of knowledge for economic ends. The main beneficiaries thus become economic actors rather than the public sector. This economic rationale also permeates the *National Plan for RDI*, where objectives such as sustainable economic growth, agricultural modernization, product competitiveness, and human capital investment are emphasized (Art. 10).

Institutionally, the ordinance established the *Advisory Board for Research, Development, and Innovation*, a consultative body composed of representatives from various economic and social sectors. Its purpose was to assist the ministry in defining the strategic direction of RDI. Later amendments, especially Law 95/1998, reaffirmed RDI as an activity conducted "without limitations or constraints" (Art. 2¹), while preserving the same general configuration of institutional actors.

Overall, *Ordinance No. 8/1997* firmly anchored innovation within economic practice. It recasts RDI as a process tied to productivity, technology transfer, and market competitiveness. While highlighting the commercial utility of scientific knowledge, it implicitly assumed that economic progress would automatically yield social benefit—a perspective that underpinned much of the subsequent policy discourse.

ORDINANCE NO. 57/2002

The contemporary legal framework for research, development, and innovation (RDI) was established by *Ordinance No. 57/2002*. Although the ordinance has undergone several amendments since Romania's EU accession, its main objectives and orientations were already set in 2002. The subsequent revisions primarily brought it into alignment with European standards and policy goals. The ordinance retains the linear model of innovation—comprising fundamental research, applied research, technological development, and innovation (Art. 2(1), as amended by Law 324/2003)—while defining RDI as a set of "activities that create and generate economic and social progress" (Art. 1).

Despite its reference to social progress, the ordinance consolidates a predominantly economic understanding of innovation. It defines innovation as the *"introduction into the economic circuit"* of a product or process that benefits consumers or improves organizational methods. Correspondingly, the state's role is framed as that of *"stimulating and supporting innovation and the absorption of innovation in the economy and society... through specific actions and means"* (Art. 82). Thus, innovation becomes both a driver and a function of economic modernization.

Structurally, the most significant transformations introduced by this legislation concern the creation of the national RDI system. The ordinance establishes the *national*

research and development system to support economic and social development and the accumulation of knowledge (Arts. 6 and 39(1)). This framework reflects the *triple-helix* model (Etzkowitz & Leydesdorff, 2000), in which the ministry coordinates partnerships among government, higher education, and industry (Art. 71). To consolidate this interaction, the state facilitates and funds collaborative initiatives linking these spheres.

The ordinance also specifies which institutions may participate in the national RDI system. While preserving state actors from earlier legislation, it opens participation to private universities, companies, and non-governmental organizations (Arts. 7–8). Participation, however, is conditional on accreditation and on RDI being an organization's principal activity (Art. 35). These eligibility rules are critical from a funding perspective: they delineate who may apply for competitive research financing and thus enable state oversight of resource allocation.

From 2002 onward, innovation acquires a central strategic role. It is defined as the process of generating, assimilating, and exploiting knowledge to create new or improved products, processes, or technologies that can be marketed or implemented in socioeconomic practice. In this conception, innovation explicitly links the economic and social spheres—stimulating competitiveness and growth while contributing to *economic and social development* and to the *quality of life*. Yet the social dimension remains instrumental: social improvement is envisioned as a byproduct of economically driven technological advancement rather than as an independent policy objective.

Overall, the legal evolution embodied in *Ordinance No. 57/2002* marks the transition from an understanding of innovation subordinated to state-controlled industrial policy toward one defined by market utility and, ultimately, by the ideals of a knowledge- and innovation-based economy. At each stage, the economic rationale prevails, while social objectives function more as a rhetorical horizon than as a structural reorientation of policy.

The three ordinances delineate Romania's gradual transition from a state-centric and non-economic conception of research toward a market-oriented and institutionally networked innovation ecosystem. While each reform broadens the scope and actors involved in RDI, the underlying logic of economic modernization and competitiveness remains constant. Social benefits, although increasingly invoked rhetorically, tend to appear as *derivative outcomes* of economic success rather than as autonomous policy aims.

1.2. THE EVOLUTION OF LEGAL REGULATIONS RELATED TO DIGITALIZATION

The trajectory of the Romanian legal regulations on digitalization has been shaped by a progressive alignment with European norms, particularly the EU's *Digital Single Market*

Strategy and the subsequent *Digital Decade* objectives. Since the early 2000s, national legislation has evolved adopting texts on electronic signatures and data protection to a comprehensive ecosystem encompassing cybersecurity, digital identity, cloud infrastructures, and trusted digital services.

In the following chapter we examine these regulatory milestones chronologically, showing how each stage consolidated the digital governance framework. We will not analyze these developments critically, assessing their success in implementation, but we will try to link them to how they influence the development of the IT sector.

1.

The early 2000s marked Romania's initial steps toward digital transformation. Two key legislative acts adopted in 2001, Law No. 455/2001 on the Electronic Signature and Law No. 677/2001 on the Protection of Personal Data, laid the foundation for the country's digital framework.

Rooted in EU Directive 1999/93/EC, *Law No. 455/2001* established the legal recognition of electronic signatures and certification services, creating the basis for secure electronic transactions between individuals, businesses, and public authorities. This law represented an essential milestone in Romania's digitalization process, introducing the first national trust framework for digital communication. *Law No. 677/2001* complemented these efforts by introducing data protection provisions that anticipated the principles of the EU's General Data Protection Regulation (GDPR). It guaranteed individuals' rights to information, access, rectification, and opposition, thus establishing a crucial connection between digitalization and privacy protection. Taken together, these two acts created a dual foundation: ensuring both trust in digital interactions and legal safeguards for personal data.

A further step in the digitalization process was the adoption of Law No. 135/2007 on the Archiving of Electronic Documents, which regulated the creation, preservation, consultation, and use of electronic documents in archives. The act sets clear rules for the functioning of electronic archives to ensure the integrity and security of stored documents. It also recognized electronic archives as having the same legal value as physical ones and required accredited providers to comply with strict standards of integrity and accessibility. By linking administrative modernization with digital document management, this law became a significant milestone in Romania's progress toward e-governance.

2.

The second stage, covering the period between 2009 and 2013, can be described as the phase dedicated to building Romania's digital infrastructure. This stage was marked by two major decisions: Decision no. 1439/2009, which established the *National Management*

Centre for the Information Society and the *"Digital Romania" Centre*, and Government Decision No. 1235/2010, which launched the *National Electronic Payment System*.

The establishment of the National Management Centre for the Information Society and the "Digital Romania" Centre aimed to coordinate interministerial policies in areas such as information technology, communications, digital infrastructure, and e-government. Their creation signaled a new phase in Romania's digital policy, as digitalization evolved from being a sectoral initiative to becoming an explicit state priority. The institutional framework was further strengthened in 2013 with the establishment of the *Romanian Digital Agenda Agency*, which expanded the coordination and implementation of national digital strategies.

At the same time, the introduction of the *National Electronic Payment System* for taxes and fees payable by bank card represented an important step toward enabling citizens and companies to make online payments to public institutions. This initiative marked Romania's first nationwide e-service platform, and its functionality was subsequently expanded in 2013 and 2020.

Through these institutional and technological developments, Romania transitioned from simply adopting legislation that enabled digital activities to building concrete digital public infrastructures, laying the foundation for a more modern and interconnected public administration.

3.

The third stage of Romania's digital transformation focused on cybersecurity and data governance. The country adopted its first dedicated piece of cybersecurity legislation in 2011, establishing *CERT-RO – the National Computer Security Incident Response Centre* through Decision no. 494/2011. The institution was responsible for coordinating the prevention of and response to cybersecurity incidents at the national level. CERT-RO also served as Romania's contact point within the EU cybersecurity network until 2021, when it was reorganized into the National Cyber Security Directorate (DNSC) under Emergency Ordinance no. 104/2021. The reorganization expanded its regulatory and operational mandate, strengthening national capacity for cybersecurity coordination and international cooperation.

A second wave of development in the field of data governance emerged through Romania's alignment with the European Union's General Data Protection Regulation (GDPR). To ensure compliance, Romania revised its legal framework by adopting Law No. 190/2018 on the implementation of the GDPR and Law No. 362/2018 on ensuring a high common level of security of network and information systems.

Law No. 190/2018 replaced *Law No. 677/2001* and introduced detailed provisions for the lawful processing of personal data, data-protection impact assessments, and the

responsibilities of the national supervisory authority (*National Supervisory Authority for Personal Data Processing*[1] – *ANSPDCP*), thus ensuring consistent standards of data protection across the European Union. Similarly, *Law No. 362/2018* transposed the provisions of EU Directive 2016/1148 on *Network and Information Systems Security* (the *NIS Directive*), establishing a common high level of security for networks and information systems. It extended security obligations to operators of essential services and digital service providers, signaling Romania's transition toward a more structured approach to cybersecurity governance.

Together, these two laws anchored privacy and security as pillars of Romania's digital legal framework, balancing the expansion of digital services with the protection of fundamental rights and critical infrastructure.

4.

The most recent phase represents the emergence of the modern Romanian digital state. During this period, Romania significantly strengthened its cybersecurity framework while linking it more closely to national defense strategy. At the same time, it expanded the digitalization of public administration through the development of cloud computing services and digital identification platforms.

In 2021, Romania reorganized its national cybersecurity system by replacing *CERT-RO* with the National Cyber Security Directorate (DNSC) under Emergency Ordinance No. 104/2021, bringing national structures into alignment with the EU Cybersecurity Act. The DNSC assumed responsibilities for policy development, coordination, and international cooperation, becoming the national authority for managing cybersecurity incidents and certification. Romania's cybersecurity framework was further reinforced by Law No. 58/2023 on Cybersecurity and National Defense, which fully integrated cybersecurity into the national security architecture. The law clearly defined institutional roles for both civil and military actors and introduced coordination mechanisms across critical sectors, aligning Romania's defense strategy with broader EU and NATO principles.

Regarding the digitalization of public administration, two major legislative developments stand out: Emergency Ordinance No. 89/2022 on the establishment, management, and development of cloud-based IT infrastructures and services for public authorities and Law No. 214/2024 on the use of electronic signatures, timestamps, and trust services.

Through *Emergency Ordinance No. 89/2022*, the government created a national framework for cloud services utilized by public institutions. This policy sought to enhance interoperability and data centralization while maintaining sovereign control over critical

[1] Autoritatea Națională de Supraveghere a Prelucrării Datelor cu Caracter Personal

digital infrastructure. The initiative reflected EU-level projects such as GAIA-X and emphasized efficiency, transparency, and compliance with cybersecurity standards within the delivery of public digital services.

Law No. 214/2024 replaced the 2001 Electronic Signature Law and introduced the RO-eIDAS framework, harmonizing national regulations with the EU Regulation (EU) No. 910/2014 on electronic identification and trust services (*eIDAS*). The law expanded the regulatory scope beyond electronic signatures to include electronic seals, timestamps, and trust services, supporting secure cross-border digital communication. It also modernized Romania's digital identity system and established trust service providers that operate in compliance with both EU and national cybersecurity standards.

* * *

The evolution of Romania's legal framework for digitalization reflects a gradual but consistent movement from basic regulatory foundations toward a complex and integrated digital governance ecosystem. Over two decades, Romanian legislation has evolved in line with European digital strategies, progressively incorporating norms related to cybersecurity, data protection, digital identity, and cloud infrastructure. Each legislative stage built upon the previous one, moving from the legal recognition of digital activities to the full institutionalization of digital governance as a central state function. Romania's digital legal framework evolved from basic legal recognition of digital tools (2001–2007) to the institutionalization (2009–2013), then to security and compliance integration (2011–2018), and finally toward a possible strategic, interoperable digital state (2021–2024). Each stage not only reinforced legal and institutional capacity but also expanded opportunities for the IT sector, driving growth, specialization, and deeper European market integration.

1.3. THE INSTITUTIONAL SETTING

In the following chapter, we examine the governmental institutional framework in which policies on research, development and innovation (RDI), and information technology (IT) are created. To achieve this, we first describe the evolution of the institutional system and then analyze the roles that various institutions have envisioned for themselves.

THE INSTITUTIONAL FRAMEWORK

Romania has a rather fragmented approach to RDI and information technology. There is no single institution responsible for decision-making in these areas, and the

institutional landscape changes frequently, not only after electoral cycles but even during government terms. This constant institutional change can partly be explained by the fact that between 1990 and 2025 Romania had 29 different governments. Such frequent changes inevitably affected institutional continuity, however, since some ministries remained relatively stable during this period, it is reasonable to assume that domain-specific factors also contributed to these constant institutional shifts.

As shown in Table 1.1, in 1990 RDI and IT were divided into two main domains. Research and development were linked to education, while IT was managed by a separate ministry. Following Romania's EU accession in 2007, development-related activities were assigned distinct functions with a stronger emphasis on economic and infrastructure issues. As a result, three separate domains emerged—public works, rural development, and EU funds—each administered by relatively stable ministries that focused on implementing EU regulations and managing EU funding.

Among these original domains, the perception and organization of research were particularly unstable. Frequent restructuring of ministries disrupted continuity in this area. Despite such inconsistencies, several common patterns can be identified.

First, most governments established independent institutions to manage research activities, while others integrated RDI into the education portfolio. The domain was assigned a separate ministry during three periods:

- the Minister of Research and Technology[2] (MCT) (1992–2000),
- the Minister of Research and Innovation[3] (MCI) (2017–2018),
- Minister of Research, Innovation and Digitalization[4] (MCID) (2020–2022).

Similarly, the establishment of specialized agencies, such as the National Agency for Science, Technology, and Innovation (ANȘTI) (1998–2000), the National Authority for Scientific Research (ANCȘ) (2004–2012), the National Authority for Scientific Research and Innovation (ANCȘI) (2015–2017), and the National Authority for Research (ANC) (from 2024 onward), illustrates policymakers' continued effort to give greater prominence to scientific research and development. It is worth noting that many of these ministerial and governmental institutions link R&D to information technology as well.

Another defining characteristic of Romania's research system is its institutional classification. In 1999, Romania established the *Executive Agency for Higher Education,*

[2] Ministerului Cercetării şi Tehnologiei
[3] Ministrul Cercetării și Inovării
[4] Ministrul Cercetării, Inovării și Digitalizării

Research, Development and Innovation Funding[5] (UEFISCDI), which separated the funding of research conducted in higher education institutions from other research activities.

This separation had several implications. First, since UEFISCDI's operations are not directly affected by ministerial restructuring, it has provided institutional stability for researchers working in universities. Second, because universities primarily conduct fundamental research, UEFISCDI's existence can also be seen as a structural separation of funding for different phases of research: UEFISCDI focuses on supporting fundamental research, while other bodies are responsible for financing applied research and research conducted within the private sector.

Between 1990 and 2024, digitalization and information technology were mostly under the authority of the Ministry of Communication. Although the ministry's name changed several times – sometimes including references to information technology – the existence of a stable institution reflected policymakers' consistent view of the field.

Another key aspect of this period was the organization of ministerial work in digitalization and IT. Except for the 1998–2007 period, all ministries had separate agencies or centers responsible for issues related to information technology and the information society. In 1990, the *National Commission of Informatics*[6] was established and operated until 1998. Later, in 2007, the government founded the *Agency for Information Society Services (ASSI)*[7], which was restructured in 2009 into two institutions: the *National Management Center for the Information Society (CNMSI)*[8] and the *National Center "Digital Romania"*.[9] In 2013, these two institutions were merged to form the *Romanian Agency for the Digital Agenda*,[10] which functioned until 2019. That year, the *Romanian Authority for Digitalization* (ADR)[11] was created, focusing on implementing EU directives in this field and radically redefining the government's role in digitalization and IT.

The year 2024 marked a major shift in how digitalization was perceived. The government separated information technology from communications and created the *Ministry of Economy, Digitalization, Entrepreneurship, and Tourism (MEDAT)*, explicitly linking digitalization to the economic sector.

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5 Unitatea Executivă pentru Finanțarea Învățământului Superior, a Cercetării, Dezvoltării și Inovării
6 Comisia Națională de Informatică
7 Agenţia pentru Serviciile Societăţii Informaţionale
8 Centrul Naţional de Management pentru Societatea Informaţională
9 Centrul Național „România digitală"
10 Agenția pentru Agenda Digitală a României
11 Autoritatea pentru Digitalizarea României

Table 1.1. The evolution of the institutional setting regulating RDI and digitalization in Romania between 1990 and 2025

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Abbreviations:

ADR: Autoritatea pentru Digitalizarea României / Romanian Authority for Digitalization
ANC: Autoritatea Națională pentru Cercetare / National Authority for Research
ANCȘI: Autoritea Naţionala pentru Cercetare Ştiinţifică şi Inovare / National Authority for Scientific Research and Innovation
ANȘTI: Agenţiei Naţionale pentru Ştiinţa, Tehnologie şi Inovare / National Agency for Science, Technology, and Innovation
ASSI: Agenţia pentru Serviciile Societăţii Informaţionale / Agency for Information Society Services
CNMSI: Centrul Naţional de Management pentru Societatea Informaţională / National Management Center for the Information Society
MAPDR: Ministerul Agriculturii, Pădurilor și dezvoltării rurale / Ministry of Agriculture, Forestry, and Rural Development
MCI: Ministrul Cercetării și Inovării / Minister of Research and Innovation
MCID: Ministrul Cercetării, Inovării și Digitalizării / Minister of Research, Innovation and Digitalization
MCSI: Ministrul comunicațiilor și societății informaționale / Minister of Communications and Information Society
MDLPA: Ministrul Dezvoltării, Lucrărilor Publice și Administrației / Minister of Development, Public Works, and Administration
MDLPL: Ministrul dezvoltării, Lucrărilor Publice și Locuințelor / Minister of Development, Public Works, and Housing
MDRL: Ministerul Dezvoltării Regionale și Locuinței / Ministry of Regional Development and Housing
MDRT: Ministerul Dezvoltării Regionale și Turismului / Ministry of Regional Development and Tourism
MEC: Ministrul Educației și Cercetării / Minister of Education and Research
MECI: Ministerul Educației, Cercetării și Inovării / Minister of Education, Research and Innovation
MECȘ: Ministrul Educației și Cercetării Științifice / Minister of Education and Scientific Research
MECT: Ministrul educației, cercetării și tineretului / Minister of Education, Research, and Youth
MECTS: Ministerul Educației, Cercetării, Tineretului și Sportului / Ministry of Education, Research, Youth, and Sports
MEDAT: Ministerului Economiei, Digitalizării, Antreprenoriatului si Turismului / Ministry of Economy, Digitalization, Entrepreneurship, and Tourism
MEN: Ministrul Educației Naționale / Minister of National Education
MENCȘ: Ministrul Educației Naționale și Cercetării Științifice / Minister of National Education and Scientific Research
MÎ: Ministerul Învățământului / Ministry of Education
MIEEI: Ministrul industriei electrotehnicii, electronicii și informaticii / Minister of Electrical Engineering, Electronics, and Information Technology
MÎȘ: Ministrul învățământului și științei / Minister of Education and Science
MLPDA: Ministrul Lucrărilor Publice, Dezvoltării și Administrației / Minister of Public Works, Development, and Administration
MMDP: Ministrul mediului și dezvoltării durabile / Minister of Environment and Sustainable Development
MPT: Ministrul poștelor și telecomunicațiilor / Minister of Posts and Telecommunications
MSI: Ministerul Societății Informaționale / Ministry of Information Society
MTI: Ministerului Transporturilor si Infrastructurii / Ministry of Transport and Infrastructure
MTIC: Ministrul Transporturilor, Infrastructurii și Comunicațiilor / Minister of Transport, Infrastructure, and Communications

ATTRIBUTES OF MINISTRIES IN SHAPING THE DOMAIN

Research, development and innovation (RDI)

To understand how research, development, and innovation (RDI) are perceived by Romanian institutions, we examined the main responsibilities of the ministry and other relevant agencies in this field. While policy and strategy development, monitoring, and funding are generally the core functions, several other responsibilities show how the state understands and approaches its role in RDI.

As shown in Table 1.2, these responsibilities can be grouped into five main categories: 1) valorizing RDI in the economy, 2) linking RDI activities with the social sphere, 3) internationalization, 4) stimulating regional development, and 5) digitalization. The first four categories remain relatively stable over time, while digitalization is mainly characteristic of the 1990s, early 2000s, and 2025.

1) Valorizing RDI in the economy

The main responsibility of the ministry, apart from policy making, is valorizing research, development, and innovation (RDI) within the economy. This activity has evolved over time and rests on several main pillars: i) stimulating technological transfer, ii) harmonizing R&D activities with industry and iii) stimulating private investments in RDI. Additionally other related functions appear periodically among the ministry's tasks, such as iv) funding R&D partnership and developing competitive research, v) involving tertial education in developing sustainable economic strategies and vi) attracting international investment funds.

In the following section, we focus on the first three activities, with brief references to the others.

a) The development of the ministry's role in ***technology transfer*** shows a process of continuous broadening and professionalization. Initially, Decision no. 809/1992 encouraged researchers to apply their results in innovation and production. By Decision no. 459/1994, the ministry acknowledged the need to create policies and procedures to connect research units with economic beneficiaries and defined technology transfer in a restrictive manner, promoting it only in the nuclear field.

Decision no. 729/1997 significantly expanded this approach by introducing financial mechanisms to help companies. especially small and medium-sized enterprises (SMEs), to make use of research results. In the early 2000s, attention shifted toward building partnerships between research centers and businesses, as well as supporting patenting as the first step in valorizing research outcomes.

The framework introduced by Decision no. 2200/2004 combined these earlier elements and integrated them into a comprehensive support system, showing that technology transfer is part of an institutionalized ecosystem linking research, industry, and finance. After 2013, Decision no. 185/2013 shortened the regulation, indicating that the ministry's role was already well established. It also introduced a clearer focus on helping SMEs access research results.

A significant shift occurred with Decision no. 27/2015, which merged technology transfer with broader RDI development and explicitly linked it to stimulating private investment. This change positioned technology transfer as a core instrument of economic modernization, closely connecting it with enterprise development and establishing RDI as a shared responsibility between the public and private sectors. Finally, Decision no. 188/2025 maintained the same direction but refined the wording, confirming that technology transfer is now a permanent and strategic pillar of Romania's innovation policy, fully integrated with private investment and aligned with the country's competitiveness within the European innovation area.

b) Another responsibility of the ministry, namely, to ***coordinate and harmonize its policies with other sectors***, has gradually expanded since 1997. At first, the focus was on connecting research and innovation with industry, commerce, and education. By 2001, the scope widened to include health and labor, reflecting growing interest in social impact of research. In 2004, education reappeared, showing the link between research, human capital, and economic growth. In 2015 a major change occurred, through the addition of the environment, marking the integration of sustainability into innovation policy. In 2017, the list became final, combining education, the environment, economy, and social sectors.

Thus, tasks regarding coordination and harmonization of RDI policies with other sectors evolved from emphasizing industrial and economic coordination to expressing a holistic vision of RDI as a cross-cutting domain that supports the industry, education, social welfare, and sustainable development, a formulation that reflects Romania's growing alignment with European innovation policy frameworks.

c) Another role of the ministry worth mentioning is ***funding research cooperation partnership and developing competitive research***. This activity has changed profoundly since 1992. At first, based on Decision no. 809/1992 the institution focused on methodological coordination, evaluation, and collaboration with national academies and ministries to improve the quality and competitiveness of research. Latter funding activities appeared linked to technological transfer.

The activity became a separate attribute in 2013. According to Decision no. 185/2013, it mainly co-financed projects that built partnerships between research units and companies, encouraging collaboration and transfer of results. The same approach was

maintained in Decision no. 27/2015, showing that these partnerships became a central tool for connecting research and the economy.

A major modernization took place in 2017. Based on Decision no. 13/2017, the ministry changed its strategy, instead of only supporting cooperation, it started to finance national research projects directly, using the top-down (policy-driven) and bottom-up (researcher-initiated) models. This model was maintained in 2020, confirming its maturity and integration into the national RDI system.

The last separate mention of the funding research cooperations and developing competitive research attribute appears in 2021. Decision no. 371/2021 expanded the ministry's mission toward building innovation infrastructure, including innovation centers, incubators, and technology transfer hubs. This addition in a way returned to roles set in 1992, changing the ministry from a pure funder into a system architect, responsible not only for financing research but also for creating environments where innovation can grow.

2) Linking RDI activities with the social sphere

A second responsibility of the ministry is related to communication with social actors and to the dissemination of information about research, development, and innovation (RDI) activities. This idea first appeared in 1994 and has remained part of the ministry's duties since then.

At the beginning, Decision no. 459/1994 referred only to supporting the exchange of technical and nuclear information and informing the public about nuclear activities. The current form of this responsibility, opening dialogue with the scientific community and civil society, and sharing information about science and innovation, first appeared in Decision no. 729/1997.

In the early 2000s, the task became more official and complex. Decision no. 23/2001 introduced two new elements: 1) the development of internal regulations and quality rules for research reporting, and 2) the promotion of a more active role of civil society in this dialogue. This decision also included education as an important factor in strengthening such interaction.

During 2013–2016, both responsibilities were simplified and presented as two clear actions: disseminating information and supporting dialogue. In Decision no. 13/2017, dissemination was adapted to the context of digitalization, mentioning the need to create a digital portal for these activities. The last modification appeared in Decision no. 188/2025, which extended the dialogue to include scientific trade unions as well.

3) Internationalization

Participation in international cooperation has been one of the ministry's main responsibilities since 1992, although its approach has changed slightly over time.

According to Decision no. 80/1992, the ministry was responsible for coordinating international cooperation in research together with other ministries and the Academy. Since 1997, this changed to stimulating and monitoring Romania's participation in international, European, and bilateral research programs, which then became a standard duty of the ministry. This shift shows that the ministry moved from a simple coordinating role to a more active and participatory one.

There were two later attempts to broaden this task. In 2013, Decision no. 185 added a new responsibility, supporting the patenting of research results as an initial form of exploitation, and in 2017, Decision no. 13/2017 introduced the idea of promoting national research identity through the trademark "Designed in Romania." However, these additions did not become a stable part of the ministry's long-term activities.

4) Stimulating regional development

From 1997, regional development appeared as a key component of RDI policy. Although the wording remained similar in each decision, several important changes reveal how the perception of RDI in regional development evolved over time. When the attribute appeared in Decision no. 729/1997, the focus was on building infrastructure (science and technology parks, innovation centers, and incubators) in order to encourage regional growth and social cohesion. Decision no. 23/2001 expanded the scope to include education, research, and support for small and medium-sized enterprises (SMEs). The concept of centers of excellence also appeared, and links between research and business became more visible, while social aspects were pushed back. By Decision no. 185/2013 the text was simplified and made more direct, focusing mainly on innovation and technology transfer entities and science and technology parks. Decision no. 13/2017 added a new clause, support for technology transfer to SMEs, reflecting a more applied direction. This approach was further enlarged by Decision no. 371/2021, expanding the focus from SMEs to all enterprises. Finally, in 2025, Decision no. 188/2025 introduced smart specialization parks, a concept borrowed from European Union innovation policy.

In short, the focus of regional development evolved from building innovation infrastructure, to connecting research and business, and finally toward strategic regional specialization within the European framework.

During the last three decades, the ministry's tasks expanded from coordinating research to supporting direct links between research, industry, and business. As in the case of the legislative framework, economic dimension became more visible over time, as technology transfer, cooperation with companies, and private investment turned into main tools for using scientific results in practice. At the same time, references to education, society, and digital transformation sometimes appeared, showing the possibilities for a broader vision of innovation as a source of both economic growth and social progress. However, this can

be explained more by Romania's continuous adaptation to European research and innovation policies than to actual policy initiatives.

5) Digitalization

Another important responsibility of the ministry is digitalization, which appeared on the attribute list of the ministry in two waves.

First, during the 1990s and early 2000s, the ministry concentrated on creating a national information system to collect and manage data related to science and technology. Decision no. 729/1997 expanded this work, formulating the need to develop national IT policies. This marked a key turning point, when information technology started to be seen as a strategic sector rather than simply a support tool. By Decision no. 23/2001, the system's scope grew wider, now covering education, research, and technology. It also introduced network development and co-financing mechanisms, showing stronger collaboration between universities and research institutes. The responsibility last appeared in Decision no. 185/2013, focused only on the implementation of national information system, and research and technological development policies.

Digitalization reappeared among the ministry's duties in 2021, marking the beginning of a more integrated approach to digital transformation and innovation policy. Decision no. 371/2021 addressed digitalization in three key areas: 1) implementing Components 7 and 9 of the National Recovery and Resilience Plan (PNRR) on digital transformation and support for the private sector in RDI, 2) developing smart and digital communities (Smart City), and 3) coordinating digital policies across public institutions to ensure all digital initiatives follow a common national framework and work together effectively. As of 2024, digitalization responsibilities have been transferred to other ministries, so these duties are no longer included among the ministry's official functions.

Table 1.2. Specific attributes in research of central institutions between 1992 and 2025

Domains of activity	**1992 Dec. 809**	**1994 Dec. 459**	**1997 Dec. 729**	**1998 Dec. 974**	**2001 Dec. 23**	**2003 Dec. 741**	**2004 Dec. 2.200**	**2013 Dec. 185**	**2015 Dec. 27**	**2017 Dec. 13**	**2020 Dec. 24**	**2021 Dec. 371**	**2024 Dec. 731**	**2025 Dec. 188**
Valorizing RDI in the economy														
Stimulating technological transfer	Art 2(4)	Art 2(6) Art 2(11)	Art 4(3)	Art 4(4)	Art 5(c)	Art 5(c)	Art 6(1)d	Art 6(3) Art 6(16)	Art 7(1)p Art 7(1)c	Art 5(i) Art 5(p)	Art 5b(f)	Art 6(2)g	Art 5(3)c	Art 7(l)
Harmonizing R&D activities with industry			Art 4(5)		Art 5(f)	Art 5(f)	Art 6(1)f	Art 6(8)	Art 7(1)g	Art 5(h)				Art 7(e)
Stimulating private investments in RDI									Art 7(1)c	Art 5(p)	Art 5b(f)	Art 6(2)g	Art 5(3)c	Art 7(l)
Funding R&D and developing competitive research	Art 2(3)				Art 5(c)	Art 5(c)		Art 6(5) Art 6(25)	Art 7(1)d Art 7(1)w	Art 5(bb)	Art 5b(o)	Art 6(2)q		
Involving tertial education in developing sustainable economic strategies					Art 5(i)	Art 5(i)								
Attracting international investment funds							Art 6(1)e							
Linking RDI activities to the social sphere														
Stimulating dialog between the scientific community and the society			Art 4(14)	Art 4(15)	Art 5(n)	Art 5(n)	Art 6(1)o	Art 6(17)	Art 7(1)q	Art 5(x)				Art 7(t)
Dissemination		Art 2(12)		Art 4(2)	Art 5(b)	Art 5(b)	Art 6(1)b	Art 6(2)	Art 7(1)b	Art 5(z)				Art 7(u)
Internationalization														
Stimulating international cooperation	Art 2(7)		Art 4(8)	Art 4(9)	Art 5(j)	Art 5(j)	Art 6(1)i	Art 6(13)	Art 7(1)l	Art 5(q)				Art 7(m)
Supporting patenting								Art 6(4)		Art 5(hh)[ii]				
Stimulating regional development														
Stimulating regional development			Art 4(10)	Art 4(11)	Art 5(m)	Art 5(m)	Art 6(1)k	Art 6(15)	Art 7(1)o	Art 5(ș)	Art 5b(h)	Art 6(2)i		Art 7(o)
Digitalization														
Coordinating digitalization in R&D	Art 2(6)	Art 2(7)	Art 4(18)	Art 4(19)	Art 5(t)	Art 5(t)	Art 6(u)					Art 5(2)l Art 6(4)l Art 6(6)b		

Digitalization

Similarly to the approach used in the analysis of RDI, we will examine how ministries responsible for information technology and digitalization understood their main responsibilities. In this case, however, the development of these responsibilities will be analyzed in two separate parts. First, we will look at the period between 1990 and 2019 from a historical perspective, and then we will analyze the competencies and functions of the ADR independently, since this newly established institution represents a clear break from previous conceptions.

During the 1990–2019 period, the main governmental roles—much like in the case of RDI—were focused on policy and strategy development, monitoring, and funding. However, a range of other responsibilities reveals how the state understood and approached its role in shaping the field of digitalization and information technology. As shown in Table 1.3, these specific responsibilities can be divided into eight main domains: 1) Policy, legislation and strategy, 2) Oversight of IT services, 3) Developing the digital Infrastructure in Romania and e-Government services, and 4) Market and economic development, 5) Research, 6)Communication and cooperation with different segments of the society and the government, 7) Harmonizing with EU law, 8) Education and training. Most of these categories remained relatively stable over time, although their specific content evolved significantly.

1) Policy, legislation and strategy

Developing, implementing, and monitoring policies, legislation, and strategies has always been one of the ministry's main responsibilities. However, the specific areas that are emphasized show how policymakers understood the key challenges of digital development.

Between 1998 and 2003, the ministry placed special emphasis on environmental protection in electronic communication, which suggests that digitalization was not yet viewed as a top priority. In later years, attention shifted toward IT security (2009–2013) and the management of internet domains (2013–2017), reflecting the growing importance of online safety and the rapid expansion of internet use in everyday life.

2) Oversight of IT services

A similar evolution can be seen in the ministry's supervisory role. As digital technologies advanced, the ministry expanded its oversight to include more activities. Initially, in Decision no. 20/2001, the first supervised areas were electronic signatures and e-commerce services. From 2009 onwards, the ministry took responsibility for a wider range of domains central to digital governance and online trust—such as approving,

regulating, and supervising electronic payment systems, digital services, e-commerce, electronic signatures, time stamps, e-notarization, and e-archiving.

Another area where the ministry played an active supervisory role was the protection of individual user rights and cybersecurity. In line with EU legislation and the growing relevance of e-Government and e-signature services, the government redefined its role to include promoting user rights, protecting online privacy, and ensuring the integrity and security of public communication networks in Decision no. 1337/2002, keeping it since.

3) Developing the digital Infrastructure in Romania and e-Government services

Building, managing, and coordinating digital infrastructure and e-Government services has been one of the ministry's most consistent and long-term responsibilities. The need to develop the national information infrastructure was already mentioned in Decision no. 386/1993, and it remained a continuous priority until 2017.

Certain elements such as the interoperability of public information systems and the development of e-Government services were especially important in the early 1990s but disappeared from official responsibilities around the mid-2000s, only to reappear in Decision no. 548/2013, reflecting renewed interest in administrative modernization.

Another important aspect of this domain was the development of public networks and internet services. While this was a consistent goal between 1993 and the early 2010s, such references disappeared after 2013, suggesting that the state either considered the main objectives of internet expansion achieved, or shifted its focus to other digital priorities.

4) Market and economic development

Economic and market-related competencies represented one of the broadest areas of responsibility. These responsibilities first appeared in Decision no. 973/1998 and have remained an important part of the ministry's role ever since. The main tasks focused on liberalizing and privatizing services, attracting investment, and coordinating policies with other key areas such as industry, trade, and education. From time to time, additional responsibilities were added — for example, supporting regional development and the growth of the private sector (between 1998 and 2003 and again after 2017), encouraging foreign investment (in 1998), and promoting e-commerce activities (in 2001).

This growing economic role reflected both broader economic transformations and technological changes. In 1998, ministry regulations dealt mainly with restructuring, privatization, and foreign capital attraction. In Decision no. 20/2001, the focus shifted toward investment in general. Through 2002–2003, the rules evolved further to include competition promotion across telecommunications, postal services, and IT, showing a more complex understanding of a competitive digital economy.

