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FOSTERING INNOVATION IN ROMANIA. INSIGHTS FROM THE SMART SPECIALIZATION STRATEGIES

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Abstract:

Innovation has invariably been a precursor to development and competitiveness, while creating (at least temporary) barriers to differentiate between its leaders and its laggards. Although Europe is ranked the second most innovative region in the world, the EU faces a significant innovation divide, that is attenuating its footprint on the global competitiveness arena and weakening its mission of enhancing the wellbeing of all Europeans. The EU's goal of the twin (green and digital) transition brings innovation (in its broadest sense) in the spotlight, while the EU Cohesion Policy (aiming to remedy the disparities between countries and regions) heavily relies on the smart specialization strategy as main methodology for reinforcing national and regional innovation eco-systems. In this context, the objectives of the paper are: (1) to explore Romania's innovation performance (and profile over time) within the EU and identify the strengths and weaknesses of Romania's innovation ecosystem – based on the analysis of the European Innovation Scoreboard (EIS) data; (2) to examine and assess how Romania and its eight development regions address the innovation challenges through their smart specialization strategies 2021(2)-2027 – based on the content analysis of the (national and regional) S3s using QDA Miner v6.0.

Key words: *EIS/RIS; innovation divide; innovation performance; QDA Miner; Romania; smart specialization strategy (S3/RIS3).*

1. Introduction and Background

Innovation (in its broadest sense) has driven and accompanied the evolution of humankind since the dawn of time. While rewarding its champions with (at least temporary) competitive advantages, **innovation** has also penalized the laggards (up to their extinction, if referring to businesses) and created (sometimes difficult to close) development gaps (if referring to regions/countries). The uneven patterns and paths innovation has adopted (across geographies) and followed (throughout history) have led to a currently quite

heterogenous (global) innovation landscape (UNCTAD, 2021; WIPO, 2021). Additionally, some of the defining features nowadays innovation exhibits – unprecedented pace (fueled by technological advancements and basically impacting every aspect of the economic and social life), intensifying diffusion/adoption rate and increasing democratization/openness – bring more complexity to this picture. Within this dynamic framework, the ability "to catch up through technological learning, imitation and innovation" (UNCTAD, 2021) is becoming more crucial than ever to reduce the risks of widening the gaps and inequalities between and within countries. From the bird's eye view it looks like North America and Europe continue to be well ahead of other regions in terms of innovation; ranked the second most innovative region globally, Europe is home to 16 economies that are innovation leaders (i.e., in the top 25) (WIPO, 2021). However, the ground level view reveals a more nuanced reality: the EU faces a significant innovation divide that is impeding its ability to boost its competitiveness and economic presence on the global arena and weakening its mission to improve the wellbeing of all Europeans, regardless of where they live (Rodríguez-Pose, 2020).

Addressing the issue of "Promoting innovation ecosystems and tackling the **innovation divide across the EU**", the New European Innovation Agenda (European Commission, 2022): (a) scrutinizes the main challenges (deep regional disparities in research and innovation performance; increasing of innovation divide; sub-optimal diffusion of innovations and adoption of breakthrough technologies; unexploited potential in and high concentration of regional innovation ecosystems; lack of incentives, experience and resources in less developed regions); (b) pinpoints the ripple effects of the innovation performance gaps (declines in economic growth, connectivity and income; rising inequality; lessening of overall performance of the EU's innovation ecosystem and hampering cohesiveness across the EU); and (c) reiterates the importance of **Smart Specialization Strategies (S3/RIS3)** as "EU's principal methodology for reinforcing national and regional innovation eco-systems", which lay the foundations for the expected EUR 56 billion in ERDF (European Regional Development Fund) assistance for research and innovation over the years 2021–2027 (European Commission, 2022).

Basically, **smart specialization** "defines a virtuous process of diversification through the local concentration of resources and capabilities in a certain number of new domains that represent possible paths for the transformation of productive structures" (Foray, 2016); these kinds of transformative processes can be either spontaneous (if the local agents possess the needed skills and motivations) or catalyzed by a dedicated **strategy/policy** (Foray, 2016). The innovation-based structural transformations anticipated by smart specialization strategies are intended to eventually produce new competitive advantages (for regions/countries) in new/modernized sectors by utilizing local strengths and opportunities; but, in order for the S3 approach to be successful, it must adhere to three key principles: "(a) concentrate on specific priorities; (b) concentrate not on structures (…) but on the transformation of these structures; (c) favor a logic of bottom-up and decentralized discovery" (Foray, Eichler, & Keller, 2021). Therefore, despite what may seem like a slight paradoxical, the smart specialization approach is particularly important for those regions/countries that are less advanced in the key fields of science or technology, because the smart specialization strategies "encourage investment in programs that will complement

the country's other productive assets to create future domestic capability and interregional comparative advantage" (Foray et al., 2009).

The S3 concept was introduced by the European Commission "in the EU Cohesion Policy 2014-2020 as an 'ex-ante conditionality' for European regions to obtain funding for research and innovation from the ERDF" (Interreg Europe, 2020). For the 2021-2027 programming period of the EU's Cohesion Policy, the European regions were required to update their S3 and address 'seven enabling conditions': "(1) up-to-date analysis of bottlenecks for innovation diffusion, including digitalization; (2) existence of competent regional / national institution or body, responsible for the management of the smart specialization strategy; (3) monitoring and evaluation tools to measure performance towards the objectives of the strategy; (4) effective functioning of entrepreneurial discovery process; (5) actions necessary to improve national or regional research and innovation systems; (6) actions to manage industrial transition; (7) measures for international collaboration" (Interreg Europe, 2020).

