# Exploring the role of research and innovation institutions in regional digital development: The experience of Lazio Region

*Marco Savastano*[*], *Irina Gorelova*[**], *Francesco Bellini*[***], *Fabrizio D'Ascenzo*[****]

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**Abstract**

Developing a strong and vibrant economic base is one of the European Union priorities for 2019-2024. According to European policymakers, research and innovation activities have a direct impact on the level of prosperity and well-being of European society. EU regional policy is among other issues concentrated on the support of the development of SMEs and strengthening regional research and innovation activities. EU Smart Specialisation Strategy (S3) prioritizes research and innovation investment as a tool for the development of the European regions. Italy is an industrial country; its manufacturing companies represent the engine of economic growth and development, with their ability to produce wealth and job opportunities. Starting from the structure of the Italian economy characterized by widespread entrepreneurship, creating a favorable environment for businesses therefore responds to a specific public interest. For this reason, industrial policy is back at the core of the government's agenda. Knowing how to take up this challenge, however, not only concerns the government, but mainly entrepreneurs, to whom the new development and digitalization plans are providing agile and flexible tools to grow, innovate and acquire competitiveness. The development of collaborations between research and development institutions and SMEs is one of the measures to achieve these goals. By considering the representative Lazio Region case, this study seeks to understand the

[*] Dipartimento di Management. Sapienza Università di Roma. marco.savastano@uniroma1.it – Corresponding author

[**] Dipartimento di Management. Sapienza Università di Roma. irina.gorelova@uniroma1.it

[***] Dipartimento di Management. Sapienza Università di Roma. francesco.bellini@uniroma1.it

[****] Dipartimento di Management. Sapienza Università di Roma. fabrizio.dascenzo@uniroma1.it

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contribution of the joint work of these platforms to the regional development and local entrepreneurial competitiveness through an in-depth analysis of strengths, weaknesses, threats and opportunities of the ongoing smart specialization and digital transformation strategies.

*Keywords*: regional development, smart specialisation strategy, digital transformation, digital innovation, Industry 4.0, digital maturity.

**Sommario**

Lo sviluppo di una base economica solida e dinamica è una delle priorità dell'Unione europea per il periodo 2019-2024. Secondo i policymaker europei, le attività di ricerca e innovazione hanno un impatto diretto sul livello di prosperità e benessere della società negli Stati membri. La politica regionale dell'UE si concentra, tra l'altro, sul sostegno allo sviluppo delle PMI e sul rafforzamento delle attività regionali di ricerca e innovazione. La Strategia di Specializzazione Intelligente dell'UE (S3) individua gli investimenti in ricerca e innovazione come strumento prioritario per lo sviluppo delle regioni europee. L'Italia è un paese industriale; le sue imprese manifatturiere rappresentano il motore della crescita e dello sviluppo economico, con la loro capacità di produrre ricchezza e opportunità di lavoro. Partendo dalla struttura dell'economia italiana caratterizzata da un'imprenditorialità diffusa, la creazione di un ambiente favorevole alle imprese risponde quindi a uno specifico interesse pubblico. Per questo la politica industriale è tornata al centro dell'agenda del governo. Saper cogliere questa sfida, però, non riguarda solo la pubblica amministrazione, ma soprattutto gli imprenditori, ai quali i nuovi piani di sviluppo e digitalizzazione stanno fornendo strumenti agili e flessibili per crescere, innovare e acquisire competitività. Lo sviluppo di collaborazioni tra istituti di ricerca e sviluppo e PMI è una delle misure per raggiungere questi obiettivi. Considerando il caso rappresentativo della Regione Lazio, questo studio ha l'obiettivo di comprendere il contributo del lavoro congiunto di queste piattaforme allo sviluppo regionale e alla competitività imprenditoriale locale attraverso un'analisi approfondita dei punti di forza, di debolezza, delle minacce e delle opportunità che caratterizzano le strategie di specializzazione intelligente e trasformazione digitale attualmente in corso.

*Parole chiave*: sviluppo regionale, strategia di specializzazione intelligente, trasformazione digitale, innovazione digitale, Industria 4.0, maturità digitale.