In Decision no. 12/2009, these functions were refined with references to the knowledge-based society, linking economic development with innovation and information use. The 2013 framework maintained this approach but emphasized the stimulation of market dynamics through strategic policymaking. Policies on restructuring, privatization, and investment attraction were still on agenda, and it remained responsible for coordinating the privatization of companies for which it represented the state's interests as a shareholder.

By 2025, the ministry's responsibilities were expressed more concisely, focusing primarily on completing privatization processes and post-privatization management. Overall, this evolution shows a gradual shift from direct state involvement in restructuring to an emphasis on competitiveness, investment strategies, and the information society.

Across these years, the evolution of the legal provisions reveals a gradual broadening of the ministry's field of action—from the initial concern with restructuring and privatization toward a more complex framework that incorporated competitiveness, investment strategies, and the information society.

5) Research

The ministry's approach to research followed the same logic described in the RDI section: research was largely seen as a support mechanism for economic development. In the early 1990s, the ministry promoted research focused on biotechnologies, integrating IT with fields such as medicine, agriculture, and industry. By the late 2000s, this focus was replaced by a broader objective: stimulating research, innovation, and technology transfer in the IT and electronic communication sectors. Between 1998 and 2003, the creation of science and technology parks and innovation centers also appeared as a key goal, reflecting attempts to build supportive ecosystems for research and technological advancement.

6) Communication and cooperation with different segments of society and the government

Efforts to strengthen communication between government and society first appeared in Decision no. 973/1998, when the ministry sought to engage civil society actors in developing policies for the ITC sector. From 2002, in Decision no. 1337/2002 the focus shifted slightly—from active involvement of civil society to communication and consultation. The scope also expanded, to include not only civil society but also economic actors, such as service providers and suppliers. By 2013, academia and international partners were added to this list, reflecting the importance of collaborative governance in digital policy.

Decision no. 36/2017 further refined the ministry's objectives, emphasizing communication with other public institutions, the private sector, and civil society in order

to shape policies and strategies effectively. Notably, the entrepreneurial sector was highlighted as the most significant partner in this cooperative process.

7) Harmonization with EU law

After Romania became a member of the European Union, aligning national laws with EU legislation became one of the ministry's main tasks. Since the EU has been very active in promoting digital transformation, Romanian authorities increasingly focused on implementing EU digital policies and ensuring that national legal frameworks followed European standards. Starting from Decision no. 12/2009, the ministry clearly listed these duties among its official responsibilities.

8) Education and training

Educational goals first appeared in Decision no. 973/1998, when promotion of IT-based education in cooperation with the Ministry of Education and Research became a core function of the Ministry of Communication.

From 2013 onwards, this collaboration became broader: the ministry no longer referred to a single institution, but to various legally recognized organizations, signaling a more open and inclusive model, where digital education was seen as a shared national goal rather than the responsibility of a single ministry. That same year, the ministry took on a new responsibility: training public servants through e-learning programs designed to improve their skills in e-Government and the use of digital administrative tools.

By 2017, the ministry's vision expanded beyond education as a functional goal to a more strategic concept of building a digital culture across society. The focus on the "information society" meant that digital technologies were now understood as integral to all aspects of life—education, administration, and communication. Education and training were thus regarded as essential drivers of national digital modernization and social development.

Table 1.3. Specific attributes in digitalization and IT of central institutions between 1992 and 2019

	1993 Ord. 386	1995 Ord. 215	1998 Ord. 973	2001 Ord. 20	2002 Ord. 1.337	2003 Ord. 744	2007 OUG 73	2009 Ord. 12	2009 Ord. 1439	2013 Ord. 548	2013 Ord. 1.132	2017 Ord. 36
Policy, legislation and strategy												
Defining policies and strategies in IT	Art. 2(1)	Art. 2(1)			Art. 3(1)1	Art. 3(1)1		Art. 4(1)		Art. 4(1)1		Art. 4(1)1
Managing internet domains										Art. 4(1)63		Art. 4(1)63 Art. 4(1)64
Elaborating policies for IT security								Art. 4(13)		Art. 4(1)13		
Environmental protection in electronic communication			Art. 4(9)	Art. 3(22)		Art. 3(1)34						
Oversight of IT services												
Supervising services in different digital domains							Art. 2(f)	Art. 4(51) Art. 4(52) Art. 4(54-59)	Art. 5(h)	Art. 3(1)54-59		Art. 4(1)54–59
Supervising services in electronic signature				Art. 3(21)					Art. 5(j)			
Supervising e-Commerce services				Art. 3(21)	Art. 3(1)32							
Ensuring competition rules in communication and IT				Art. 3(34)								
Promoting the rights and interest of users in different domains					Art. 3(1)36			Art. 4(10)		Art. 3(1)10		Art. 4(1)10
Promoting the rights of individuals for privacy online					Art. 3(1)10	Art. 3(1)10		Art. 4(12)		Art. 3(1)12		Art. 4(1)12
Ensuring the integrity and security of public electronic communications networks					Art. 3(1)11	Art. 3(1)11			Art. 18(b)	Art. 3(1)13		Art. 4(1)13
Developing the digital Infrastructure in Romania and e-Government services												
Developing the national information infrastructure	Art. 2(5)	Art. 2(4)	Art. 4(11) Art. 4(13)	Art. 3(10)		Art. 3(1)17	Art. 2(a)-(c) Art. 2(g)-(h)	Art. 4(19)	Art. 5(a) Art. 18(a)	Art. 3(1)19	Art. 4(a)	Art. 4(1)19
Coordinating policies on ensuring the interoperability of information systems in public administration		Art. 2(12)								Art. 3(1)20	Art. 4(e)	Art. 4(1)20
Developing IT systems at the level of government institutions	Art. 2(4) Art. 2(6)	Art. 2(3)	Art. 4(15)							Art. 3(1)43	Art. 4(d)	Art. 4(1)43
Developing public networks and internet services	Art. 2(15)	Art. 2(11)		Art. 3(8)	Art. 3(1)17	Art. 3(1)18		Art. 4(20) Art. 4(35)	Art. 5(e)			
Market and economic development												
Liberalization and privatization of services			Art. 4(1) Art. 4(7)	Art. 3(1)	Art. 3(1)6 Art. 3(1)13 Art. 3(1)14	Art. 3(1)6 Art. 3(1)13 Art. 3(1)14		Art. 4(7) Art. 4(8) Art. 4(15) Art. 4(16)		Art. 3(1)7 Art. 3(1)8 Art. 3(1)15 Art. 3(1)16		Art. 4(1)8 Art. 4(1)7 Art. 4(1)16

	1993 Ord. 386	1995 Ord. 215	1998 Ord. 973	2001 Ord. 20	2002 Ord. 1.337	2003 Ord. 744	2007 OUG 73	2009 Ord. 12	2009 Ord. 1439	2013 Ord. 548	2013 Ord. 1.132	2017 Ord. 36
					Art. 3(1)36							
Attracting investment in the field of electronic communications				Art. 3(1)	Art. 3(1)12 Art. 3(1)13	Art. 3(1)12 Art. 3(1)13		Art. 4(14) Art. 4(15)		Art. 3(1)14 Art. 3(1)15		Art. 4(1)14 Art. 4(1)15
Aligning its own policy with policies in the fields of industry, trade, education, and other areas			Art. 4(2)		Art. 3(1)37	Art. 3(1)38		Art. 4(39)		Art. 3(1)40	Art. 5(25^2)	Art. 4(1)40
Stimulating regional development			Art. 4(18)	Art. 3(13)								Art. 2(i)
Stimulating the development of the private sector												Art. 2(i)
Attracting foreign investment in the field of electronic communication			Art. 4(1)									
Developing e-Commerce activities in the country				Art. 3(12)								
Research												
Stimulating research, development, innovation and technology transfer in electronic communication and the IT sector			Art. 4(4)	Art. 3(4)			Art. 4(4), Art. 4(18)	Art(3)4, Art(3)13	Art. 3(1)12	Art. 3(1)12		Art. 4(14)
Promoting and supporting the development of biotechnologies	Art. 2(3)	Art. 2(10)			Art. 3(1)39	Art. 3(1)40		Art. 4(42)				
Establishing and developing science and technology parks, innovation centers			Art. 4(18)	Art. 3(13)								
Communication and cooperation with different segments of society and the government												
Communication with public authorities, civil society, and actors from the IT sector			Art. 4(21)	Art. 3(6)	Art. 3(1)35	Art. 3(1)36		Art. 4(38)		Art. 3(1)39	Art. 5(25^1) Art. 5(25^3)	Art. 2(f) Art. 4(1)39
Development and coordination of informational systems on governmental level								Art. 4(41)				
Harmonization with EU law												
Implementing EU policies in various IT domains								Art. 4(6)		Art. 3(1)6		Art. 4(1)6
Harmonizing national legislation with EU law								Art. 4(7)		Art. 3(1)7		Art. 4(1)7
Education and training												
Promoting education based on information technology				Art. 3(25)	Art. 3(1)38			Art. 4(40)		Art. 3(1)41		Art. 4(1)41
Ensuring institutional and operational framework for formation in e-Governance and informational society										Art. 3(1)42		Art. 4(1)42

The attributes of the Romanian Authority for Digitalization (ADR)

The appearance of the *Romanian Authority for Digitalization* (ADR) in 2020 marked a radical change in how digitalization was perceived. First and foremost, ADR received a detailed, coherent and well thought out set of attributes, grouped in several domains of activity, based on the different EU level strategies and regulations on digitalization and information technology. Second, after 2024, the government separated information technology from communications permanently, creating the Ministry of Economy, Digitalization, Entrepreneurship, and Tourism (MEDAT). This resolution decisively linked digitalization to the economic sector.

Article 5 of Decision nr. 89/2020 on the organization and function of ADR groups the main objectives, roles, and areas of responsibility of ADR into nine key areas: 1) strategy and planning, 2) reporting, 3) promotion, 4) representation, 5) European affairs, 6) regulation, supervision and control, 7) programs and projects, 8) IT systems and electronic services, and 9) technical assistance.

ADR therefore not only becomes the central institution responsible for coordinating Romania's digital transformation, but it acts as Romania's national authority for EU and international cooperation in digital affairs. It administers major EU programs in digitalization (*Digital Europe Programme*, *CEF Digital)* financed through EU structural funds and the *National Recovery and Resilience Plan (PNRR)*. Furthermore, it promotes advanced technologies, smart communities, and digital education while providing technical support to public institutions, serving both as strategic coordinator and operational center for digital modernization in Romania.

This breaks with previous practices, mentions related to the market, development and research appear only indirectly among ADR's competencies. Its relationship with the economic and private sector is reflected primarily in its functions related to innovation, investment, and partnership development. ADR is tasked with creating and financing innovation and business incubation centers, Digital Innovation Hubs (DIHs), and technology transfer centers, through the involvement of private companies and startups. Additionally, by promoting adoption of advanced technologies, ADR encourages companies to innovate and integrate digital tools, strengthening Romania's digital economy. In other words, based on the document, the economic sector appears not only as a beneficiary but an active partner and driver of innovation, helping expand digital transformation beyond government institutions.

Research has a more peripheral role. Although several of ADR's attributes connect to this field, such as the need to develop strategies in robotization or artificial intelligence or the development of innovation centers, explicitly is mentioned only in its possible

collaboration with the Ministry of Research, Innovation, and Digitalization, and by the fact that ADR needs to ensure that its policies are aligned with national RDI priorities. ADR therefore promotes research not as a separate activity, but as an instrument for applied innovation, which transforms technological knowledge into practical tools for digital governance and the economy.

ADR keeps its consultative relationship with civil society, emphasizing the need to create partnerships and cooperation with civil society and academia. It also needs to collaborate with civil society actors to develop citizens' digital skills. Therefore, the civil sector appears both as a collaboration partner and an audience for digital inclusion.

Compared to the abovementioned domains, the role of ADR in education is more emphasized. Education appears as a central element in Romania's digital transformation, ADR being the governmental agency which integrates digital education and training into national policies and public administration. As a result of its role in developing citizens' digital skills, and in developing digital skills within the public administration, ADR works to promote digital education systems and supports the creation of technology-based learning environments in cooperation with educational institutions. Furthermore, it designs curricula and educational programs, organizes training in digital fields for public administration and other target groups. In other words, ADR is determined to improve the skills of public servants, helping both citizens and state employees navigate the all-expanding technology-driven environment.

1.4. NATIONAL STRATEGIES ON RESEARCH, DEVELOPMENT, INNOVATION AND DIGITALIZATION

In the past 20 years Romania developed several strategical documents on RDI and digitalization. Since its accession to the European Union, it adopted three *National Strategies on Research, Development and Innovation* (2007-2013,[12] 2014-2020[13] and 2022-2027[14]), each strategy having its own national implementation plans. In the domain of

[12] National Strategy for Research, Development and Innovation 2007 – 2013 (https://uefiscdi.gov.ro/resource-82540%20), National Plan for Research, Development, and Innovation 2007–2013 (https://uefiscdi.gov.ro/resource-82544) and the Sectorial Operative Program for Increasing Economic Competitiveness (https://oipsi.gov.ro/despre-oipsi/programe/pos-cce-2007-2013/)

[13] National Strategy for Research, Development and Innovation 2014 – 2020, National Plan for Research, Development, and Innovation 2015–2024, and POC 2014 – 2020 Operational Program on Competitiveness can be downloaded from the https://www.fonduri-ue.ro/poc-2014 webpage.

[14] National Strategy for Research, Innovation, and Smart Specialization 2022-2027 (https://www.research.gov.ro/programe-nationale/strategia-nationala-de-cercetare-inovare-si-

digitalization the state developed the *National E-Romania Strategy 2010-2013* in 2010,[15] the *Smart Growth, Digitization, and Financial Instruments Program 2021 – 2027*[16] in 2021, the *National Strategy on Artificial Intelligence 2024-2027*,[17] the *National strategy in the field of quantum technologies for the 2024-2029 period*,[18] the *National Strategy for the Development and Support of Digital Innovation Centers in Romania 2024-2027*[19] and the *National Action Plan for the Digital Decade for Romania 2030*[20] in 2024. Before the detailed presentation of these strategies, two important comments need to be made. First, based on their adoption date and timeframe, these strategies clearly follow the European program cycles, and we will analyze them accordingly. Second, most of the strategies concerning digitalization were adopted in 2024, their impact is not yet visible in statistical data and empirical analysis. Therefore, in the following sections we will not present them in detail.

THE 2007–2013 FRAMEWORK

The National Strategy for Research, Development and Innovation 2007–2013 (referred to as SNCDI 2013) was Romania's first national strategy focused on RDI. This strategy aimed to respond both to the challenges of joining the European Union and to internal problems within the national research system. The main challenges it identified were: 1) chronic underfunding and delayed restructuring of the RDI sector, 2) a low number of researchers, 3) weak performance in international cooperation, and 4) a limited culture of innovation in both academic and private institutions.

SNCDI 2013 established three main strategic goals: 1) to increase the visibility and contribution of the Romanian RDI system to global knowledge and ensure that research results are transferred to the economy and society, 2) to raise the competitiveness of the

specializare-inteligenta-2022-2027/), National Plan for Research, Development, and Innovation 2022–2027 (https://www.research.gov.ro/programe-nationale/planul-national-de-cercetare-dezvoltare-si-inovare-2022-2027/pncdi-iv-programe-subprograme-instrumente-de-finantare/).

15 https://legislatie.just.ro/public/DetaliiDocument/118294

16 https://mfe.gov.ro/pocidif/despre-programul-pocidif/

17 https://www.research.gov.ro/programe-nationale/strategia-nationala-in-domeniul-inteligentei-artificiale-2024-2027/

18 https://www.research.gov.ro/programe-nationale/strategia-nationala-in-domeniul-tehnologiilor-cuantice-2024-2029-2/

19 https://www.mcid.gov.ro/wp-content/uploads/2024/04/STRATEGIE-.pdf

20 https://www.adr.gov.ro/autoritatea-pentru-digitalizarea-romaniei-anunta-aprobarea-oficiala-a-planului- 1. Crearea de cunoaştere, respectiv obţinerea unor rezultate ştiinţifice şi tehnologice de vârf, competitive pe plan mondial, având ca scop creşterea contribuţiei sistemului românesc de CDI la dezvoltarea stocului mondial de cunoaştere, creşterea vizibilităţii internaţionale şi transferul rezultatelor în economie şi societate.national-de-actiune-privind-deceniul-digital-pentru-romania/

Romanian economy by promoting innovation and integrating knowledge into economic activities, and 3) to improve social well-being by developing solutions that generate visible benefits for citizens. To put these goals into practice, the strategy defined four specific objectives: improving performance, strengthening institutional capacity and resources, expanding international cooperation, and increasing private-sector involvement.

The strategy also identified seven priority research areas for investment: information technology, energy, environment, healthcare, agriculture, biotechnology, innovative materials (processes and products), security, and social sciences. In most of these areas, the strategy linked specific goals directly to economic development. For example, the IT sector was included as a priority because it is one of Romania's most competitive economic fields. Directing public funding in this area was expected to help meet the technological needs of other industries. In the environmental field, the focus was on developing eco-friendly technologies across different sectors, while naming innovative materials, processes, and products a key field, was clearly linked to the possible development of new materials and technologies that could improve the competitiveness of Romanian businesses. Even in social sciences, economic thinking played a cardinal role. The strategy encouraged research on topics like using cultural heritage to support tourism, studying the social and cultural impact of technology, and developing better management solutions. The strategy clearly stated that research should be problem-oriented, aiming to meet the needs of companies and public authorities (p. 30).

A separate chapter dealt with innovation, described as "the main driver of economic competitiveness" (p. 31). It presented the state as a key factor in stimulating innovation, through funding RDI activities of private companies and supporting entrepreneurship based on innovation. The rational behind this was that it was perceived that public investment in innovation would stimulate private investment (p. 32). The strategy also proposed some tax incentives for companies that engage in RDI activities in partnership with universities or public research institutes.

The other strategic document worth analyzing is the *National e-Romania Strategy (2010–2013)*. This is the first policy document focusing on e-Governance activities and the need to transform public administration into a knowledge-based information society in Romania. Its main goals are interoperability, trust, data security, and collaboration among public authorities while pursuing European integration, economic growth, and inclusion. Its main result should have been a centralized e-Romania portal, which would have provided unified access to public services in different domains, such as health, environment, education, justice, culture, tourism, or agriculture.

Although the document has several references of its societal importance (ex. the system should have a citizen-centered design, multilingual access, and non-discriminatory service

availability), its need is defined in economic terms as well. The strategy explicitly references collaboration with the economic sector, with particular emphasis on the IT industry. It believes that public administration modernization requires close cooperation with the private sector. It calls for public–private partnerships (PPPs) to accelerate ICT infrastructure development and describes the IT sector a strategic partner in implementation and developing software, but also in capacity building activities, planning to involve them actively in training public administration personnel and transferring knowledge regarding e-Government solutions.

The economic environment is also named as one of the main beneficiaries of e-Government. Digital public services would reduce administrative barriers for businesses, cut costs, and are seen to improve competitiveness. The strategy believes that by increasing the efficiency e-Governance services, which support entrepreneurship, investment, and innovation, economic growth can be increased and stimulated. Additionally, the document mentioned the need to encourage innovation and market involvement by opening opportunities for local IT firms to contribute to national digital projects.

In other words, in both documents, collaboration with the economic sector is presented as a necessary step to achieve modernization and growth, while partnership with the IT sector is considered a *core implementation pillar* for the e-Romania strategy. IT firms are seen not just as technology suppliers, but as a strategic ally in innovation, knowledge sharing, and capacity building. Therefore, the strategy will offer financial and market possibilities for IT firms to prosper.

THE 2014–2020 FRAMEWORK

The National Strategy for Research, Development, and Innovation 2014–2020 (referred to as SNCDI 2020) did not radically change Romania's main goals for RDI. Instead, it kept a slightly updated version of the three objectives introduced in 2007.

The first objective, originally about creating knowledge and integrating it into global knowledge networks, was redefined in SNCDI 2020 as increasing Romania's contribution to frontier research. The second objective, boosting the competitiveness of the Romanian economy through innovation, remained unchanged, while the third objective evolved from improving the quality of social life to strengthening the role of science in society.

What changed more significantly were the specific goals. SNCDI 2020 placed stronger emphasis on the economic and social value of RDI activities, defining four specific goals: 1) to create a supportive environment for private-sector initiatives, 2) to promote smart

specializations in priority fields, 3) to focus RDI activities on societal challenges, and 4) to support excellence in frontier research.

The first two goals involve active state support for the economic sector, while the third focuses on improving the public sector. The fourth stressed the importance of adequate funding for fundamental research in universities and research institutes.

Compared to the previous strategy, SNCDI 2020 introduced several new approaches. First, the assumption that public investment will stimulate private sector contributions to research activities dominates its approach. Consequently, it proposed a broader set of incentives and fiscal policies designed to make the private sector more competitive: tax deductions for innovative companies, the creation of seed and venture capital funds for start-ups, and updates to patent and intellectual property laws to encourage innovation. These measures go beyond the more traditional funding mechanisms found in SNCDI 2013.

Second, the strategy stated more clearly that Romania's research and innovation activities should focus on critical economic sectors. It identified four main priority areas: 1) Bioeconomy, 2) Information technology, communications, and security, 3) Energy, environment, and climate change and 4) Eco-nanotechnologies and advanced materials. While these areas overlap with those listed in the previous strategy, they are interdisciplinary fields with a stronger economic orientation. This focus is reinforced by the strategy's interest in funding RDI projects initiated by private companies and by its support for developing marketing and commercialization capacity within universities (p. 19).

This economic approach is present even in the third special objective, addressing societal challenges. Although the strategy focuses on socially relevant areas – 1) Healthcare, 2) Cultural heritage and national identity, 3) The social and cultural impact of new technologies –, when dealing with public issues it places strong emphasis on private-sector involvement, encouraging public–private partnerships to design and test new solutions. It also mentions "the use of pre-commercial public procurement" (p. 24) as possible solution, a funding tool that supports research, prototypes, and pilot projects for products that did not reach the market, helping to turn early-stage innovations into future commercial products.

Third, unlike the previous strategy, SNCDI 2020 planned to build a continuous funding scheme, ensuring annual allocation of resources from public budgets for research and innovation activities. This makes the system more predictable and stable.

The National Strategy for Research, Innovation, and Smart Specialization 2022–2027 (SNCISI) continues the direction set by the previous ones, being the most advanced of the three national strategies. Unlike earlier versions, it introduces four main objectives: 1) Developing the research, development, and innovation system, 2) Supporting innovation ecosystems associated with smart specializations, 3) Mobilizing for innovation, and 4) Increasing European and international collaboration.

Objectives 1 and 4 reflect a more traditional understanding of RDI, focusing mainly on universities and research institutions, while Objectives 2 and 3 take a more economic approach, emphasizing smart specialization and innovation. This part of the strategy continues the previous focus on public-private partnerships, technology transfer, and innovative entrepreneurship, but goes further by highlighting the importance of innovative ecosystems, strong, connected networks between researchers, businesses, and public authorities to support collaboration and development.

Compared to earlier strategies, SNCISI introduces several new elements. One of the most important is the reference to the Strategic Research Agenda, which identifies six key areas that respond to current societal challenges: 1) Digitalization, industry, and space, 2) Climate, energy, and mobility, 3) Food, bioeconomy, natural resources, biodiversity, agriculture, and environment, 4) Health, 5) Culture, creativity, and inclusive society, 6) Civil security for society.. This marks a shift from the previous strategies, which focused almost entirely on economic growth. The new emphasis includes broader social and environmental priorities.

The new strategy also recognizes regional differences by defining specific goals and areas of specialization for each development region. These were established based on the unique strengths and weaknesses of each region, acknowledging the different levels of development among regions.

According to Table 1.4, the most common objective across all regions is to *increase RDI activities and capacity*. However, the way this goal is expressed, varies: regions with stronger RDI systems (such as Bucharest-Ilfov, North-West, and North-East) focus on expanding their research output, while less developed regions plan mainly to maintain or strengthen their existing capacity. Interestingly, the Southern region does not mention RDI capacity building at all.

The second most common objectives relate to *economic competitiveness* and *digitalization*. Four regions (North-East, South-East, South-West, and West) aim to improve competitiveness, while Bucharest-Ilfov seeks to maintain its current position. Efforts in

digital transformation appear in the strategies of Bucharest-Ilfov, North-East, South-West, West, and Center regions.

Other goals are mentioned less frequently. The objective of *developing or strengthening innovative capacity* appears in four regions (South, South-West, North-West, and Center), while *improving skills related to smart specialization* is a focus in the North-East, South-East, and South regions. The internationalization of RDI activities is mentioned in the North-West and Center regions, and cooperation and technology transfer are priorities in Bucharest-Ilfov and South-West.

Three regions also have specific targets. The North-West region focuses on developing administrative capacity, the South region aims to develop human capital for a knowledge-based economy, while the Center region plans industrial modernization in its key sectors.

Table 1.5 lists the most promising areas for smart specialization, which align with both local potential and global trends. The domains most frequently selected are *digital economy* (named by all regions), *advanced materials*, *bioeconomy*, and *healthcare* (chosen by nearly all regions).

Despite the national strategy's shift toward socially relevant issues, economic goals remain dominant at the regional level, showing that local development strategies still focus strongly on supporting economic growth.

Table 1.4. Regional objectives in the National Strategy for Research, Development and Innovation 2022–2027

Objective	Development region							
	Bucharest	**Nord-East**	**South-East**	**South**	**South-West**	**West**	**Nord-West**	**Center**
Developing, consolidating, sustaining, or increasing RDI activities and capacities	✓ Developing	✓ Developing Increasing	✓ Consolidating		✓ Consolidating	✓ Consolidating	✓ Developing Increasing	✓ Sustaining
Increasing, intensifying, sustaining competitiveness	✓ Sustaining	✓ Intensifying	✓ Increasing		✓ Increasing	✓ Increasing		
Digitalization of the economy	✓	✓			✓	✓		✓
Increasing, development or consolidating innovative capacity of firms				✓ Developing	✓ Consolidating		✓ Increasing	✓ Developing
Developing or improving competences for smart specializations		✓ Developing	✓ Developing	✓ Improving				
Internationalization							✓	✓
Developing, consolidating cooperation and technology transfer of actors	✓ Consolidating				✓ Developing			
Developing administrative capacities							✓	
Developing human capital for the transition to a knowledge-based economy,				✓				
Industrial modernization of regional sectors of excellence								✓

Table 1.5. Potential areas for smart specialization by region in the National Strategy for Research, Development and Innovation 2022–2027

Domain of interest	Nr. of regions it appears in	Development region							
		Bucharest	**North-East**	**South-East**	**South**	**South-West**	**West**	**North-West**	**Center**
Advanced functional materials	7	✓	✓	✓	✓	✓		✓	✓
Advanced manufacturing	4	✓	✓				✓		✓
Bioeconomy	7	✓		✓	✓	✓	✓	✓	✓
Cultural and creative industry	3	✓				✓	✓		
Digital economy and space technologies	8	✓	✓	✓	✓	✓	✓	✓	✓
Energy and mobility	4				✓	✓		✓	✓
Environment and eco-technologies	4				✓		✓	✓	✓
Healthcare	7	✓	✓		✓	✓	✓	✓	✓
Tourism	3				✓			✓	✓

SUMMARY

Romania's RDI strategies have developed consistent core goals over the past two decades, gradually expanding their scope. Strengthening research capacity, promoting innovation, and linking science to economic growth are challenges constantly preoccupying the state. The key question is how much actual progress has been made in these areas.

The earlier strategies (2007–2013 and 2014–2020) treated research and innovation mainly as instruments for improving economic competitiveness and productivity. The 2022–2027 strategy keeps this focus but places a stronger emphasis on social, environmental, and regional dimensions. However, even with these broader goals, economic competitiveness remains the main driving force. Both at the national and regional levels, policies continue to prioritize sectors with strong market potential.

Across all strategies, private enterprises are consistently identified as the main drivers of innovation, although their role has changed over time. In the earlier period, the state acted as the main investor, encouraging private participation. By contrast, in the 2022–2027 strategy, the emphasis shifts toward the importance of collaboration, joint investment, and knowledge transfer, giving businesses a more active and collaborative role in research and innovation governance.

The 2022–2027 framework also directly links RDI priorities to regional potential and smart specialization. This marks a clear change from earlier, more centralized approaches to a decentralized one, aiming to reduce regional disparities while better aligning national objectives with local strengths.

1.5. CONCLUSION: THE POLICY ENVIRONMENT OF THE IT SECTOR

Over the past three decades, the legal and policy frameworks for RDI and digitalization in Romania moved from post-socialist reconstruction toward integration with EU standards, particularly the Digital Decade and Horizon Europe frameworks. Also, RDI policy moved from a linear model of research (fundamental → applied → technological development) toward the triple helix model, an integrated collaborative ecosystem emphasizing collaboration between academia, state, and industry. In other words, the policy discourse increasingly frames the state not as the sole provider of innovation funding, but as a broker and enabler of partnerships among research institutions, businesses, and civil society.

From an institutional perspective, the system is characterized by institutional instability. Ministerial reform was frequent, however, entities like UEFISCDI and ADR have provided growing continuity, professionalization, and EU-level coordination. Despite this progress, the overlapping mandates of ministries and agencies (MCID, MEDAT, ADR, ANC, UEFISCDI) continue to complicate coherent governance of RDI and digital policy, reflecting a structural need for simplification and stable leadership.

In terms of content, the general development of the system is dominated by an economic perspective. Despite references to social or environmental goals, each major ordinance, strategy, and institutional reform frames innovation primarily as a tool for economic modernization and competitiveness. Social benefits remain a secondary outcome of market-driven policy.

A further important change is related to decentralization. By introducing region-specific smart specialization strategies, local capacities, industrial niches, and digital potential could guide public investment.

Also, digitalization becomes gradually a strategic pillar. What began first as e-Government and regulatory infrastructure (electronic signatures, data protection) has evolved into a systemic state priority supported by cloud computing, cybersecurity, digital identity, and smart specialization frameworks. This is illustrated by chances in institutional setting as well. While RDI and digitalization policies were separated in the 1990s and 2000s, they gradually converged under shared objectives: innovation ecosystems, technological transfer, and the digitization of public administration and industry. The establishment of ADR (2020) symbolizes this integration, however its integration under MEDAT (2024) strengthens even more the economic approach dominating the field.

Last, but not least, we should turn to how these strategies could affect the IT sector. First and foremost, across all these strategies, the IT sector has evolved to become a central driver of modernization and digital governance. In other words, it is no longer seen merely as a service provider for public administration, but as a strategic partner in shaping innovation, developing digital infrastructure, and supporting smart specialization. One useful way to measure the success of this policy shift is to look at the share of IT firms among all innovative companies.

Second, RDI and digitalization frameworks consistently position the IT industry as a catalyst for competitiveness and innovation, integrating it into Romania's broader economic modernization agenda. In other words, it believes that by strengthening the IT sector, the whole economic ecosystem and society would benefit, facilitating the transformation and wellbeing of the society as well. On an empirical level this would mean that interaction between the IT sector and other key sectors of the Romanian economy

would grow, and that the policy developments affecting the sector would have a positive impact on employment.

In other words, Romania's conception on RDI and digitalization can be described as what Tyfield et al. (2017) call the "knowledge economy credo". This means that they firmly believe that RDI activities contribute substantially to economic growth, and that funding of R&I is best legitimated in such terms. Furthermore, corporate and entrepreneurial investment ensures a unique dynamism and productivity in RDI, maximizing the benefit of all (especially of consumers). The relationship between RDI activities and economic growth are not empirically demonstrated, some seeing even an inverse relationship between the two (Edgerton, 2017). This is also the case with the link between private investment and societal benefit. Many authors argue that private firms are interested in maximizing their investment and profit (Mazzucato, 2011), and financing private investment in RDI, does generate profit without prosperity (Pagano & Rossi, 2017).

In other words, supporting private enterprises in their economic activity without a clear conception of how these investments will benefit society, makes taxpayers the ultimate risk bearers, while private firms the beneficiaries. Although the state frames its policies as benefiting the public good, at the end of the line by favoring specific technologies and approaches it selects the winners of the process (Papaioannou, 2020), the IT sector being one of the major beneficiaries.

2. INNOVATION ACTIVITY OF ROMANIAN ENTERPRISES BETWEEN 2002 AND 2022

As stated earlier, Romania transformed its RDI and digitalization policy framework in line with EU directives, moving from a state-led linear model to a collaborative, market-driven innovation ecosystem (Triple Helix – academia, industry, public sector). Although these changes improved the institutional and strategic architecture, questions remain about their impact on the actual innovation activity of firms. Therefore, in order to understand their effect, after analyzing the policy and institutional frameworks related to research, development, and innovation (RDI), the following chapter focuses on how these frameworks translated into measurable outcomes for Romanian enterprises between 2002 and 2022.

In the following section, we examine the innovation performance of Romanian companies based on data from the Romanian Statistical Institute. We will explore several thematic dimensions and indicators: the share of companies implementing innovation in total and by the type of innovation they implement, turnover and number of employees in innovative firms, sectoral patterns, ownership, partnerships, factors hindering innovation, and the structure of domestic and foreign sales markets. For the sake of clarity, we illustrated regional dispersions with GIS maps, and identified the most innovative economic sectors.

In the following paragraphs we assess the level, evolution, and structure of innovation activity among Romanian enterprises over two decades and relate these patterns to the broader policy environment. We will explore several thematic dimensions and indicators: share of innovators, turnover and employment in innovative firms, sectoral patterns, ownership, partnerships, obstacles, and regional dispersion.

In our analysis we used two datasets, the INSSE Tempo online database of the Romanian Statistical Office (NIS), and the summary statistical report on the innovation activities of Romanian companies, published by NIS, every two years since 2002 (the most recent one in 2023 covering the 2020-2022 period). We base our analysis on Madaras (2020), which allows us to analyze longitudinal data in a comparative manner, tracking changes across time, firm size, sector, and region.

The analyzed period covers all three major policy cycles – 2007–2013, 2014–2020, and 2021–2027 – allowing to see whether the introduced strategic priorities and funding instruments were translated to improvements in firm-level innovation. Also, it incorporates a pre-EU-accession period (2002–2007), which could be a key turning point for Romanian enterprises. By contrasting enterprise-level innovation indicators with the strategic

priorities and instruments discussed in Chapter 1, this analysis evaluates the effectiveness of Romania's innovation policy in fostering a dynamic, knowledge-based private sector.

2.1. INNOVATORS AND SUCCESSFUL INNOVATORS

As shown in Table 2.1, the twenty years between 2002 and 2022 can be divided into two main periods: a period of growth and a period of decline. In the first phase, up to 2008, the share of innovative companies grew steadily (from 17.0% to 33.0%). However, starting in 2010, their share began to fall, dropping from 30.8% to 10.2%. By 2016 it remained low, slightly increasing in 2018 (14.6%), and declining even further in 2022 to 8.8%. Overall, during the second part of the period, the innovation performance of Romanian companies remained relatively weak.

The share of successful innovators followed a similar trend. It was 16.9% in 2002, rising to 21.0% in 2006 (the highest value), but then falling to 14.3% in 2018 and 8.5% in 2022. These figures suggest that companies which engaged in innovation still had a reasonable chance of success, even during periods of decline.