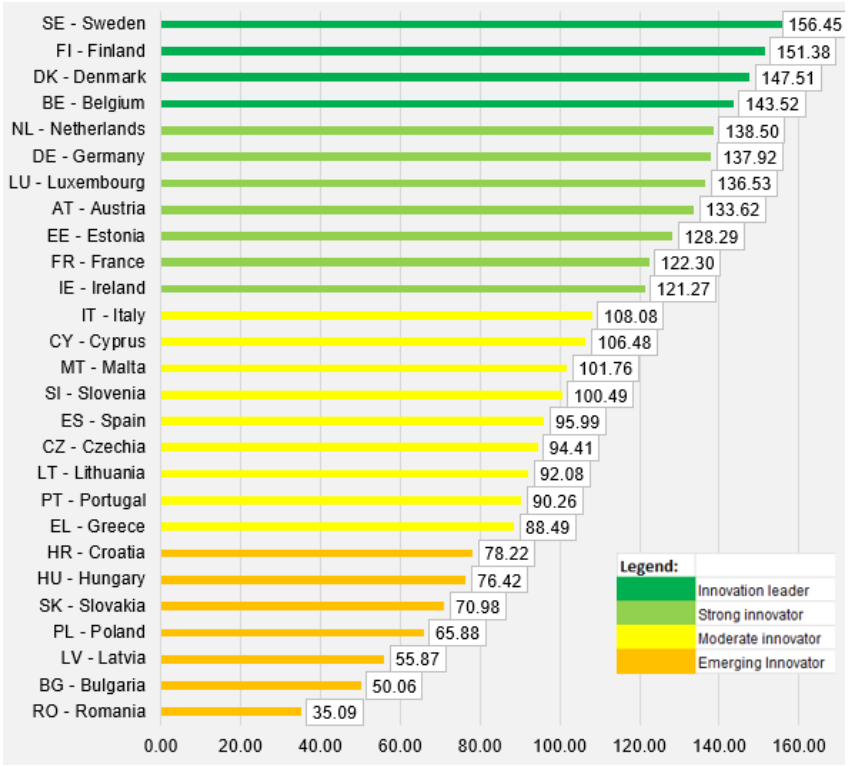
Against this background, the paper is focusing on two main questions: How does Romania (and its development regions) perform in terms of innovation? and How do Romania's national and regional smart specialization strategies foster innovation? Consequently, the objectives of the paper are: (1) to explore Romania's innovation performance (and profile over time) within the EU and identify the strengths and weaknesses of Romania's innovation ecosystem – based on the analysis of the European Innovation Scoreboard (EIS) data; (2) to examine and assess how Romania and its eight development regions address the innovation challenges through their smart specialization strategies – based on the content analysis of the (national and regional) S3s using QDA Miner v6.0.

1. Romania's Innovation Performance within the European Union

Each year, the European Innovation Scoreboard (**EIS**) **assesses and compares the research and innovation performance** of the EU Member States. By identifying the relative **strengths** and **weaknesses** of those systems EIS aids the EU countries in determining the **intervention areas** and **initiatives** needed to enhance their innovation performance. EIS 2021 uses **4** main types of **activities** (**1.** Framework conditions – the main drivers of innovation performance external to the firm; **2.** Investments – made in both the public and business sector; **3.** Innovation activities **–** in the business sector; and **4.** Impacts – effects of enterprises' innovation activities) and **12** innovation **dimensions** to capture a total of **32 indicators**. Basically, the dimensions and indicators used for the EIS largely coincide with the **key areas and main drivers** that contribute to a **well-balanced and effective** (in all respects) **innovation system** that the **countries performing at a high level in terms of innovation** need: "an appropriate level of public and private **investment** in education, research and skills development, effective innovation **partnerships** among companies and with academia, as well as an innovation-friendly **business environment**, including strong digital infrastructure and skills" (European Commission, 2021-2). The Summary Innovation Index assigns equal weight and a similar number of indicators to each of the main groups; every indicator has the same weight inside each category (Hollanders, 2021-1).

EIS 2021 reveals (Figure 1) four performance groups in terms of EU countries' innovation performance: **Innovation Leaders** (countries whose innovation performance is above 125% of the EU average: Sweden, Finland, Denmark, and Belgium), **Strong Innovators** (countries whose innovation performance is between 100% and 125% of the EU average: Netherlands, Germany, Luxembourg, Austria, Estonia, France, and Ireland), **Moderate Innovators** (countries whose innovation performance is between 70% and 100% of the EU average: Italy, Cyprus, Malta, Slovenia, Spain, Czechia, Lithuania, Portugal, and Greece), and **Emerging Innovators** (countries whose innovation performance is below 70% of the EU average: Croatia, Hungary, Slovakia, Poland, Latvia, Bulgaria, and **Romania**) (European Commission, 2021-2).