## 1. Introduction

Regional development, as defined by the Economic and Social Council (ECOSOC) of the United Nations in the Resolution 1582, has two main components: social and economic. To promote and ensure regional development

initiatives, the UN centre for Regional Development (UNCRD) was established. The UNCRD serves as the training and research center, provides consulting services, promotes the exchange of research data and practical experience and plays a mediating role between the stakeholders of the process. Organization for Economic Co-operation and Development (OECD) defines regional development as a broad term, which can be seen as a general effort to improve living standards in all regions, making more sound contribution to national development and to promote the most inclusive and resilient society. The approach to regional development, of both the United Nations and the Organization for Economic Cooperation and Development, offers a useful tool for sustainable development and corresponds to the UN Sustainable Development Goals (SDGs) introduced by the Agenda 2030 in 2015. European regional development policy has its origins in the Treaty of Rome, which established the European Economic Community in 1957. It has now become the EU's main investment policy addressing all regions and cities of the European Union in order to support business competitiveness, economic growth, sustainable development and social resilience. The European Union Cohesion policy has been evolving over the years; becoming more specific, with a closer approach to social resilience. In order to boost regional development, the European Union introduced a Smart Specialisation (S3) policy, a place-based approach to regional development by means of the support and development of the regional strengths and Entrepreneurial Discovery Process (EDP) (Interreg Europe, 2020). An example of one of the instruments to promote the collaboration between European research and innovation (R&I) institutions and small and medium-sized enterprises (SMEs), according to Smart Specialisation policy, are the Digital Innovation Hubs (DIHs). DIHs are multi-partner, regional, single-window organizations; which aim to support SMEs and the public sector in their digital development and transformation. Smart Specialisation policy sees DIHs as one of the engines for regional development. An important basis for the development of the collaboration between R&I institutions and SMEs in Europe is the European innovation and digitalization policy. In 2020 following the 2014-2019 Digital Single Market Strategy, the European Commission published a series of documents that should define Europe's digital future and illustrate the European Union goal to become the world leader in the digital market. The EU innovation policy is based on 3 pillars: open innovation – in terms of making innovation a cross sectorial process; open science – in order to diffuse knowledge using digital technologies and open the world – in order to promote international cooperation in scientific process.

Italian policy documents and strategies reflect the importance of innovation and digitalization on a national level and stress the role of R&I and

SMEs cooperation in boosting regional and economic development. Industry 4.0 national plan (Piano nazionale Industria 4.0), replaced with the Enterprise 4.0 national plan (Piano nazionale Impresa 4.0) in 2020, spelled the basis for the further development of the industry in the context of 4.0 technologies development and application. The creation and development of DIHs and competence centers is one of the key objectives for the Industry 4.0 national plan (Calenda, 2017). The Enterprise 4.0 national plan provides a synergy between the regional DIHs and the Competence Centers that have a national character and are equipped with high technological skills. The Transition 4.0 national plan (Piano Nazionale Transizione 4.0) updates the Enterprise 4.0 national plan by modifying the package of measures provided. It offers greater support to companies that invest in the modernization and digitalization of production processes, skills training and knowledge sharing within the company and development of new products and processes. The R&I institutions which have the role of stimulating companies' demand for innovation and strengthening their level of knowledge and awareness, fit perfectly into new strategy.

The Lazio Region developed its Smart Specialization strategy in 2016. The strategy defined three main objectives for the smart specialization of the region – to develop regional production through the knowledge sharing and adaptation of technologies of excellence; to support the internationalization of local market players and to renew the competitive capacity of the regional entrepreneurial fabric. The Lazio region was selected for this study since its Smart Specialisation strategy is supported by a high presence of R&I institutions, which represent a particular strength of the region. Indeed, Lazio region has several R&I institutions that together create an innovative regional fabric. The DIH of Lazio is Cicero, founded in 2018. Cicero works with big companies and SMEs as well as universities and research and excellence centers of Lazio, Italy and EU. Its main strategic sectors of operation are ICT, aerospace, life sciences, renewable energy, green economy, automotive, creative industry and tourism. The competence center deployed in Lazio region is Cyber 4.0; one of the 8 national competence centers with special orientation at cybersecurity. Cyber 4.0 aims to develop competitiveness on the regional and national levels by offering guidance and training services to companies and public administrations and by financing research and innovation projects to raise the level of protection from the risk of cyber-attacks to strategic, corporate and national systems, processes and assets. The Science and Technology Parks (STP) of Lazio operate to increase the competitiveness of the region through the activation and management of research and development, technology transfer and business development projects. STP also favours the cooperation between companies, universities and research centers,

public administrations and credit institutions. Each STP deals with specific thematic sectors, for example: environment, aerospace, biotechnology, telecommunications, hi-tech and multimedia. The Lazio Region has founded three Technological Districts (TD) on its territory that operate in the field of Aerospace, Biosciences and Cultural Heritage conservation. Given the contextual and infrastructural strengths characterizing the Lazio Region (e.g., high concentration of universities and research centers, industrial international groups, great entrepreneurial vitality, high international attractiveness of Rome, etc.), the authors decided to take it as a benchmark to analyse the level of development of the Smart Specialisation strategy in Italy considering the timeframe between the end of the first S3 period introduced by the EU Cohesion Policy 2014-2020 and the beginning of the new Cohesion Policy 2021-2027 (Interreg Europe, 2020).