Throughout 2002–2022, most firms were non-innovative enterprises. Their share decreased from 83.0% in 2002 to 66.7% in 2008, but later increased again, reaching 91.2% in 2022.

The most innovative companies tended to develop several types of innovations simultaneously. The share of firms focusing only on product or only on process innovation remained low — 2.4% and 1.8% in 2022, compared with 2.4% and 6.6% in 2008. By 2022, the share of product-only innovators had almost doubled compared to the previous period. After 2018, however, no data are available on process innovators.

During the whole study period, the percentage of unfinished or abandoned innovations remained low (below 1.0% until 2012), reaching its highest level in 2018 (2.4%), and falling again to 1.0% in 2022.

Table 2.1. The share of innovators and successful innovators from the total enterprises (2002–2022)

	2002		2004		2006		2008		2010		2012	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Total	23 404	100.00	26 024	100.00	28 488	100.00	29 979	100.00	26 330	100.00	28866	100.00
Innovative companies	3 983	17.00	5 171	19.90	6 013	21.10	9 986	33.30	8 116	30.80	5968	20.70
Successful innovators	3 963	16.90	5 136	19.70	5 970	21.00	5 748	19.20	3 631	13.80	1691	5.90
Product-only innovators	582	2.40	472	1.80	525	1.90	710	2.40	635	2.40	351	1.20
Process-only innovators	413	1.80	1 203	4.60	1 169	4.10	1 965	6.60	955	3.60	706	2.40

	2002		2004		2006		2008		2010		2012	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Innovators with unfinished and or abandoned activities	20	0.10	35	0.20	43	0.10	159	0.50	132	0.50	115	0.50
Non-innovative enterprises	19 421	83.00	20 853	80.10	22 475	78.90	19 993	66.70	18214	69.20	22898	79.30

	2014		2016		2018		2020		2022	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Total	28 380	100.00	28 809	100.00	28 776	100.00	27 196	100.00	26 986	100.00
Innovative companies	3 645	12.80	2 925	10.20	4 198	14.60	2 900	10.70	2 380	8.80
Successful innovators	1 529	5.40	2 795	9.70	4 124	14.30	2 750	10.10	2 297	8.50
Product- only innovators	313	1.10	430	1.50	1 836	6.40	1 209	4.40	1 108	4.10
Process-only innovators	511	1.80	478	1.70	:	:	:	:	:	:
Innovators with unfinished and or abandoned activities	311	1.10	130	0.40	703	2.40	398	1.50	278	1.00
Non-innovative enterprises	24 735	87.20	25 884	89.80	24 578	85.40	24 296	89.30	24 606	91.20

(Source: Own calculations, INSSE database)

2.2. NUMBER OF INNOVATIVE ENTERPRISES BY SIZE AND ECONOMIC ACTIVITY

When looking at the distribution of innovative companies by size (Table 2.2), we can observe a clear shift over time. At the beginning of the period, large companies played the main role in innovation, accounting for 56.04% in 2002. By contrast, by 2022, small companies became the majority, representing 67.10% of all innovators (Table 2).

In 2004, medium-sized enterprises dominated innovative activities (56.02%). The highest share of small companies implementing innovations was recorded in 2018 (71.99%). Innovation activity among large firms also remained relatively high, reaching 42.24% in 2014 and 43.84% in 2020, although both values are slightly below the 46.00% recorded at the end of the period.

Table 2.2. Distribution of innovative enterprises by size in Romania (2002–2022)

	2002		2004		2006		2008		2010		2012	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Total	23 404	100.00	26 024	100.00	28 488	100.00	29 979	100.00	26 330	100.00	28 866	100.00
Innovative enterprises	3 983	17.00	5 171	19.90	6 013	21.10	9 986	33.30	8 116	30.80	5 968	20.70
Small	2 137	53.65	2 851	55.13	3 523	58.59	6 797	68.07	5 613	69.16	4 089	68.52
Medium	1 183	55.36	1 597	56.02	1 836	52.11	2 388	35.13	1 874	33.39	1 400	34.24
Large	663	56.04	723	45.27	654	35.62	801	33.54	629	33.56	479	34.21

	2014		2016		2018		2020		2022	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Total	28 380	100.00	28 809	100.00	28 776	100.00	27 196	100.00	26 986	100.00
Innovative Enterprises	3 645	12.80	2 925	10.20	4 198	14.60	2 900	10.70	2 380	8.80
Small	2 527	69.33	2 059	70.39	3 022	71.99	2 001	69.00	1 597	67.10
Medium	786	31.10	643	31.23	825	27.30	625	31.23	537	33.63
Large	332	42.24	223	34.68	351	42.55	274	43.84	247	46.00

(Source: Own calculations, INSSE database)

As seen in Table 2.3, between 2002 and 2022, data on innovation by sector of activity are incomplete, as some figures for agriculture and services are missing. However, based on the available information, a clear structural change is visible in the economy. During these two decades, the share of industrial companies among innovators decreased significantly (from 72.99% in 2002 to 44.41% in 2022), while the share of service companies increased from 27.01% to 55.59% (Table 3). Within industry, most innovative companies were active in the manufacturing sector.

In conclusion, industry dominated innovation for most of the period, especially between 2002 and 2010, and throughout the second decade except for 2014, 2020, and 2022. However, by 2022, the trend had clearly shifted, with the service sector overtaking industry in terms of the proportion of innovative firms (Table 3).

Table 2.3. Distribution of innovative enterprises by economic activity (2002–2022)

	2002		2004		2006		2008		2010		2012	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Total	3 983	100.00	5 171	100.00	6 013	100.00	9 986	100.00	8116	100.00	5 968	100.00
Industry	2 907	72.99	3 489	67.47	3 789	63.01	6 003	60.11	4439	54.69	3 415	57.22
Extractive industry	23	0.58	33	0.64	44	0.73	81	0.81	61	0.75	45	0.75
Manufacturing industry	2 832	71.10	3 402	65.79	3 675	61.12	5 698	57.06	4 143	51.05	3 200	53.62
Electric, thermal energy, gas and water	52	1.31	54	1.04	70	1.16	:	:	:	:	:	:
Electricity, therm. energy and gas prod. and supply	:	:	:	:	:	:	58	0.58	71	0.87	58	0.97
Water dist., san., waste management	:	:	:	:	:	:	166	1.66	164	2.02	112	1.88
Services	1 076	27.01	1 682	32.53	2 224	36.99	3 983	39.89	3 677	45.31	2 553	42.78

	2014		2016		2018		2020		2022	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Total	3645	100.00	2925	100.00	4198	100.00	2900	100.00	2380	100.00
Industry	1843	50.56	1493	51.04	2298	54.74	1404	48.41	1057	44.41
Extractive industry	21	0.58	2	0.07	13	0.31	4	0.14	:	:
Manufacturing industry	1754	48.12	1455	49.74	2176	51.83	1303	44.93	1007	42.31

	2014		2016		2018		2020		2022	
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Electric, thermal energy, gas and water	:	:	:	:	:	:	:	:	:	:
Electricity, therm. energy and gas prod. and supply	26	0.71	11	0.38	37	0.88	20	0.69	:	:
Water dist., san., waste management	42	1.15	25	0.85	72	1.72	77	2.66	38	1.60
Services	1802	49.44	1432	48.96	1900	45.26	1496	51.59	1323	55.59

(Source: Own calculations, INSSE database)

2.3. THE TURNOVER OF INNOVATIVE ENTERPRISES BY SIZE AND ECONOMIC ACTIVITY

As can be seen in Table 2.4, between 2002 and 2008, the share of turnover generated by innovative companies increased significantly, from 41.53% to 60.38%. During this time, large companies had the highest share, with their turnover from innovation rising from 56.77% to 72.00%. The turnover of small and medium-sized companies also grew. In 2002, the turnover of innovators represented 14.42% in the case of small firms and 25.68% of medium-sized firms. By 2008 these shares increased to 34.50% and 51.52%, respectively.

In the second half of the period (from 2010 onward), the share of turnover from innovative companies declined steadily. By 2014, less than half of large companies' turnover (40.25%) and less than one-quarter of medium-sized companies' turnover (21.75%) came from innovation activities. At the end of the period, in 2022, only 24.75% of all companies' turnover was generated by innovators. Within this total, large companies accounted for 36.02%, medium-sized companies for 12.55%, and small companies for 8.82%.

In summary, throughout the entire study period, company size was one of the key factors influencing value creation through innovation. Larger companies were consistently better positioned to generate significant turnover from innovative activities.

Table 2.4. The turnover of innovative enterprises by size classes (2002–2022)

		2002		2004		2006		2008	
		Mil. RON	%	Mil. RON	%	Mil. RON	%	Mil. RON	%
Total	Total	185 533.70	100.00	298 028.92	100.00	457 951.76	100.00	648 366.73	100.00
	Small	38 032.19	100.00	65 965.45	100.00	855 89.82	100.00	121 410.95	100.00
	Medium	39 145.70	100.00	67 217.62	100.00	94 767.76	100.00	146 019.98	100.00
	Large	108 355.82	100.00	164 845.85	100.00	27 7594.19	100.00	380 935.80	100.00
Innovators	Total	77 051.45	41.53	135 533.47	45.48	219 737.31	47.98	391 459.50	60.38
	Small	5 482.72	14.42	13 245.12	20.08	15 522.11	18.14	41 972.04	34.57
	Medium	10 054.40	25.68	22 319.12	33.20	30 117.48	31.78	75 224.15	51.52
	Large	61 514.34	56.77	99 969.24	60.64	17 4097.72	62.72	274 263.31	72.00

		2010		2012		2014		2016	
		Mil. RON	%	Mil. RON	%	Mil. RON	%	Mil. RON	%
Total	Total	580 659.53	100.00	667 323.19	100.00	800 965.59	100.00	864 765.52	100.00
	Small	108 080.01	100.00	143 290.93	100.00	147 439.30	100.00	161 085.53	100.00
	Medium	148 342.55	100.00	161 056.06	100.00	174 219.30	100.00	207 376.11	100.00
	Large	324 236.98	100.00	362 976.20	100.00	479 306.99	100.00	496 303.89	100.00
Innovators	Total	339 489.60	58.47	267 691.82	40.11	250 620.88	31.29	200 181.38	23.15
	Small	35 314.05	32.67	27 921.02	19.49	19 799.24	13.43	14 140.59	8.78
	Medium	65 432.49	44.11	51 760.92	32.14	37 884.37	21.75	28 590.29	13.79
	Large	238 743.05	73.63	188 009.88	51.80	192 937.27	40.25	157 450.50	31.72

		2018		2020		2022	
		Mil. RON	%	Mil. RON	%	Mil. RON	%
Total	Total	967 479.08	100.00	1 038 747.57	100.00	1 497 944.21	100.00
	Small	191 520.18	100.00	212 952.58	100.00	303 433.03	100.00
	Medium	245 690.94	100.00	250 096.40	100.00	367 988.16	100.00
	Large	530 267.96	100.00	575 698.59	100.00	826 523.02	100.00
Innovators	Total	284 229.49	29.38	276 699.41	26.64	370 690.27	24.75
	Small	25 024.07	13.07	26 608.50	12.50	26 776.68	8.82
	Medium	50 482.89	20.55	41 503.77	16.60	46 174.59	12.55
	Large	208 722.53	39.36	208 587.13	36.23	297 739.00	36.02

(Source: Own calculations, INSSE database)

In 2002, the largest share of innovative companies' turnover came from the industrial sector (51.24% in total). Within this, Manufacturing contributed 52.65%, while the Extractive industry achieved a much higher share (85.05%). In the same year, 26.84% of the total turnover of companies in the service sector came from innovative firms (for detailed data see Table 1 in the Appendix).

From the perspective of the industry, the whole period can again be divided into two main phases. The first phase, up to 2008, was a period of growth: the share of turnover from innovative companies in industry increased, reaching 66.50%. Of this, 85.31% belonged to the Extractive industry and 67.93% to Manufacturing. The Extractive industry maintained a high share throughout most of the period, except for 2006, when only 27.08% of total turnover in this sector came from innovators (Table 1 in the Appendix).

The second phase, between 2010 and 2016, was marked by a decline in the share of turnover from innovation in both industry and services. The lowest level was recorded in 2016, when only 25.19% of total industrial turnover came from innovative companies. Within industry that year, 64.60% corresponded to Extractive industries and 25.74% to Manufacturing. The ratio grew moderately in the following years, and by 2022, innovation-related turnover reached 32.65% in industry, with a large decrease in Extractive industries (1.10%) and 34.77% in Manufacturing (Table 1, Appendix).

In the service sector, innovative companies had the highest share of turnover in 2008 (54.91%). After that, the proportion steadily declined to 23.95% in 2018, and further to 15.94% in 2022. Unfortunately, comparable data for other sectors are not available for the same period.

In summary, over the entire 20-year period, industry in general and Manufacturing in particular consistently showed a much higher share of turnover from innovative companies compared to services. By 2022, this difference was considerable, 32.65% compared to 15.94% in services (Table 1, Appendix).

2.4. NUMBER OF EMPLOYEES IN INNOVATIVE ENTERPRISES BY SIZE AND ECONOMIC ACTIVITY

A key question is whether innovative companies have the capacity to create jobs or not. Based on statistical data presented in Table 2.5, company size is a key factor in this process: among innovative firms, larger companies tend to generate more employment. The period under review can be divided into two main phases. Up to 2010, employment within innovative companies increased steadily, while after that sharply decreased and stagnated.

In 2002, innovative companies employed 51.78% of workers in large firms, 22.97% in medium-sized firms, and 14.72% in small firms. By 2010, these proportions had grown to 64.48%, 40.45%, and 28.48%, respectively. The second phase, beginning after 2010, was characterized by a general decline in employment among innovators, although the size pattern remained the same. By 2022, employment in innovative large companies had fallen to 27.58%, while the shares for medium-sized and small companies were 11.77% and 8.06%, respectively.

Overall, innovative companies were an important source of job creation in Romania. In 2002, 39.87% of all employees worked for these companies. This share exceeded 50% in 2008 and 2010, before gradually declining to 19.26% by 2022.

Table 2.5. Number of employees in innovative enterprises by size (2002–2022)

		2002		2004		2006		2008	
		1000 Pers.	**%**	**1000 Pers.**	**%**	**1000 Pers.**	**%**	**1000 Pers.**	**%**
Total	Total	2 671.94	100.00	2 454.04	100.00	2 454.92	100.00	2 461.92	100.00
	Small	383.90	100.00	382.37	100.00	427.79	100.00	552.36	100.00
	Medium	611.21	100.00	633.88	100.00	641.40	100.00	686.81	100.00
	Large	1 676.83	100.00	1 437.79	100.00	1 385.73	100.00	1 222.75	100.00
Innovators	Total	1 065.22	39.87	996.14	40.59	999.56	40.72	1 250.92	50.81
	Small	56.53	14.72	64.85	16.96	78.43	18.33	171.06	30.97
	Medium	140.39	22.97	169.88	26.80	180.26	28.10	291.59	42.46
	Large	868.31	51.78	761.41	52.96	740.87	53.46	788.27	64.47

		2010		2012		2014		2016	
		1000 Pers.	%	1000 Pers.	%	1000 Pers.	%	1000 Pers.	%
Total	Total	1 949.25	100.00	2 035.97	100.00	2 031.20	100.00	2 087.09	100.00
	Small	440.79	100.00	461.74	100.00	450.16	100.00	456.64	100.00
	Medium	497.07	100.00	546.12	100.00	538.85	100.00	562.84	100.00
	Large	1 011.40	100.00	1 028.11	100.00	1 042.19	100.00	1 067.61	100.00
Innovators	Total	978.72	50.21	722.35	35.48	470.66	23.17	338.09	16.20
	Small	125.53	28.48	89.04	19.28	55.66	12.36	42.54	9.32
	Medium	201.05	40.45	147.92	27.09	87.19	16.18	68.89	12.24
	Large	1 949.25	100.00	2 035.97	100.00	327.82	31.45	226.67	21.23

		2018		2020		2022	
		1000 Pers.	%	1000 Pers.	%	1000 Pers.	%
Total	Total	2 107.41	100.00	1 969.43	100.00	1 973.54	100.00
	Small	461.00	100.00	437.71	100.00	434.15	100.00
	Medium	543.90	100.00	501.79	100.00	502.80	100.00
	Large	1 102.51	100.00	1 029.93	100.00	1 036.59	100.00
Innovators	Total	521.93	24.77	421.64	21.41	380.12	19.26
	Small	61.74	13.39	41.73	9.53	35.00	8.06
	Medium	92.86	17.07	73.51	14.65	59.20	11.77
	Large	367.32	33.32	306.40	29.75	285.92	27.58

(Source: Own calculations, INSSE database)

The increase between 2002 and 2008 also reveals interesting changes in the sectoral distribution of employees. In 2002, most employees in innovative companies worked in industry (39.87%), particularly in the Extractive industry (64.60%). By 2008, these shares rose to 52.00% and 78.05%, respectively. The service sector also showed growth during this period: in 2002, 33.66% of service employees worked in innovative firms, and this increased to 48.49% by 2008 (For details see Table 2 in the Appendix).

However, the decline in employment at innovative companies after 2010 is reflected in the changing sectoral distribution. The share of workers employed in innovative industrial companies decreased steadily, while the service sector began to take the lead. In 2018 and 2020, employment in innovative service firms (27.39% and 22.27%) exceeded that in industry (23.08% and 19.21%). The sharpest decline was observed in the Extractive industry, where by 2022 only 1.14% of employees worked in innovative firms. In the same year, 19.30% of industrial employees and 19.21% of service employees worked for companies engaged in innovation.

In summary, by 2022, approximately one in five employees in Romania was working for an innovative company, whether in industry or services (Table 2 in the Appendix).

2.5. MARKET DISTRIBUTION OF INNOVATIVE ENTERPRISES

Data on the territorial distribution of sales markets for innovative and non-innovative companies in Romania cover the period 2004–2020 (Table 2.6). Throughout this period, innovative companies sold primarily in local and national markets, while their share in international markets remained comparatively low. In 2020, for innovative enterprises, 10.00% of sales were within the national market, 5.20% in EU or EFTA countries, and 5.70% in other international markets.

The local and national markets were consistently dominated by non-innovative companies — in 2016, they accounted for 81.40% of local/regional sales and 85.60% of national sales in 2020. Interestingly, the data also show that Romanian non-innovative firms are more active internationally: their sales in EU and EFTA markets are almost five times higher than those of innovative companies.

Table 2.6. Sell goods market location of innovative and non- innovative enterprises (2002–2022)

		2004	2006	2008	2010	2012	2014	2016	2018	2020
		%	%	%	%	%	%	%	%	%
Innovative enterprises	Local/regional market	5.70	14.70	15.80	23.50	18.40	11.60	9.20	:	:
	National market (other regions of Romania)	12.50	12.80	16.40	18.10	13.50	9.30	7.50	13.40	10.00
	Other EU or associated countries	7.20	7.00	10.20	10.50	7.10	6.20	6.00	:	:
	Other countries of the EU or EFTA countries	:	:	:	:	:	:	:	7.30	5.20
	Other countries of the World	1.80	2.10	3.10	3.70	3.10	3.00	3.20	3.90	5.70
Non-innovative	Local/regional market	37.50	57.90	37.90	54.10	69.40	79.60	81.40	:	:
	National market (other regions of Romania)	35.60	39.30	24.20	30.40	38.30	44.70	51.40	81.60	85.60
	Other EU or associated countries	18.40	18.40	15.40	14.70	22.90	24.10	29.90	:	:
	Other countries of the E. U. or EFTA countries	:	:	:	:	:	:	:	25.90	24.40
	Other countries of the World	2.30	2.90	3.20	3.60	6.00	8.40	11.50	7.70	6.10

(Source: Own calculations, INSSE database)

When analyzed by company size (Table 2.7), among innovative enterprises selling to both local and national markets, large companies have held the largest share since 2010. (However, data for 2018 and 2020 on local/regional markets are missing.) In 2020, sales distribution in the national market among innovative firms was 20.80% for large companies, 12.30% for medium-sized companies, and 8.80% for small companies.

For non-innovative companies, the pattern is quite different. On both local and national markets, small and medium-sized firms dominate. In 2020, the national market was

dominated by non-innovative firms (81.60%), in the case of small companies the percentage was 87.70%, while in the case of medium companies 80.30%, and large companies 70.30%. Overall, non-innovative companies clearly dominate domestic and local markets across all size categories.

Table 2.7. Share of innovative and non-innovative enterprises, in local, regional and national markets, by size

			2004	2006	2008	2010	2012	2014	2016	2018	2020
			%	%	%	%	%	%	%	%	%
Innovative enterprises	Local/regional market	Total	5.70	14.70	15.80	23.50	18.40	11.60	9.20	:	:
		Small	5.70	12.70	15.90	22.10	16.60	10.60	8.60	:	:
		Medium	5.90	18.60	15.90	26.70	22.70	12.90	10.30	:	:
		Large	4.90	25.60	14.00	36.10	31.70	22.00	14.50	:	:
	National market (other regions of Romania)	Total	12.50	12.80	16.40	18.10	13.50	9.30	7.50	13.40	10.00
		Small	9.20	9.40	13.10	15.00	11.40	8.10	6.80	12.40	8.80
		Medium	16.40	18.60	23.40	25.60	18.70	11.30	9.10	14.50	12.30
		Large	33.00	32.40	41.10	43.30	31.40	22.20	14.40	26.10	20.80
Non-innovative enterprises	Local/regional market	Total	37.50	57.90	37.90	54.10	69.40	79.60	81.40	:	:
		Small	43.20	63.20	42.50	58.20	73.00	82.40	83.40	:	:
		Medium	27.80	47.10	25.50	42.90	60.00	73.10	76.70	:	:
		Large	13.50	35.80	13.50	27.70	44.80	58.50	67.60	:	:
	National market (other regions of Romania)	Total	35.60	39.30	24.20	30.40	38.30	44.70	51.40	81.60	85.60
		Small	36.30	39.50	24.30	31.10	37.60	43.30	50.20	83.70	87.70
		Medium	35.00	39.60	24.70	29.50	41.60	50.20	55.60	76.90	80.30
		Large	30.90	34.80	20.40	23.20	38.10	46.00	55.30	63.90	70.30

(Source: Own calculations, INSSE database)

An opposite pattern appears in foreign markets (see Table. 2.8). Among innovative firms, large companies achieved notably higher sales abroad, more than three times those of small companies. Specifically, in 2016, the share of large innovative firms selling to EU and EFTA countries was 14.40%, rising to 16.80% in 2020 for these same countries, and 17.60% for other foreign markets. A similar trend is seen among non-innovative companies, though at slightly different levels. For instance, in 2020, large non-innovative companies accounted for 17.20% of sales to non-EU or non-EFTA countries.

Table 2.8. Share of innovative and non-innovative enterprises, in local, foreign markets, by size

			2004	2006	2008	2010	2012	2014	2016	2018	2020
			%	%	%	%	%	%	%	%	%
Innovative enterprises	Other EU of associated countries	Total	7.20	7.00	10.20	10.50	7.10	6.20	6.00	:	:
		Small	3.80	3.80	6.60	6.90	4.50	4.80	5.00	:	:
		Medium	11.40	11.70	18.20	19.40	13.10	8.90	7.90	:	:
		Large	27.70	27.70	34.60	38.50	28.80	20.60	14.40	:	:
	Other countries of the EU or EFTA countries	Total	:	:	:	:	:	:	:	7.30	5.20
		Small	:	:	:	:	:	:	:	5.90	3.80
		Medium	:	:	:	:	:	:	:	10.30	8.70
		Large	:	:	:	:	:	:	:	20.70	16.80
	All other country	Total	1.80	2.10	3.10	3.70	3.10	3.00	3.20	3.90	5.70
		Small	0.80	1.00	1.60	2.20	1.70	2.10	2.50	3.60	4.30
		Medium	2.00	3.50	5.70	6.60	5.80	4.20	4.20	3.80	9.40
		Large	11.20	10.80	18.70	19.50	17.90	14.30	10.00	10.20	17.60
Non-innovative enterprises	Other EU of associated countries	Total	18.40	18.40	15.40	14.70	22.90	24.10	29.90	:	:
		Small	13.70	14.40	12.30	11.70	19.00	18.80	24.60	:	:
		Medium	27.80	27.70	26.00	25.30	35.60	40.60	45.20	:	:
		Large	33.00	31.60	22.10	23.30	38.50	47.20	56.10	:	:
	Other countries of the EU or EFTA countries	Total	:	:	:	:	:	:	:	25.90	24.40
		Small	:	:	:	:	:	:	:	20.90	19.80
		Medium	:	:	:	:	:	:	:	42.20	39.40
		Large	:	:	:	:	:	:	:	47.30	46.90
	All other country	Total	2.30	2.90	3.20	3.60	6.00	8.40	11.50	7.70	6.10
		Small	1.80	2.40	2.60	2.70	4.30	6.40	9.50	6.50	4.40
		Medium	2.50	3.70	4.80	6.30	11.10	13.80	15.80	10.20	10.90
		Large	5.60	7.00	6.90	7.10	17.00	20.40	28.00	18.80	17.20

(Source: Own calculations, INSSE database)

Summarizing the results of Table 2.7 and Table 2.8, we can state that domestic markets predominate for both innovative and non-innovative companies. At the same time, however, the main drivers of international sales are large companies. This suggests that innovative companies have not yet fully exploited the possibilities offered by global markets.

2.6. OWNERSHIP STRUCTURE OF INNOVATIVE ENTERPRISES

Another important question is whether foreign ownership influences innovation activity in Romanian companies. Based on statistical data from 2004 to 2020 (Table 2.9), it can be concluded that only a very small proportion of enterprises belonging to a foreign enterprise group have implemented innovation (2.30% in 2020). A similar situation is

observed among companies that are part of an enterprise group in general, where the percentage of innovative companies was only 3.30% in 2020.

Table 2.9. Ownership structure of innovative enterprises

		2004	2006	2008	2010	2012	2014	2016	2018	2020
		%	%	%	%	%	%	%	%	%
Innovative	Enterprises which are part of an enterprise group	2.70	3.00	4.30	4.10	3.00	1.90	1.80	3.20	3.30
	Enterprises which are part of an enterprise group and have foreign head office	1.50	1.80	2.80	2.90	2.00	1.30	1.40	2.10	2.30
Non-innovative	Enterprises which are part of an enterprise group	3.30	4.70	3.20	3.60	5.80	5.10	7.50	5.60	6.00
	Enterprises which are part of an enterprise group and have foreign head office	1.70	2.60	2.00	2.30	3.70	3.60	5.80	3.90	4.80

(Source: Own calculations, INSSE database)

2.7. THE MOST IMPORTANT INNOVATIVE SECTORS IN ROMANIA

Table 2.10 shows the top ten innovative activities in Romania during three periods: 2016–2018, 2018–2020, and 2020–2022. The data reveal several important changes in which sectors were most active in innovation.

In the first period (2016–2018), the highest share of innovative activity was in information services (58.5%), followed by computer programming, consultancy and related activities (51.3%), and scientific research and development (45%). These results show that innovation was strongest in knowledge-intensive and technology-based sectors.

In the next period (2018–2020), the ranking changed significantly. Scientific research and development took the first place with 60.5%, becoming the main driver of innovation. The insurance, reinsurance and pension funding sector also improved its position from 8th to 2nd place (39.7%), while pharmaceutical manufacturing moved up to 3rd (26.9%). At the same time, the information services and computer programming sectors dropped several places, suggesting a slowdown in their innovation activities. New entries such as financial intermediation and the manufacture of coke and oil processing products appeared in the top ten, showing growing innovation in more traditional industries around 25%. During the last period (2020–2022), the top positions remained mostly stable, IT related sectors holding their 6th and 7th position, both with a ratio above 20%.

Some sectors, such as waste management, tobacco manufacturing, and printing, disappeared from the ranking after 2018, which suggests that their innovation activity decreased or that other, more dynamic sectors replaced them.

Overall, between 2016 and 2022, innovation in Romania became more concentrated in scientific research, financial services, and pharmaceuticals, while ICT-related sectors (information services and programming) lost some of their earlier strength. Traditional industries showed some innovation but remained at a lower level.

Table 2.10. The top 10 innovative activities in Romania 2016–2022

	2016–2018		2018–2020		2020–2022	
	Position in top 10	**Share of innovative active (%)**	**Position in top 10**	**Share of innovative active (%)**	**Position in top 10**	**Share of innovative active (%)**
Scientific research and development	3	45	1 ↗	60.5	1 =	53.7
Insurance, reinsurance and pension funding, except compulsory social security	8	27.1	2 ↗	39.7	2 =	38.9
Manufacture of basic pharmaceutical products and pharmaceutical preparations	5	43.7	3 ↗	26.9	3 =	35
Manufacture of coke oven products and products obtained from crude oil processing	-	-	5 ↗	24.9	4 ↘	30
Financial intermediation, except for insurance activities and pension funds	-	-	4 ↗	25	5 ↗	26.7
Information service activities	1	58.5	6 ↘	21.5	6 =	25.2
Computer programming, consultancy and related activities / Service activities in information technology	2	51.3	7 ↘	21	7 =	22.7
Advertising and market research activities	-	-	8 ↗	19.7	8 =	21.2
Manufacture of other non-metallic mineral products	10	25.1	9 ↗	19.4	9 =	15
Manufacture of electrical equipment	-	-	10 ↗	17.2	10 =	13.7
Remediation activities and other waste management services	4	44.6	– ↘	–	–	–
Manufacture of tobacco products	6	40	– ↘	–	–	–
Printing and reproduction of recorded media	7	29.6	– ↘	–	–	–
Manufacture of furniture	9	26.1	– ↘	–	–	–

(Source: Data from https://insse.ro/cms/en/search/node/Innovation%20in%20business%20environment)

2.8. THE PARTNERSHIP TYPE OF INNOVATIVE ENTERPRISES

As can be seen in Table 2.11. between 2018 and 2020, 31.3% of Romania's innovative companies were engaged in some form of cooperation. This type of activity was mainly characteristic of large enterprises, the share of innovative among large companies rising to 39.7%. Among the different cooperation partners, suppliers (11.9%) and buyers (8.5%) had the highest shares. Collaboration with universities and other higher education institutions was most common among large companies (17.5%) and slightly higher in the services sector (6.4%).

Table 2.11. The share of innovation partnerships by enterprise size and activity type (2018–2020) (%)

Partnership	Entreprises				Activities	
	Total	Small	Medium	Large	Industry	Services
Any type of cooperation	31.3	29.3	34.2	39.7	32.5	30.2
Suppliers of equipment, materials, components or software	11.9	9.5	13.3	26.1	10.9	12.7
Private sector customers or buyers	8.5	6.2	11.4	18.1	7.7	9.2
Consultants, commercial laboratories	7.6	5.6	8.5	20.0	7.0	8.2
Other private enterprises	5.1	4.1	6.0	10.5	3.0	7.2
Enterprises within the group	5.0	2.2	5.9	15.9	4.4	5.5
Universities or other higher education institutions	5.5	2.5	9.9	17.5	4.6	6.4
Public administration, public research institutes	4.1	2.7	6.1	9.4	3.4	4.7
Competitors or other businesses in the same sector of activity	3.7	2.9	4.0	9.2	3.9	3.5
Public sector customers or buyers	2.8	1.5	4.8	7.4	1.9	3.5
Non-profit organizations	2.2	1.5	2.9	5.8	1.5	2.9

(Source: Data from https://insse.ro/cms/en/search/node/Innovation%20in%20business%20environment)

2.9. OBSTACLES HINDERING THE INNOVATION ACTIVITY OF ENTERPRISES

Between 2016 and 2020, the factors hindering innovation in Romanian enterprises revealed more detailed reasons than those identified at the end of the period (see Table 2.12). In the 2016-2018 and 2018-2020 period, the main obstacles included limited external and internal funding, a shortage of highly qualified specialists, a lack of cooperation and knowledge, and market and competitiveness constraints. Overall, these barriers were reported in a higher proportion by non-innovative enterprises compared to innovative ones.

In the 2020–2022 period, the situation changed significantly. The most common reason given for not innovating was that "there was no need," reported by 4.6% of innovative enterprises and 72.8% of non-innovative enterprises. The second most important barrier was the lack of resources, affecting 1.8% of innovative and 10.1% of non-innovative companies.

Table 2.12. Hindering factors, for Romanian enterprises' innovation activities, 2016–2022 (%)

	2016–2018		2018–2020		2020–2022	
	Innovative enterprises	**Non-innovative enterprises**	**Innovative enterprises**	**Non-innovative enterprises**	**Innovative enterprises**	**Non-innovative enterprises**
There was no need	-				4.6	72.8
Reasons other than lack of resources					2.4	8.3
Lack of resources					1.8	10.1
Innovation costs too high	4.6	18.6	1.9	16.3		
Lack of internal finance for innovation	3.6	13	1.8	11.4		
Lack of skilled employees within your enterprise	3.2	12.1	2.1	9		
Lack of credit or private equity	3	10.2	1.3	9.7		
Too much competition in your market	2.7	11.5	1.3	9.7		
Difficulties in obtaining public grants or subsidies for innovation	2.5	10.4	2.1	11.6		
Different priorities within enterprise	2.1	11.4	1.6	10.8		
Uncertain market demand for your ideas for innovations	2	8.6	1.5	8.2		
Lack of collaboration partners	1.5	8.3	0.8	6.9		
Lack of access to external knowledge	0.9	5.1	0.8	4.9		

(Source: Data from https://insse.ro/cms/en/search/node/Innovation%20in%20business%20environment)

2.10. THE REGIONAL DISPERSION OF INNOVATION ACTIVITY IN ROMANIA

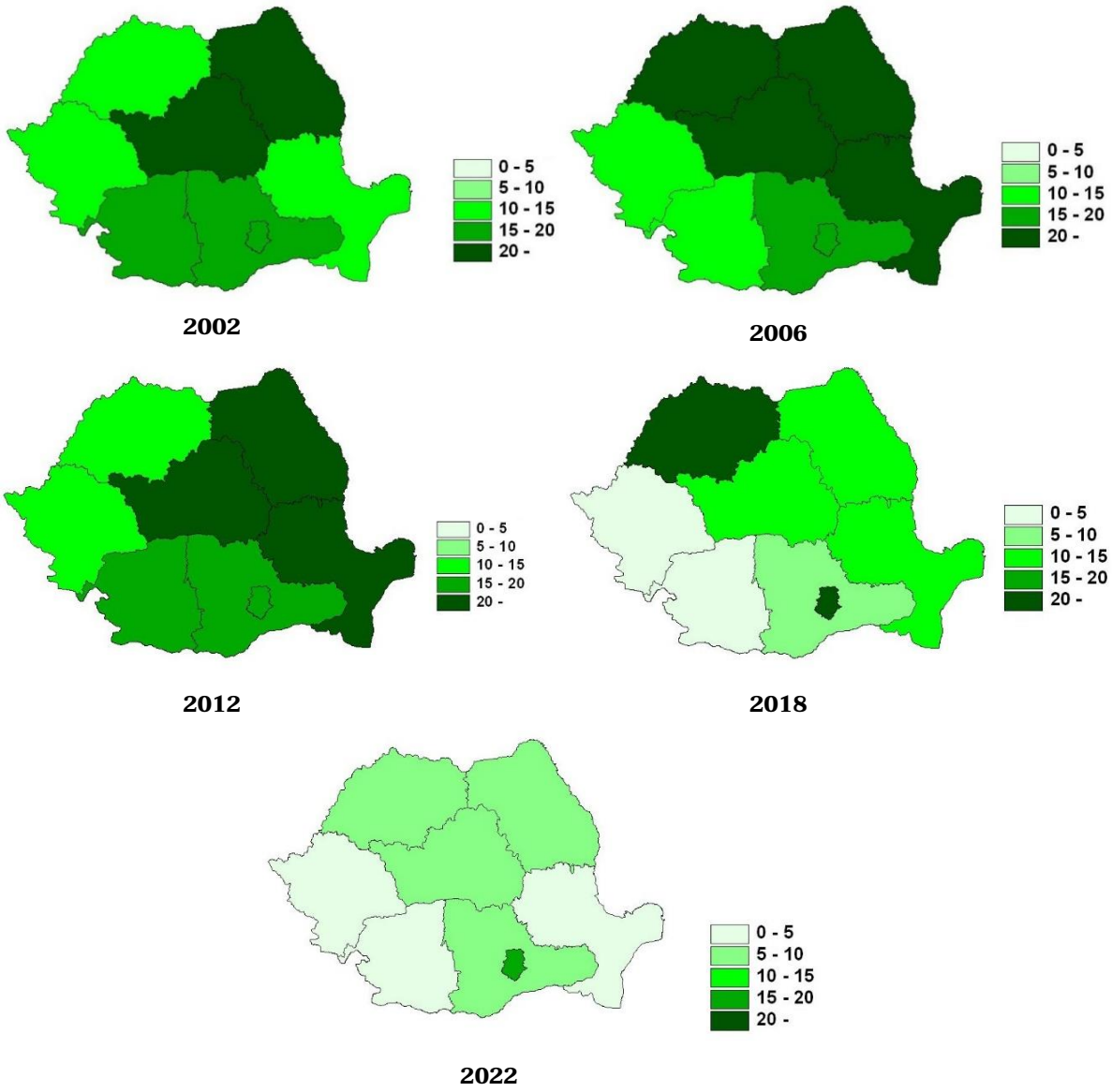
As seen on Figure 1 and on Table 3 in the Annex, the proportion of companies implementing innovation in Romania shows considerable variation across NUTS 2 regions, although a general decrease can be observed in all areas over time. In the first year examined, 2002, the highest shares of innovative enterprises were recorded in the Center (21.64%), North-Est (21.07%), and Bucharest-Ilfov (19.19%) regions.