Figure 1. Summary Innovation Index – EU countries, 2021

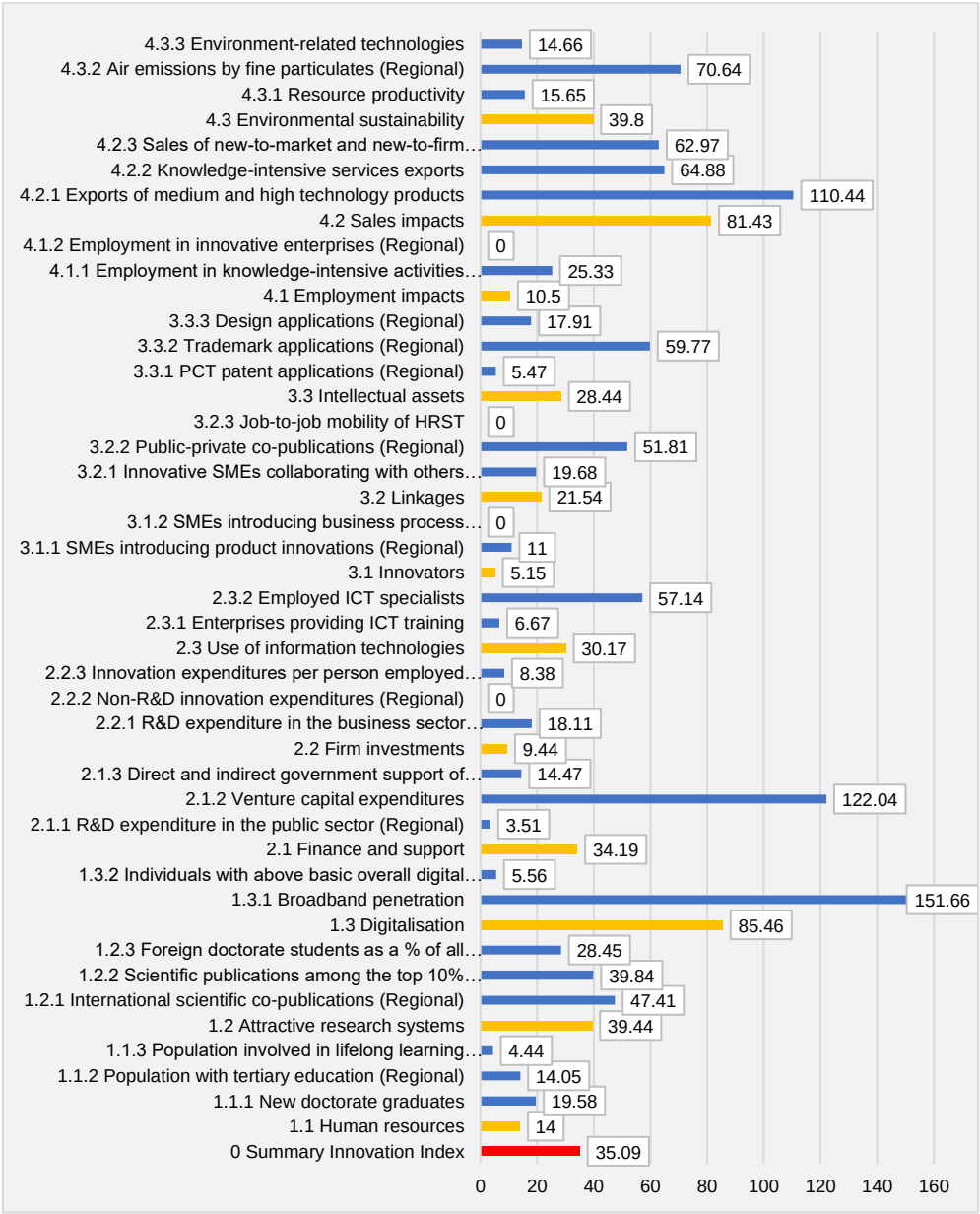


Source: own representation, based on EIS 2021 data (https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis)

A 35.09 Summary Innovation Index places **Romania** the last among the EU countries. Its innovation profile (Figure 2) shows an Emerging Innovator, whose only better than the EU countries' average indicators are **Broadband penetration** (151.66 score), **Venture capital expenditures** (122.04 score), and **Exports of medium and high technology products** (110.440 score). Unfortunately, the relative advantage of Broadband penetration is far from being fully capitalized, as **Individuals with above basic overall digital skills** scores very low (5.56); however, the two indicators make **Digitalization** the best ranked dimension in Romania's innovation index (85.46 score). On the other hand, the **Sales Impact** dimension (81.43 score) is the most balanced one (beside ranking the second

overall) – gathering **Knowledge-intensive services exports** (64.88 score), and **Sales of new-to-market and new-to-firm innovations** (62.97 score) – in addition to Exports of medium and high technology products. As regards the third best indicator – Venture capital expenditures – it is a component of the **Finance and support** dimension, that only scores 34,19 – due to the low performance in terms of **Direct and indirect government support of business R&D** (14.47 score) and an even lower one as regards **R&D expenditure in the public sector** (3.51 score).

Figure 2. Innovation Profile – Romania, 2021

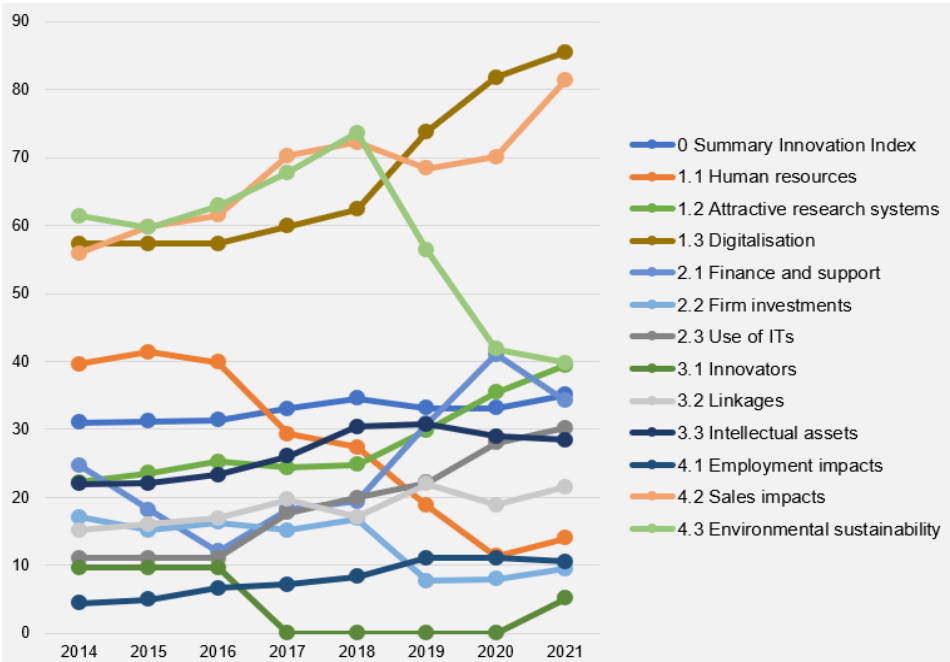


Source: own representation, based on EIS 2021 data (https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis#)

The most problematic dimensions, having the lowest scores (bellow 20) are: (i) **Innovators** (5.15 score) – grouping **SMEs introducing product innovations** (scoring 11), and **SMEs introducing business process innovations** (scoring 0); (ii) **Firm investments** (9.44 score) – bringing together **R&D expenditure in the business sector** (scoring 18.11), **Non-R&D innovation expenditures** (scoring 0), and **Innovation expenditures per person employed** (scoring 8.38); (iii) **Employment impacts** (10.50 score) – gathering **Employment in knowledge-intensive activities** (scoring 25.33), and **Employment in innovative enterprises** (scoring 0), and (iv) **Human resources** (14.00 score) – bringing together **New doctorate graduates** (scoring 19.58), **Population with tertiary education** (scoring 14.05), and **Population involved in lifelong learning** (scoring 4.44).

The remaining four dimensions are scoring between 20 and 40: (a) **Linkages** (21.54 score) – referring to **Innovative SMEs collaborating with others** (19.68 score), **Public-private co-publications** (51.81 score), and **Job-to-job mobility of HRST** (0 score); (b) **Intellectual assets** (28.44 score) – evaluated through the following indicators: **PCT patent applications** (scoring 5.47), **Trademark applications** (scoring 59.77), and **Design applications** (scoring 17.91); (c) **Use of information technologies** (30.17 score) – composed by **Enterprises providing ICT training** (6.67 score) and **Employed ICT specialists** (57.14 score), and (d) **Attractive research systems** (39.44 score) – evaluated through the following indicators: **International scientific co-publications** (47.41 score), **Scientific publications among the top 10% most cited** (39.84 score), and **Foreign doctorate students as a % of all doctorate students** (28.45 score).