Relying on the reference scientific and managerial literature as well as current initiatives and ongoing projects on European and Italian level, the authors posed the following research questions for this study:

*RQ1: What is the current development of the R&I ecosystem in the Lazio Region according to the objectives set by the EU S3 strategy?*

Concerning the concept of ecosystem included in RQ1, given the contextual characteristics of the subject under investigation, we refer to it accordingly to the management research. More in detail, adopting the multi-actor network perspective highlighted in Tsujimoto *et al.* (2018) we define it as the complex dynamic networks, interactions and relationships among actors with different attributes, ranging from private firms, entrepreneurs and investors to innovators outside of company pipelines, users/user communities, universities and research centers, governmental bureaucrats/policy makers, and consortiums.

*RQ2: What are the sectors and main activities covered by the R&I institutions in the Lazio region?*

Therefore, this research aims at providing a clear and detailed outline of the current degree of development concerning the R&I ecosystem foreseen by European and regional plans for the Lazio region, highlighting implications, gaps and possible improvements. R&I institutions' presence in the Lazio region is an advantage for its development; R&I institutions leverage entrepreneurial ecosystem building and boost the digital transformation of the region. The Lazio region, with its policy dedicated to the S3 implementation

and specific investments in the digital transformation of the local ecosystems, represents a benchmark for many other regional contexts. The R&I institutions' inclusion in regional development represents a good example for the development of other European regions in the framework of the new Cohesion Policy 2021-2027. The results obtained in this study will allow practitioners and policy makers to evaluate the current state of R&I institutions' inclusion in regional development and foresee possible future actions for improvements. The possibility of such an interregional exchange approach, by finding the most effective policy solutions for S3, makes this kind of research an important starting point for policy learning on both regional and European level.

The paper is structured as follows: section two presents a literature review focusing on the topics of Regional Development, Smart Specialization and R&I institutions and platforms. Next, section three provides the research design and methodology used in this study. Section four details the main results, discussion, and implications of the study. In section five conclusion, limitations and future research paths are outlined.

## 2. Theoretical background

### *2.1. Regional Development and Smart Specialisation*

Regional Innovation and Smart Specialisation Strategy are inevitable elements of smart and sustainable regional growth. First of all, regional innovation development processes depend on the human capital resources and welfare of the region, but also on the regional economy's technological capacity "understood in a broad sense as a level of technological advancement of industry and service sectors, the academic sphere that introduces innovations to the economy" (Kogut-Jaworska *et al.*, 2020). Innovations and knowledge transfer are important components of the regional development and smart specialisation of the European regions (McCann & Ortega-Argilés, 2013). The Smart Specialisation policy has inspired European regional innovation strategies over the last ten years, approximately. It has introduced a successful driver for change in governance settings, inclusive of the policy processes and adoption of strategic priorities combining science and communities as a knowledge base for their identification and joint growth (Interreg Europe, 2020). Smart specialisation initiatives differ significantly from region to region due to the inequality of economic conditions and local governance as well as the relationship between regional and local government (McCann & Ortega-Argilés, 2014). Capello and Lenzi (2015) corroborate

this idea by affirming that the implementation of smart specialisation strategy differences in regionally specific modes of governance. Smart specialisation initiatives implementation also differs between new and traditional industries (Ylinenpää *et al.*, 2016). Innovation and entrepreneurship are considered as the drivers and core processes for regional development in the framework of smart specialisation strategy (Romano *et al.*, 2014). EDP strengthens the links among the regional research and innovation stakeholders hereby contributing to regional development (Ranga, 2018; Szerb *et al.*, 2020). At the same time, the establishment of horizontal and vertical innovation networks is one of the mechanisms that facilitates continuous EDP (Roman *et al.*, 2018). For effective functioning of quadruple helix innovation model in the framework of regional development regions should strengthen collaborative innovation activities and support the cooperation between SMEs and innovation experts (Suzic *et al.*, 2020). Some authors claim that despite the long existence of smart specialisation policy in Europe, critical principles of how to design regional innovation policies are still missing. Focusing on these principles is one of the main steps to define regional innovation policy 4.0 (Benner, 2020).