By 2018, the situation had changed, companies located in the Bucharest-Ilfov region recorded the highest proportion of innovative firms (25.47%) compared to other regions, maintaining its leading position in the following years. In the last year observed, 2022, 16.40% of companies in Bucharest-Ilfov were innovators, followed by the Center (9.78%) and North-West (9.50%) regions.

At the other end of the ranking, the West region had the lowest share of innovative companies (11.73%) in 2002. In the later years, especially from 2016 onward, the Soth-West became the laggard, consistently showing the lowest innovation levels, reaching only 2.64% in 2022.

In summary, throughout the entire period examined, the Bucharest-Ilfov region, which includes the capital and is the most developed economic area in Romania, maintained a clear advantage in innovation activity. In contrast, in the less developed regions, the share of companies implementing innovation remained much lower.

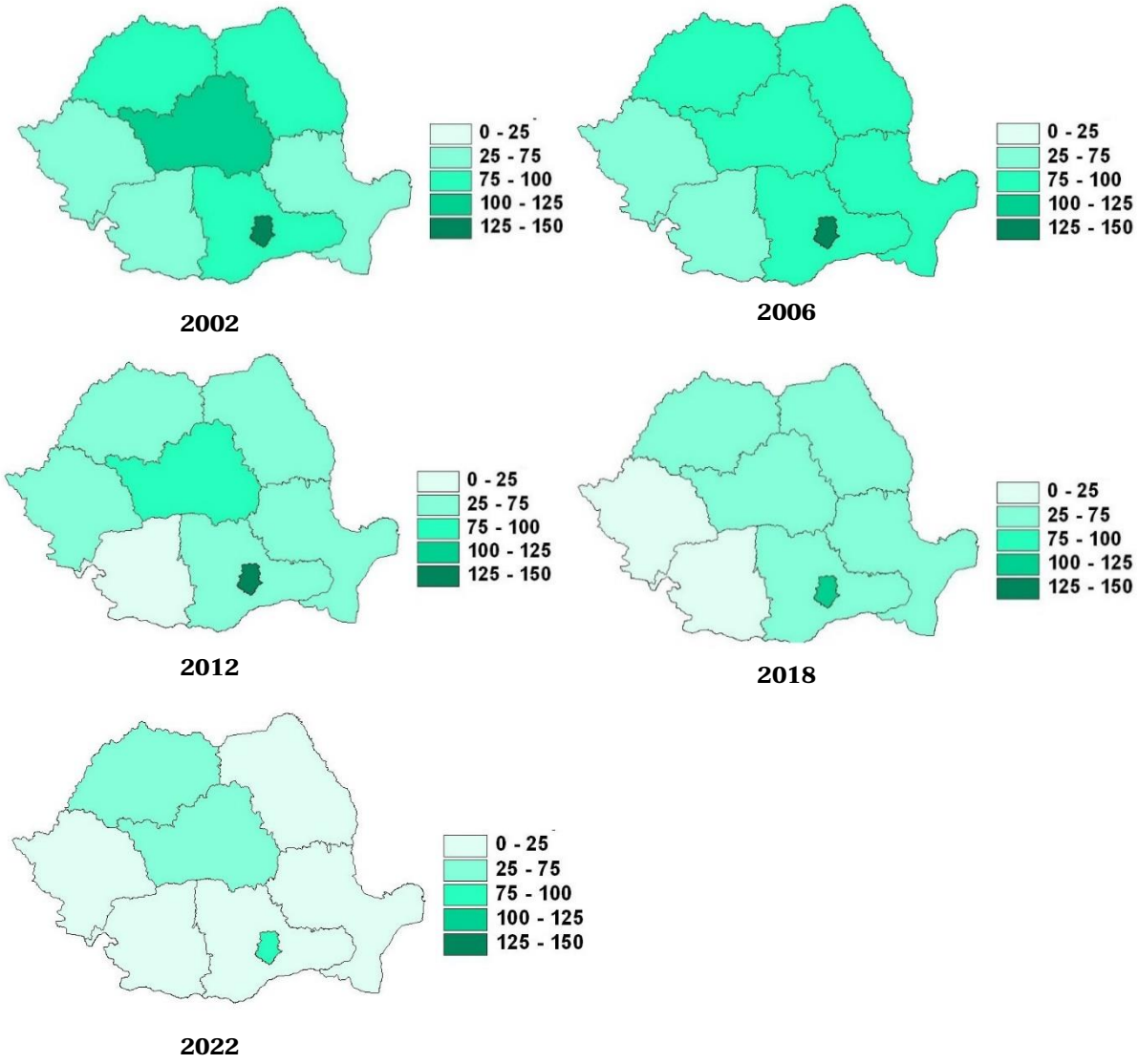
Figure 2.1. The proportion of innovative enterprises by NUTS2 regions between (2002–2022) (%)



(Source: Own calculations, INSSE database)

Figure 2.2 illustrates the evolution of the number of large companies by region between 2002 and 2022. The statistical maps clearly show a continuous decline in the number of innovative large enterprises over the past 20 years. In 2002, besides the Bucharest-Ilfov region, the Center region also had more than 100 large companies engaged in innovation. However, the year-by-year decrease led to a situation where, by 2022, the number of large innovative companies fell below 100 even in the region including the capital. What is more, in five regions it dropped to 25 or fewer.

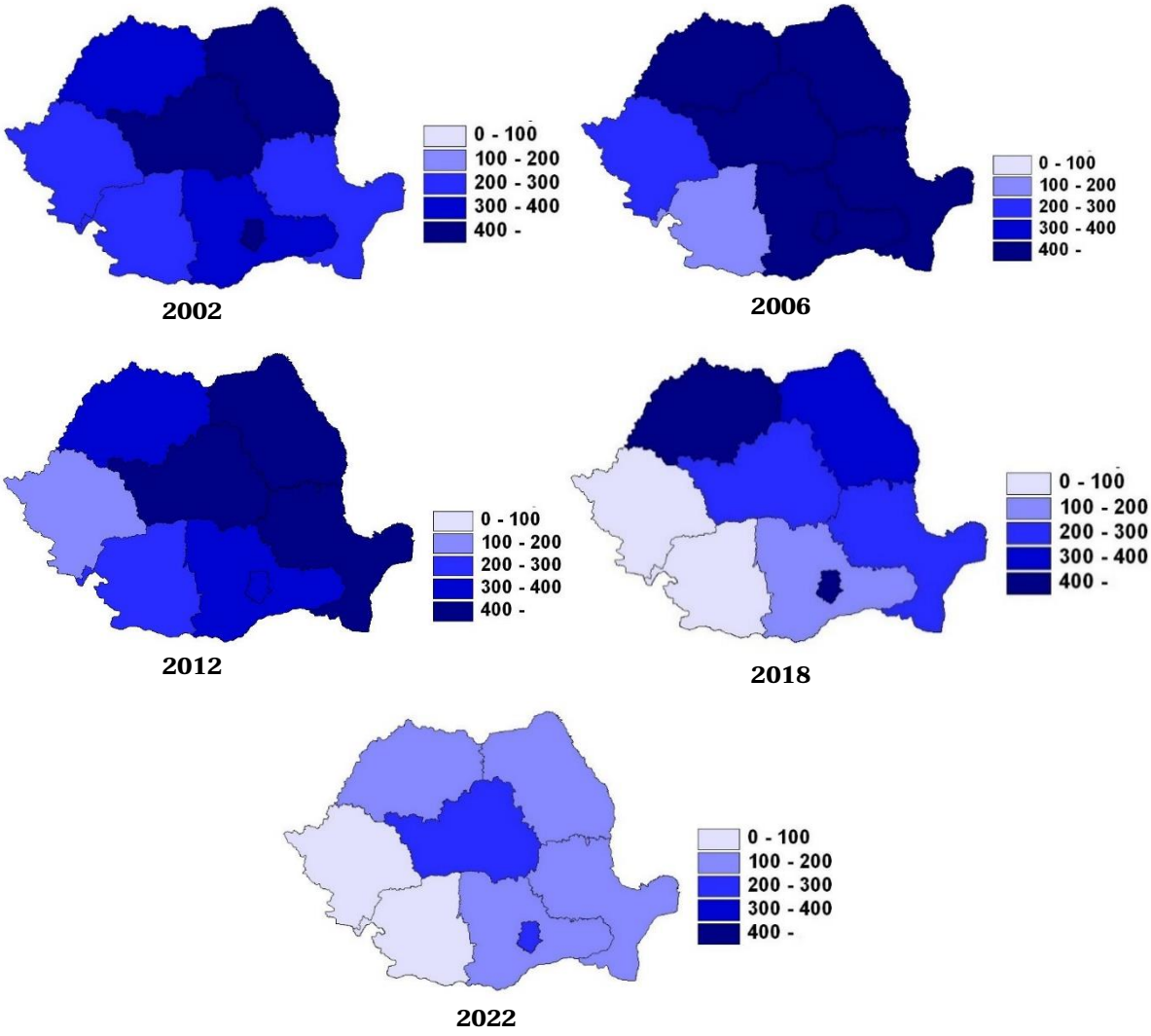
Figure 2.2. The e number of large innovation enterprises by NUTS2 regions (2002–2022) (%)



(Source: Own calculations, INSSE database)

Regional data on innovative companies by sector are available only for industry and services, but their analysis reveals a notable spatial and structural change over time. Figure 2.3 illustrates the evolution of the number of innovative enterprises in the industrial sector. In 2006, all regions except two had more than 400 innovative enterprises. By 2018, only the North-West and Bucharest-Ilfov regions reached these numbers. In 2022, the Bucharest-Ilfov region registered 237 innovative companies, followed by the Center region (212). In all other regions, the numbers were below 150.

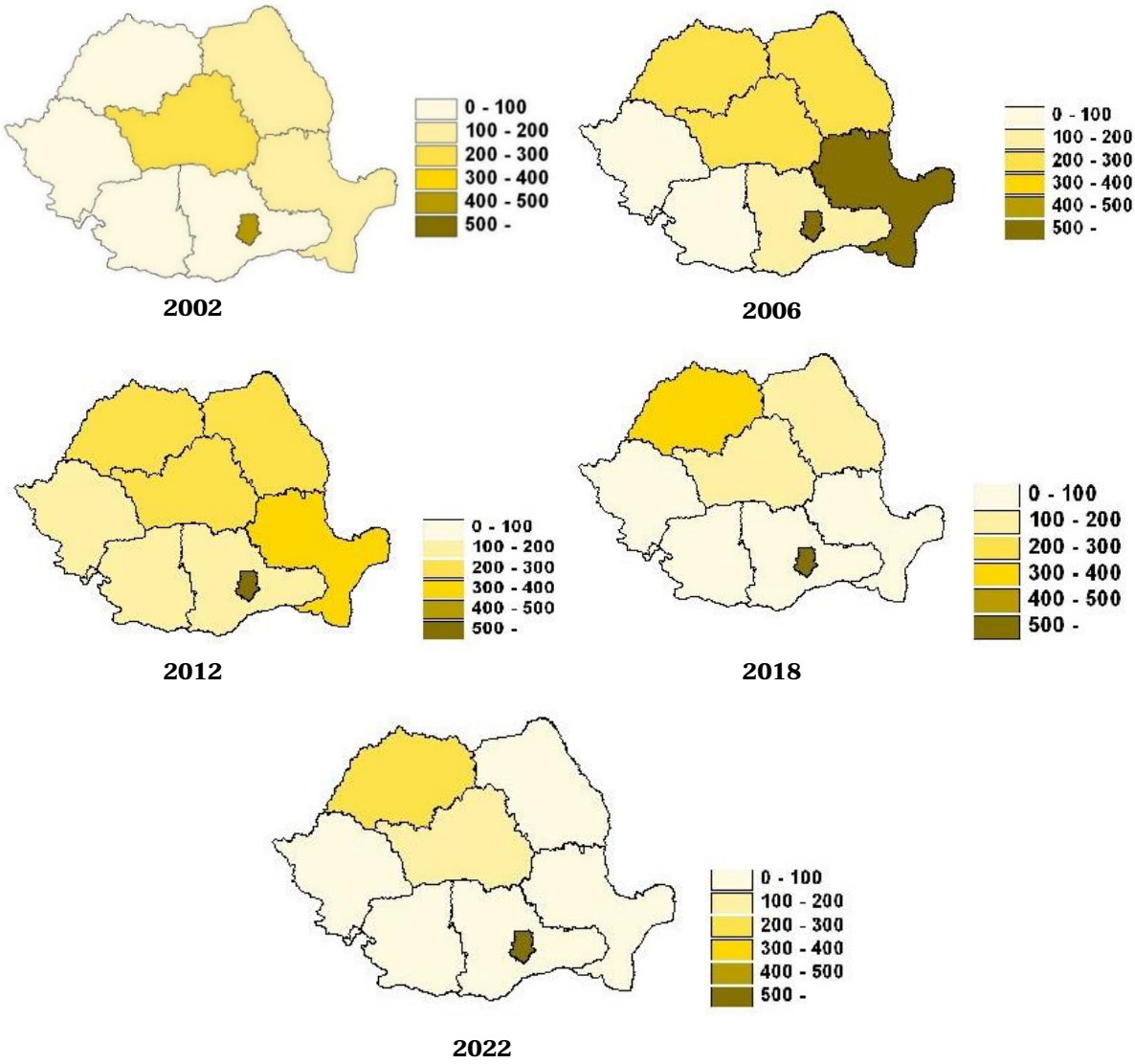
Figure 2.3. The number of innovative enterprises in industry by NUTS2 regions 2002–2022)



(Source: Own calculations, INSSE database)

The spatial distribution of innovative companies in the service sector also changed considerably over the years. As illustrated in Figure 2.4, in 2006, the South-Est region recorded the highest number of such companies slightly preceding the Bucharest-Ilfov region. In 2012, the capital region is the clear leader, the North-Est and South-Est regions ranking second. In 2022, the Bucharest-Ilfov region (740 companies) and the North-West region (265 companies) had the largest numbers of innovative companies in the service sector.

Figure 2.4. The number of innovative enterprises in the services sector by NUTS2 regions (2002–2022)



(Source: Own calculations, INSSE database)

2.11. SUMMARY

As the date show, despite the increasingly sophisticated RDI and digitalization strategies, the innovation capacity of Romanian enterprises has remained weak and unevenly distributed.

The twenty-year trend reveals two distinct phases: 1) expansion until 2008, stimulated by early EU-accession optimism, and 2) stagnation and decline, reflecting the effects of the economic crisis, lack of technological upgrading, and structural weaknesses in the

private sector in the post-2008 period. By 2022, only 8.8 % of enterprises were innovative, far below the 2008 level (33%).

As it was shown, innovation remains concentrated among large firms, though small enterprises dominate numerically. In the early periods the number and percentage of innovative firms was higher in the industrial sector, but in the post-2016 period the service sector overtook initiative. However, its innovations are often incremental rather than radical.

Innovation is regionally unequally distributed. Although in the early periods each of the regions had its strengths and weaknesses, in 2022 innovation is highly concentrated in the Bucharest-Ilfov region and a few urban centers (Cluj, Timiș, Iași), mirroring regional inequalities in RDI capacity.

A possible explanation for this low turnout of innovative firms is related to the weak internationalization and limited cooperation of Romanian firms. Most innovative firms sell primarily on domestic markets and engage little in collaborations, while foreign-owned enterprises show modest innovation involvement, suggesting that foreign investment does not automatically generate knowledge transfer. This is particularly important from policy perspective, as the attraction of foreign investment and internationalization are key elements of the Romanian RDI policy strategy.

There are also several structural barriers that discourage companies from innovating. These include limited funding, shortage of skilled labor, poor cooperation networks, and low market demand for new products. Also, a growing percentage of firms believe that they do “no need to innovate”. This could suggest that they don’t feel pressure or motivation to introduce new products, services, or processes. In other words, they perceive their current products, technologies, or business model as sufficient for maintaining profitability and market share. This attitude is logical, as most firms serve local markets and are not involved in international cooperations, where competition is much higher.

Another possible explanation for these trends can be the mistaken or weakly implemented policy mechanisms. Reluctance to embrace innovation can be caused by weak diffusion of innovation policy support mechanisms, few or unpredictable public procurement programs for innovative solutions, low connectivity between firms, universities, and technology centers (only larger firms cooperate with universities) and limited human capital and managerial capabilities to identify innovation opportunities.

In the context of overall modest innovation performance, the IT sector is considered by many an refreshing exception. However, global macro data just partly supports this. Although the IT sector is one of the most innovative sectors in Romania, however it lost its leading position in the post-2018 period occupying the 6th and 7th position on the list. In the following we will analyze the performance of the IT sector, focusing on its growth

dynamics and contribution to Romania's economy. In this context, the IT sector can be considered an exception, as it is one of the most innovative sectors in Romania.

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3. THE IT SECTOR IN ROMANIA. A LITERATURE REVIEW

The main objective of this chapter is map how the IT sector has evolved in Romania, identifying main actors, narratives, and structural constraints. This will not only help in interpreting how policy goals on innovation shaped the evolution of the sector, but could also offer possibilities to operationalize how these changes could be measured on an empirical level.

As we could see in the preceding chapters, Romanian policy frameworks is dominated by a discourse on economic modernization, EU alignment, and the "knowledge economy credo." It have consistently portrayed digitalization and ICT as central instruments of economic modernization. The literature reviewed here reflects and sometimes questions this policy narrative, showing how these ambitions have translated into the actual structure, performance, and meaning of the IT sector.

The statistical data discussed in Chapter 2, showed that the IT sector clearly appeared as a prospering economic sector, but it contributes to innovation unevenly. This calls for a more nuanced and contextual interpretation of processes. The following review examines how scholars have conceptualized this apparent paradox, exploring whether the IT industry represents a genuine innovation ecosystem or rather an isolated pocket of competitiveness within a largely underperforming economy.

In the following we will address four important questions. 1. How has the Romanian IT sector evolved in Romania and how it is linked to broader RDI and digitalization policies? 2. How do patterns of innovation and competitiveness appear in the IT literature? 3. Which actors and institutions are believed to have shaped the development of the sector? 4. How do national and international discourses (indexes, global benchmarks, EU policies) define Romania's position within the digital economy?

3.1. THE DEVELOPMENT OF ICT IN ROMANIA – A SHORT OVERVIEW

Grundey and Heeks (1998) distinguish two major periods in the development of the Romanian ICT industry: the pre-transition era and the period following the revolution in 1989. Within the framework of the Romanian socialist system, a protectionist and isolationist economic policy prevailed. As a result, on the one hand, a domestic technological base was beginning to take shape; on the other hand, ICT products were outdated, innovation was under central control, and ICT served mainly military and internal security purposes, with the access in the civil sector being highly limited. The *National Commission for Informatics* controlled the development of the sector and

supervised the *Institute of Calculus Techniques and Informatics* (ICTI), which functioned as a research institution and employed around 3000 IT specialists before the regime change. ICTI consisted of two institutions: the *Calculus Techniques Institute*, established in 1968 and responsible for hardware production, and the *Central Institute for Informatics*, founded in 1970 and dealing with software production. The former also had *Regional Offices* (Grundey & Heeks, 1998). On the Scale of General Technological Capability and the Scale of Software Technological Capability, Romania reached medium levels during this period, meaning it was capable of "basic production," of creating "a situation-specific application from a package," and of "simple software production" (Grundey & Heeks, 1998, pp. 10–11).

After the 1989 regime change, during the transition period, Romania moved toward a market economy and privatization. Despite the fact that the transition process appeared slow, both the state and society showed a form of developmental idealism, characterized by the desire for progress and catching up with the West, as well as a belief that such convergence was indeed possible (Thornton et al., 2012). This mindset was present in the ICT sector as well: ICT development was viewed as a tool for economic growth, while relatively little attention was paid to social impacts or equality of opportunity (Bakó, 2007). The goal was to build a new economy and an information society driven by globalization, rapid technological innovation, and flexibility (Pelinescu, 2007).

In the 1990s, the first national strategies targeting the ICT sector appeared, such as the *National Strategy for the Information Society*, which aimed to transform Romania into an information society aligned with European directions, and the *Horizon 2000* – Romania's National Program of Scientific Research and Technological Development for the years 1996–2000, led by the *Ministry of Research and Technology*. During this period, the *National Commission for Informatics* was also established, becoming the central body for IT policy. However, data from the 1990s indicate that the ICT sector faced significant difficulties: in a comparative analysis of 51 countries, Romania ranked among the last, based on the share of ICT within GDP (which stood at 1.3% at the time) (Pelinescu, 2007). Another issue was the drastic decline of state funding for research and development by the mid-1990s. Efforts were made to compensate for this through EU – then European Community – programs such as *PHARE* (Grundey & Heeks, 1998). Changes were also occurring at the corporate level during this period: the number of private software companies increased, multinational corporations entered the market, the number of employees in the sector grew significantly, and software production began to outpace hardware manufacturing (Grundey & Heeks, 1998).

In 1998, the beginning of Romania's European Community accession process provided renewed grounds for optimism. In the period that followed, the specific literature

highlights that although Romania was still in a catching-up position, alignment with European standards, the establishment of legal frameworks, and participation in international projects were significant steps toward strengthening the information society (Petac & Petac, 2003). Moreover, the pace of development in the ICT sector was, in certain respects, faster than the global average (Pelinescu, 2007). At the same time, during the 1995–2005 period, there were serious shortcomings in research, development, and innovation. According to World Bank data, innovation-related indicators declined rather than gradually improving between 1995 and 2005, and progress in the field of education was extremely slow (Goschin & Constantin, 2007).

Bakó (2007) highlights that by the end of the EU accession process, the drive to catch up with the member states had accelerated ICT regulation. As a result, new "e-" tools—also mentioned in the introduction—began to appear, such as e-signature, e-commerce, and e-government, whose wider adoption brought additional challenges. At the societal level, this period saw an increase in internet penetration and a rise in the popularity of technological devices. This was due in part to various digital inclusion programs for education, such as *RoEduNet* and *200 Euro*. The latter, led by the *Ministry of Communications and Information Technology* and the *Ministry of Education and Research*, enabled disadvantaged, low-income families to purchase devices (Bakó, 2007). At the level of companies, new opportunities emerged with the rise of e-business. However, according to Grama and Fotache (2007), during the period of EU accession, this shift represented more of a disadvantage for small and medium-sized enterprises, as they were not yet sufficiently prepared to integrate ICT in a way that would allow them to outperform competitors. In the "new" environment, having an email address or a simple website was no longer enough.

After 2010, the literature reports a significant growth in the ICT sector and emphasizes the ways in which its development contributed to the growth of the Romanian economy (Fotache et al., 2020; Țimiraș, 2015; Veith, 2018). Data show that the ICT sector's share of the national gross added value grew from 4.9% to 6.6% between 2010 and 2014 (Țimiraș, 2015), and by the end of 2017 the sector accounted for 6% of GDP, with its market value exceeding 5 billion euros (Fotache et al., 2020; Veith, 2018). The sector's expansion was also visible in the increasing number of companies: for example, between 2011 and 2017, the number of firms and startups nearly doubled, and the number of employees in the IT sector also grew considerably. This growth resulted in the emergence of major hubs where the ICT sector is strongly concentrated: Bucharest, Cluj-Napoca, Iași, and Timișoara (Fotache et al., 2020). These centers are also university cities characterized by a young workforce with strong English-language skills (Veith, 2018). Although the growing software development centers, fast internet connectivity, and high number of ICT graduates were clear strengths by the late 2010s, there were still dimensions in which

Romania performed poorly: citizens' digital competence remained low—even though the first stage of the digital divide (Tőkés, 2022; Vajda & Tőkés, 2019) was overcome with the spread of mobile devices. Therefore, online service use remained low, and e-government services were so underdeveloped that Romania ranked last among EU member states (Tocan et al., 2021).

The year 2020 brought the outbreak of the global pandemic, which on the one hand highlighted that digitalization is not a "luxury" but an essential economic and social tool, and on the other hand completely reshaped corporate culture and work practices (through the spread of home office), the functioning of education (shift to online education and remote learning—during which the state provided 250,000 devices to disadvantaged students to help them connect to classes), and made online data reporting and administrative procedures indispensable (to avoid queues and prevent large numbers of people from gathering in one place) (Tocan et al., 2021). The systems developed during this period transitioned into the post-pandemic era, and today many employees express a clear preference for working from home.

It is important to note, that working outside the physical boundaries of the company is not a new phenomenon, nor did it begin with the outbreak of the Covid-19 pandemic. This crisis merely accelerated digitalization and the mass spread of telework, even in countries where it had previously been barely present—for example, in Romania (Andrei, 2022). The literature highlights that the origins of the phenomenon go back to the early computers and later PCs that emerged in the 1960s and 1970s, and that working from home continued to evolve with the expansion of the internet and mobile networks (Andrei, 2022). Iordache et al. (2021) distinguish three generations of telework: (1) home office, which represents an initial phase where telework is technically limited; (2) mobile office, which enables mobile work and often takes place in "third places," such as coworking spaces; and (3) virtual office/smart working, which refers to cloud-based, flexible work arrangements. The latter introduces the concept of work that can be performed anytime and anywhere: with the help of portable devices and cloud-based systems, work can extend even to the car or the street (Messenger & Gschwind, 2016). This also means that the development of telework is closely linked to improvements in ICT technologies and digital infrastructure, the spread of cloud-based technologies, and households' internet access; without these, today's forms of telework would not exist (Andrei, 2022; Aniela et al., 2021; Iordache et al., 2021). By the onset of the Covid-19 pandemic, the necessary conditions were already in place to support not only "home office" arrangements but also fully developed forms of "virtual office" work.

At present, the ICT sector faces yet another challenge—but also an opportunity: the rise of artificial intelligence.

3.2. FOLLOWING WESTERN MODELS – DEVELOPMENT AS A DOMINANT DISCOURSE

As mentioned above, in the period following the regime change—and especially with the beginning of the EU accession process—the idea of following Western models, including in the field of ICT, spread widely in Romania as a dominant discourse linked to the promise of development. Petac and Petac (2003) sought to provide a comprehensive overview of the evolution of Romanian ICT policy and training structures in the early 2000s in the context of EU integration, with particular attention to the *EUQuaSIT* (European Qualifications and Strategies in ICT) project. The aim of this project at the time was to compare ICT training strategies across Europe and to harmonize ICT professions and training frameworks within the EU. Before the EU accession, they concluded that although Romania had made significant institutional and legal progress, alignment between training and the labor market was still lacking. Major challenges included the shortage of ICT professionals, gaps in vocational training, and weak cooperation between the public and private sectors (Petac & Petac, 2003). The development of ICT was considered particularly important because the literature regarded ICT as the backbone of the knowledge economy, an essential tool for promoting economic growth and sustainable development.

International Western organizations are regarded as key actors shaping the discourse on development, as the information they publish (e.g., the creation of various indices and the ranking of countries based on these) influences how citizens perceive their own country's level of development and its position on the international landscape. At the same time, these organizations significantly affect the formation of ICT policy—partly through different funding mechanisms (for example, between 2007 and 2013, 336 million euros in structural funds were available to support ICT development[21]), and partly by offering models for political and economic actors and giving a push to the introduction of ICT regulations (e.g., e-signature, e-governance) (Bakó, 2007; Grama & Fotache, 2007). New opportunities and long-term success were seen in the development of human resources and stronger research and development—highlighting the importance of university–industry cooperation—along with proper project management, international partnerships, and balancing outsourcing with innovation (Grama & Fotache, 2007; Pelinescu, 2007). These challenges continue to shape the ICT sector today.

In the 2010s, even after EU accession, the discourse of catching up with the West remained present, and economic growth continued to be articulated as a central goal. Although the ICT sector was still considered a key factor in the economic and social

[21] The funding primarily aimed to expand internet penetration, establish rural telecentres, support e-business and e-government systems, and enhance the security of electronic transactions.

development of the EU and its member states, new findings emerged showing that the share of the ICT sector in GDP—Romania being above the EU average in this regard—did not have a significant positive impact on economic growth; in some cases, a slightly negative relationship could even be observed (Cioacă et al., 2020).

In the pursuit of development and the adoption of Western models, increasing emphasis has been placed on elements such as sustainable development, the knowledge economy, and Green ICT—areas in which Romania, despite the dynamic growth of its ICT sector, still lags (Hadad, 2017; Radu, 2018; Țimiraș, 2015). During this period, it was argued that Romania was approaching the EU average, but that structural reforms were still needed for ICT to truly become a driver of sustainable development (Țimiraș, 2015). Furthermore, in a knowledge-based economy, those who cannot adequately adapt are left behind, and both countries and companies face competitive disadvantages if they are unable to utilize knowledge as a strategic resource (Hadad, 2017). Romania is classified among the lagging countries in this regard, this disadvantage arising mainly from weaknesses in ICT infrastructure and innovation capacity. In the mid-2010s, four priority areas for development were identified: ICT, education (e.g., improving digital skills and promoting lifelong learning), innovation (such as digital development of SMEs and e-governance), and institutional reforms that could lead to more effective regulation (Hadad, 2017). In terms of Green ICT—the spread and development of environmentally friendly information and communication technologies—Romania is also at a disadvantage compared to other EU countries. EU regulations (e.g., Directive 2012/19/EU, RoHS 2, Directive 2002/96/EC) are not adequately put into practice in Romania (Radu, 2018). This is attributed to weak e-waste management, low research and development investment, and insufficient digital skills—areas in which Romania must continue to improve in order to catch up with the rest of the EU (Radu, 2018).

APPLIED INDEXES

A number of indexes have been developed to measure the ICT sector, the knowledge-based economy, and the level of digitalization. The ICT-focused literature (see for example Cibian et al., 2022; Drăgan et al., 2024; Goschin & Constantin, 2007; Grama & Fotache, 2007; Hadad, 2017; Herman, 2020; Savulescu, 2015) as well as international institutions and organizations frequently refer to these indexes in their reports (see for example European Commission, 2025; European Investment Bank & European Commission, 2023). Such indexes make it possible to rank countries and highlight the areas in which each nation needs to improve the most. These include the *Knowledge Economy Index* (KEI), calculated based on the *World Bank's Knowledge Assessment Methodology* (KAM), which incorporates the ICT index—particularly relevant during the EU accession process and the first years following

accession—as well as the *Digital Economy and Society Index* (DESI) index or the *World Economic Forum's Networked Readiness Index*. Savulescu (2015) examines the correlation between the latter and the *Global Competitiveness Index*, demonstrating that ICT development, network readiness, and competitiveness are closely linked, and that countries with a higher ICT sector share typically also score higher on competitiveness indicators.

Table 3.1 below summarizes the dimensions along which three popular indexes compare and rank the countries. Based on these indicators, recent literature has attempted to present Romania's position in these areas, often comparing it with other countries in the world or within the EU.

The *Knowledge Economy Index* (KEI), calculated using the *World Bank's Knowledge Assessment Methodology* (KAM), proved to be a highly useful metric during the EU accession preparation period for describing Romania's general development level of the knowledge-based economy and its preparedness to compete in the KE. In 2005, the index showed that the country held a favorable position in the field of education; however, significant shortcomings were observed in innovation and research and development (R&D). The ICT dimension also performed poorly: Romania needed to catch up in internet usage, mobile phone penetration, and computer use (Goschin & Constantin, 2007). After accession, the 2012 KEI revealed that although the country continued to perform well in education, the increasingly developing ICT dimension still needed more rapid progress in order to catch up with the other member states (Hadad, 2017).

The *World Economic Forum's Networked Readiness Index* "evaluates how well prepared a country is to participate in the network economy by benefiting from the ICT advantages" (Grama & Fotache, 2007, p. 23). In 2006, Romania ranked 58th out of 115 countries. According to Grama and Fotache (2007), this relatively unfavorable position was due to underdeveloped infrastructure, an incomplete legal framework, and the fact that companies were not yet able to consciously and effectively utilize the advantages of ICT. Following EU accession, data from 2013 show that Romania ranked second-to-last among the EU member states—sharing the same score as Greece—and surpassed only Bulgaria, indicating that the country had not sufficiently met the previously established goals. Savulescu (2015) also highlights that these countries rank among the lowest positions in the *Global Competitiveness Index*[22], and that the two indexes (the *Networked Readiness Index* and the *Global Competitiveness Index*) correlate. Therefore, if a country is able to participate in the network economy by benefiting from the advantages of ICT, it can also increase its competitiveness. According to the most recent 2024 *Networked Readiness*

[22] The dimensions of the Global Competitiveness Index: Economic performance, Government efficiency, Business efficiency, Infrastructure

Index, Romania ranks 57th out of 133 countries overall and second-to-last among EU member states, this time ahead of Croatia (Dutta & Lanvin, 2024). The country received favorable evaluations in areas such as mobile tariffs, secure internet servers, the ICT regulatory environment, and e-commerce legislation. However, improvements are needed in the Future Technologies dimensions, specifically in innovation (e.g., investment in emerging technologies), in artificial intelligence (AI talent concentration), and in companies' effective use of ICT (e.g., firms with websites and the number of venture capital deals invested in AI). Digital inequality also persists within society (e.g., rural-urban divide in digital payment use) (Dutta & Lanvin, 2024).