Figure 3. Romania - innovation profile over time (2014-2021)



Source: own representation, based on EIS-RIS 2021 data (https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis#)

Although very low, Romania's Summary Innovation Index 2021 (35.09) has slightly improved over time (since 2014 – when evaluated at 31.00). If considering its dimension (Figure3): **Digitalization** (measuring "the level of digital technologies") and **Sales impact** (measuring "the economic impact of innovation") are the only ones that have constantly scored over 55.00 (from 57.36 in 2014 to 85.46 in 2021, and from 55.93 to 81.43 respectively).

Following a promising start (while increasing from 61.44 in 2014 to 73.61 in 2018), **Environmental sustainability** (capturing "improvements to reducing the negative impact on the environment") has dropped in 2021 to 39.80; **Human resources** (measuring "the availability of a high-skilled and educated workforce") registered quite a dramatic decrease – from 39.62 in 2014 to only 14.00 in 2021; also decreases have been registered in terms of **Firm investments** (dimension including **"**indicators on R&D and Non-R&D investments that firms make to generate innovations**")** **–** from 17.14 in 2014 to 9.44 in 2021 – and **Innovators** (dimension "measuring the share of SMEs that have introduced innovations on the market or within their organizations") – whose score has decreased from 9.66 in 2014 to 5.15 in 2021.

The remaining six dimensions recorded (relatively) minor (given the gap to cover) improvements during the reference period: **Attractive research system** (measuring "the international competitiveness of the science") has increased its score from 22.27 in 2014 to 39.44 in 2021; **Finance and support** ("including private funding, R&D expenditures in universities and government research organizations and direct government funding and government tax support for business R&D") has risen from a 24.73 score in 2014 to 34.19 in 2021; **Use of Information Technologies** (capturing "the use of information technologies") has increased its score from 11.09 in 2014 to 30.17 in 2021; **Intellectual assets** (capturing "different forms of intellectual property rights generated by the innovation process") have risen their score from 21.99 in 2014 to 28.44 in 2021; **Linkages** ("measuring innovation capabilities") have increased from 15.13 in 2014 to 21.54 in 2021; and **Employment impacts** (measuring " the impact on employment") have advanced from 4.42 in 2014 to 10.50 in 2021.

When it comes to **Romania's eight (development) regions**, they are all Emerging Innovators, according to the Regional Innovation Scoreboard (RIS) 2021 (Hollanders, 2021-2). Scoring 56.9 for RII (Regional Innovation Index), București-Ilfov has the highest innovation performance, more than 3.4 times that of the lowest performer, Sud-Vest Oltenia (scoring 16.7 for RII). In the same time, București-Ilfov is the only region in the "Emerging Innovators +" performance subgroup (of regions with innovation performance between 52.1% and 70% of EU average) all the other seven regions being "Emerging Innovators -" (as their performance is below 34.1% of EU average) – and the region whose 2021 innovation performance relative to the EU in 2014 has improved the most. Modest improvements also registered Nord-Vest, Vest, Centru, Sud-Vest Oltenia and Sud-Muntenia, while Sud-Est and Nord-Est have declined in 2021 in terms of their innovation performance relative to the EU in 2014 (Table 1).

Table 1. Innovation performance in Romania – by regions

NUTS Region	RII 2021/2014	RII 2021/2021	Rank 2021	Change	Performance Subgroup
RO11 Nord-Vest	36	31.4	232	9.2	Emerging Innovator -
RO12 Centru	30.04	26.5	235	5.4	Emerging Innovator -
RO21 Nord-Est	23.9	20.9	237	-1	Emerging Innovator -
RO22 Sud-Est	20	17.4	239	-2.7	Emerging Innovator -
RO31 Sud - Muntenia	20.7	18	238	1.3	Emerging Innovator -
RO32 Bucuresti - Ilfov	65.4	56.9	197	12.4	Emerging Innovator +
RO41 Sud-Vest Oltenia	19.2	16.7	240	4.4	Emerging Innovator -
RO42 Vest	34.8	30.3	233	8.8	Emerging Innovator -

RII 2021/2014: performance in 2021 relative to that of the EU in 2014. RII 2021/2021: performance in 2021 relative to that of the EU in 2021. Rank: rank performance in 2021 across all regions (240 European regions considered). Change: performance change calculated as the difference between the performance in 2021 and 2014 relative to that of the EU in 2014.

Source: own representation, based on (Hollanders, 2021-2) & RIS 2021 database

2. Addressing Romania's Innovation Challenges through Smart Specialization Strategies

The National Strategy for Research, Innovation, and Smart Specialization 2022-2027 (MCID, 2022) articulates Romania's **Vision 2030**, built on four (interconnected) pillars (corresponding to the strategy's four general objectives), each with its own (indicators and) targets (Table 2). If considering overall innovation performance (as mirrored in the EIS), Romania's goal is to become a **moderate innovator** (i.e., have an innovation performance between 70% and 100% of the EU average).

Table 2. Romania's National Strategy for Research, Innovation, and Smart Specialization 2022-2027 - main targets

Pillar / Indicator	Target
Romania develops, concentrates, and connects excellency to the scientific frontier and to societal challenges	
• Number of doctorate graduates in relation to the number of graduates from higher education	10% increase
• Researchers per one thousand employed persons	0.12 annual growth (from 2.0 currently to 3.2 in 2030)
• Number of "leader" researchers (as defined in the 'EU framework for research careers') working in Romania in 2030	20% increase
• Number of WoS indexed articles in relation to the number of researchers	Proportional increase
• Research productivity (articles/researchers)	Increase from 0.85 to 1
• Quality of knowledge production	
○ Articles in top 10% most cited articles	Increase from 7% to 10% (current EU average: 12%)
○ Articles in top 1% most cited articles	Increase from 04% to 0.6%
○ Number of triadic patents (as compared to 2021)	50% increase
There is a large mobilization of enterprises towards innovation	
• EIS performance	Achieving the status of Moderate Innovator
• Share of enterprises introducing new innovative products on the market	Increase from 2.9% to 6% (EU average in 2018: 13%)

• Share of innovative enterprises collaborating with research organizations	More than 7% (from 3.5% collaboration with universities and 1,5% collaboration with institutes in 2018)
• Number of public-private co-publications per one million inhabitants	Increase from 24.5 to 50 (current EU average: 95)
• Employment in innovative enterprises	Increase from 2.6% to 5% (EU average in 2018: 11.8%)
Innovation ecosystems associated with smart specializations support advancement in global value-added chains	
• Growth rates of employment, value added, and exports in ecosystems associated with smart specialization areas and benefiting from major projects	Twice as high - compared to the national average
Internationalization and European and international cooperation	
• Funding drawn from the Horizon Europe Program	Double - compared to funding drawn from Horizon 2020 (about 500 mill. euros between 2022 and 2027)
• Number of international scientific co-publications per one million inhabitants	Increase from 284 to 600 (current EU average: 1172)
• Public financing allocated to joint programs and European partnerships (including inter-regional investments in EU projects) – as percentage from the national public financing for R&D	Minimum 5%
• Bilateral collaborations are complementary to these interventions and contribute to networking capacity building	