### *2.2. R&I stakeholders and Smart Specialization initiatives*

The role of universities in regional development and innovation becomes sounder with the emergence of smart specialisation policies (Secundo *et al.*, 2017; Rinaldi *et al.*, 2018). On the one hand, the scientific production of the university crosses the borders of the region due to international nature of the research but on the other hand, universities can become a magnet for the highly-skilled professionals, knowledge and networks from outside the region (Kempton & Delivering, 2015). The last statement is also true for the research infrastructures, such as laboratories (Snickars & Karlsson, 2017). Communities offer a platform for universities to collaborate with other actors of the entrepreneurial discovery process (EDP) and create a strategic vision on their role in regional development (Marinelli & Elena-Perez, 2017). In order to be effective contributors to regional development, universities should develop their strategies in accordance with the development paths in their regions – development of new industries; implementation of an industry from another region or nation; diversification of an industry into related industries or development of existing industries (Gjelsvik, 2018). The cooperation of the universities and SMEs leads to the development of creative entrepreneurship which results in the increase of welfare of a region (Pirnau *et*

*al.*, 2018). The Digital Innovation Hubs are considered by European policy-makers to play several roles in connection to the regional innovation strategy. The efforts of DIHs can also support the development of the regional innovation ecosystem as well as business growth and upgrading of local suppliers (Rissola & Sörvik, 2018). In this context, the study of Hervas-Oliver *et al.* (2020) provides an empirical analysis of the European Commission (EC) digital DIH program, by exploring the activities of ten Spanish DIHs designed for fostering the regional transition into Industry 4.0 and facilitating new path development. These institutions were found to be multi-actor collaborative platforms, including non-local actors, with aims to stimulate transition into Industry 4.0 by promoting place-based collaboration opportunities that respond to local/regional contextual specificities and demands. In this way, these entities are facilitators of public-private partnerships that co-design policy, spatially bound oriented initiatives for digital transformation projects.

### *2.3. Evidence from Italy*

Italian experience and peculiarities in the development and implementation of S3 and the role of R&I institutions is reflected in the scientific literature of the recent years. D'Adda *et al.* (2019) in their study explored the coherence between the technological domains chosen by Italian regions to implement S3 and those in which they show actual innovative capabilities, the research shows that the set of technological domains included by the Italian regions in the S3 is lower than those in which regions show some kind of strength. Balletto *et al.* (2020) studied cohesion policies in the Italian metropolitan cities and highlighted the dualism in Italian context – a country is divided in two areas: North and South that influences the EU cohesion policy implementation. The differences between the more developed center-north and the less developed south were also highlighted by Dileo and Pini (2021) in their study of the Quadruple Helix partnerships for enterprise eco-innovation. Another research (Bellini *et al.*, 2021) shows the differences in the S3 implementation between regions belonging to the same geographic area – Sicily and Apulia (South of Italy); the comparative analysis shows that the two regions approached RIS3 learning in a substantially different way. The case study of Emilia-Romagna region (Labory & Bianchi, 2021) has led to an important outcome that successful S3 requires the deployment of dynamic capabilities, especially in lagging regions, characterized by different barriers that create constraints for the entrepreneurs in their attempt to seize opportunities. The case study of the University of Macerata (Marche region, Italy) (Rinaldi *et al.*, 2018) analysed the

potential contributions of the universities to the development and enhancements of capacities that change the innovation concept through a S3 approach; the findings show that the universities can play a broader role to support regions in designing and implementing of the S3. Del Vecchio *et al.* (2017) discuss the importance of Living Labs as an effective mechanism that can support the creation of innovation ecosystems on the regional level; the study analyses 20 cases of Italian Living Labs and explores their relevance for setting regional strategies for smart growth. The study of Crupi *et al.* (2020) claims that Italian DIHs act not only as knowledge brokers but also as knowledge sources that give rise to a digital imprinting process that is able to shape the digital transformation of the Italian SMEs.