Based on the *Digital Economy and Society Index* (DESI)—which tracks the digital performance and progress of EU member states and which, since 2023, has been integrated into the *State of the Digital Decade* report—Romania consistently occupies one of the lowest positions in the ranking (see for example Cibian et al., 2022; European Commission, 2025b, 2025a; Drăgan et al., 2024; European Investment Bank & European Commission, 2023; Tocan et al., 2021). There is consensus, however, that the country's strengths include its good infrastructure and the high number of ICT graduates (Cibian et al., 2022; European Investment Bank & European Commission, 2023; Tocan et al., 2021). Another frequently mentioned strength is the continuous development of software hubs such as Bucharest, Cluj-Napoca, Iași, Timișoara, and Brașov (Tocan et al., 2021). However, this concentration of knowledge also carries risks: such clustering can deepen regional inequalities between major software hubs and other areas. It is also important to note that there is a significant gender gap in digital skills between women and men (European Commission, 2025b, 2025a). Tocan at al. (2021) emphasizes the need for educational reform and the improvement of citizens' general digital competencies as essential steps to narrow this gap. Weaknesses identified in the DESI-related literature include the state of e-government and online public services (Cibian et al., 2022; Tocan et al., 2021), as well as the low level of ICT adoption among SMEs, which reduces their competitiveness (Cibian et al., 2022; European Commission, 2025a; Drăgan et al., 2024). Data show that only 30% of Romanian SMEs are able to make effective use of digital technologies (compared to the EU average of 69%), and just 12% of companies engage in e-commerce (compared to the EU average of 23%). The use of AI- and Big Data-based solutions among SMEs is also minimal (European Commission, 2025a, 2025b).

In the situation described above, a digital paradox emerges: despite strong infrastructure, fast internet, and expanding IT hubs, digital skills within society remain weak, and e-services and e-government remain insufficient (Tocan et al., 2021). The development of ICT is not an objective in itself, but rather a means (Cioacă et al., 2020) toward building a digital society, ensuring sustainable development, advancing public services and governance, and increasing the competitiveness of companies—including SMEs.

Table 3.1. Overview of Indexes

Index	What does it measure?	Dimensions
Knowledge Economy Index (KEI) calculated using the Knowledge Assessment Methodology (KAM) – World Bank	It is „an aggregate index representing a country's or region's general development level of the knowledge-based economy or the overall preparedness to compete in the Knowledge Economy (KE)" (Hadad, 2017, 418).	The KAM Basic Scorecard (Chen & Dahlman, 2006): Performance Average annual GDP growth (%) Human Development Index Economic Incentive and Institutional Regime Tariff and non-tariff barriers Regulatory Quality Rule of Law Education and Human Resources Adult literacy rate (% age 15 and above) Secondary enrolment Tertiary enrolment Innovation System Researchers in R&D, per million population Patent applications granted by the USPTO, per million population Scientific and technical journal articles, per million population Information Infrastructure Telephones per 1,000 persons, (telephone mainlines + mobile phones) Computers per 1,000 persons Internet users per 10,000 persons
World Economic Forum Networked Readiness Index – World Economic Forum	„Evaluates how well prepared a country is to participate in the network economy by benefiting from the ICT advantages" (Grama & Fotache, 2007, 23). The indicators have continuously changed over the years. In 2024, they set further specific objectives: public-private partnership for digital readiness (Portulans Institute, 2025)	Pillars/sub-pillars (Dutta & Lanvin, 2024): Technology pillar Access Content Future Technologies People pillar Individuals Businesses Governments Governance pillar Trust Regulation Inclusion Impact pillar Economy Quality of Life SDG Contribution
Digital Economy and Society Index (DESI) – European Commission	Tracks the digital performance and digital progress of EU member states (European Commission, 2025b). The indicators have changed in the past years, since 2023 has been integrated into the *State of the Digital Decade* report (Sofrankova et al., 2025).	Dimensions in 2022 (Sofrankova et al., 2025): Human capital Connectivity Integration of digital technology Digital public services Dimensions in 2023 and 2024 integrated into the *State of the Digital Decade report* (Sofrankova et al., 2025): Digital Skills Digital infrastructure Digital transformation of business Digitalization of public services

Source: World Bank, Dutta & Lanvin, 2024, Sofrankova et al., 2025

3.3. ICT ACTORS IN ROMANIA

In a context where Western international organizations shape the discourse on ICT and largely determine the directions of development (Bakó, 2007), five additional key actors can be identified within the Romanian ICT landscape:

(1) The state (see for example Bakó, 2007; Davidoi, 2024; Manda, 2021; Manelici & Pantea, 2021; Petac & Petac, 2003; Țimiraș, 2015; Veith, 2018)
(2) Companies and the business sector (see for example Bakó, 2007; EY & Endeavor, 2024; Fotache et al., 2020; Petac & Petac, 2003; Țimiraș, 2015; Veith, 2018)
(3) The civil sector (see for example ARIES, 2017; Bakó, 2007)
(4) The education system (see for example Cibian et al., 2022; Drăgan et al., 2024; Fan et al., 2019; Petac & Petac, 2003; Veith, 2018)
(5) The population (see for example Cibian et al., 2022; Țimiraș, 2015)

The literature generally views ICT development in Romania as being driven by the state and the business sector. While major decisions are made by the state, the business sector strongly influences these decisions (Bakó, 2007), and ICT has a significant impact on the competitiveness of companies. Accordingly, most studies on ICT in Romania focus primarily on these two actors (the state and businesses) and the phenomena associated with them.

THE STATE AS AN ACTOR

Governmental actors dominate the shaping of ICT policy (Bakó, 2007).[23] At the same time, the state has three different roles in the field of ICT: (1) Catalyst, encouraging companies and society to adopt and use ICT through various interventions; (2) Regulator, providing the legal framework—closely linked to the first role; (3) Market actor, through the digitalization of public administration and the development of e-government (Petac & Petac, 2003).

Being a catalyst and regulator, it is not surprising that the literature frequently raises the question of how various laws have influenced the development of the ICT sector (see for example Davidoi, 2024; Manelici & Pantea, 2021; Petac & Petac, 2003). In the early 2000s, several measures were introduced with the aim of stimulating investment in the

[23] Bakó (2007) highlights actors such as: Ministry of Communications and Information Technology, National Regulatory Authority for Communications, General Inspectorate for Communications and Information Technology, National Institute for Research and Development in Informatics, National Audio-Visual Council, The Romanian Post

ICT sector[24] and supporting SMEs[25], including tax incentives for programmers[26], as well as regulations designed to align with standards required by the European Community: electronic signatures, personal data protection, and intellectual property protection[27] (Petac & Petac, 2003). Later, Manelici and Pantea (2021) examined the effects of the personal income tax exemptions introduced in the ICT sector in 2001[28] and 2013[29]. These tax incentives had a notable impact on ICT firms: they were able to increase their revenues (by 24% after the 2001 reform and 20% after the 2013 reform), expand their number of employees (by 13% after 2001 and 10% after 2013), and grow their stock of assets (by 12% after 2001 and 17% after 2013). The effects were positive for young, small firms as well, but stronger for larger and more experienced companies (Manelici & Pantea, 2021). Overall, in addition to stimulating business growth, an important positive effect was the reduction of programmer migration, helping to reduce "brain drain" (Davidoi, 2024; Manelici & Pantea, 2021). Davidoi (2024) refers to the period 2017–2022 as a "fiscal revolution"[30] during which major reform elements were introduced, such as the reduction of the income tax rate, the reduction of social security contributions, and the shift of contribution payment obligations from employers to employees. The 2023 regulations[31] brought further changes: instead of full tax exemption, only partial exemption now applies, affecting a significant share of IT employees and potentially reducing their net income—unless companies compensated by increasing gross salaries. Although ICT remains the most competitive industry in the country, instability in tax policy creates uncertainty and planning difficulties within the sector (Davidoi, 2024). According to Belascu et al. (2021), maintaining "digital competitiveness" will only be possible if the Romanian economy can compensate for the loss of fiscal advantages through greater innovation and efficiency.

The literature also highlights the importance of EU funds and government support as essential conditions for further growth, especially in the context of the state's regulatory and catalyst roles (Veith, 2018). At the same time, supporting SMEs is identified as a key objective for ensuring stability, while developing ICT infrastructure beyond the dominant software hubs is also presented as a priority (Fan et al., 2019; Veith, 2018).

The state also appears as a market actor as a beneficiary of ICT through the digitalization of public administration and the development of e-government. The OECD also emphasizes the importance of e-government: "In the era of digital transformation, a mature digital

[24] Law 332/2001 (Petac & Petac, 2003)
[25] Law 133/1999 (Petac & Petac, 2003)
[26] Government Emergency Ordinance 94/2001 (Petac & Petac, 2003)
[27] Law 455/2001, 677/2011, 8/1996 (Petac & Petac, 2003)
[28] Government Emergency Ordinance 94/2001, later approved as law by the Parliament
[29] Order 539/225/1479/2013, later adopted as law
[30] Government Emergency Ordinance 79/2017, Government Emergency Ordinance 130/2021
[31] Law 296/2023 and law OUG 115/2023

government is essential for a responsive and inclusive public sector that meets the evolving needs of users, while ensuring equal access and treatment for all. The fast-paced adoption of digital technologies in the public sector demands robust governance arrangements that balance opportunities and risks." (OECD, 2023, p. 3) The *Lisbon Strategy* and the *Europe 2020* programs set the direction in this regard and act as incentives (Manda, 2021). EU funds are important here as well, but their use tends to be slow and bureaucratic (Cibian et al., 2022). Other challenges highlighted by the literature is that state-led digitalization projects are primarily technology-oriented rather than user-oriented (Cibian et al., 2022), and public administration cannot compete with the salaries offered by the private sector, which slows down e-government development (Fan et al., 2019).

The OECD formulates additional recommendations in its report *Digital Government Review of Romania: Towards a Digitally Mature Government*. According to the OECD, Romania needs to strengthen the e-government and develop a comprehensive strategy to guide its digital transformation. Clearer leadership, accountability, and a shift from merely adopting legal measures to ensuring their effective implementation are essential for building a data-driven public sector. Enhancing open government data is also crucial to maximize the social and economic value of public sector information. Finally, Romania should focus on inclusive, user-centered public services to improve government responsiveness, and public trust (OECD, 2023, pp. 8–10).

At the same time, several international best practices may serve as references for Romania. In Denmark, for example, every citizen is required to create a digital mailbox for e-administration, as paper-based communication is no longer possible. Iceland performs exceptionally well in e-government programs, while Sweden is often mentioned as a success story in the digitalization of healthcare (Manda, 2021).

COMPANIES AND THE ISSUE OF COMPETITIVENESS

Already in 2000, 4,257 ICT-profile companies operated in Romania, employing 14,843 people, and a clear geographical concentration could already be observed: firms were predominantly located in Bucharest, as well as in Cluj, Timiș, and Iași counties (Petac & Petac, 2003). In the years that followed, the sector continued to grow: the number of employees increased, IT equipment sales expanded, and the turnover of software and IT services rose (Țimiraș, 2015). Before the pandemic, the shortage of human resources was considered one of the main challenges in the ICT sector, leading companies to recruit both from universities and from informal sources (Veith, 2018). A study conducted among employees in the IT sector showed that 10% of workers did not hold even a BSc degree (Fotache et al., 2020). During the pandemic, most IT companies remained concentrated in

Bucharest, Cluj, Ilfov, Timiș, and Iași counties, and the majority continued to focus on software development. The ICT sector became one of the "winners" of the COVID period, as digital demand increased dramatically (Belascu et al., 2021). However, as a consequence, by 2021 a decline in the number of IT employees could be observed (I. Tofan & Condrea, 2022).

The main goals of companies include maintaining competitiveness and generating profit. When examining the factors that influence the profitability of firms within Romania's ICT sector, research shows that management, strategy, and efficiency are primary determinants—rather than regional characteristics (Belascu et al., 2021). Regional effects are nonetheless statistically significant, with the most profitable companies concentrated in more developed areas: Bucharest–Ilfov, Cluj-Napoca, Brașov, Timișoara, and Iași host firms with exceptionally high profitability. This "mini–Silicon Valley" phenomenon demonstrates that clustering enhances performance. At the same time, findings indicate that regional effects are stronger for large companies, while firm-specific effects (e.g., internal strategy, management) are more influential for medium-sized companies (Belascu et al., 2021). It must be noted, as highlighted in the subsection on the state as an actor, the government's income tax exemptions (introduced in 2001 and 2013) brought more substantial benefits to larger, more experienced firms than to younger, smaller ones (Manelici & Pantea, 2021).

Overall, employees working in the IT sector are satisfied with their jobs, typically report moderate levels of work-related stress, and display strong professional self-confidence. At the same time, the sector experiences a high degree of job-hopping: employees frequently change jobs when better opportunities arise (Fotache et al., 2020). Employee expectations include: competitive salaries and benefits, a good work atmosphere, professional development, flexible schedules, security, social values, as well as employer transparency and reputation (Tőkés, 2021). This is where the issue of employer branding becomes relevant, as it can be crucial for retaining talented workers (Tőkés, 2018). From this perspective, large international companies are at an advantage: they already have well-developed employer branding strategies, and their brand promises encompass financial (e.g., various benefits and high salaries), functional (e.g., training, opportunities for development and promotion), and symbolic elements (e.g., team spirit, work–life balance). In contrast, small companies' brands are still in the process of forming (Tőkés, 2018).

Research examining the profile of Romanian tech entrepreneurs shows that more than half aim to target the global market (53%), while 30% focus on the regional market and 17% exclusively on the domestic market. Romanian tech entrepreneurs also tend to start their first company at a young age, often have international experience (e.g., studies abroad), possess a higher education degree, and are not afraid of taking risks (EY & Endeavor, 2024).

In the subsection on companies, it is also necessary to address the issue of digitalization among SMEs, including those not operating directly in the ICT field. Due to globalization, Romanian companies—regardless of size—must perform at an internationally competitive level (Grama & Fotache, 2007). However, in terms of digitalization, Romanian SMEs lag behind the EU average and are unable to fully exploit the opportunities offered by ICT—mainly because of shortcomings in infrastructure and organizational culture. This reduces their productivity and competitiveness and prevents them from integrating into international value chains (Grama & Fotache, 2007; European Investment Bank & European Commission, 2023). The European Investment Bank (2023) formulates three key recommendations for supporting the digital catch-up of SMEs: (1) develop a national-level digitalization strategy; (2) create targeted financing and training programmes for SMEs; (3) strengthen the innovation ecosystem, including startup support and university–industry partnerships.

OTHER ACTORS

Civil society organizations are barely visible in shaping ICT in Romania, and their influence on processes and decision-making is weak. Bakó (2007), in the mid-2000s, points out that a greater role for the civil sector is an important future challenge. The author also argues that bottom-up initiatives should be supported, because these can address social problems beyond market interests—for example, reducing gender inequality in digital skills.

Among advocacy organizations, the *Romanian Association for the Electronic and Software Industry* (ARIES) is the most notable, particularly influential during the 2010s. The organization collaborated with around 250 companies from across Romania and partnered with both central and local Romanian authorities. ARIES described itself as "the largest and most influential organization created for the IT&C industry in Romania, with four regional branches: Timișoara, Brașov, Cluj, and Craiova," stating that it "has grown together with Romania's SMEs and large companies in the industry and continues to develop through innovation, partnerships, clustering, technical support services, and technology transfer" (Asociația Română pentru Industria Electronică și Software, n.d.). ARIES was, for example, a co-organizer of the 2017 Open Innovation 2.0 Conference, the purpose of which was "to bring successful stories to light and support collaborative projects among different members of the innovation ecosystem at regional and local levels" (ARIES, 2017). The organization also published reports on the development of the IT sector. In the period following the pandemic, ARIES published fewer materials, but it continued to be present and active at various industry events (Neascu, 2024).

In the case of the education system, Petac and Petac (2003) highlight, first, the importance of bringing ICT education increasingly in line with the *European Qualification Framework* (EQF), which supports student mobility, lifelong learning, and professional development. Second, in the 2000s, they identify as key goals the reform of the education system and the introduction of ICT from primary school to university level and adult education. By the 2020s, one can see that the number of digital education hours in secondary schools (e.g., ICT classes and programming classes) is high in Romania (Drăgan et al., 2024). Additionally, new programmes have emerged, such as *SMART-Edu* (Modern Accessible School Based on Digital Resources and Technologies–Școala Modernă Accesibilă bazată pe Resurse și Tehnologii digitale). Its objectives include:

- "developing cross-curricular digital competences at all levels of education"
- "developing and multiplying public–private partnerships through participation in digital networks,"
- "exchanging best practices on local, national, and international e-learning platforms," and
- "supporting initial and continuous digital training for teachers" (SMART-Edu, n.d.).

The latter is particularly important because teachers' digital preparedness varies greatly depending on the region and type of school in which they teach (Drăgan et al., 2024), a factor that may further increase already existing social inequalities. The urban–rural divide is also evident in infrastructure: 90% of urban schools have internet access, compared to only 55% of rural schools. The introduction of digital education during the pandemic further deepened these inequalities (Cibian et al., 2022).

In the case of higher education, the literature draws attention to two major issues: first, the labour demand of the ICT sector—especially in the 2010s—(Veith, 2018), and second, the importance of cooperation between universities and companies (Fan et al., 2019; Veith, 2018). Veith (2018) identified the shortage of qualified labour as one of the greatest challenges of the late 2010s in the ICT sector. He emphasized that approximately 7,000 IT graduates enter the labour market each year—only half of what the market demands—and that, alongside the 100,000 professionals active at the time, Romania would need an additional 200,000 IT specialists in the following years. In contrast, in 2025 a constant question is how the increase in employment during the pandemic and the rise of AI will influence job opportunities for new graduates. Regarding higher education, development opportunities are seen in the establishment of strong university–industry(-municipality) partnerships, and it is highlighted that Romania will need structural educational reforms to maintain its leading position in ICT (Veith, 2018). Today, we can observe that in cities such as Cluj-Napoca, Babeș–Bolyai University and other institutions offer customized

training programmes tailored to company needs (Fan et al., 2019). They also frequently partner with firms that participate in mentoring programmes or take part in teaching certain courses.

Romanian citizens are also actors of ICT, for example in terms of technological access, and—as noted above—their digital skills must be strengthened in order to support development and catching up with Western standards. Currently, internet penetration continues to rise: between 2020 and 2023, the share of households with internet access increased from 78.2% to 88.6% (Institutul Național de Statistică, 2021, 2022, 2023, 2024). However, this increase has not solved the problem of low digital skills, and digital inequalities persist within society (Bakó, 2007; Tőkés, 2022; Tőkés, 2023). At the same time, citizens often perceive technological development as a threat. In 2022, 60% of Romanians feared that technological progress would lead to job losses (Cibian et al., 2022), and this share is increasing with the spread of AI.

3.4. THE FUTURE OF THE ICT SECTOR: DIRECTIONS AND RECOMMENDATIONS

Today, new goals are emerging both at the EU and global levels, and Romania must adapt accordingly. Within the framework of sustainable development, the European Union emphasises decent work and economic growth, as well as reducing inequalities (Cioacă et al., 2020). In terms of Green ICT adaptation, proper e-waste management, increased investments in research and development, and the improvement of digital skills are essential (Radu, 2018). Another area in which Romania currently performs less well—but which represents an important technology of the future—is fintech, a field of technology-driven financial innovation that creates new business models and services (Strat & Radev, 2024).

Romania must also adapt to global ICT trends such as cybersecurity and data protection. This makes the effective use of EU funds essential for developing ICT infrastructure (Tocan et al., 2021). Several EU programmes and projects are available to support this process, including *InvestEU*[32], the *Connecting Europe Facility*[33], and the *Digital Europe Programme*[34]. Alongside cybersecurity and data protection concerns, we are also witnessing the continuous rise of AI, which—especially in fields such as fintech—is increasingly seen as a

[32] A programme to provide long-term funding to companies and to support Union policies (European Union, n.d.)

[33] an EU funding programme to implement the Trans-European Networks for Energy policy (European Commission, n.d.)

[34] An EU funding programme focused on bringing digital technology to businesses, citizens and public administrations (European Commission, n.d.-b)

source of competitive advantage (Strat & Radev, 2024). AI applications are likewise supported by the European regulatory framework through the *EU AI Act*[35].

In light of the global trends mentioned above and the rise of AI, the following question is raised in 2025: Is Romania's ICT sector indeed facing a crisis? After the large wave of staff reduction in 2023, the number of job cuts has gone down around the world, but it is still higher than in the period before the pandemic. This is partly due to the over-hiring during the COVID period and partly due to inflation and rising interest rates (D. Tofan, 2025). In public discourse, AI is often portrayed as the main threat, predicted to replace human labour. However, according to the literature, the impact of AI is still more theoretical than practical: productivity gains cannot yet be measured quantitatively. The potential is significant, but concrete results remain limited, and AI mainly automates routine, administrative, and development-related tasks, rather than replacing complex creative work. Some companies have indeed undergone a degree of restructuring in response to the AI—most notably large tech giants such as IBM, Dropbox, and Microsoft—but this is not characteristic of the broader market. In the current, more uncertain context, one effect is a decline in job-hopping, after years in which frequent job changes had been typical in the IT sector (D. Tofan, 2025).

2024 data show that, despite previous worst-case expectations, employment in Romania's ICT sector is at a record level, and the sector makes up 8% of the country's GDP. At the end of 2024, the government abolished the income tax exemptions for IT employees, which did lead to a certain loss of confidence and some market disruption, as net salaries could decrease (D. Tofan, 2025). The literature points out that political unpredictability and fiscal decisions currently pose a much greater risk than AI (Davidoi, 2024; D. Tofan, 2025). According to the current situation, the Romanian IT sector has not collapsed, but is instead undergoing transformation, with a broader structural shift taking place. This transformation will likely involve further legislative changes, shaped by state actors and political interests (Davidoi, 2024).

The Covid pandemic demonstrated that the sector is highly capable of adapting to challenges. One such challenge was adapting to telework. During the pandemic and the period that followed, several comparative analyses were published with the aim of examining how well EU Member States adapted to the spread of telework during the COVID-19 crisis, and what factors determine the "adaptivity" of remote work. The data show that in 2018 only 5% of employees in the EU—not only IT professionals—worked regularly from home, yet by April 2020 this proportion had jumped to 37% (Iordache et al., 2021). In EU-level comparisons, one approach classifies Romania among the countries

[35] The AI Act is a European regulation on artificial intelligence (AI) – the first comprehensive regulation on AI by a major regulator anywhere. (Regulation (EU) 2024/1689)

with medium levels of adaptation, characterized by moderate digital preparedness, limited use of home office (virtual office) before the pandemic, and a need to expand tools and skills (Iordache et al., 2021). Another approach, however, places Romania in the cluster of countries with low adaptive capacity (Aniela et al., 2021).

Numerous studies have examined the effects of Covid-19 and the experiences of remote working, seeking to present the situation from the employees' point of view (see e.g., Radulescu et al., 2020; Săvescu et al., 2022; Stîncel et al., 2021; Türkeş et al., 2024). Telework was especially common among employees in the IT and financial sectors. Those involved generally considered working from home to be efficient, noting significant time savings, flexible working hours, and reductions in travel costs and stress (Radulescu et al., 2020; Türkeş et al., 2024). At the same time, the phenomenon also had its downsides: in addition to loneliness and isolation (Türkeş et al., 2024), empirical research reported that some IT professionals worked more than they had previously in the office, which led to burnout, as well as neck and back pain (Stîncel et al., 2021).

Remote work did not disappear with the fading of the pandemic; many employees still favor this mode of work—that can be regarded as one of the pandemic's legacies. Beyond the advantages mentioned above, another important factor also influences whether employees prefer telework or a return to the office: predictability and transparent employment contracts. This means that employees wish to continue working from home only if their contracts properly set out the provisions related to telework and clearly define the rights and obligations of both parties (Türkeş et al., 2024).

The virtual office and remote work can also be linked to another social phenomenon: mobility. Although we cannot speak of a clear "urban exodus" (Incaltarau et al., 2024), the fear of future lockdowns, lower living costs in rural areas, and the possibility of remote work have increased mobility intentions (Incaltarau et al., 2024; Mutu et al., 2025). Surveys report that during the pandemic and in the period following it, many people left large cities (for example, from IT hubs such as Bucharest or Cluj-Napoca) for surrounding areas. However, their new homes are typically located 20–40 km away from the city, meaning that this movement can be described more as "peri-urban" migration (Mutu et al., 2025).

During the pandemic, the ICT industry continued to expand, and ICT infrastructure became the backbone of economic functioning—supporting e-government, e-commerce, distance education, telemedicine, and remote work (Dobre et al., 2025). The European Commission also highlights positive developments, noting that "Romania has continued to invest heavily in the digitalisation of public services" and "has improved its performance for the availability of eHealth data" (European Commission, 2025b, 2). At the same time, however, the decline in the number of innovative companies is cause for concern, as it signals a weakening of long-term innovation capacity (Dobre et al., 2025) and the risk that

Romania may remain primarily an outsourcing destination. Overall, past experience shows that the sector is capable of transformation and adaptation, and it is more likely that we are witnessing a structural shift rather than the collapse of the sector.

Finally, it is important to mention the recommendations of international organizations and institutions. The OECD (2023), in its *Digital Government Review of Romania: Towards a Digitally Mature Government* report, formulates several key policy recommendations for Romania. According to the OECD public sector digital capabilities need improvement through a comprehensive investment management framework, better coordination of digital skills, and targeted training for initiatives like cloud services and data interoperability. To advance a data-driven public sector, Romania should establish clear leadership and create a national data strategy (OECD, 2023, 9-10).

3.5. SUMMARY

As the literature consistently shows, there is a broad consensus that the IT sector has been the main driver of Romania's economic transformation since the 2000s. Both policymakers and researchers see it as a key force behind modernization and convergence, and many authors also highlight the sector's strengths in export-oriented competitiveness, highly skilled labor, and integration into global value chains.

From a structural point of view, the literature identifies several important characteristics and challenges. Most notably, many scholars argue that the sector has largely remained an outsourcing destination, with foreign capital dominating its ownership structure. As a result, it maintains relatively weak connections with local economic actors and domestic innovation systems.

Much of the existing research reflects the broader Europeanisation and development discourse found in policy documents, framing analyses in terms of EU competitiveness, digital transformation, and innovation policies. However, some authors adopt a more critical tone, creating a tension between those who view the IT sector as an "island of excellence" and others who stress its structural isolation. This highlights the need for further analysis of how the sector functions within the overall economy, how strongly it interacts with other industries, how much it contributes to gross value added, and whether it generates measurable multiplier effects.

Another common conclusion in the literature concerns the uneven geographical distribution of ICT performance in Romania. Activity is concentrated in several urban knowledge hubs, such as Bucharest, Cluj, Iași, ore Timișoara, while smaller towns show lower levels of firm activity and weaker digital infrastructure. Researchers generally agree

that these patterns reflect differences in labor skills, proximity to universities, and local policy support. These regional strengths and disparities could be examined more deeply using both macroeconomic and firm-level data to provide a clearer picture of how these clusters have evolved and performed economically over time.

Finally, the literature consistently emphasizes that the competitiveness of Romanian IT firms depends on the quality of human capital. However, they also relate that this foundation is increasingly under pressure from labor mobility and skill shortages. Longitudinal firm-level analysis could help clarify how these dynamics have developed over time and how they have influenced company performance.

4. THE ROLE OF THE IT SECTOR IN THE ROMANIAN ECONOMY: INPUT-OUTPUT ANALYSIS

As already mentioned, the IT industry is among the fastest-growing markets globally, including in Central and Eastern Europe. However, it also responds quickly to global economic shifts. For example, the recent downturn in the German automotive industry has led to a decline across the sector all over the Central and Eastern European region.

Researchers almost unanimously consider the IT sector to be the main growth engine of the Romanian economy. Forecasts[36] suggest that Romania's IT outsourcing market will keep growing in 2025. Each year, about 10,000 IT students graduate from Romanian universities, and senior developers' salaries and the opportunity to work remotely makes this field very appealing. However, despite these impressive numbers, most studies pay little attention to how deeply the IT sector is integrated into the Romanian economy or how it connects with other industries.

According to the 2024 N-iX Report, Romanian IT companies are concentrated in three main hubs (Bucharest, Cluj-Napoca, and Iași) serving clients from a wide variety of industries. These include information technology, business and financial services, e-commerce, healthcare, automotive, telecommunications, education, consumer goods, manufacturing, retail, supply chain management, logistics, and transport (Lesniak, 2024).

The aim of this chapter is to evaluate the role of the IT sector in Romania from both the supply and the demand perspective. More specifically, it aims to examine how the sector is integrated into the national economy, to identify its connections with other industries, and to estimate the multiplier effects that changes in IT-sector demand or supply can produce across the broader economy. To achieve these objectives, we employ input–output analysis, a well-established modeling tool that reveals the sectoral interdependencies within the national economy.

To determine whether the observed patterns in Romania are unique or shared, we conduct the analysis in a comparative manner with Hungary. This allows us to place Romania's IT development within a broader regional context. Like Romania, Hungary has a rapidly expanding IT sector. The 2025 N-iX Report (Petriv, 2025) indicates that Hungary's IT industry is mainly concentrated in three major cities, Budapest, Győr, and Szeged. Companies primarily work with clients from sectors such as financial services, information technology, e-commerce, business services, healthcare, consumer goods, telecommunications, manufacturing, education, automotive, and public administration.

[36] https://www.brainsconsulting.ro/the-it-market-in-romania-in-2025-a-hub-for-innovation-and-growth/

The report also points out Hungary's main competitive advantages, which include a favorable business climate, a low corporate tax rate, and well-developed infrastructure.

In the following sections, after briefly outlining the methodology, we present the results of the input–output analysis in a comparative framework.

4.1. METHODOLOGY AND DATA SOURCES

Input-output analysis was developed by Wassily Leontief (1936) and since then it has become a widely used modelling tool. It can be applied to reveal sectoral interdependencies in an economy, to analyze the structure of the total output and input of a particular sector, to investigate the direct and indirect linkages between sectors, and to identify the key sectors in the national economy from both the demand and supply sides. Key sectors are those that can trigger the most significant changes in national production, employment, income, and related indicators. Due to the above-mentioned capabilities, input-output models can also be used as policy tools, as they allow the prediction of changes in output, income, or employment levels resulting from the implementation of a given policy measure (Mattas et al. 2006; 55).

Input-output analysis is based on the input-output table. The rows of this table represent the structure of the demand for the output of each sector, while its columns contain the structure of the inputs used by each sector (Table 4.1). The IO table is composed of three quadrants:

- The first quadrant contains the transaction matrix, which shows the intermediate transactions of the economic sectors;
- The second quadrant (on the right-hand side) contains the final demand (Y) for the output of each sector, including consumption of households, consumption of the government and NGOs, respectively gross formation of fix capital, changes in inventories and export;
- The third quadrant (below the first quadrant) shows the primary inputs (or final payments) (P) coming from the rest of the economy, represented by the compensations of employees, taxes and subventions on the products, and inputs purchased from abroad (the imports).
- The elements of the fourth quadrant representing the transactions of the primary inputs and final demand categories are generally not presented in the input-output tables.

Table 4.1. The input-output table

		Intermediate demand (purchasing sectors)						Final demand	Total output
		1	2	...	j	...	n		
Intermediate inputs (selling sectors)	1	x_{11}	x_{12}	...	x_{1j}	...	x_{1n}	Y_1	X_1
	2	x_{21}	x_{22}	...	x_{2j}	...	x_{2n}	Y_2	X_2
	...	...	...	...	...	...	...	...	...
	i	x_{i1}	x_{i2}	...	x_{ij}	...	x_{in}	Y_i	X_i
	...	...	...	...	...	...	...	...	...
	n	x_{n1}	x_{n2}	...	x_{nj}	...	x_{nn}	Y_n	X_n
Primary inputs		P_1	P_2	...	P_j	...	P_n		
Total inputs		X_1	X_2	...	X_j	...	X_n		

Source: Own edition based on Mattas et al., 2006, p. 59.

Equations (1) and (2) can be written for each of the sectors.

$$X_i = \sum_{j=1}^{n} x_{ij} + Y_i \qquad (1)$$

- where X_i represents the total output of sector i, x_{ij} is the value of products or services sold by sector i for sector j, Y_i represents the final demand for products or services of sector i, n is the number of the sectors of the economy.

$$X_j = \sum_{i=1}^{n} x_{ij} + P_j \qquad (2)$$

- where X_j represents the total input of sector j, x_{ij} is the value of the products or services purchased by sector j from sector i and P_j represents the primary inputs of sector j.

MEASURING DIRECT INTERSECTORAL LINKAGES: THE FLOW INDEX

Based on the share of the intermediate uses over the total intermediate inputs and outputs, degree of direct relationship between two sectors can be estimated using the flow index. The flow index between sectors i and j (FI_{ij}) can be calculated by taking the average of the share of intermediate uses (x_{ij}) over the total intermediate input of sector j and over the total intermediate output of sector *i (* JRC-IPTS 2007: 3*)*. (3)

$$FI_{ij}(\%) = (x_{ij} / \sum_{i=1}^{n} x_{ij} + x_{ij} / \sum_{j=1}^{n} x_{ij}) / 2 * 100 \qquad (3)$$

Sector i is strongly *backward interrelated* with sector j if an important part of sector i's intermediate inputs is purchased from sector j and, at the same time, this amount represents a relatively high share in sector j's total intermediate output.

Sector i is strongly *forward interrelated* with sector j if sector j is an important consumer of the intermediate outputs of sector i and, at the same time, these products represent an important share in the total intermediate inputs of sector j.

MEASURING INDIRECT LINKAGES: THE MULTIPLIERS

Multipliers are used to quantify direct and indirect changes in the total national output, income, employment, value added and so on triggered by a one-unit increase in the final demand or primary inputs of a particular sector. Sectors with the highest values can be considered key sectors as they can generate the highest changes on the level of the economy. However, it is important to remark that all the sectors of the economy are somewhat important, so, "identification of key sectors may only be justifiable on ordinal terms" (Kweka, Morrissey and Blake 2001: 21).

The identification of key sectors can be carried out from both the demand and supply side. From demand side, those sectors can be considered key sectors where a one-unit increase in final demand for their output generates the largest change in the total economy's production, income, or employment. These effects can be estimated using *backward multipliers*.

On the other hand, supply-side analysis can identify those sectors which, through a one-unit increase in their primary inputs, are able to provide the greatest changes on the level of the economy. These effects can be calculated using *forward multipliers*.

The calculation method of the multipliers is presented below:

1. Calculation of the technical coefficients:

$$\text{Input coefficients: } A = Z * \text{diag}(x)^{-1} \quad (4)$$

$$\text{Delivery coefficients: } A^{*} = \text{diag}(x)^{-1} * Z \quad (5)$$

- where Z is the transactions matrix, x – the output column vector

2. Computation of the Leontief inverse matrix of input coefficients and Ghosh (1958) inverse matrix of delivery coefficients:

$$\text{Leontief inverse: } L = (I - A)^{-1} \quad (6)$$

$$\text{Ghosh inverse: } L^{*} = (I - A^{*})^{-1} \quad (7)$$

CALCULATION OF THE MULTIPLIERS

The *backward multipliers* show the interconnection of a particular sector to those sectors from which it purchases inputs. For example, the output backward linkage of sector i (OBL_i) represents the increase in the total output on the level of the economy which is required to satisfy one-unit increase in the final demand of sector i.

The *forward multipliers* reflect the interrelationship of a particular sector with those sectors to which it sells its outputs. The output forward linkage of sector i (OFL_i) shows the increase in total output on the level of the economy triggered by one-unit change in the primary inputs of sector i.