Source: (MCID, 2022)

The National Strategy for Research, Innovation, and Smart Specialization 2022-2027 (National Strategy) – developed by the Ministry for Research, Innovation and Digitalization (MCID) – was designed to work in synergy with the eight regional Smart Specialization Strategies – developed by the respective Regional Development Agencies (ADR) (MCID, 2022). Therefore: (a) the smart specialization dimension of the **National Strategy** aims to set: the smart specialization areas of national priority (focusing on areas that could drive other sectors of the economy and society and for which the national dimension of collaboration is crucial); actions to be taken (to support the national smart specialization areas and the potential synergies with regional funds); and the areas of interregional thematic convergence (as basis for joint calls for projects between regions); (b) the role of each **regional S3** is to establish: the vision of regional development (through the lens of smart specialization); objectives and directions of action (to support the diffusion of innovation in regional ecosystems, the mobilization of collaborations between research organizations and industry in the field of experimental and applied research, as well as international interregional cooperation for RDI); regional areas of smart specialization (able to drive economic competitiveness and social development, as well as the twin - green and digital - transition); and the mechanisms that facilitate ongoing dialogue between the local players associated with smart specializations (in order to support the identification and development of joint ambitions, initiatives and projects) (MCID, 2022).

Basically, the development processes of S3s have followed the European Commission's guidelines and recommendations (as well as the analysis-formulation-implementation – AFI – framework of developing a strategy); the National Strategy has been elaborated in line with the European and national policies and strategies, with the regional

S3s serving as inputs for its smart specialization dimension. At the same time, the smart specialization areas (and their niches/sub-areas) (Table 3) have been identified (and/or updated/revised) as results of complex processes, due importance being given to the bottom-up approach (based on substantial participation and involvement of stakeholders) defining the entrepreneurial discovery process (MCID, 2022; ADR Nord-Vest, 2021; ADR Centru, 2021; ADR Nord-Est, 2021; ADR Sud-Est, 2021; ADR Sud-Muntenia, 2021; ADR Bucuresti-Ilfov, 2021; ADR Sud-Vest Oltenia, 2021; ADR Vest, 2021).

Table 3. Romania's S3 Smart Specialization Areas

Country level	Regional level
Bioeconomy (technologies for blue economy; improvement of seeds and breeds; technologies for eco-agriculture, agroecology, and forestry; agriculture 4.0; safe and sustainable food for healthy diet) **Digital economy and space technologies** (microelectronic devices and systems for smart products; networks of the future, communications, and IoT; technologies for spatial economy; XR technologies; AI systems; cybersecurity; traceability technologies; robots and cognitive agents) **Energy and mobility** (green mobility; modern technologies for low/zero emission energy generation; digitalization of energy; energy storage) **Advanced manufacturing** (manufacturing technologies for aeronautics; digitalization and robotization of manufacturing; advanced manufacturing technologies) **Advanced (functional) materials** (optoelectronics; smart composite materials; recyclable materials and technologies for materials recycling; materials for electronic, electric, photonic, magnetic, and sensoristic applications; biocompatible materials; materials for energy) **Environment and eco-technologies** (technologies for environmental monitoring and management, and pollution control) **Health – prevention, diagnosis, and advanced treatment** (precision surgery; new generation nuclear technologies for diagnosis and treatment; longevity medicine; early diagnosis; technologies for the autonomous life; e-health; personalized and genomic medicine; technologies for wearables)	**Nord-Vest:** Food; Cosmetics and food supplements; Health; New materials; Advanced production technologies; ICT
	Centru: Automotive and mechatronics industry; Aeronautical industry; Agri - food sector; Forestry, wood processing and furniture industry; Light industry; IT sector and creative industries; Health; Sustainable built environment; Tourism
	Nord-Est: Agri-food & wood industry; Energy; Environment; Textile; ICT; Health; Tourism
	Sud-Est: Engineering and shipping; Clothing industry; Agri-food and biotechnology; Aquaculture and fishing; Tourism; Information and communication technology
	Sud – Muntenia: Construction of machinery, components, and production equipment; Agriculture and food industry; Tourism and cultural identity; Bioeconomy: development of the circular economy; Smart localities that offer innovative services to citizens; High Technology Industry and Research; ICT; Health
	Bucuresti-Ilfov: Information and communication technology (ICT); Cultural and creative industries; Intelligent systems and components (electronics, optoelectronics, mechatronics, microelectronics, etc.); Advanced materials; New foods and food safety; Health
	Sud-Vest Oltenia: Transport systems; Industrial and materials engineering; Agri-food; Health and wellness; ICT and digitalization; Creative industries
	Vest: Agriculture and food industry; Energy efficiency and sustainable buildings; Manufacturing and manufacturing industry; Cultural and creative industries; ICT and automotive; Health and quality of life

Source: Romania's National and Regional Strategies for Smart Specialization

To further perform the analysis on the eight (regional) plus one (national) smart specialization strategies, QDA Miner v6.0 was used. QDA Miner is "an easy-to-use qualitative data analysis software package for coding textual and graphical data, annotating, retrieving and reviewing coded data, documents and images" (Provalis Research). The "software may be used to analyze interview or focus group transcripts, legal documents,

journal articles, speeches, and even entire books" (Péladeau, 2021); it is recommended for and used by researchers in the (broad) fields of business and management (Boiral et al., 2019; Sallis, et al., 2021; Tomazevic, 2019).

The (nine) documents containing the S3s were stored in QDA Miner. Coding was made following a management-based logic developed around both the strategies and the transformations they were aiming for, while considering the formal requirements and the literature recommendations regarding S3 designing. Thus, fifteen topics/items were selected and grouped within three categories, each made up of five codes (Figure 4): (1). **inputs** – including: *entrepreneurial discovery process* (*EDP*); *challenges*; *innovative potential*; *priority areas; targets and strategic objectives;* (2). **processes** – including: *transformation(s) / transition(s)*; *actions and interventions*; *smart specialization*; *innovative activities; governance, monitoring and evaluation*; and (3). **outputs** – including: *results*; *competitive advantage(s) and competitiveness; impact(s); innovation (eco)system; collaboration(s)*.