## 3. Research Methodology

Given the exploratory nature of this paper, the case study research provided the most suitable approach. To answer the research questions, data retrieved from official and reliable sources (e.g., European Commission policies, Lazio Region reports or plans, the official websites of the R&I Institutions under consideration, etc.) was collected for their further analysis and triangulation. Particularly, in an initial phase, secondary data was collected; this include evidence from scientific literature and official documents on European, Italian and regional level policies. For this phase we considered, as a guiding model, the study of Rumyantsev (2018), who used structural and functional analysis of the research and innovation activities in the macroregion of the North-West of Russia, to assess its current status and development trend. Thus, the author found evidence on the creation and development of a polycentric structure of research and supporting polices for regional innovation activities from the standpoint of economic stability. Therefore, from our side, it is important to explore what missions – testing and experimentation, financing, skills, and ecosystem-building (Miörner *et al.*, 2019) – are covered by the R&I institutions operating in the Lazio region and what are their target sectors – public organizations or private sector, including SMEs and large companies. The present analyses of the collected data present clear evidence on the settings and activities of such institutions in the context of regional development, to provide a systemic picture on the overall current degree of achievement of the planned program of the digital agenda and of the S3 strategy for the Lazio region. Particularly, the analysis was carried out by specifically referring to the development in the 5 regional provinces of Lazio. In order to offer a schematic output, that clearly and immediately shows the current state of development of R&I institutions in the

different areas of interests as well as provinces of Lazio Region, a comprehensive table (Table 1) is presented at the end of the first sub-section of the results. As a second phase, based on the evidence obtained in the first one, the authors implemented a SWOT analysis, as the strategic planning tool used to assess the strengths, weaknesses, opportunities and threats of the regional economic system. Following the research objectives, the results will allow researchers, practitioners and policy makers to evaluate the current level of development as well as value offered to the context in which they are embedded and foresee possible improvements.

## 4. Results and Discussions

Starting from the financial resources for the three-year period 2019-2021, according to the official performance plan of the Lazio Region identified in the financial forecast budget approved by the regional law no. 14, it is possible to identify the areas of investments for the last three years of the previous policy with the aim of increasing the region's economic development and competitiveness. The following table (Table 1) shows the financial resources for the three- year period 2019-2021, divided by missions (main functions of the Region) and programs (homogeneous aggregates of activities aimed at pursuing the objectives defined within the missions).

*Table 1.* Financial resources for the period 2019-2021 allocated by the Lazio Region

| Mission | Program | 2019 (€) | 2020 (€) | 2021 (€) |
|---|---|---|---|---|
| Economic development and competitiveness | Industry, SMEs and Crafts | 28.837.863,57 | 5.101.000,00 | 3.500.000,00 |
| | Commerce – distribution networks – consumer protection | 13.353.436,61 | 5.440.000,00 | 4.500.000,00 |
| | Research and Innovation | 69.356.888,42 | 18.200.000,00 | 18.400.000,00 |
| | Networks and other public utility services | 0,00 | 0,00 | 0,00 |
| | Unified regional policy for economic development and competitiveness | 209.815.762,04 | 97.693.539,42 | 85.827.202,12 |
| | TOTAL MISSION | 321.363.950,64 | 126.434.539,42 | 112.227.202,12 |

Lazio smart specialization strategy defines 7 specialization areas of Lazio region – Aerospace, Life Sciences, Cultural Heritage and Culture Technologies, Digital Creative Industries, Agrifood, Green Economy and Security. These are the most significant and successful sectors of the Lazio region in terms of the level of knowledge transfer, research and development infrastructure and the maturity and development of business projects. As implied by the very nature of smart specialization, these areas are the main sectors that should have been developed and supported in order to achieve the objectives of the Lazio region development. In order to answer the research questions posed in this paper, the authors found it interesting to study the level of presence of R&I institutions in each S3 area.