The interpretation of the employment and income multipliers is similar, instead of the output, changes are considered on the level of national employment and income.

Table 4.2 contains the calculation formulas of the multipliers.

Table 4.2: Multipliers' calculation formulas

	Backward multipliers	**Forward multipliers**
Output	*(8)* OBL: e^t L	*(9)* OFL: L^* e
Employment	*(10)* EBL: l^t L	*(11)* EFL: L^* l
Income	*(12)* IBL: w^t L	*(13)* IFL: L^* w

- where: *e* represent the column vector of 1-s, *l* – employment coefficients, *w* – income coefficients.

DATA SOURCES

For Romania, symmetric product-by-product input-output tables (at basic prices, in current prices, in million ROL) were available for the period between 2013 and 2022 for 33 aggregated sectors, [37] published by the National Institute of Statistics (NIS). In the case of Hungary, symmetric product-by-product IO tables (at basic prices, in current prices, in million HUF) were available only for the years 2010, 2015, and 2020, covering 63 aggregated sectors, provided by the Hungarian Central Statistical Office (HCSO). In order to allow for a longer time series in the case of Hungary, descriptive statistics presented in the following section, were based on *use tables*[38] (at purchaser prices, in current prices), which were available for the period between 2013 and 2022. For Romanian employment data, Eurostat statistics were used.

[37] For 2022 for 88 sectors

[38] Use tables describe how much of each product is used as input by each industry and by final consumers. These tables are generally used to calculate input coefficients (inputs per unit of output) and for building symmetric IO tables. Considering that analyses refer to aggregated sectors, differences between the use of use tables and symmetric IO tables, may be modest.

The activity of the IT sector is represented by the aggregated data of the following two sectors: ***62 – Computer programming, consultancy and related activities***, and ***63 – Information service activities.*** To ensure comparability, the input-output tables for both Romania and Hungary contain 33 aggregated sectors for each year.

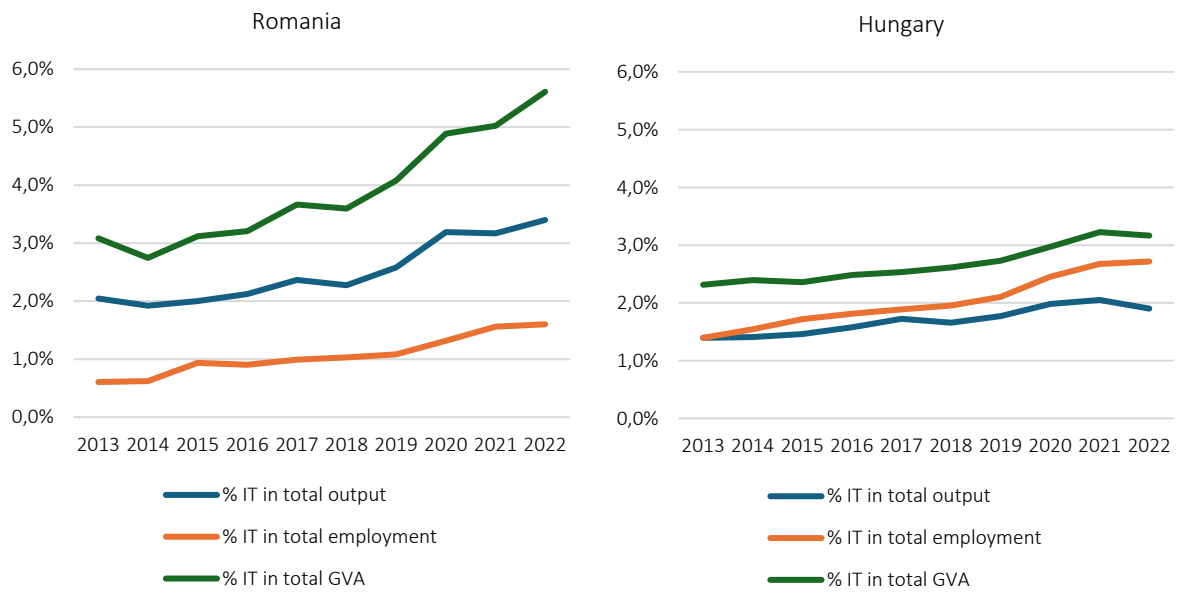
4.2. RESULTS

DESCRIPTIVE STATISTICS

The share of the IT sector in Romania's total national output, employment, and gross value added (GVA) showed a growing tendency between 2013 and 2022. The highest share appears in the case of total GVA, and the sharpest increase is also observable for this indicator: rising from about 3% to almost 6%. The share of employment remains relatively low, at about 1.6%, showing a smaller increase of only 1%. However, the absolute increase in employed persons seems significant: from 49.5 thousand in 2013 to 123.7 thousand in 2022. This growth can mainly be explained by the sector's increased productivity, growing automation, and rising wages. Bucharest, Cluj-Napoca, Timișoara, Iași, and Brașov have become high-tech centers in the country, while IT employment remains very low in other regions.

In Hungary, all three indicators also show a growing tendency, and similarly to Romania, the share of the IT sector in GVA is the highest. However, its growth rate is lower, at about 1%. The share of employment is 2.7%, showing a 1.3% increase since 2013. In absolute terms, this represents a twofold increase, from about 56 thousand persons to 129 thousand persons. The explanation is similar to the Romanian case.

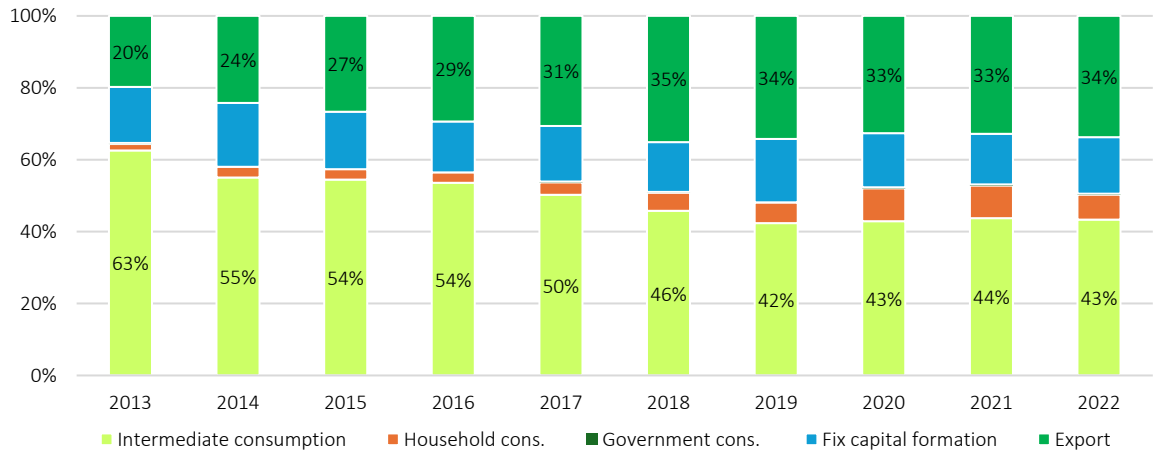
Figure 4.1. The share of the IT sector in total national output, employment and GVA in Romania and Hungary in the period 2013 – 2022



Source: own calculations based on NIS, Eurostat and HCSO data

The most important structural change in the total output of Romania's IT sector is the substantial increase in the share of exports over the past ten years — from 20% to 34%. This can be explained, on one hand, by the growth of total output and, on the other hand, by the improved performance of the sector, which has opened new markets for Romanian IT products. Romania has become a regional hub for IT outsourcing and nearshoring, and many global companies have established service centers in the country that directly serve international clients. The share of household consumption has also increased in recent years, reaching 7–9%.

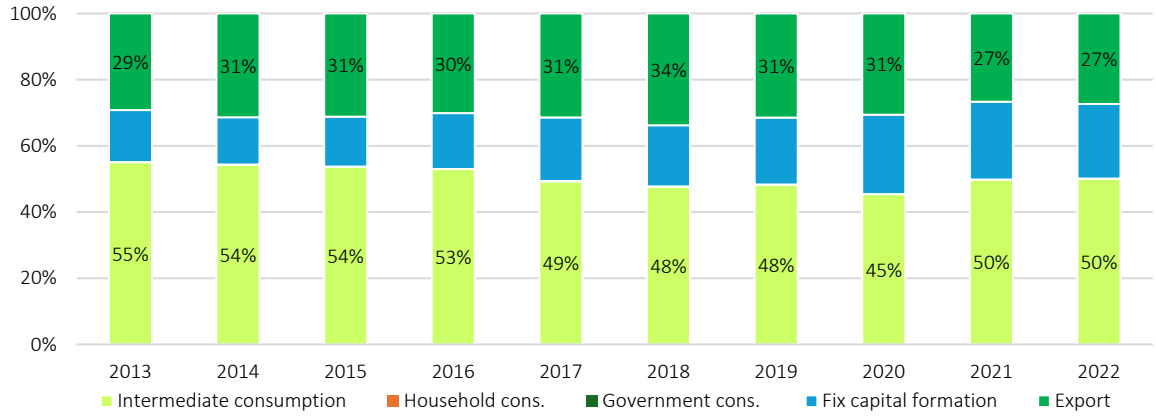
Figure 4.2. The structure of the IT sector's total output in Romania in the period 2013–2022



Source: own calculations based on NIS data

The structure of the IT sector's total output in Hungary has followed a different trajectory compared to Romania over the past ten years. The share of exports has slightly decreased, from 29% to 27%. This trend can be explained primarily by the fact that, although IT exports, particularly services, have grown, domestic demand has also increased, especially from large multinational companies and public-sector digitalization projects. Many Hungarian IT firms work on domestic projects or regional outsourcing contracts, which don't count as exports. At the same time a large share of Hungarian IT companies operates as service providers or subcontractors for larger, often foreign firms, so they provide outsourced development or support but do not sell independent products or licenses abroad, and these are often accounted for as domestic output, not as formal exports.

Figure 4.3. The structure of the IT sector's total output in Hungary in the period 2013–2022



Source: own calculations based on HCSO data

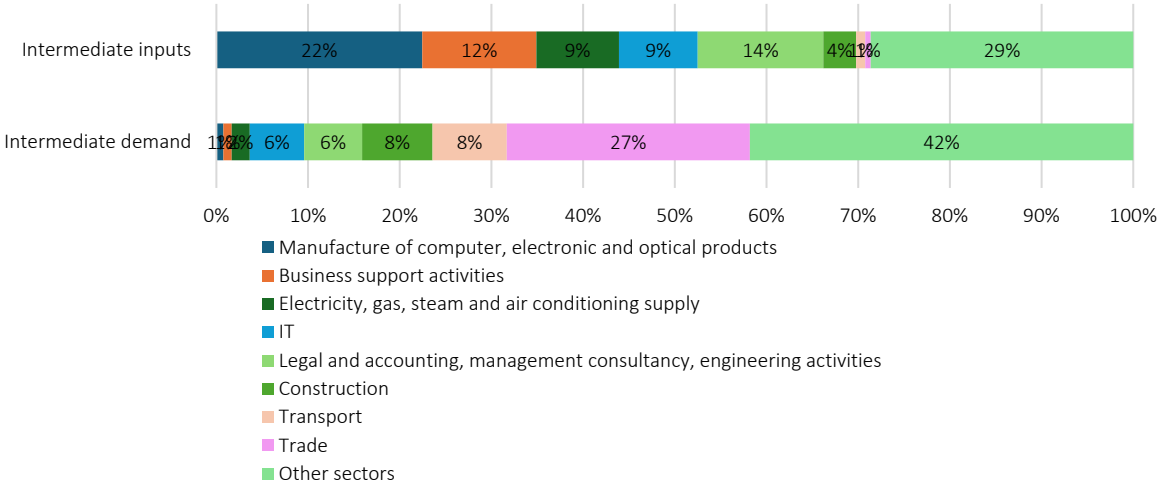
The main similarities in the export activity of the IT sectors in Romania and Hungary are as follows: both countries lack large-scale companies that export proprietary software or platforms; large multinational firms often do not invoice clients directly from the country, meaning a portion of IT output is statistically invisible as export; and digitally delivered exports—such as cloud services—are difficult to measure accurately.

Significant differences can be observed between Romania and Hungary regarding the share of imports in the total inputs of the IT sector. In Romania, the import share is much lower, ranging between 8% and 14% during the period from 2013 to 2022. The most recent figure (from 2022) stands at 10%. In contrast, Hungary reported an import share of 22% in 2015 and 24% in 2020. This difference may mainly be attributed to the fact that the Romanian IT sector places greater emphasis on low-cost local development. Additionally, in Hungary, many IT activities are carried out by subsidiaries of multinational

corporations, which frequently purchase IT services, such as licenses, cloud services, or software development, from their foreign parent companies or affiliates abroad.

The analysis of *intermediate demand* for IT sector products in Romania reveals the most important consumer sectors as follows: *trade* (wholesale and retail), followed by *transport*, *construction*, *legal and accounting services, management consultancy, engineering activities*, the *IT sector itself*, and *business support services*. In contrast, the structure of the *intermediate inputs* used by the IT sector presents a very different picture. The *manufacturing of computer, electronic, and optical products* ranks first, followed by *legal and accounting services*, *management consultancy, engineering activities, business support services, the IT sector, electricity, gas, steam and air conditioning supply*, and *construction*. The contributions from other sectors are much lower.

Figure 4.4. The structure of the IT sector's intermediate demand and inputs in Romania (2022)



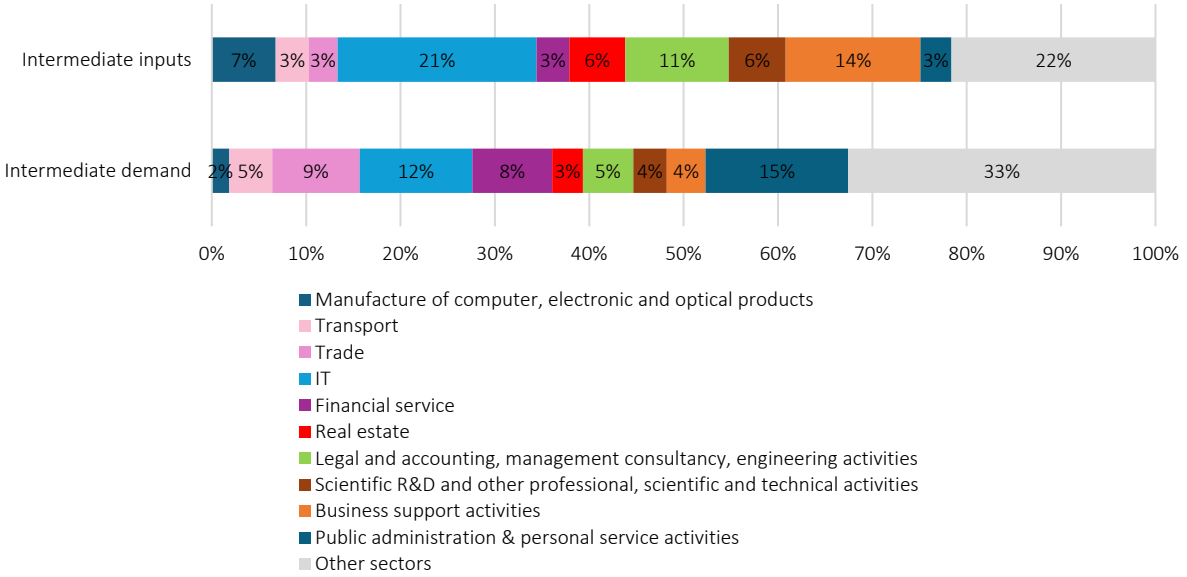
Source: own calculations based on NIS data

In Hungary the *public administration and personal service activities* sector is the main consumer of the IT services, being followed by the *IT sector*, *trade*, *financial services* and *business services* sectors. The main inputs of the IT companies come from the other IT companies, followed by the *business support activities*, *legal and accounting services, management consultancy, engineering activities, manufacture of computer, electronic and optical products, real estate* and *scientific R&D, and other professional, scientific and technical activities.*

In Hungary, the *public administration and personal service activities* sector is the main consumer of IT services, followed by the *IT sector* itself, *trade*, *financial services*, and *business services*. The primary inputs used by IT companies come from other *IT* firms, followed by *business support services*, *legal and accounting services, management*

consultancy, engineering activities, the manufacture of computer, electronic, and optical products, real estate activities, scientific research and development, and *other professional, scientific, and technical services*.

Figure 4.5. The structure of the IT sector's intermediate demand and inputs in Hungary (2020)



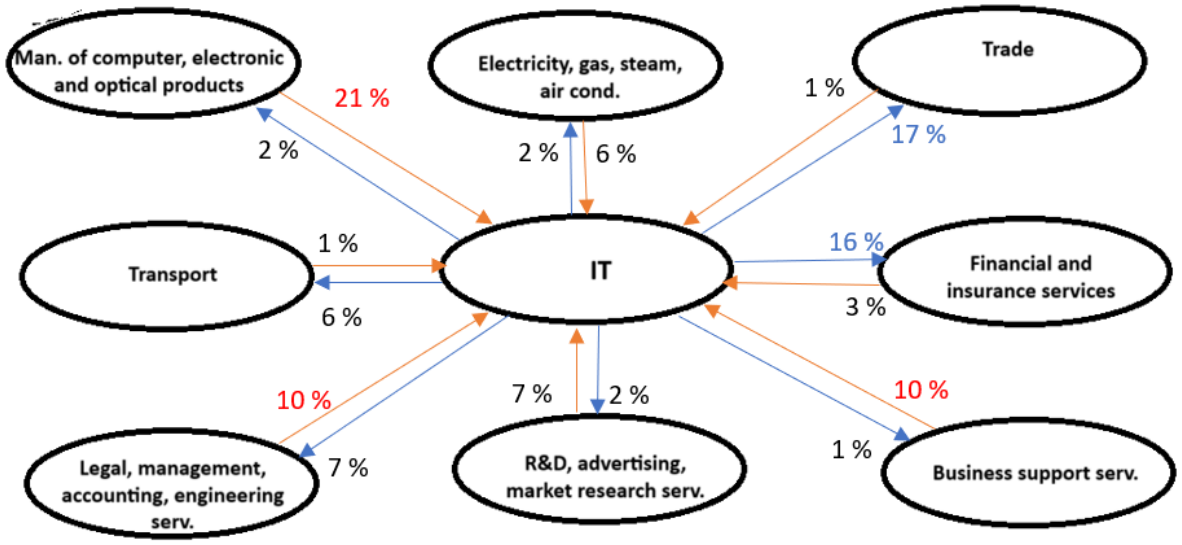
Source: own calculations based on HCSO data

FLOW INDEXES

The flow indexes reflect the interconnections between sectors from both the demand and supply sides simultaneously. As Figure 4.6 illustrates, the Romanian IT sector exhibits its strongest backward linkages with the *manufacture of computer, electronic, and optical products*, indicating that the IT sector purchases a significant share of its inputs from this industry. At the same time, the IT sector is also an important consumer of the outputs from the *computer products manufacturing* sector. Relatively strong backward linkages are also observed with *business support services*, *legal, management, and related services*, as well as *electricity, gas, steam, and air conditioning supply*.

Regarding forward linkages, the most significant connections are with *trade*, *financial and insurance services*, and *legal and management services*. This means that the IT sector supplies a substantial portion of its products to these sectors, which in turn represent a significant share of their inputs.

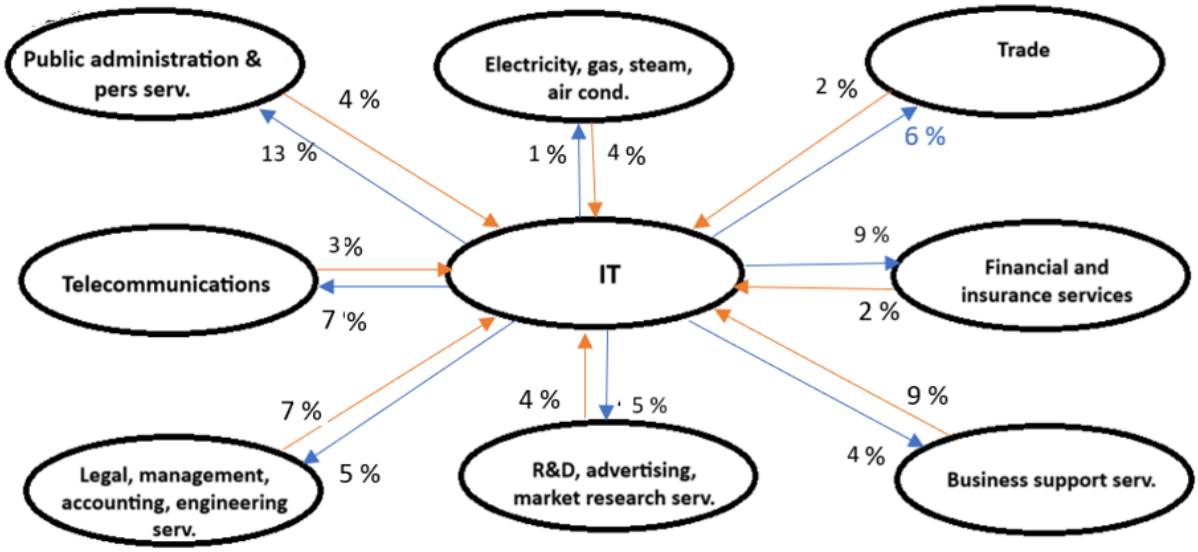
Figure 4.6. Flow indexes of the IT sector in Romania (2022)



Source: own calculations based on NIS data

In Hungary, the highest backward flow indexes are observed in the *business support services* and *legal, management, and related services sectors*, although these values remain relatively low, below 10%. Forward flow indexes are generally not very high either, with the exception of the *public administration and personal services sector*. Following this are the *financial and insurance services*, *telecommunications* and *trade* sectors.

Figure 4.7. Flow indexes of the IT sector in Hungary (2020)



Source: own calculations based on HCSO data

KEY SECTOR ANALYSIS

The key sector analysis based on the calculation of output, employment, and income backward and forward multipliers indicates that the IT sector cannot be considered a key sector in either Romania or Hungary. It does not rank among those sectors that generate the most significant changes in the economy (in terms of total output, employment, and income) when there is a one-unit change in final demand or primary inputs.

In both countries, the IT sector achieves its highest ranking in terms of the *income forward linkage (IFL)*, placing 7th. This means that when there is a one-unit increase in the primary inputs of the sector, the IT sector ranks seventh in terms of the impact on national income (measured as employee compensation). In Romania, the IFL for the IT sector is 1.36. Therefore, if the primary inputs of the IT sector increase by 1 million ROL, the national income will rise by 1.36 million ROL. In Hungary, the IFL is lower, at only 0.44.

The second-highest ranking for the IT sector in both countries is observed in the case of *income backward linkages (IBL)*. In Romania, the IT sector ranks 8th with a value of 0.36, while in Hungary, it ranks 10th with a value of 0.35. The reason why the income multipliers are the highest lies in the following factors: the IT sector is highly labor-intensive, particularly in terms of skilled labor. A significant portion of its output consists of wage payments to highly educated and well-paid professionals, rather than material inputs. Unlike manufacturing or other traditional industries, IT services rely on relatively few intermediate inputs from other sectors. As a result, a larger share of the sector's output is transformed directly into income, primarily wages.

In both countries, the IT sector's *output backward* and *forward linkages* are relatively low compared to other sectors. In terms of *output backward linkages (OBL)*, the IT sector ranks 20th in Romania and 28th in Hungary. This can primarily be explained by the fact that the IT sector requires relatively few physical or intermediate inputs from other sectors, as its main input is human knowledge rather than goods or materials. Many inputs, such as software tools, are often sourced internally within firms or procured internationally, rather than from local suppliers.

Output forward linkages (OFL) are relatively higher for the IT sector compared to its backward linkages, but they still remain low in comparison to many other sectors. This is because, although IT services support a wide range of industries, they are not always recorded as direct inputs in national input-output tables. Additionally, a significant share of the IT sector's output is exported. As a result, the IT sector's integration into the production processes of other domestic sectors is less visible in input-output data.

Employment backward and *forward linkages* for the IT sector are somewhat higher compared to its output linkages, but they still remain low overall, especially the backward

linkages in both Romania and Hungary. The reasons are similar to those for the output multipliers: the IT sector requires relatively few intermediate inputs from other sectors, and the inputs it does rely on (such as business services) are often not labor-intensive or are highly automated. As a result, the indirect employment effects are limited, leading to low employment backward linkages. *Employment forward linkages* are also relatively low because the IT sector typically does not serve as a labor-generating input for other industries. Instead, it functions primarily as a technology provider (e.g., automation, digitalization). In many cases, IT services even reduce labor demand in the sectors that use them. Industries that consume IT outputs, such as trade, finance, or public administration, do not become more labor-intensive as a result.

Table 4.3. The highest output, employment and income backward and forward linkages of the Romanian sectors of the economy (2022)

	OBL		OFL		EBL		EFL		IBL		IFL	
	Value	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**
Mining and quarrying	1.15	32	2.99	2	0.77	31	14.75	14	0.07	30	0.86	15
Trade	27.51	1	3.00	1	155.08	1	120.82	1	9.48	1	6.64	1
Transport	3.40	2	1.75	18	11.49	2	24.33	6	0.72	2	1.36	6
Publishing, broadcasting	1.67	14	2.53	6	2.24	20	28.33	4	0.32	10	1.79	3
Telecommuni-cations	2.23	3	1.37	27	5.37	7	9.86	20	0.39	7	0.60	20
IT	1.53	20	1.94	13	2.16	21	20.44	11	0.36	8	1.36	7
Financial and insurance services	1.46	23	2.59	5	2.87	15	36.81	2	0.29	12	2.15	2
R&D, advertising, market research, aso	1.93	6	2.51	8	3.22	14	28.53	3	0.28	13	1.65	5
Business support activities	1.80	9	2.66	3	5.12	9	27.59	5	0.45	6	1.71	4

Source: own calculations based on NIS data

Table 4.4. The highest output, employment and income backward and forward linkages of the Hungarian sectors of the economy (2020)

	OBL		OFL		EBL		EFL		IBL		IFL	
	Value	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**
Mining and quarrying	1.15	33	2.63	1	0.01	33	0.05	23	0.05	33	0.22	19
Manufacture of food and beverages	1.95	3	1.46	24	0.06	15	0.04	25	0.22	18	0.17	25
Manufacture of metal products	1.48	23	2.12	3	0.03	23	0.05	19	0.14	23	0.20	20
Constructions	1.98	2	1.27	27	0.09	8	0.07	16	0.27	14	0.18	24

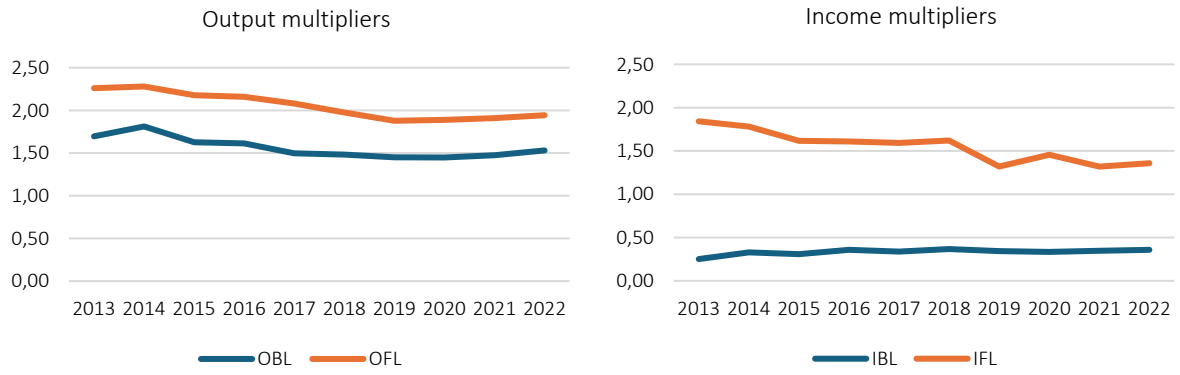
	OBL		OFL		EBL		EFL		IBL		IFL	
	Value	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**
Tourism	2.05	1	1.19	29	0.14	1	0.12	3	0.43	5	0.33	13
IT	1.41	28	1.78	16	0.06	14	0.08	12	0.35	10	0.44	7
Business support activities	1.50	22	2.29	2	0.09	7	0.13	1	0.36	9	0.51	2
Public defense and other activities	1.46	26	1.15	30	0.10	6	0.09	7	0.49	3	0.44	5

Source: own calculations based on HCSO data

The evolution of the IT sector's multipliers in Romania between 2013 and 2022 is presented in Figure 8. Since the input-output tables are available at current prices, it is not advisable to analyze employment linkage based on these data due to the distorting effects of inflation, neither for Romania, nor for Hungary.

Output backward and *forward linkages* show a very slow upward trend in the most recent years; however, prior to this, the trend was generally declining. *Income forward linkages* have also declined over the period, while *income backward linkages* have remained relatively stable in recent years.

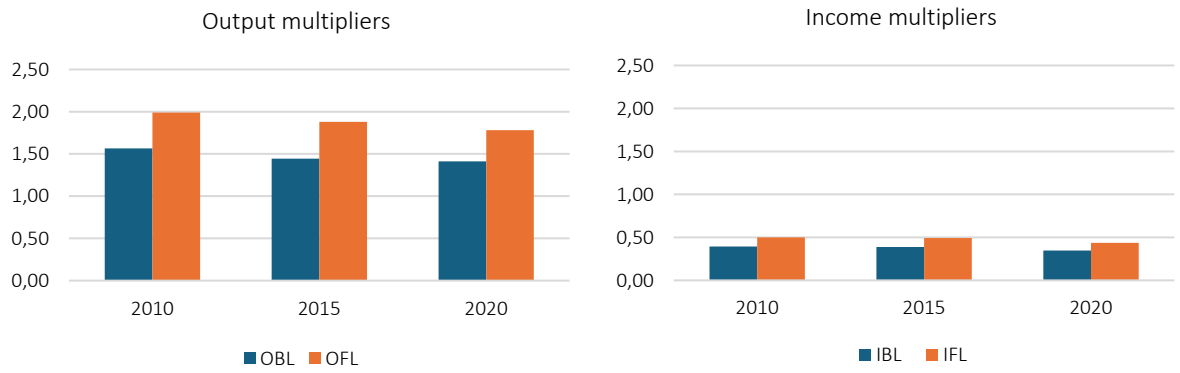
Figure 4.8. Evolution of the IT sector's multipliers in the period 2013–2022 in Romania



Source: own calculations based on NIS data

For Hungary, data are available for only three years, but in all cases, a declining trend can be observed.

Figure 4.9: Value of the IT sector's multipliers in 2010, 2015 and 2020 in Hungary



Source: own calculations based on HCSO data

4.3. SUMMARY

The analysis showed that over the past decade, the IT sector has become a high value-added and rapidly growing branch of the economy in both Romania and Hungary. However, despite its strong performance and contribution to GDP growth, the IT sector remains only weakly integrated with other parts of the economy. The sector's multipliers are relatively low, meaning that an increase in final demand in IT generates only modest spillover effects in other domestic industries. This suggests that much of the sector's expansion depends on external demand and imported inputs rather than strong intersectoral linkages.

In practical terms, the IT industry relies heavily on imports of hardware, software, and high-tech intermediate goods, which creates only limited demand for domestic suppliers. Local sourcing mainly involves manufacturing computers and business services. At the same time, it can be stated that Romania's IT sector functions largely as an outsourcing-based enclave with few backward linkages to the domestic economy. In terms of forward linkages, in RomaniaIT services mainly serve trade, transport and constructions. The use of IT products in traditional industries such as manufacturing or energy remains limited, showing that digitalization has not yet spread fully across the economy.

According to the flow and key-sector indexes, IT cannot yet be considered a key industry in terms of intersectoral connectivity, despite its strong productivity and export performance. Its influence on other sectors through demand for IT services is still weaker than that of more traditional branches. Nevertheless, the sector plays an increasingly important role as a provider of modern technologies and as a driver of intangible productivity improvements in other industries.

It is also important to note that the real extent of the IT sector's forward linkages might be underestimated in traditional input-output models. This happens because many outputs of the sector are intangible services that are not always recorded as intermediate inputs. As the strategic role of digital technologies continues to expand, these forward linkages are expected to become much more visible in the future.

Overall, these results confirm the arguments discussed in Chapter 3. The literature emphasized the dual nature of Romania's IT industry: on the one hand, it is a globally competitive, export-oriented "island of excellence", while on the other, it remains relatively isolated from domestic value chains. The input–output analysis supports this view, showing that while the sector's direct contribution to national output is significant, it produces only limited multiplier effects within the domestic economy. In other words, the Romanian IT sector's strategic importance does not lie in its intersectoral integration but in other factors.

Placed in the broader analytical and policy context presented in Chapters 1 and 2, the findings illustrate that the sector's development reflects Romania's post-2000 modernization path and its integration into European and global digital markets. However, the continued weakness of structural embeddedness raises questions about the sustainability and inclusiveness of this growth model. To explore how these macro-level patterns are affected by firm behavior, ownership structure, and human capital dynamics, the next chapter adopts a microeconomic perspective. Chapter 5 examines the performance of Romanian IT companies between 2008 and 2023, focusing on how firm-level characteristics and strategies relate to the structural tendencies identified by the input-output analysis.

5. THE PERFORMANCE OF ROMANIAN IT COMPANIES IN THE 2008-2023 PERIOD

As discussed in the literature review, the IT sector has become one of the most dynamic and high-performing areas of Romania's economy. However, previous research has emphasized its strong dependence on foreign capital, its concentration in a few regions, and its limited integration with local value chains. These observations were partly confirmed by our analysis in Chapter 4, where macroeconomic evidence showed that, despite its impressive growth and significant contribution to GDP, the Romanian IT sector still has weak intersectoral linkages and functions mainly as an outsourcing-based enclave. Therefore, the next analytical step is to focus on firm-level data to better understand why this pattern continues.

Building on the findings of the previous sections, this chapter analyzes the firm-level dynamics of Romanian IT companies between 2008 and 2023. The main aim is to investigate how firm characteristics and performance indicators reflect or contradict the structural trends observed at the sectoral level. This approach helps to explain the sector's limited integration, while also exploring regional disparities and differences.

To achieve this, we use financial data from more than 45 thousand IT companies from the webpage https://listafirme.ro/[39] classified under several NACE codes (See Table 5.1). The analysis includes two major components: 1) a descriptive overview of key indicators for the 2008–2023 period, such as territorial distribution, company size, total turnover, number of employees, profit, assets, debts, and age structure, and 2) a cross-sectional comparisons of these indicators for three selected years (2011, 2017, and 2023), including a year-to-year performance comparison and a k-means cluster analysis to identify regional and structural patterns.

Table 5.1. The distribution of companies by NACE code

NACE code	Companies	%
6201: Activities of customer-oriented software development	27 297	60.33
6202: Activities of information technology consultancy	6 176	13.65
6203: Activities of management, management and exploitation of computing resources	1 021	2.26
6209: Other information technology service activities	2 863	6.33
6311: Data processing, web page management and related activities	5 497	12.15
6312: Activities of web portals	1 818	4.02
6391: Web portal activities and other information service activities	132	0.29
6399: Other information service activities	439	0.97
Total	45 243	

[39] The webpage is a catalog of active companies in Romania, delivering business information, data sets, reports, and statistics about individual companies.