Figure 4. Tree structure of the categories and codes

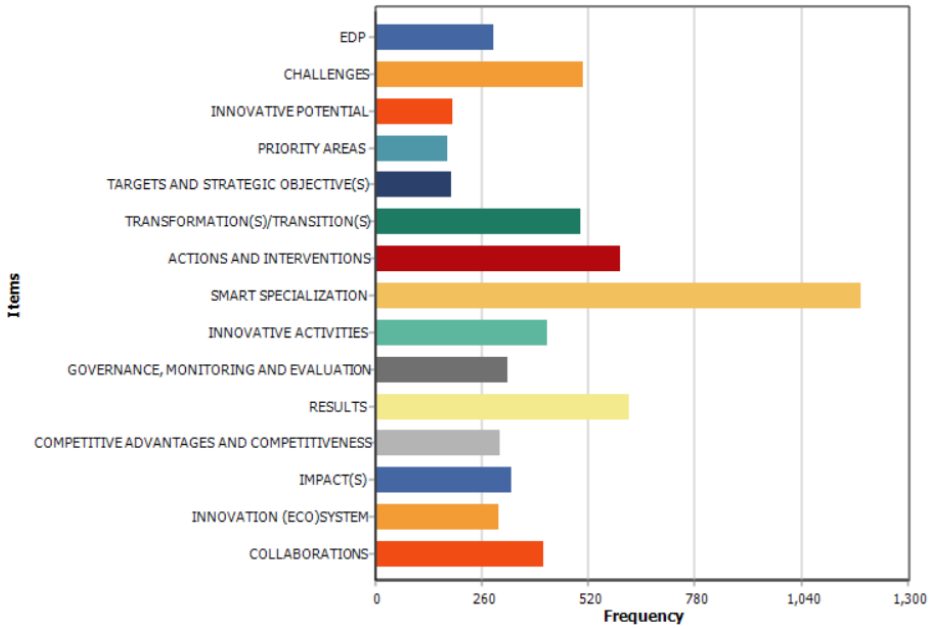
	Count	% Codes	Cases	% Cases
INPUTS				
EDP	285	4.5%	9	100.0%
CHALLENGES	502	8.0%	9	100.0%
INNOVATIVE POTENTIAL	185	2.9%	9	100.0%
PRIORITY AREAS	171	2.7%	9	100.0%
TARGETS AND STRATEGIC OBJECTIVE(S)	182	2.9%	9	100.0%
PROCESSES				
TRANSFORMATION(S)/TRANSITION(S)	496	7.9%	9	100.0%
ACTIONS AND INTERVENTIONS	595	9.5%	9	100.0%
SMART SPECIALIZATION	1183	18.8%	9	100.0%
INNOVATIVE ACTIVITIES	417	6.6%	9	100.0%
GOVERNANCE, MONITORING AND EVALUATION	319	5.1%	9	100.0%
OUTPUTS				
RESULTS	617	9.8%	9	100.0%
COMPETITIVE ADVANTAGES AND COMPETITIVENESS	301	4.8%	9	100.0%
IMPACT(S)	329	5.2%	9	100.0%
INNOVATION (ECO)SYSTEM	296	4.7%	9	100.0%
COLLABORATIONS	408	6.5%	9	100.0%

Source: own representation, using QDA Miner

The analysis of coding frequency (Figure 5) reveals the following Top 5 ranking of topics/codes (considering the number of times each code has been used):

Smart Specialization - is by far the dominant presence in S3s; it occurs in the nine S3s in association with concepts such as *national/regional strategy, EDP, policy, instrument, (strategic) priorities, potential, processes, (selection of) areas / domains / niches / sectors, (local) innovation (eco)systems, DIH (digital innovation hub)*, *governance structures, regional characteristics, regional development, industrial transition, entrepreneurship, programmes, competitiveness, reviewing of areas*, *survey*, *monitoring and evaluation*, but also with *(innovative) services, (product) innovation, digitalization*, *adoption of advanced technologies, projects, (industrial) parks, partnerships, clusters, platforms, financing, absorption of funding, training, skills and capabilities, development of competencies*, *centers of excellence for students*, *quality of education,* etc.

Figure 5. Coding Frequency: Distribution of codes



Source: own representation, using QDA Miner

Results, which include both the outputs of the S3s and those of other processes (particularly connected to research, technology, and innovation), come in second place, in relation to: *smart and sustainable economic transformation, indicators, absorption of funding, valorization/commercialization, high quality, research and development activity/projects, international recognition, propagation/multiplication effect, validation, transfer and applicability, implementation, increasing of visibility, tracking and evaluation systems, EDP, economic and context analysis, international visibility, S3 implementation*, *sustainability*, *open science*, *discovery of entrepreneurial actors, learning, universities,* etc.

Actions and Interventions is the third most frequent topic; basically, each S3 has an *Action plan* to address its objectives, built around specific *directions* – to *support smart specialization, diffusion of innovation, technological transfer, modernizing of SMEs technological capabilities, RDI infrastructure development, digital transformation, employees / researchers training, development and mobility, scientific and technological parks, innovative clusters / start-ups, regional partnerships, collaboration, synergies, participation in innovation networks, modernization and efficient use of RDI infrastructure,* etc., while the *Interventions* primarily consider the *intervention logic,* and the *support / assistance* needed in terms of *resources, implementation procedures, methods, testing/calibrating, scientific, economic, and societal impact, financing, impact, priorities, sectors,* etc.

Challenges refer to both specific (*innovation* and/or *smart specialization* related) aspects and broader ones (either *global, economic,* or *societal*) to be tackled (through innovation and/or smart specialization – the challenges being associated with: *innovation and technological advancements, new technologies, open science, innovation diffusion, fragmentation of innovation chain, sustainability of RDI structures, industrial competitiveness, regional development (policy), administrative and institutional capacity,*

labor market transition, changes in consumer behavior, new business and innovation models, EDP, etc. – but also to the *gaps* (between regions and between Romania and the EU average) – in terms of *productivity and competitiveness, (diffusion of) innovation / digitalization, SMEs robotization and digitalization, SMEs financing, research results, R-D spendings*, etc. – to be closed;

Transformation(s) / Transition(s) also address a variety of topics: *transformative factors* and *changes, smart and sustainable economic transformation, transformation through innovation, technological transformations, structural/industrial transformation, digital transformation, transformation of* specific *sectors/domains/areas* and organizations (from SMEs and large companies to public institutions and universities), *transformation of regional needs for competencies, socio-economic transformation, adjustment to (new) markets and needs, transformation of regional resources into high value products/services, transformation path, green and smart transition, transition to open science, industrial (and entrepreneurial) transition, transition to a knowledge-based economy*, etc.