### *4.1 Aerospace*

The Aerospace S3 area is one of the soundest for the Lazio region. According to S3 strategy of Lazio, it is the only Italian region with the entire supply chain present in one region. So further development of the aerospace area affects other sectors, causing positive effects on the quality of business processes, goods and services and providing innovative solutions for the benefit of citizens and society. The S3 strategy of Lazio region stipulates that by the time of the strategy elaboration, the aerospace sector exceeded 5 billion Euros of annual turnover and employed 30,000 people in 250 companies in the various areas of the sector. Lazio Aerospace Technological District (DTA) was created with the aim to promote research, knowledge and technology transfer and the launch of new entrepreneurial initiatives within the ambit of aerospace S3 area. Cicero, the DIH of Lazio supports the entrepreneurial activities of the companies operating in the Lazio region. In particular, Cicero supports companies' digital transformation, so companies from Lazio region can make use of the services offered by Cicero in order to produce excellence in strategic sectors of the region, including aerospace. One of 8 national competence centers located in Lazio, Cyber 4.0, has its main scope in the raising of the level of protection against the risks of cyber-attacks and operates in the sphere of aerospace too. The companies located in the Technological Park, Tecnopolo Tiburtino, operate in ten different sectors; aerospace sector is one of them. Universities located in Lazio are also contributing to the development of this sector. Main Universities located in Rome (Sapienza University of Rome, Tor Vergata University of Rome and Roma Tre University) have aerospace department or faculties. University of Tuscia in Viterbo also participates in EU aerospace projects.

### *4.2. Life Sciences*

The Life Sciences sector is of great importance for Lazio region. It has a strong scientific and research background in the region. In the same way as the aerospace S3 area, the life sciences area has a transversal nature, so it favours the overflow of knowledge and skills in contiguous sectors. According to S3 strategy of Lazio region, the local life sciences sector was ranked second at the national level for turnover (8 billion euros) and number of employees (18,000), but first in terms of export value (4.7 billion euros). Cicero DIH and Cyber 4.0 also contribute to the development of this area creating a field for knowledge transfer and funding opportunities. Technological parks, Technopolo Castel Romano and Technopolo Tiburtino, also contribute to the life sciences S3 area. There is also a sound presence of the universities in this area; for example, the university center, Sabina Universitas in the province of Rieti, has its medical center with bachelor courses in: nursing, medical radiology techniques, imaging and radiotherapy, prevention techniques in the environment and in the workplace and biomedical laboratory techniques. In the province of Latina, the university center Ce.R.S.I.Te.S. at the premises of Sapienza University of Rome has a Pharmacy and medicine faculty.

### *4.3. Cultural Heritage and Culture Technologies*

The cultural heritage of Lazio is undoubtedly one of the most unique in the world. It is a strategic asset on both regional and country levels. The presence of such important historical and cultural heritage poses new challenges for the region – it is important to apply and improve measures and approaches for the restoration and preservation of cultural artifacts. The region has sufficient infrastructure to make these improvements. Of course, the Cultural Heritage and Culture Technologies sector is one of its strongest and the most efficient sectors in which development should be deepened by smart specialization measures' application. As follows from the S3 strategy of Lazio region, the turnover of the cultural heritage sector was over 11.5 billion euros, with 172,000 employees involved. Lazio is the Italian region with the highest intensity of visits and income deriving from museums and archaeological sites, with around 18.5 million visitors in 2014. In order to strengthen the competitive positioning of the sector in the region, the Technological District for Cultural Heritage (DTC) was created. This institution promotes economic and territorial development of the region, activating a collaboration between the stakeholders of the domain, consolidating the more innovation-oriented participants in the sector, in order to promote knowledge and

technology sharing and create infrastructure for research and innovation in the sector. Among the founders of DTC are the universities of Rome (Sapienza University of Rome, Tor Vergata University of Rome and Roma Tre University), University of Cassino and Southern Lazio (province of Frosinone) and Tuscia University (Viterbo).

### *4.4. Digital Creative Industries*

Over the years, Lazio region has concentrated special knowledge and skills, which make a basis for the creation and development of creativity and different types of arts. Development of creative industries attracts creative and cultural human capital that leverages innovation processes in the region and supports the economy's competitiveness. According to Lazio Innova, the creative and digital industries are a very important economic reality, so that more than 90,000 employees are employed in over 18,000 companies (20% of the national total) for a wealth produced of close to 7 billion euros[1]. Collaboration with the representatives of the creative industries area is one of the activities of Cicero DIH. The Technological Park, Tecnopolo Tiburtino, operates in the area of creative industries – especially with a group of companies engaged in design and implementation of audiovisual and multimedia communication systems; as well as companies focused on publishing, graphics and web design. Universities presented in the region have more than 20 bachelor and master programs in the field of creative industries.