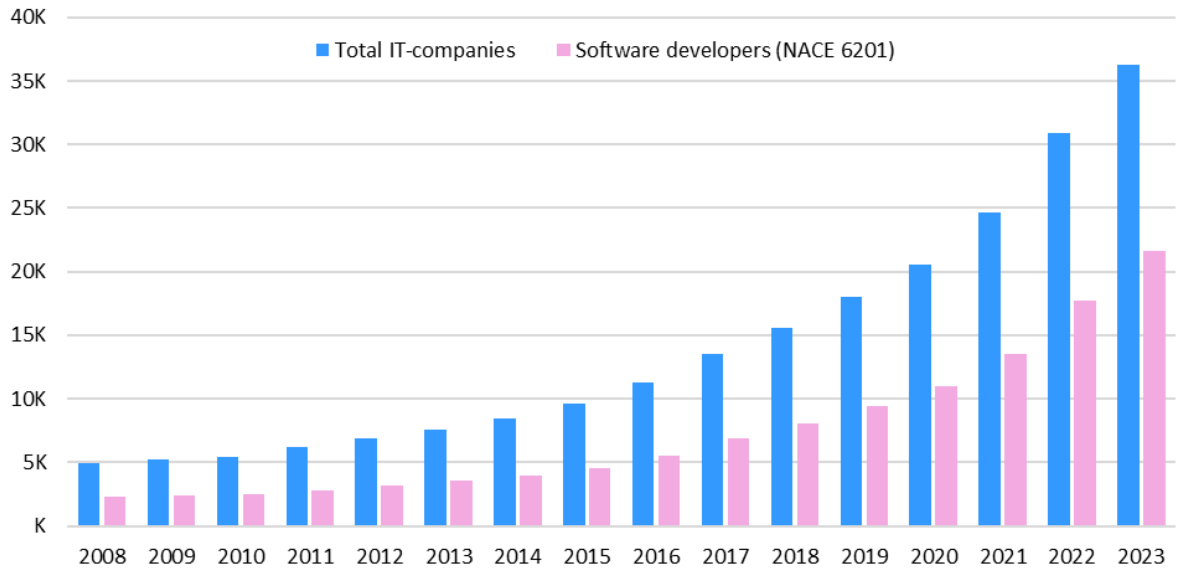
The selected time frame covers all major policy cycles (2007–2013, 2014–2020, and 2021–2027) and external shocks, including the global financial crisis, the COVID-19 pandemic, and the rise of AI technologies and post-pandemic restructuring.

5.1. DESCRIPTIVE OVERVIEW OF THE SECTOR

FINANCIAL AND STATISTICAL INDICATORS OF ROMANIAN IT COMPANIES IN THE 2008-2023 PERIOD

As it can be seen on Figure 5.1, IT companies had shown a strong growth in the 2008 – 2023. While in 2008 there were only 4 909 IT companies registered in Romania, their number doubled until 2015, reaching more than 36 000 in 2023. The growth of software developer companies was even sharper. In 2008 there were 2274 software developer companies in Romania, their number increasing almost tenfold by 2023. Over the years, both groups grew continuously, with faster growth rate after 2016. In 2008 46% of all IT companies were software developers, their number reaching almost 60% in 2023. This shows how Romania's IT sector has expanded quickly, especially in recent years, becoming an important part of the country's economy.

Figure 5.1. Total number of Romanian IT companies and total number of software developer companies (NACE 6201) between 2008 and 2023



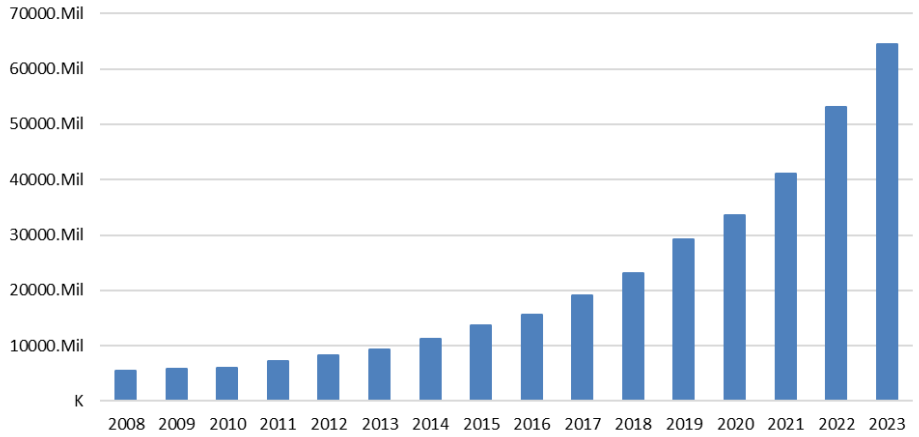
(Source: Individual tax returns of companies, compiled by listafirme.ro)

In the 2008–2023, the evolution of total turnover, total profit, total assets and total depts of Romanian IT companies offered a similar upward trend. As shown in Figure 5.2.a, total turnover increased continuously over the past 15 years, from 5.5 billion RON in 2008 to 64.4 billion RON in 2023, This is more than ten times higher than in 2008. The pace of growth became much faster after 2016, and almost exponential in post-COVID years. Total profits grew in a similar manner (Table 5.2.b), starting from a relatively low number in 2008 (around 500 million RON), rising steadily each year after 2015, to reach 96 billion RON in 2023. Total asset value of Romanian IT companies increased continuously, from 3.3 billion RON in 2008, to 45 billion RON in 2023 (Figure 5.2.c). After 2016, the growth became much faster, showing how the IT sector expanded and strengthened its financial base. Similarly, total debts grew more sharply after 2016, continuously increasing until the end of the period. By 2023, total debts exceeded 20.5 billion RON, roughly thirteen times higher than in 2008 (Table 5.2.d). When interpreting these numbers, it is worth to consider the impact of inflation rates, especially in the 2022–2023 period.

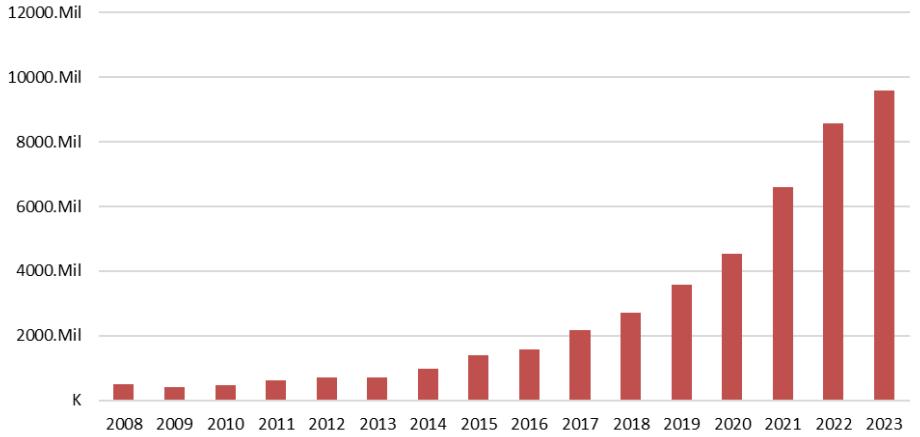
All in all, this impressive rise in the number of companies, and the growth of their financial results show that the IT industry in Romania not only expanded in numbers but also became much more productive and profitable. In addition, these numbers indicate that in the past five years IT companies were very much interested in investing in their own infrastructural development as well.

Figure 5.2. Financial indicator of Romanian IT companies between 2008 and 2023 (RON)

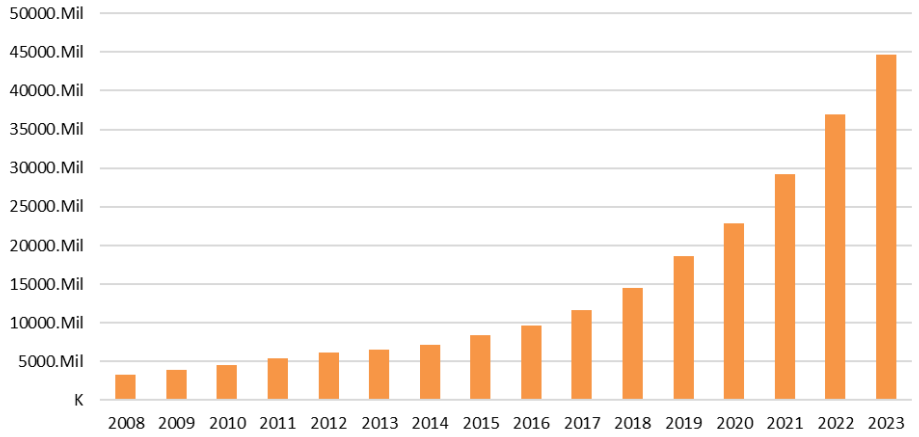
(a) Total turnover



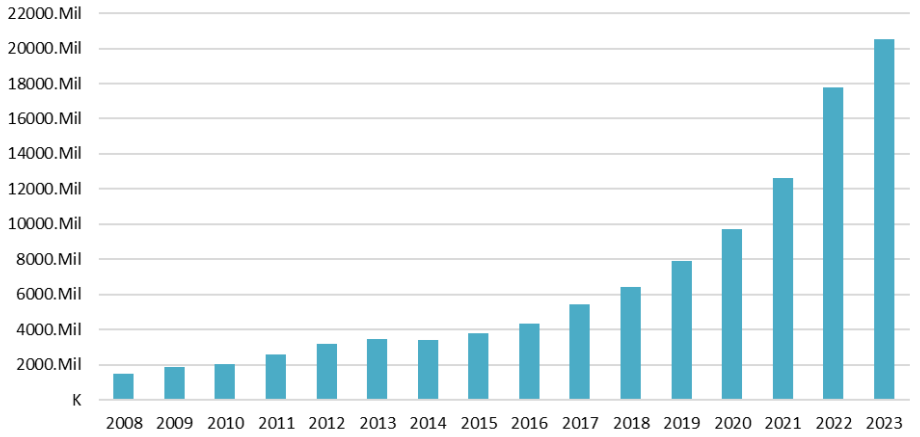
(b) Total profits



(c) Total assets



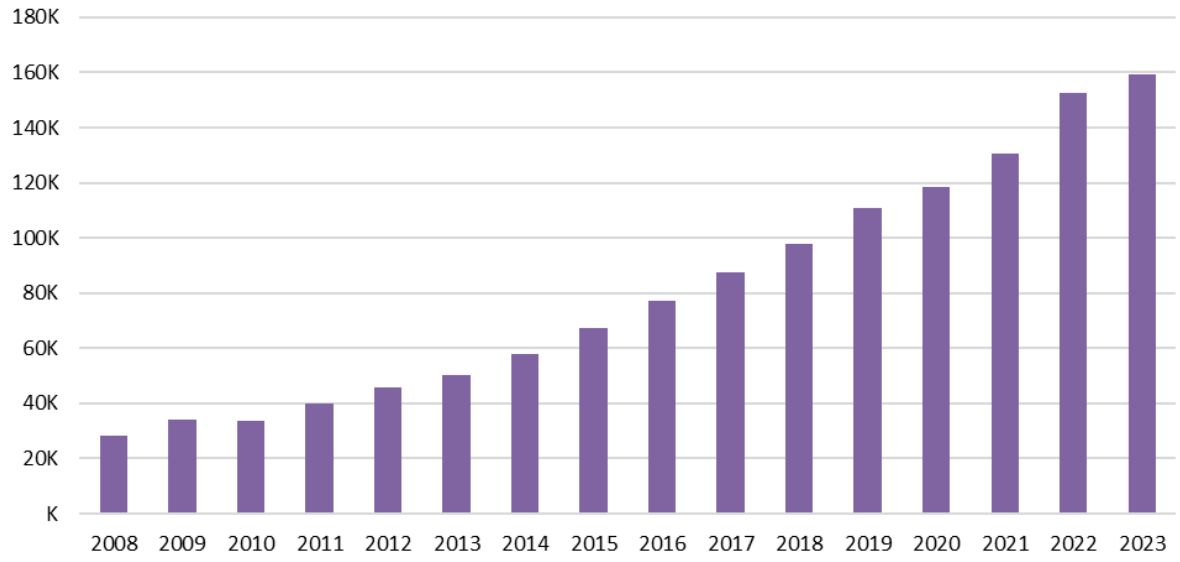
(d) Total depts



(Source: Individual tax returns of companies, compiled by listafirme.ro)

The number of employees working in the IT sector shows almost a linear growth. In 2008, there were around 28,000 employees, their number growing every year, reaching almost 160,000 by 2023 (Figure 5.3). Although the growth rate of employment is not as dynamic as the previous financial indicators, longitudinal data shows that the financial expansion of the sector goes hand in hand with the rapid job expansion as well.

Figure 5.3. Number of employees in Romanian IT companies between 2008 and 2023 (persons)



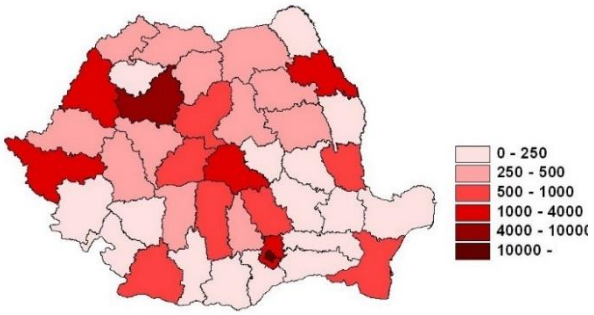
(Source: Individual tax returns of companies, compiled by listafirme.ro)

GEOGRAPHICAL DISTRIBUTION IN 2023

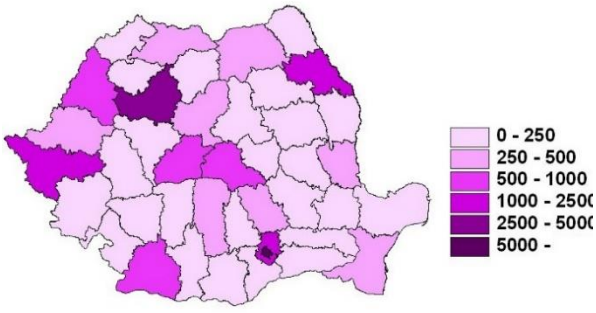
The maps in Figure 5.4. show the distribution of IT companies and software development companies (NACE 6201) in Romania in 2023. Both maps reveal a strong concentration in a few major areas. Bucharest (11 383 IT companies in total, 5 850 software development companies) and Cluj (4 352 IT companies in total, and 3 102 software development companies) stand out clearly, while in other centers such as Timis (2041 IT companies in total, and 1 258 software development companies) and Iasi (1967 IT companies in total, 1 250 software development companies) the concentration of companies is also higher than in the rest of the country (Figure 5.2). Interestingly the relative concentration of software development companies in the highest in Cluj reaching 71.3% of all IT companies.

Figure 5.4. The distribution of total IT companies, and software development companies (NACE 6201) by county (2023)

(a) total IT companies



(b) software development companies (NACE 6201)



(Source: Own calculations. Individual tax returns of companies, compiled by listafirme.ro)

When we look at large companies with more than 250 employees (see Table 5 in the Appendix), we can see that these are located exclusively in Bucharest, Brasov, Cluj, Dolj, Ilfov, Iasi, Mures, Sibiu and Timis. In most other counties, the sector is made up almost entirely of micro (0 to 10 employees) and small (fewer than 50 employees) companies (see Table 4 in the Appendix).

In 2023, 98.40% of Romanian IT companies did not have any secondary headquarters outside their primary offices. A small number of companies however expanded geographically, 724 having working on fewer than 10 locations, and 19 companies operating more than 10 branches (Table 5.2).

Table 5.2. The distribution of number of branches for Romanian IT companies (2023)

Nr. of branches	Nr. of companies
1	44 500
1-10	724
10-50	17
50-100	1
More than 100	1

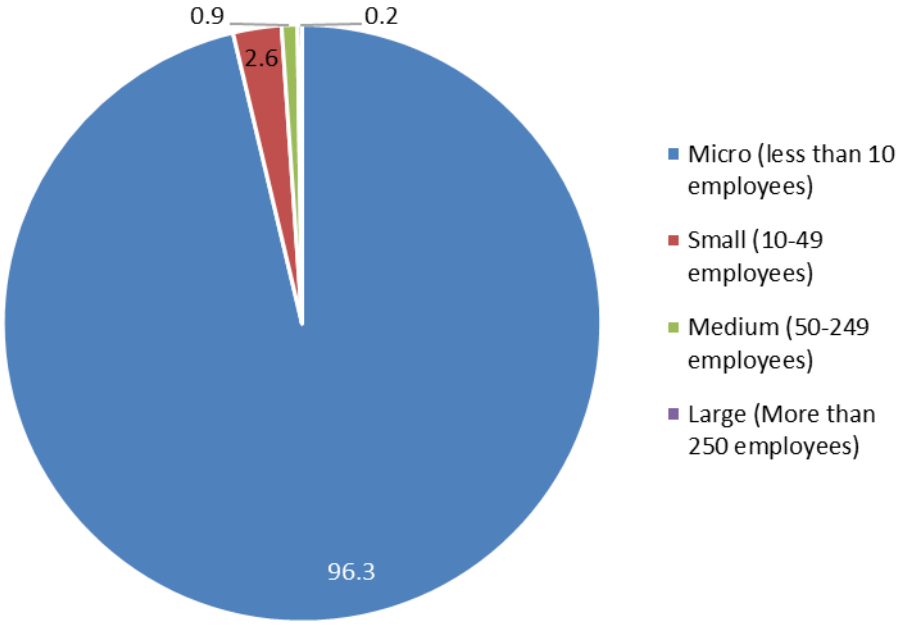
(Source: Individual tax returns of companies, compiled by listafirme.ro)

THE ROLE OF MICRO-ENTERPRISES IN THE IT SECTOR

In 2023, the structure of Romania's IT sector was dominated by micro-enterprises (Figure 5.5). Out of all registered IT companies which we have data on, 34,929 firms (96.3%) employed fewer than ten people. Small companies, employing between 10 and 50 people, represented 2.6% of the total, while medium-sized enterprises (50 to 249 employees)

accounted for only 0.9%. Large companies, with more than 250 employees, were rare, just 88 firms, making up 0.2% of the total. For around 9,000 companies size data were unavailable.

Figure 5.5. Distribution of Romanian IT companies by size in 2023 (%)

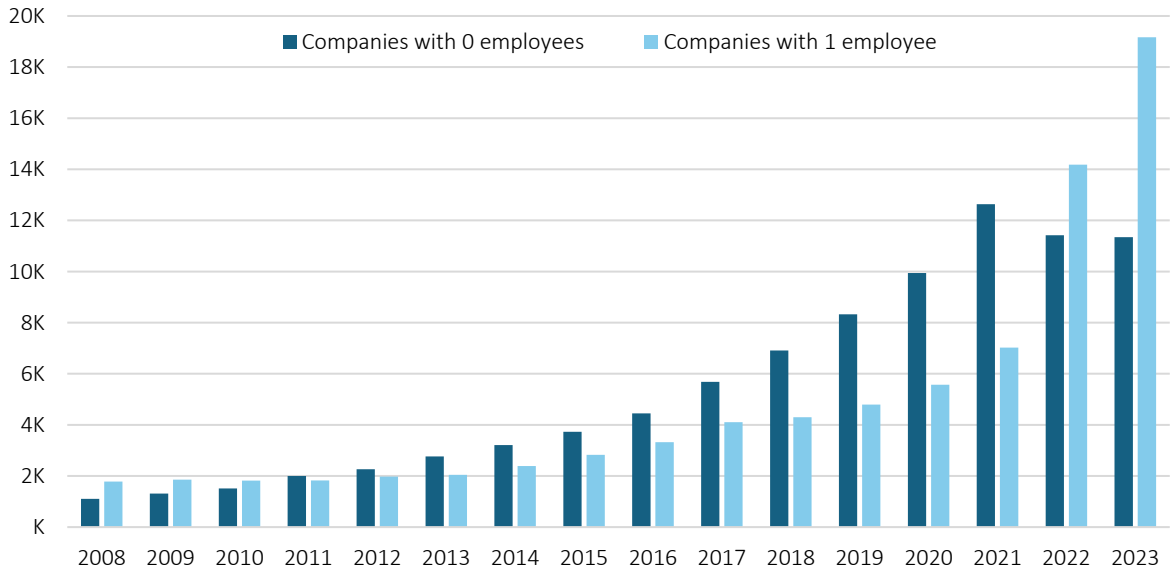


(Source: Own calculations. Individual tax returns of companies, compiled by listafirme.ro)

One possible explanation for the large number micro enterprises is the unusual way of "association" characteristic to the IT sector. As mentioned in the literature review, it is common in this field for big companies to practically "outsource" their employees, by encouraging or even forcing them to create their small firms. These individuals then collaborate with large companies on existing development projects through individual contracts, rather than being hired as regular employees.

To better understand this phenomenon, we examined more closely the changes in numbers of companies with 0 and 1 employees. As shown in figure 5.6, the number of both companies grew steadily in the 2008–2021 period, however the trend shifted after 2021. Starting from 2022, the number of companies with 0 employees began to decline, while number of companies with 1 employee rose sharply. By 2023, there were 11 347 companies with zero, and 19 165 companies with one registered employee, together representing 87.3% of all micro enterprises.

Figure 5.6. The evolution of IT companies with 0 and 1 employees between 2008 and 2023 (number)

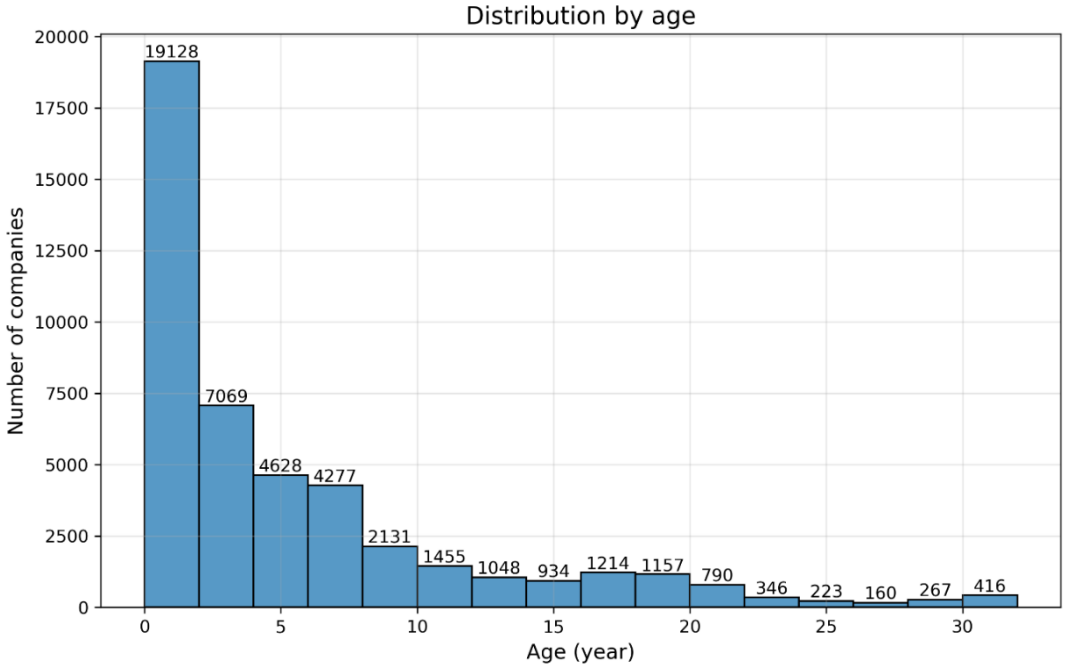


(Source: Own calculations. Individual tax returns of companies, compiled by listafirme.ro)

AGE DISTRIBUTION

Another important sectorial indicator is the age distribution of companies. As shown in Figure 5.7, in 2023, most companies were relatively young, 30 825 of them (68.1%) were created after 2018, and 38,006 (84%) were less than 10 years old. Meanwhile 5,518 companies (12.2%) are between 10 and 20 years old, and 1,719 (3.8%) were older than 20 years. The number of companies that were registered before 1993 is 416, making up 0.92% of all companies. It is worth noting that more than 42% of all active IT companies (19,128) were created in the last two years, between 2022 and 2023.

Figure 5.7. The age distribution of companies in 2023



(Source: Individual tax returns of companies, compiled by listafirme.ro)

When we compare company age with company size (Table 5.3), I clear pattern emerges: older companies usually have more employees, large companies having an average age 15.45, while micro enterprises are much younger, with an average age of 5.69 years.

Table 5.3. Age distribution of Romanian IT companies, by size (2023)

	Number of employees in 2023	**Age distribution (year)**			
		min	**mean**	**max**	**std**
Micro	0–9	0	5.69	32	6.61
Small	10 – 49	0	11.70	32	7.88
Medium	50 – 2490	0	13.09	32	7.96
Large	250+	0	15.45	32	8.51

(Source: Individual tax returns of companies, compiled by listafirme.ro)

5.2. CROSS-SECTIONAL ANALYSIS FOR 2011, 2017 AND 2023

In order to understand changes within the sector, we selected three representative points in the beginning, middle and end of the period (2011, 2017 and 2023) that could capture long-term trends of the examined period. There were several reasons for choosing these years.

- 2011 is part of the first innovation cycle, and also a year far enough from the negative effects of the 2008 global financial crisis. This means the data from that

year can reflect a more stable economic environment, making it a good starting point for comparisons.

- By 2017 the implementation of the is the second innovation cycle already begun, and also stands roughly halfway through the period. This would allow us to observe how the sector developed.
- While 2023 not only reflects the current situation, but is also part of the currently implemented innovation strategy of the country.

For each year we calculated the annual change for the most important indicators. In the case of 2017, 2015 was taken as the basis year), and we applied K-means cluster analysis to find groupings or patterns within our dataset.

ECONOMIC TRENDS IN THE IT SECTOR BASED ON COMPANY DATA (2010–2011, 2015–2017, AND 2022–2023)

Changes between 2010 and 2011

As shown in Table 5.4 for 2010 and 2011, the total turnover of the Romanian IT sector increased by 911.53 million RON. Of this growth, 41.4% (377.29 million RON) came from large companies, followed by small companies contributing 24.3% (221.82 million RON). There is also a clear difference in average turnover across company size groups, large companies earned more than 12 times the turnover of medium-sized firms on average, and many times more than that of small or micro enterprises.

During the same period, the total profit of IT companies rose by 141.78 million RON. Large companies were responsible for 41.20% of this increase (58.42 million RON), while micro enterprises with 2–9 employees contributed 19.6% (27.84 million RON) and those with 0–1 employee 19.3% (27.33 million RON).

Employment in the IT sector also grew, with 4,966 more people working in 2011 compared to 2010. Most of this growth came from large companies (2,212 employees, or 44.54%) and medium-sized companies (1,641 employees, or 33.0%). Small companies also played a role, adding 1,058 employees (21.3% of the increase). On average, large firms increased their workforce by 96 employees, medium-sized firms by 17, and small firms by 3 employees each.

Micro enterprises with 0 or 1 registered employee, however, showed a different trend. The number of people in this category decreased by 721, suggesting that many of these very small firms released their only employees in 2011.

Table 5.4. Change in total turnover, total profit and number of employees by size of companies in the 2010 – 2011 period

	Statistics	sum	mean	std	min	max
	Number of employees in 2011	Million RON	Million RON	Million RON	Million RON	Million RON
Total turnover (2011–2010)						
Micro	0–1	32.51	0.01	0.17	-4.50	2.34
Micro	2–9	150.86	0.09	0.82	-10.65	20.32
Small	10–49	221.82	0.62	3.33	-17.32	44.89
Medium	50– 249	129.06	1.33	6.27	-33.80	17.03
Large	250+	377.29	16.40	30.12	-25.73	109.62
Total		911.53	0.17	2.56	-33.80	109.62
Total profit (2011–2010)						
Micro	0–1	27.33	0.01	0.07	-1.02	1.33
Micro	2–9	27.84	0.02	0.23	-2.32	7.14
Small	10–49	4.98	0.01	1.47	-21.53	11.40
Medium	50– 249	23.20	0.24	1.29	-5.04	5.01
Large	250+	58.42	2.54	5.76	-6.91	19.37
Total		141.78	0.03	0.60	-21.53	19.37
Number of employees (2011–2010)						
Micro	0–1	-721	-0.23	1.25	-39	1
Micro	2–9	776	0.45	1.66	-20	9
Small	10–49	1 058	2.98	7.24	-24	44
Medium	50– 249	1 641	16.92	30.20	-71	135
Large	250+	2 212	96.17	95.17	-62	322
Total		4 966	0.92	10.15	-71	322

(Source: Individual tax returns of companies, compiled by listafirme.ro)

Changes between 2015 and 2017

As shown in Table 5.5, between 2015 and 2017 the total turnover of active companies in Romania increased by 4,331.57 million RON. This number is four times larger than the increase recorded in the previously analyzed period. More than half of this growth came from large companies, indicating that their expansion was significantly stronger than in 2010–2011.

During the same period, the total profit of the IT sector grew by 508.53 million RON. Although this amount is higher than in the earlier period, profits grew slower than turnover. When broken down by company size, a different pattern appears: micro enterprises with 2–9 employees recorded the largest profit increase (151.12 million RON, or 29.7%), followed by micro firms with 0–1 employees (127.57 million RON, or 25.1%) and small companies (100.40 million RON, or 19.7%). Large companies, which had led in profit growth during 2010–2011, moved to fourth place, contributing 17.9% of the total profit increase. Average figures offer a more nuanced view. Large companies still are

ranked first in average profit per firm, but their profitability declined significantly compared to 2010–2011, their average profit falling from 2.54 million to 1.75 million RON.

Employment growth continued to accelerate. Between 2015 and 2017, the total number of employees increased by 14,678, which is about three times higher than the one registered in the previous period. Large companies accounted for 57.3% of this increase (adding 8,406 employees), followed by medium-sized companies, which contributed 25.2% of the total growth. On average, large companies each hired 162 new workers, which is almost double the number in 2010–2011, while medium-sized companies added an average of 21 employees each. Micro-enterprises with 0 or 1 employee continued to decrease their employees, 1,177 such firms letting go of their only employee during this period.

Table 5.5. Change in total turnover, total profit and number of employees by size of companies in the 2015–2017 period

	Statistics	sum	mean	std	min	max
	Number of employees in 2017	Million RON	Million RON	Million RON	Million RON	Million RON
Total turnover (2017 - 2015)						
Micro	0–1	131.61	0.02	0.46	-15.42	11.03
Micro	2–9	397.31	0.17	1.37	-11.15	32.69
Small	10–49	692.20	1.08	5.96	-42.30	73.54
Medium	50– 249	931.65	5.39	10.47	-61.40	52.66
Large	250+	2 178.79	41.90	54.97	-112.99	244.62
Total		4 331.57	0.45	5.57	-112.99	244.62
Total profit (2017 - 2015)						
Micro	0–1	127.57	0.02	0.34	-8.77	20.01
Micro	2–9	151.12	0.06	0.56	-6.51	16.88
Small	10–49	100.40	0.16	2.43	-8.77	45.16
Medium	50– 249	38.40	0.22	3.58	-12.53	35.65
Large	250+	91.04	1.75	6.56	-20.94	26.19
Total		508.53	0.05	1.01	-20.94	45.16
Number of employees (2017 - 2015)						
Micro	0–1	-1 177	-0.19	1.29	-40	1
Micro	2–9	886	0.38	7.70	-346	10
Small	10–49	2 864	4.45	11.00	-117	39
Medium	50– 249	3 699	21.38	38.96	-148	150
Large	250+	8 406	161.65	268.22	-619	1099
Total		14 678	1.54	24.17	-619	1099

(Source: Individual tax returns of companies, compiled by listafirme.ro)

Changes between 2022 and 2023

As shown in Table 5.6, the IT sector continued to expand in terms of total turnover, growing by 11,465.81 million RON between 2022 and 2023. The largest contribution came from large companies (4,610.62 million RON), but their share of the total turnover

decreased compared to the previous periods, reaching only 40.2%. This change can be partly explained by the expanding performance of micro enterprises, which recorded a sharp increase in turnover. Micro firms with 0–1 employees grew by 1,711.48 million RON (14.9%), while those with 2–9 employees by 1,263.91 million RON (11.0%).

When looking at total profit, the trend is very different. Micro and small firms became the main contributors in terms of total profit, micro companies with 0–1 employees accounted for 226.93 million RON (54.8%), small companies for 152.44 million RON (36.8%), and micro companies with 2–9 employees for 143.28 million RON (34.6%). In contrast, medium and large companies did not manage to increase their profits compared to the previous year.

Regarding employment, the sector added 6,192 new jobs in the 2022–2023 period. Although this suggest a continued grow of the sector in terms of human resources, the pace of growth slowed down considerably compared to previous years. Nearly 80% of the new jobs were created by large and medium-sized companies, while micro enterprises with 0–1 employee continued their previously observed decline, 1,338 firms in this category renouncing to their only employee.

Table 5.6. Change in total turnover, total profit and number of employees by size of companies in the 2022–2023 period

	Statistics	**sum**	**mean**	**std**	**min**	**max**
	Number of employees	**Million RON**	**Million RON**	**Million RON**	**Million RON**	**Million RON**
Total turnover (2023–2022)						
Micro	0–1	1 711.48	0.07	1.82	-39.43	259.76
Micro	2–9	1 263.91	0.30	3.14	-41.31	136.70
Small	10–49	1 801.31	1.95	7.38	-60.98	99.76
Medium	50– 249	2 078.50	6.86	12.69	-27.27	108.03
Large	250+	4 610.62	53.00	189.65	-97.11	1702.97
Total		11 465.81	0.38	10.87	-97.11	1702.97
Total profit (2023–2022)						
Micro	0–1	226.93	0.01	1.24	-169.92	64.05
Micro	2–9	143.28	0.03	1.53	-16.59	82.36
Small	10–49	152.44	0.16	2.62	-17.23	45.76
Medium	50– 249	-12.48	-0.04	5.46	-46.86	20.41
Large	250+	-95.72	-1.10	14.79	-57.29	64.89
Total		414.45	0.01	1.65	-169.92	82.36
Number of employees (2023–2022)						
Micro	0–1	-1 338	-0.05	5.79	-630	1
Micro	2–9	1 001	0.24	2.17	-75	10
Small	10–49	1 583	1.71	7.53	-82	36
Medium	50– 249	2 308	7.62	21.74	-74	124
Large	250+	2 638	30.32	252.58	-584	1969
Total		6 192	0.20	14.8	-630	1969

(Source: Individual tax returns of companies, compiled by listafirme.ro)

Overall, data from the three examined periods show that the Romanian IT sector has experienced steady and continuous growth in turnover, profit, and employment. However, the sources and structure of this growth have changed over time. While large companies initially played the leading role, in recent years micro and small enterprises have become increasingly important, both in terms of profit generation and adaptability. At the same time, employment growth remains strongly driven by large and medium-sized firms.

CLUSTER ANALYSIS OF ROMANIAN IT COMPANIES FOR 2011, 2017 AND 2023

In our cluster analysis, we included six variables: turnover, profit, equity capital, social capital, number of branches, and the county where the company is registered. For the last variable, we created an ordinal scale ranging from 1 to 7, reflecting the level of research and development (R&D) activity in each county. Counties with the lowest R&D activity were placed in category 1, while those with the highest were assigned to category 7.