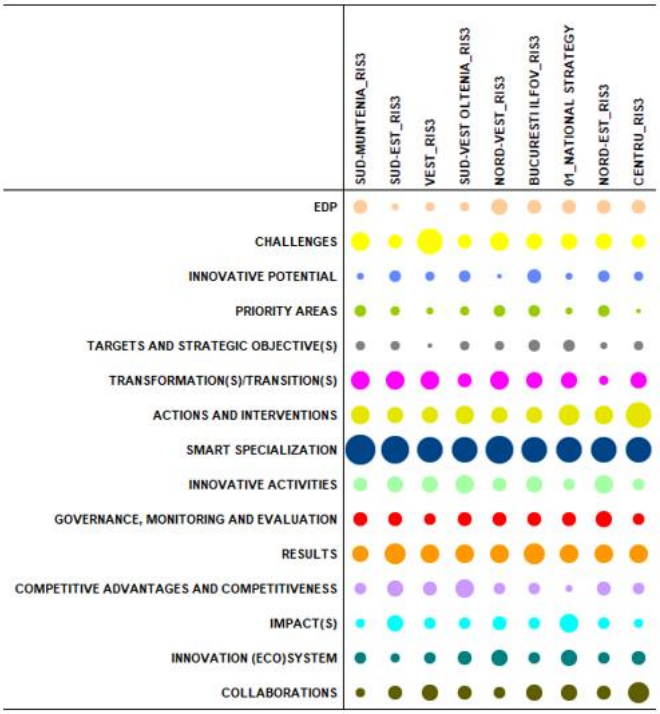
The second group of five items (considering their frequency in the S3s) is made of: **Innovative activities** – occurring in relation to: *innovation and technological centers* – and their needs for *top researchers, the low level of innovative activities in high value areas, integration in regional knowledge flows, connection with major societal challenges, barriers hindering innovations, innovative enterprises, research centers*, *supporting innovation activities in innovative clusters,* etc.; **Collaborations** – either *bi- or multi-lateral, regional, national and European*, *between research organizations (including universities) and the private sector, between and within clusters / smart specialization actors / innovation networks,* in *research, accelerating innovation and increasing competitiveness, scientific publications, creation of start-ups, participation in European mechanisms, local value-chains, joint research projects*, etc.; **Impact(s) –** of both the transformations envisioned and the S3s (including *impact indicators, monitoring and evaluation*): *regional/propagated, direct/indirect* impact of *research /* specific *industries* / *the fourth industrial revolution* / *policies* / *workforce dynamics / teleworking / innovations / new products*, on *society/economy/environment, wellbeing, economic / sustainable development, productivity, investments attractiveness, innovation absorption, mobility, energy*, etc.; **Governance, monitoring and evaluation –** basically, each S3 has dedicated chapters for *governance (ensuring of participation and engagement)* on the one hand (referring to *good/inclusive/smart/multilateral/sustainable governance, governance mechanisms/systems/structures/quality, innovative models of governance, large participation of stakeholders, coordination of regional and national governance*), and *monitoring and evaluation* on the other hand (*intermediary/final evaluation, mechanisms, instruments*, *indicators and goals, development of implementation, monitorization and evaluation systems, reviewing of S3, satisfying of predictability needs, facilitating monitoring, communicating the progress*, etc.); **Competitive advantages and competitiveness** – refer to both exiting competitive advantages (to be better capitalized upon) / disadvantages (to be overcome) and emergence of new competitive advantages (based on local strengths and opportunities) – through: *regional benchmarks, identification of areas/domains, development of new products, high qualified workforce, intensifying of R-D spendings / activities, re-technologization, adoption of innovative approaches*, etc. – and

results such as: *capitalizing on competitiveness potential, economic / industrial / SMEs / value chain competitiveness, competitiveness poles,* etc.

The third group gathers: **Innovation (eco)system** – is present in S3s in relation to: *indicators, consolidation/support/stimulation, capacity development, articulation to improve innovation capability, transformative effects, entrepreneurship, financing, supporting the actors, strategic implications, EDP, smart specialization areas, clusters, development of partnerships, digital innovation*, *ensuring access for researchers, stakeholders, promoters of innovative projects, knowledge exchange between regions,* etc.; **EDP** – finds its place within each S3, which emphasizes on what EDP is, why it is important, how it was unfolded, and what its results were, while discussing: *events/work-shops/focus groups, areas/niches of smart specialization, evaluation / reviewing of smart specialization areas, regional/national development, development of regional actors competencies, priorities, human capital, new technologies, identification of value chains* and *pilot projects*, etc.; **Innovative potential** – of *SMEs / start-ups / large companies* / advanced materials / *project applicants* within regions – is related to specific areas of *smart specialization, partnerships, development of researchers' entrepreneurial skills, increasing levels of regional innovation, competitive advantages, value-added creation, social impact, technological transfer, innovation diffusion, market impact, smart growth, digitalization*, etc.; **Targets and strategic objectives** are present in each S3, accompanied by or in correlation to: *instruments* (to achieve them), strategy *monitoring* and *evaluation* systems, *policy mix, operational objectives, strategic priorities / investments, smart specialization areas, result/impact indicators, projects, regional economy/development, digital connectivity,* upper-level (national/European) strategies and goals (i.e., sustainable development, smart Europe, green transition); **Priority areas** are identified, following specific *methodologies* (that also include *selection criteria* or *reviewing procedures*), at both national and regional levels, and addressed in association with topics such as: S3s' *strategic objectives, growth of regional economic competitiveness and attractiveness, focus of applied research, capitalization of research results, synchronization with educational offers, attraction of foreign investments, impact on the quality of life*, etc.

If taking a more focused approach, by looking at each of the nine smart specialization strategies through the lens of the above-mentioned topics, it is possible to see (Figure 6) the diversity of perspectives regarding the relative priority assigned to them in the S3s – e.g., EDP has the highest frequency rate in Nord-Vest_RIS3, Challenges are more frequently mentioned in Vest_RIS3, Innovative potential is mentioned the most in Bucuresti-Ilfov_RIS3, Priority areas – in Sud-Muntenia_RIS3 and Nord-Vest_RIS3; Targets and Strategic objectives – in National Strategy, Actions and Interventions – in Centru_RIS3, Smart Specialization – in Sud-Muntenia_RIS3, Innovative activities – in Nord-Est_RIS3, Governance, Monitoring and evaluation – in Nord-Est_RIS3, Results – in Sud-Est_RIS3, Competitive Advantages and Competitiveness – in Sud-vest Oltenia_RIS3, Impact(s) – in National Strategy, Innovation (Eco)System – in National Strategy, Collaborations – in Centru_RIS3.