### *4.5 Agrifood*

Agrifood is another significant sector for regional economics. Being a traditional sector of the region, its innovation can become an advantage for the development of other S3 areas such as Security and Green Economy. According to the Lazio Innova official site, the agrifood S3 area represents 3% of the wealth of regional economy, with 6.3 billion in annual turnover. There are more than 3,400 companies in the area employing almost 17,000 employees, with exports settling at around 550 million euros per year[2]. In the province of Latina, the scientific and technological park of Southern Lazio (Pa.L.Mer.) carries out chemical analyses for the agrifood sector. Universities of Lazio also actively presented in the research and didactics in this area. For example, Sabina Universitas has the program of Mountain Sciences, the

[1] http://www.lazioinnova.it/reti-cluster-innovazione/industrie-creative-digitali/
[2] http://www.lazioinnova.it/reti-cluster-innovazione/agrifood/

only one existing in Italy. This program has its aim to provide knowledge in the forestry, agricultural, environmental and economic sectors, as well as encouraging entrepreneurial growth in mountain areas.

### *4.6 Green Economy*

Lazio region is adopting green solutions in the region, transforming environmental problems into real economic opportunities. Hence, Lazio is taking green measures to reduce plastic waste, to fight air and water pollution, to increase energy efficiency and the use of renewable energy and to develop a more efficient and green transportation network, etc. To achieve these goals, Lazio region develops several specific support measures and allocates budget funds (Regione Lazio, 2020). At the time of the publishing of S3 strategy of Lazio region, Lazio was in third place after Lombardy and Veneto with just over 28,000 companies (8.6%) that had invested or were aiming to invest in green products and technologies. According to the statistics of GreenItaly report 2020 by of Fondazione Symbola – Unioncamere (Fondazione Symbola, 2020), considering the 5-years period 2015-2019; Lazio is in third place for investments (9.3%) made by companies in green products and technologies. Although Green Economy is one of the burning issues nowadays, not all the universities presented in this study are fully engaged in the study of this topic. Cicero DIH, Technological parks Technopolo Castel Romano and Technopolo Tiburtino perform their activities in the green economy area too.

### *4.7 Security*

Security is a broad area that includes technologies for environmental surveillance and control, effective communications, identification and detection systems of urban infrastructures, energy safety, etc. Since this S3 area ensures the stability and efficiency of other S3 areas, it is of high relevance and priority for the region. According to Lazio Innova, Aerospace and Security S3 areas, in the context of the regional economy, are sectors of vital interest in the regional economy due to the possibility of using scalable and transferable applications that generate virtuous multiplicative circuits of research, development and innovation activities. The soundest example of the R&I institution that operates in the security area is the recently established Cyber 4.0 competence center. Cyber 4.0 carries out its activity in four areas of specialization: Cyber Security Core Services, Aerospace, Automotive and eHealth. Among the

members of Cyber 4.0 competence center are all the main universities of Lazio, showing the interest of the universities in this topic. Cicero DIH and technological park, Tecnopolo Tiburtino, are engaged in the development of ICT technologies that are directly related to cybersecurity.

Table 2 vividly shows the distribution of the discussed R&I institutions organised according to S3 areas and provinces of Lazio.

*Table 2*. R&I institution according to S3 areas and provinces of Lazio presented in the text