Looking at the cross-sectional statistics of Romanian IT companies in 2023 based on these variables (Table 5.7), we can observe a quite wide variation across all indicators. The most significant differences appear in profitability and turnover, as some companies are even operating at a loss. On average, firms employ 4.39 people, with the largest one having 4,372 employees. Most companies do not have branches in other counties, although the maximum recorded number of branches is 102. The average company age is 5.02 years, while the oldest company has been active for 32 years.

Table 5.7. Company statistics of Romanian IT companies for 2023

		Sum	Average	Standard Deviation	Minimum	Maximum
Turnover	Million RON	64 389.35	1.77	21.54	-0.67	1 702.97
Profit	Million RON	9 589.10	0.26	2.03	-81.22	184.69
Number of employees	Number	159 232.00	4.39	56.36	0.00	4 372.00
Fixed assets	Million RON	11 146.26	0.31	6.98	-0.05	1 105.42
Current assets	Million RON	33 493.21	0.92	9.15	-0.13	589.90
Receivables	Million RON	20 532.56	0.57	6.30	-0.01	494.67
Equity	Million RON	22 690.00	0.63	7.46	-79.51	906.42
Social capital	Million RON	3 004.39	0.08	4.14	0.00	689.09
Branches	Number	-	0.14	0.83	0	102.00
Age	Number	-	5.02	6.56	0	32.00
County range by RDI expenditure	Number	-	5.17	2.14	1	7.00

(Source: Own calculations. Individual tax returns of companies, compiled by listafirme.ro)

Since the variance of each variable was very high, we used the logarithmed values of the financial indicators (turnover, profit, equity capital, and social capital) to reduce skewness and minimize the influence of outliers. To do this, we excluded companies with negative turnover or profit values. Because outliers were more frequent among microenterprises, we included only companies with at least 10 employees in the analysis. We then applied K-means clustering to the remaining dataset, which consisted of 556 companies in 2011, 1,035 in 2017, and 1,459 in 2023.

In each of the three years, three clusters emerged. We named the first cluster "Leaders", representing the most developed companies based on their financial indicators. The second cluster was labeled "Followers", and the third "Laggers", as it included companies with the weakest financial performance.

As shown in Table 5.8, in 2011, five IT companies were categorized as Leaders, 28 as Followers, and 523 as Laggers. Financial indicators such as turnover, profit, equity capital, and social capital were highest among Leaders and lowest for Laggers. Interestingly, companies in the second cluster had the most branches, followed by those in the first cluster. All firms belonging to Cluster 1 were located in counties with the highest R&D activity.

In 2017, the number of companies in the first two clusters decreased to three and 27, while the third cluster included 97.1% of all firms. The characteristics of these clusters remained consistent with 2011: turnover, profit, equity capital, and social capital continued to be highest in Cluster 1, followed by Cluster 2 and Cluster 3. All companies in Cluster 1 were located in the most R&D-developed counties, while Cluster 2 still had the highest average number of branches, although the difference between Clusters 1 and 2 had narrowed.

By 2023, several changes were observed. The number of companies in Cluster 1 increased to 12, and in Cluster 2 to 87, while Cluster 3 still contained the majority of firms (93.21%). Although the general pattern of cluster characteristics remained the same, Cluster 1 now included companies that stood out not only for their financial indicators but also for a higher number of branches. The geographical distribution of companies became more diverse, as not all firms were locaded in counties with the highest R&D activity.

Table 5.8. K-means cluster analysis of small, medium and large profitable companies

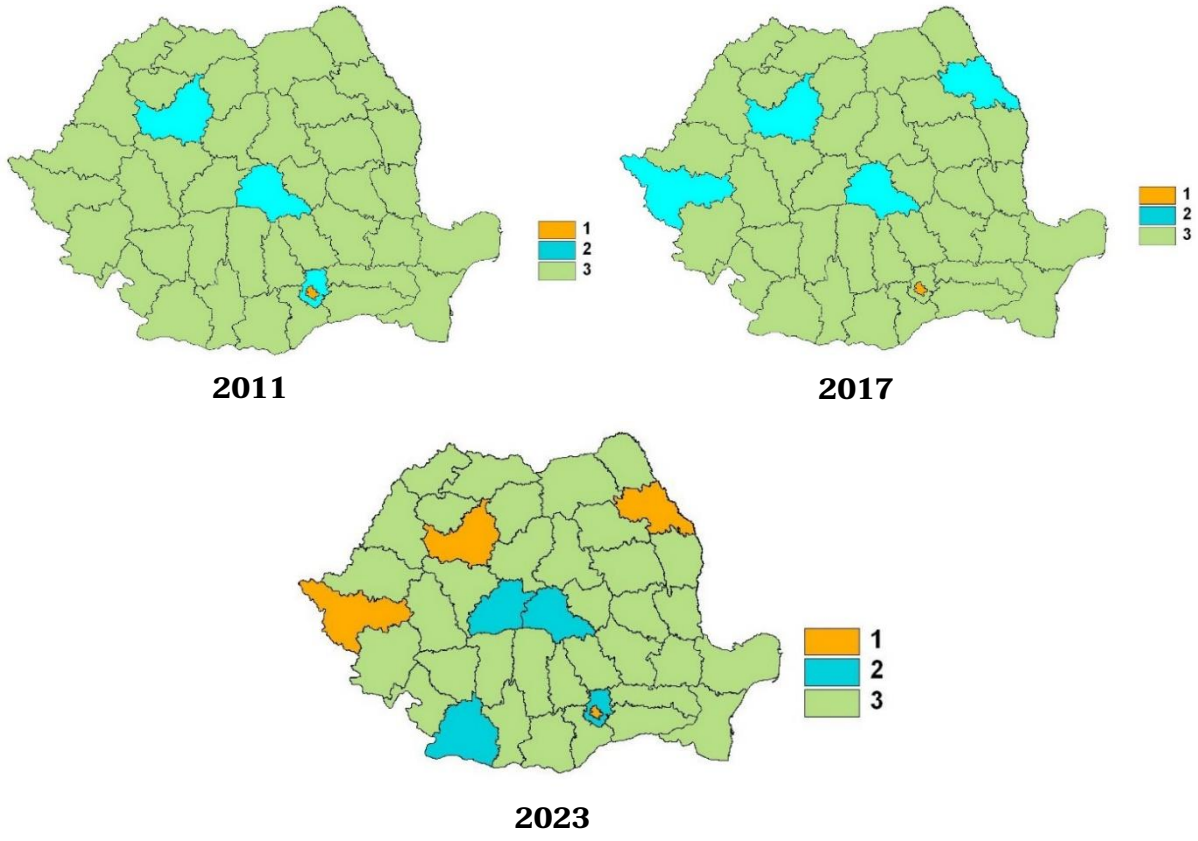
Cluster name	Companies Nr.	Companies %	Turnover*	Profit*	Equity capital*	Social capital*	Nr. of branches	County order
2011								
Cluster 1: Leaders	5	0.9	19.58	16.54	18.02	13.39	2.80	7.00
Cluster 2: Followers	28	5.04	17.82	14.89	16.31	12.83	4.32	6.71
Cluster 3: Laggers	523	94.06	14.82	11.99	13.36	8.35	1.09	5.54
Total	556	100.00	15.01	12.20	13.56	8.62	1.27	5.61
2017								
Cluster 1: Leaders	3	0.29	20.60	16.86	18.20	12.60	4.33	7.00

Cluster name	Companies Nr.	Companies %	Turnover*	Profit*	Equity capital*	Social capital*	Nr. of branches	County order
Cluster 2: Followers	27	2.61	18.85	16.19	17.31	12.32	4.89	6.59
Cluster 3: Laggers	1 005	97.10	15.26	12.72	13.78	8.22	1.04	5.76
Total	1 035	100.00	15.37	12.83	13.89	8.34	1.15	5.78
2023								
Cluster 1: Leaders	12	0.82	20.59	17.41	19.14	15.10	6.25	6.58
Cluster 2: Followers	87	5.96	18.99	16.05	17.29	11.98	2.06	6.69
Cluster 3: Laggers	1 360	93.21	15.93	13.49	14.51	8.36	0.94	5.76
Total	1 459	100.00	16.15	13.68	14.73	8.63	1.05	5.82

** Logarithmed values of company indicators*

After defining the clusters, we analyzed their spatial distribution in a second step. As shown in Figure 5.8, in 2011 and 2017, all leading IT companies (those belonging to Cluster 1) were located in Bucharest. This pattern changed by 2023, when companies in this top category were found across four locations: Bucharest, Cluj, Iași, and Timiș. These regions can be regarded as the main hubs of the Romanian IT sector, as they accounted for 83.26% of the total turnover and 80.19% of total employment in 2023 (Table 5.9).

Figure 5.8. The IT companies' cluster membership by their headquarters by county in 2011, 2017 and 2023



(Source: Own calculation, based on data of individual tax returns of companies, compiled by listafirme.ro)

Table 5.9 also presents the characteristics of the Followers, companies grouped in Cluster 2. These firms were mainly located in Brașov, Cluj, and Ilfov in 2011; in Brașov, Cluj, Iași, and Timiș in 2017; and in Brașov, Dolj, Ilfov, and Sibiu in 2023. In that year, this cluster accounted for 5.58% of the total turnover and 6.69% of total employment in the sector.

In other words, the analysis, by using statistical methods, illustrates the progress of certain counties, such as Iași and Timiș, which evolved from being "Laggards" in 2011 to "Followers" in 2017 and "Leaders" by 2023. It also shows the advancement of Cluj from the Follower category in 2011 and 2017 to Leader in 2023, and the stagnation of the IT sector in Brașov (see Figure 5.9).

Table 5.9. The cumulative turnover and employment of the companies in Leaders (Cluster 1) and Followers (Cluster 2) counties

Year	Cluster 1 counties	Turnover (Million RON)	Total turnover (Million RON)	Number of employees	Total employees
Cluster 1: Leaders					
2011	Bucharest	5 099.63	5 099.63	21 341	21 341
2017	Bucharest	11 743.20	11 743.20	44 982	44 982
2023	Bucharest	33 250.09	53 608.47	72 973	127 682
	Cluj	10 488.81		27 301	
	Iași	3 068.85		11 466	
	Timis	6 800.72		15 942	
Cluster 2: Followers					
2011	Brașov	230.47	795.56	1 794	6 383
	Cluj	562.04		4 560	
	Ilfov	3.04		29	
2017	Brașov	587.98	5 074.17	3 070	3 070
	Cluj	2 821.81		14 000	
	Iași	850.37		5 527	
	Timiș	814.01		4 777	
2023	Brașov	1 722.04	3 594.12	4 645	10 646
	Dolj	530.21		1 814	
	Ilfov	42.42		93	
	Sibiu	1 299.45		4 094	

(Source: Own calculations. Individual tax returns of companies, compiled by listafirme.ro)

5.3. THE FUTURE OF THE IT SECTOR, A QUALITATIVE INSIDER PERSPECTIVE

The 2024–2025 period brought significant policy changes that likely had a major impact on the IT sector. Romania eliminated several fiscal incentives that had previously supported

the industry, while competition with other countries continued to intensify. Since no company-level data was available for the period after 2023, we carried out a series of interviews to better understand the internal dynamics of the Romanian IT sector. Although these interviews may not fully represent the entire industry, they offer valuable insights into the expectations and perspectives of professionals regarding the sector's future.

Our interviewees agreed that in terms of employees, in the past two years we can observe a structural transformation in the IT sector. While on a global level everybody talks about large-scale layoffs the value of highly qualified experts have raised, leading to stricter selection and recruitment processes. The layoffs affected mostly junior and less experienced professionals and those working in the B2B segment. Another characteristic of this transformation is that those affected were connected to bigger firms through external collaborations. In other words, we cannot necessarily talk about simple staff-reduction, but an optimization in human resources, ensuring that top-tier professionals remain active in ongoing projects.

Another change was generated by the spread of Artificial intelligence in the daily work of IT specialists. AI is changing productivity dynamics in IT work, meaning that tasks previously requiring large teams can now be handled by fewer specialists using AI copilots and automation tools. This reduce time spent on research and repetitive tasks radically. These tools are not yet perfect, still errors and "bugs" are frequent, therefore, the oversight of skilled programmers is still demanded.

Interviewees agreed that Romania has predominantly an outsourcing-based IT sector, thus, such trends heighten competition, especially since many global IT firms look for cheaper labor markets, like India or Brazil. Furthermore, in the post-COVID transformation of the sector, due to remote work teams became more international and less tied to local offices. In other words, IT activity is not concentrated exclusively in key cities such as Cluj, Bucharest, Iași, Timișoara or Brașov.

In conclusion, in relation to the changes in the Romanian IT sector after 2023, we can draw attention to some important phenomena, that need further research: the spread of home office developed in the post-COVID period generated structural changes, in which higher knowledge is more valued and the dismissal of lower-skilled workers are continuous. The use of AI assistants is increasing, reducing the number of lower-level programmers needed for projects. Most companies from the Romanian IT sector live from outsourcing, which tightens their competition with the IT-sectors of counties with cheaper labor force, such as India or Brazil.

5.4. SUMMARY

Between 2008 and 2023, the IT sector in Romania was a dynamic and profitable industry. Firm-level data from more than 45,000 companies reveal important structural patterns that both confirm and deepen the macroeconomic findings of previous chapters. In the researched period, the sector expanded at a remarkable pace, both in the number of active firms and in financial and employment terms. The number of IT companies increased from around 5000 in 2008 to more than 36 thousand in 2023, while total turnover grew more than tenfold to over 64 billion RON in 2023. Asset accumulation and profitability followed similar trends, underlining a solid capital foundation and the sector's long-term sustainability. The development of the sector accelerated even more in the post-2016 period, indicating that the sector became a structural pillar of Romania's economy.

Despite its remarkable financial growth, the sector's structure is highly polarized. Micro-enterprises (0–9 employees) account for more than 96% of all IT firms, reflecting a strong fragmentation of production units and the growing prevalence of one-person firms and independent contractors. This pattern is linked to an outsourcing-driven model in which large companies externalize work to small entities or freelancers rather than expanding internal staff. The prevalence of these practices has increased flexibility in labor allocation but also limits firms' capacity for long-term knowledge accumulation.

The geographical analysis confirms a high degree of spatial concentration. Bucharest remains the uncontested national leader, followed by Cluj, Timiș, and Iași. Cluster analysis shows that, while in 2011 Bucharest was the sole "Leader" county, by 2023 Cluj, Iași, and Timiș joined this category. Large parts of the country, however, remain underdeveloped, many counties do not host medium-sized or large firms.

Comparative analyses for 2011, 2017, and 2023 reveal important structural changes. While in 2011 large firms dominated turnover and profit generation, after 2017, micro and small enterprises became the main drivers of growth, while large companies remained central in employment creation.

Employment in IT rose from about 28,000 in 2008 to nearly 160,000 by 2023, although in the most recent period, growth slowed and hiring became more selective. The position of highly qualified professionals has become more stable, however entry-level and routine positions are being reduced. The diffusion of telework and digital collaboration since COVID-19 further internationalized labor relations, decoupling many Romanian professionals from the domestic labor market.

6. CONCLUSIONS

The main goal of this report was to examine the situation of the IT sector in Romania, a field often described as one of the country's most dynamic and innovative economic branches. To achieve this, we critically analyzed Romania's policies on research, development, innovation (RDI), and digitalization, and we explored how these policies are connected to the IT sector's growth. Furthermore, we assessed the IT sector's role within the national economy and conducted a firm-level analysis covering nearly 45,000 companies.

Romania's approach to RDI and digitalization fits to what Tyfield et al. (2017) call the *"knowledge economy credo."* Policymakers tend to assume that RDI activities are key drivers of economic progress and that public support for research and innovation will automatically translate into overall economic and social development. Accordingly, innovation policies have framed technological advancement primarily as a tool for competitiveness and economic growth, while social and environmental goals have remained secondary and largely rhetorical.

Digitalization is viewed as a strategic pillar for both innovation and economic development. The IT sector is therefore considered a central driver of modernization, a catalyst for competitiveness, innovation, and digital governance, as well as a facilitator of societal transformation and well-being. Between 2007 and 2024, the Romanian state granted substantial fiscal and policy advantages to companies operating in information technology.

Despite policy expansion, however, the proportion of innovative firms declined dramatically after EU accession, falling from around one-third in 2008 to below 9% in 2022. This suggests that strategic reforms and innovation policies failed in stimulating innovation activity at an enterprise level. Moreover, innovation is highly concentrated among large firms located in the Bucharest–Cluj–Timiș axis, while micro- and small enterprises, particularly in peripheral regions, show very limited engagement in innovation. Within this overall context of modest innovation performance, the IT sector is one of Romania's most innovative sectors, although it has slipped from a leading position in 2018 to sixth or seventh place in more recent rankings.

Regarding the IT sector itself, existing literature widely agrees that Romanian IT is competitive, strongly export-oriented, and heavily reliant on outsourcing and foreign demand. Our analysis supports these conclusions. Input–output tables reveal that while the IT sector generates significant value added, it maintains weak backward and forward linkages with other sectors of the economy. This indicates an enclave-like structure rather than an industry with broad domestic spillover effects. Firm-level data also show that

although the number of IT companies has risen sharply, most of these firms (over 95%) are micro-enterprises. This points to a fragmented, outsourcing-based ecosystem rather than a cohesive innovation network.

A second key finding concerns the geographic concentration of the IT sector. Previous studies highlighted that most IT firms are located in Romania's most innovative regions, such as Bucharest, Cluj, Iași, and Timiș. Our firm-level results confirm this pattern, showing the central role of Bucharest, and how Cluj, followed by Timiș and Iași, have become major growth poles, the four regions accounting for the majority of the sector's turnover and profits. Over the past 25 years, a large number of firms, responsible for the growth of the sector, concentrated in these urban centers, while most other Romanian regions still lack even a single medium-sized IT company.

Overall, the IT sector has clearly benefited from a favorable policy environment and has become a leading contributor to Romania's economic growth. Yet, a closer look reveals a more nuanced picture, one marked by enclave-type development, internal dependencies, and growing inequalities. The strength and economic contribution of the IT sector is unquestionable. However, its weak linkages with other sectors mean that, despite its large contribution to GDP, its integration into global economy, its connection to the national economy remains limited. In other words, the sector's success does not automatically translate into broader economic benefits and cannot be considered a driving force for other economic sectors.

Moreover, by 2023, micro-enterprises were the main drivers of growth in the sector, reflecting an outsourcing-based model rather than a genuine innovation engine. This observation casts doubt on the effectiveness of Romania's RDI and digitalization policies. Although the turnover and profit of these firms is high, it is mostly due to subcontracting and tax-driven competitiveness and not innovation or R&D investment.

As we could see, the largest and most successful IT firms are concentrated in a few major cities, meaning that economic gains are distributed very unevenly across society and regions, both in terms of employment opportunities and tax revenues. Consequently, the benefits of policy incentives targeting the IT sector have not contributed evenly to national development. Instead, they have reinforced regional disparities and concentrated advantages in specific urban centers, raising important questions about fairness and equity in Romania's overall innovation and development strategy.

In conclusion, the evolution of Romania's IT sector presents a dual reality. On one hand, central pillar of modernization and a key driver of the country's global economic integration. On the other hand, its benefits are unevenly distributed, and its long-term sustainability remains uncertain. Moreover, public policies have rather reinforced, than reduced existing inequalities.

Future research should explore these processes in greater depth. Particularly how IT companies have used fiscal incentives and subsidies, and how their gradual withdrawal influenced the sector's performance. It is also important to understand why certain regions have succeeded in catching up while others have stagnated or failed, and what the IT landscape looks like in less developed parts of the country. In addition, further studies could examine whether IT sector growth generates positive spillovers for surrounding industries and sectors or local administrations on a local level.

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8. APPENDIX

Table A1. The turnover of innovative enterprises by activities 2012–2022

		2002		2004		2006		2008		2010		2012	
		Million RON	%	Million RON	%	Million RON	%	Million RON	%	Million RON	%	Million RON	%
Total	Total	185 533.70	100	298 028.92	100	457 951.76	100	648 366.73	100	580 659.53	100	667 323.19	100
	Industry	111 690.93	100	177 381.62	100	222 258.15	100	305 773.78	100	304 241.05	100	366 835.83	100
	Extractive industry	11 395.72	100	14 554.86	100	20 915.69	100	27 614.98	100	24 407.50	100	29 384.53	100
	Manufacturing industry	78 646.00	100	131 687.24	100	165 032.08	100	221 816.16	100	220 195.55	100	268 402.67	100
	Electric, thermal energy, gas and water	21 649.21	100	31 139.53	100	36 310.37	100	:	100	:	100	:	100
	Electricity, therm. energy and gas prod. and supply	:	100	:	100	:	100	45 713.66	100	46 552.32	100	53 840.58	100
	Water dist., san., waste management	:	100	:	100	:	100	10 628.98	100	13 085.69	100	15 208.05	100
	Services	73 842.77	100	120 647.30	100	235 693.62	100	342 592.95	100	276 418.49	100	300 487.37	100
Innovators	Total	77 051.45	41.53	135 533.47	45.48	219 737.31	47.98	391 459.50	60.38	339 489.60	58.47	267 691.82	40.11
	Industry	57 235.43	51.24	96 092.13	54.17	118 633.84	53.38	203 327.03	66.5	193 010.92	63.44	171 589.62	46.78
	Extractive industry	9 691.95	85.05	11 289.72	77.57	5 663.61	27.08	23558.69	85.31	18 335.84	75.12	24 903.38	84.75
	Manufacturing industry	41 410.50	52.65	68 762.12	52.22	91 217.60	55.27	150 685.83	67.93	139 952.05	63.56	112 603.13	41.95
	Electric, thermal energy, gas and water	6 132.98	28.33	16 040.29	51.51	21 752.63	59.91	:	:	:	:	:	:
	Electricity, therm. energy and gas prod. and supply	:	:	:	:	:	:	24 634.94	53.89	30 138.21	64.74	29 253.95	54.33
	Water dist., san., waste management	:	:	:	:	:	:	4 447.57	41.84	4 584.82	35.04	4 829.15	31.75
	Services	19 816.02	26.84	39 441.35	32.69	101 103.47	42.9	188 132.48	54.91	146 478.68	52.99	96 102.20	31.98

		2014		2016		2018		2020		2022	
		Million RON	%	Million RON	%	Million RON	%	Million RON	%	Million RON	%
Total	Total	800 965.59	100	864 765.52	100	967 479.08	100	1 038 747.57	100	1 497 944.21	100
	Industry	383 713.24	100	408 150.88	100	516 877.78	100	493 614.79	100	789 543.82	100
	Extractive industry	27 085.91	100	20 082.71	100	28 042.21	100	24 774.81	100	24 542.78	100
	Manufacturing industry	293 559.73	100	324 980.51	100	417 404.96	100	392 362.90	100	616 363.81	100
	Electric, thermal energy, gas and water	:	100	:	100	:	100	:	100	:	100
	Electricity, therm. energy and gas prod. and supply	50 245.64	100	51 787.53	100	56 400.73	100	60 699.69	100	125 235.87	100
	Water dist., san., waste management	12 821.97	100	11 300.13	100	15 029.88	100	15 777.39	100	23 401.36	100
	Services	417 252.34	100	456 614.64	100	450 601.30	100	545 132.78	100	708 400.39	100
Innovators	Total	250 620.88	31.29	200 181.38	23.15	284 229.49	29.38	276 699.41	26.64	370 690.27	24.75
	Industry	157 006.43	40.92	102 813.74	25.19	176 307.49	34.11	165 328.71	33.49	257 784.86	32.65
	Extractive industry	21 518.74	79.45	12 973.61	64.6	17 723.79	63.2	14 484.29	58.46	269.66	1.1
	Manufacturing industry	112 797.11	38.42	83 658.45	25.74	132 946.89	31.85	119 811.58	30.54	214 285.04	34.77
	Electric, thermal energy, gas and water	:	:	:	:	:	:	:	:	:	:
	Electricity, therm. energy and gas prod. and supply	20 522.13	40.84	5 508.95	10.64	23 595.68	41.84	29 487.59	48.58	41 244.23	32.93
	Water dist., san., waste management	2 168.46	16.91	672.74	5.95	2 041.13	13.58	1 545.25	9.79	1 985.92	8.49
	Services	93 614.45	22.44	97 367.63	21.32	107 922.00	23.95	111 370.69	20.43	112 905.41	15.94

Table A2. The number of employees in innovative enterprises by activities 2012–2022

		2002		2004		2006		2008		2010		2012	
		1000 pers.	%	1000 pers.	%	1000 pers.	%	1000 pers.	%	1000 pers.	%	1000 pers.	%
Total	Total	2 671.94	100	2 454.04	100	2 454.92	100	2 461.92	100	1949.25	100	2035.97	100
	Industry	2 062.24	100	1 871.48	100	1 666.32	100	1 630.38	100	1259.82	100	1290.17	100
	Extractive industry	148.08	100	140.86	100	105.38	100	82.42	100	65.69	100	55.92	100
	Manufacturing industry	1 702.51	100	1 568.25	100	1 426.90	100	1 387.27	100	1036.34	100	1074.23	100
	Electric, thermal energy, gas and water	211.66	100	162.38	100	134.04	100	:	100	:	:	:	:
	Electricity, therm. energy and gas prod. and supply	:	:	:	:	:	:	87.97	100	81.91	100	77.88	100
	Water dist., san., waste management	:	:	:	:	:	:	72.72	100	75.89	100	82.15	100
	Services	609.7	100	582.56	100	788.6	100	831.54	100	689.43	100	745.8	100
Innovators	Total	1 065.22	39.87	996.14	40.59	999.56	40.72	1 250.92	50.81	978.72	50.21	722.35	35.48
	Industry	860.02	41.7	794.85	42.47	650.46	39.04	847.72	52	599.27	47.57	458.32	35.52
	Extractive industry	95.66	64.6	109.92	78.04	34.63	32.86	64.33	78.05	37.45	57.01	28.66	51.26
	Manufacturing industry	707.31	41.55	631.96	40.3	557.91	39.1	708.25	51.05	488.3	47.12	363.28	33.82
	Electric, thermal energy, gas and water	57.05	26.95	52.97	32.62	57.93	43.22	:	:	:	:	:	:
	Electricity, therm. energy and gas prod. and supply	:	:	:	:	:	:	38.08	43.29	42.12	51.43	45.74	58.74
	Water dist., san., waste management	:	:	:	:	:	:	37.06	50.96	31.4	41.38	20.64	25.12
	Services	205.21	33.66	201.3	34.55	349.1	44.27	403.21	48.49	379.45	55.04	174.18	23.35

		2014		2016		2018		2020		2022	
		1000 pers.	%	1000 pers.	%	1000 pers.	%	1000 pers.	%	1000 pers.	%
Total	Total	2031.2	100	2087.09	100	2 107.41	100	1 969.43	100	1 973.54	100
	Industry	1279.61	100	1297.27	100	1 282.80	100	1 160.35	100	1 130.09	100
	Extractive industry	44.98	100	38.15	100	34.4	100	33.99	100	23.95	100
	Manufacturing industry	1081.51	100	1112.05	100	1 104.24	100	983.17	100	968.28	100
	Electric, thermal energy, gas and water	:	:	:	:	:	:	:	:	:	:
	Electricity, therm. energy and gas prod. and supply	73.73	100	68.35	100	63.87	100	62.68	100	58.26	100
	Water dist., san., waste management	79.39	100	78.72	100	80.29	100	80.52	100	79.61	100
	Services	751.6	100	789.82	100	824.62	100	809.08	100	843.44	100
Innovators	Total	470.66	23.17	338.09	16.2	521.93	24.77	421.64	21.41	380.12	19.26
	Industry	331.41	25.9	211.88	16.33	296.09	23.08	241.47	20.81	218.08	19.3
	Extractive industry	25.22	56.06	15.12	39.63	12.6	36.63	10.81	31.82	0.27	1.14
	Manufacturing industry	261.95	24.22	188.26	16.93	259.37	23.49	206.91	21.05	198.16	20.47
	Electric, thermal energy, gas and water	:	:	:	:	:	:	:	:	:	:
	Electricity, therm. energy and gas prod. and supply	28.38	38.5	3.8	5.56	12.29	19.24	15.09	24.07	13.61	23.35
	Water dist., san., waste management	15.87	19.99	4.7	5.96	11.83	14.73	8.66	10.75	6.05	7.59
	Services	139.24	18.53	126.22	15.98	225.84	27.39	180.17	22.27	162.03	19.21

Table A3. Share of innovative enterprises by NUTS2 region in Romania

NUTS2 region		2002		2004		2006		2008		2010		2012		2014		2016		2018		2020		2022	
		Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
Total	Romania	23 404	100.0	26 024	100.0	28 488	100.0	29 979	100.0	26 330	100.0	28 866	100.0	28 380	100.0	28 809	100.0	28 776	100.0	27 196	100.0	26 986	100.0
	North-West	3 574	100.0	3 907	100.0	4 288	100.0	4 561	100.0	3 986	100.0	4 926	100.0	4 393	100.0	4 482	100.0	4 461	100.0	4 325	100.0	4 326	100.0
	Center	3 530	100.0	3 637	100.0	4 026	100.0	4 305	100.0	3 663	100.0	3 955	100.0	3 937	100.0	3 946	100.0	3 878	100.0	3 744	100.0	3 703	100.0
	North-Est	2 881	100.0	3 030	100.0	3 226	100.0	3 293	100.0	2 711	100.0	3 028	100.0	3 080	100.0	3 063	100.0	3 196	100.0	2 988	100.0	3 022	100.0
	South-Est	2 636	100.0	2 695	100.0	3 026	100.0	3 158	100.0	2 856	100.0	3 037	100.0	3 029	100.0	3 009	100.0	2 903	100.0	2 716	100.0	2 654	100.0
	South	2 301	100.0	2 559	100.0	2 883	100.0	3 135	100.0	2 784	100.0	3 007	100.0	3 056	100.0	3 108	100.0	3 177	100.0	3 064	100.0	3 138	100.0
	Bucharest-Ilfov	4 420	100.0	6 007	100.0	6 394	100.0	6 669	100.0	6 166	100.0	6 397	100.0	6 407	100.0	6 801	100.0	6 640	100.0	6 133	100.0	5 953	100.0
	South-West	1 581	100.0	1 466	100.0	1 686	100.0	1 856	100.0	1 632	100.0	1 844	100.0	1 754	100.0	1 774	100.0	1 834	100.0	1 704	100.0	1 706	100.0
	West	2 481	100.0	2 723	100.0	2 959	100.0	3 002	100.0	2 532	100.0	2 672	100.0	2 724	100.0	2 626	100.0	2 687	100.0	2 522	100.0	2 483	100.0
Innovative enterprises	Romania	3 983	17.02	5 171	19.87	6 013	21.11	9 986	33.31	8 116	30.82	5 968	20.67	3 645	12.84	2 925	10.15	4 198	14.59	2 900	10.66	2 380	8.82
	North-West	440	12.31	675	17.28	909	21.20	1 260	27.63	1 106	27.75	593	12.04	401	9.13	592	13.21	940	21.07	386	8.92	411	9.50
	Center	764	21.64	712	19.58	808	20.07	1 316	30.57	896	24.46	838	21.19	463	11.76	280	7.10	429	11.06	409	10.92	362	9.78
	North-Est	607	21.07	688	22.71	862	26.72	1 554	47.19	1 154	42.57	974	32.17	444	14.42	424	13.84	436	13.64	357	11.95	177	5.86
	South-Est	395	14.98	923	34.25	1 307	43.19	1 409	44.62	1 054	36.90	1 108	36.48	560	18.49	508	16.88	313	10.78	99	3.65	132	4.97
	South	391	16.99	458	17.90	573	19.88	961	30.65	919	33.01	520	17.29	353	11.55	132	4.25	201	6.33	169	5.52	164	5.23
	Bucharest-Ilfov	848	19.19	1 145	19.06	990	15.48	2 388	35.81	2014	32.66	1 186	18.54	1 129	17.62	714	10.50	1 691	25.47	1 248	20.35	976	16.4
	South-West	247	15.62	216	14.73	235	13.94	482	25.97	504	30.88	365	19.79	120	6.84	57	3.21	81	4.42	68	3.99	45	2.64
	West	291	11.73	354	13.00	329	11.12	616	20.52	469	18.52	384	14.37	175	6.42	218	8.30	107	3.98	164	6.50	111	4.47

(Source: Own calculations, INSSE database)

Table A4. The distribution of total Romanian IT companies by counties, in 2023

County	Total	Micro	Small	Medium	Large
AB	359	355	4	0	0
AG	620	611	7	2	0
AR	479	471	8	0	0
B	11 383	10 776	409	150	48
BC	431	429	2	0	0
BH	1 042	1 015	21	6	0
BN	286	284	2	0	0
BR	176	176	0	0	0
BT	164	159	4	1	0
BV	1 423	1 379	27	14	3
BZ	223	221	2	0	0
CJ	4 352	4 155	126	56	15
CL	106	106	0	0	0
CS	107	107	0	0	0
CT	717	709	8	0	0
CV	165	160	5	0	0
DB	371	369	2	0	0
DJ	759	745	9	4	1
GJ	234	229	4	1	0
GL	505	490	12	1	2
GR	137	136	1	0	0
HD	274	270	3	1	0
HR	338	331	7	0	0
IF	2 175	2 142	29	3	1
IL	113	112	1	0	0
IS	1 967	1 856	84	23	4
MH	73	73	0	0	0
MM	466	452	11	3	0
MS	726	699	21	5	1
NT	289	281	7	1	0
OT	204	201	3	0	0
PH	887	871	14	2	0
SB	812	769	28	13	2
SJ	215	212	2	1	0
SM	313	305	7	1	0
SV	412	405	6	1	0
TL	93	92	0	1	0
TM	2 041	1 948	62	20	11
TR	139	136	3	0	0
VL	325	319	6	0	0
VN	214	213	1	0	0
VS	162	160	2	0	0

(Source: Own calculations. Individual tax returns of companies, compiled by listafirme.ro)

Table A5. The distribution of total Romanian software development companies by counties, in 2023

Jud	Micro	Small	Medium	Large	Missing data
AB	220	4	0	0	67
AG	346	4	2	0	91
AR	282	5	0	0	73
B	5 850	220	98	33	1 586
BC	191	1	0	0	59
BH	636	9	2	0	143
BN	195	1	0	0	57
BR	83	0	0	0	21
BT	97	2	1	0	29
BV	851	20	12	2	243
BZ	98	1	0	0	30
CJ	3 102	92	48	14	760
CL	59	0	0	0	14
CS	57	0	0	0	16
CT	362	3	0	0	92
CV	84	2	0	0	16
DB	206	2	0	0	58
DJ	501	6	4	1	135
GJ	117	3	0	0	25
GL	275	7	1	0	67
GR	72	0	0	0	17
HD	159	1	1	0	46
HR	182	6	0	0	40
IF	1 154	12	0	1	294
IL	67	1	0	0	20
IS	1 258	55	16	2	392
MH	35	0	0	0	12
MM	294	9	2	0	121
MS	450	12	3	1	102
NT	166	5	1	0	49
OT	105	3	0	0	26
PH	433	9	1	0	108
SB	469	23	10	1	134
SJ	144	2	1	0	44
SM	190	4	0	0	59
SV	251	3	0	0	92
TL	49	0	1	0	9
TM	1 250	42	17	8	393
TR	65	2	0	0	19
VL	189	2	0	0	27
VN	120	0	0	0	28
VS	89	1	0	0	22

(Source: Own calculations. Individual tax returns of companies, compiled by listafirme.ro)

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