Figure 6. Code frequency for file (Column percent)



Source: own representation, using QDA Miner

3. Discussion and Conclusions

The New European Innovation Agenda states that ”innovation is essential to drive Europe’s competitiveness and to ensure the health and well-being of its citizens. Innovation shapes markets, transforms economies, stimulates step changes in the quality of public services and is indispensable to achieve the overarching objectives of the twin green and digital transition” (European Commission, 2022). However, despite Europe being home to 16 economies that are innovation leaders (i.e., in the top 25), the EU faces a significant innovation divide, as EIS 2021 is revealing four performance groups in terms of innovation performance.

A 35.09 Summary Innovation Index according to EIS 2021 places Romania (an Emerging Innovator) the last among the EU countries. An in-depth analysis of Romania’s innovation profile highlights quite severe gaps (compared to the EU countries’ average) in all the four dimensions of EIS. Out of the 12 indicators, only four score higher than the Summary Innovation Index (Digitalization, Sales impacts, Environmental sustainability, and Attractive research systems), while the others (Finance and support, Use of information technologies, Intellectual assets, Linkages, Human resources, Employment impacts, Firm investments, and Innovators) register very low values. Moreover, there is no obvious trend of the indicators' improvement when looking at the dynamics (2014–2021). If considering Romania's eight (development) regions, they are all Emerging Innovators; scoring 56.9 for RII, București-Ilfov has the highest innovation performance, more than 3.4 times that of the lowest performer, Sud-Vest Oltenia (scoring 16.7 for RII).

Within this framework, the paper explored Romania's eight (regional) plus one (national) smart specialization strategies, whose role in reinforcing the national and regional innovation eco-systems has been reiterated by the European Commission into the New European Innovation Agenda. The analysis considered the 2021(2)-2027 national and regional S3s; prior studies have analyzed earlier strategic approaches (programming periods) on Romania's smart specialization (strategy) and/or have been focused on specific areas of interest (Healy, 2016; Gheorghiu et al., 2017; Ranga, 2018; Scutaru, Prelipcean, & Cozorici, 2019; Șerbănică, 2021).

Basically, the National Strategy (for Research, Innovation and Smart Specialization 2022-2027) - targeting, in terms of innovation performance, the status of moderate innovator for Romania - has been elaborated in line with the European and national policies, with the regional S3s serving as inputs for its smart specialization dimension. Thus, the smart specializations areas at national level were designed to support the development of emerging technologies with cross-cutting impact on local industries and particularly on regional smart specialization areas, while the smart specialization priorities at the national level were designed to be synergistic to the smart specializations of the regions; the transformative dimension at national level is expected to be provided by investments in significant project-based collaboration initiatives between research organizations and the private sector, able to ensure the critical mass of actors acting together for a common research agenda - that includes international partnerships and national-regional synergies - emerged as result of continuous dialogue for entrepreneurial discovery and developed based on the monitoring of associated ecosystems (MCID, 2022).

To deepen the content analysis on the S3s, the nine main documents containing the S3s were stored in QDA Miner; the analysis has been further guided by the letter and spirit of "strategy", attention being paid (during the coding process) to: EU's formal requirements regarding the smart specialization approach; literature's recommendations on the elaboration of strategy in general, and of the smart specialization strategy in particular; identification and addressing of strategic challenge(s). Thus, the coding (of the 15 chosen topics) has been made in three categories (each made of 5 topics/codes): (1) inputs – referring to the strategies' initial conditions, their main directions of intervention, and set goals (EDP, challenges, innovative potential, priority areas, targets and strategic objectives); (2) processes – gathering the measures to be taken / changes to be made (to reach the set goals) and the ways strategies are to be managed (transformation(s)/transition(s), actions and interventions, monitoring and evaluation, smart specialization, innovative activities, governance); (3) outputs – grouping different types of strategies' outcomes, from specific results of the undertaken processes to broader national/regional competitiveness (results, collaboration(s), competitive advantage(s) and competitiveness, impact(s), innovation (eco)system). When ranking the categories according to the frequency of their codes (the analyzed topics) processes come first, outputs are second, and inputs are last. However, these findings should be regarded with some caution, due to the following: the (15) topics' cross-cutting nature blurs the boundaries between the three categories; the analysis part is actually the most consistent one in the eight regional S3s (so topics categorized as processes are frequently occurring either as bottlenecks or projections – the same being valid for outputs).

If considering the overall approaches of the S3s – through the lens of strategic management: all the eight regional S3s are following the analysis-formulation-implementation framework of strategy (the analysis part being missing from the National Strategy), while combining the planning approach with the entrepreneurial discovery one. However, specific targets to be met are only set (at least so far) in the National Strategy; the regional S3s are referring either to national targets (specified in other programmatic documents) or to yet-to-be-formulated (and monitored) targets. As regards the strategic objectives, they are outlined in each S3, but designed rather as goals (i.e., they do not meet SMART requirements). From the strategic management perspective, specific objectives/targets are crucial for every strategy, because once set (following a thorough analysis of the strategic challenge), the objectives/targets become the backbone of the strategy – to support the articulation of the entire endeavors to be taken to fulfill them. Adding SMART objectives to the S3s would make it more effectively and efficiently to envision, formulate, and further evaluate the transformation processes needed by Romania and its development regions to close the innovation gap.

Some of the study's limitations have to be mentioned: the content analysis of the S3s using QDA Miner was exclusively performed on the basis of the main strategic documents; some of the S3s have annexes and/or additional files – that were not taken into account (i.e., the difficulties and challenges faced by the Romanian RDI system are detailed in a distinct document, "Analysis of the factors that obstruct the diffusion of innovation, including digitization"; the Nord-Est and Centru regions' S3s have several Annexes to complement the main document), others mention that subsequent updates will follow (i.e., the Action Plan of Bucuresti-Ilfov S3 will be completed upon the approval of Operational Programmes), while others, even though mentioning annexes included in the main document, omit the content of the annex (i.e., Sud-Est S3, missing the Action Plan Annex). These circumstances may have altered the accuracy of results. On the other hand, the analysis was carried out using the Romanian versions of the S3s (the only available ones in most of the cases) and the English version of QDA Miner, which limited the (types of) analysis that could be performed, as well as the veracity of results. Future studies may address more thoroughly the S3s, in search of (more) granular/specific approaches, dynamics, and outcomes.

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