| **R&I institution / Provinces** | **University** | **DIH** | **CC** | **STP** | **TD** |
|---|---|---|---|---|---|
| **AEROSPACE** | | | | | |
| Rome | - Sapienza University of Rome<br>- University of Rome "Tor Vergata"<br>- University of Rome "Roma TRE" | Cicero DIH | Cyber 4.0 | Tecnopolo Tiburtino | Lazio Aerospace Technological District (DTA) |
| Latina | | | | | |
| Frosinone | | | | | |
| Viterbo | Tuscia University | | | | |
| Rieti | | | | | |
| **LIFE SCIENCES** | | | | | |
| Rome | - Sapienza University of Rome<br>- University of Rome "Tor Vergata"<br>- University of Rome "Roma TRE" | Cicero DIH | Cyber 4.0 | - Polo Tecnologico di Castel Romano<br>- Tecnopolo Tiburtino | |
| Latina | Ce.R.S.I.Te.S (Sapienza university of Rome) | | | | |
| Frosinone | University of Cassino and Southern Lazio | | | | |
| Viterbo | | | | | |
| Rieti | Sabina Universitas | | | | |
| **CULTURAL HERITAGE AND CULTURE TECHNOLOGIES** | | | | | |
| Rome | - Sapienza University of Rome<br>- University of Rome "Tor Vergata"<br>- University of Rome "Roma TRE" | | | | Lazio Cultural Technological District (DTC) |
| Latina | | | | | |
| Frosinone | University of Cassino and Southern Lazio | | | | |
| Viterbo | Tuscia University | | | | |
| Rieti | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **DIGITAL CREATIVE INDUSTRIES** | | | | | |
| Rome | - Sapienza University of Rome<br>- University of Rome "Tor Vergata"<br>- University of Rome "Roma TRE" | Cicero DIH | | Tecnopolo Tiburtino | |
| Latina | | | | | |
| Frosinone | | | | | |
| Viterbo | | | | | |
| Rieti | | | | | |
| **AGRIFOOD** | | | | | |
| Rome | - Sapienza University of Rome<br>- University of Rome "Tor Vergata"<br>- University of Rome "Roma TRE" | | | | |
| Latina | | | | Pa.L.Mer – Parco Scientifico e Tecnologico del Lazio Meridionale | |
| Frosinone | University of Cassino and Southern Lazio | | | | |
| Viterbo | Tuscia University | | | | |
| Rieti | Sabina Universitas | | | | |
| **GREEN ECONOMY** | | | | | |
| Rome | - Sapienza University of Rome<br>- University of Rome "Tor Vergata"<br>- University of Rome "Roma TRE" | Cicero DIH | | Polo Tecnologico di Castel Romano<br>Tecnopolo Tiburtino | |
| Latina | Ce.R.S.I.Te.S (Sapienza university of Rome) | | | | |
| Frosinone | University of Cassino and Southern Lazio | | | | |
| Viterbo | Tuscia University | | | | |
| Rieti | | | | | |
| **SECURITY** | | | | | |
| Rome | - Sapienza University of Rome<br>- University of Rome "Tor Vergata"<br>- University of Rome "Roma TRE" | Cicero DIH | | Tecnopolo Tiburtino | |
| Latina | Ce.R.S.I.Te.S (Sapienza university of Rome) | | | | |
| Frosinone | University of Cassino and Southern Lazio | | | | |
| Viterbo | Tuscia University | | | | |
| Rieti | | | | | |

To systematize this data, a SWOT analysis was performed in table 3. The main strengths of the R&I institutions activity in Lazio region are the significant presence of universities in all the S3 areas and in all provinces. This presence provides better knowledge sharing and creates a fertile ground for the research and innovation activities. The existence of Digital Innovation Hub and Competence Center in the territory of the region, as well as a wide range of R&I institution's types, provides stakeholders with better accessibility to their services and efficient cooperation. The main weaknesses of the R&I institutions' activity in the Lazio region are their uneven distribution and their unequal coverage of the S3 areas. The transversal nature of some S3 areas that supports the overflow of knowledge and skills in contiguous areas can help to achieve the goals set in the opportunities section and reduce the weaknesses. The main threat authors see, resides in the consequences of the COVID-19 pandemic that may affect the priority of the S3 areas' development in the region (for instance Life sciences), that can negatively affect the development of other S3 areas and the activity of R&I institutions.

*Table 3.* SWOT analysis of the activities of R&I institutions in Lazio region in the framework of the S3 Strategy

| **Streng** | **Weakn** |
|---|---|
| – The sound presence of universities in all the S3 areas<br><br>– Existence of Digital innovation Hub and Competence Center on the territory of the region, that provides the stakeholders with better accessibility to their services<br><br>– Wide range of R&I institution's types in the region | – Uneven distribution of R&I institutions in the Lazio region<br><br>– Not a11 the S3 areas are equally covered with the activity of R&I institutions |
| **Opportunit** | **Thr** |
| – Increase of number of R&I in the provinces of Latina, Frosinone, Viterbo and Rieti<br><br>– Increase the activity of R&I institutions in the following S3 areas: Digital creative industries, Agrifood<br><br>– A transversal nature of some S3 areas that favors the overflow of knowledge and skills in contiguous areas | – The consequences of the COVID-19 pandemic may affect the priority of the S3 areas development (for instance Life sciences), that can negatively affect the development of other S3 areas |

A practical example of a systemic application of this strategy at the regional level is Lazio Innova, an in-house company of the Lazio Region. Lazio Innova's mission is to support the development of the region through incentives for the creation of new businesses (e.g., innovative start-ups), the enhancement of existing ones through the internationalization process, the promotion of business networks and regional excellence and the implementation of measures for social inclusion. It provides both effective managerial and technical consulting tools and a direct connection to the business world through local chambers of commerce, and creates a regional network of innovation centers. Lazio Innova is strongly linked to the culture of the provincial area where they are located and embedded inside business incubators. As part of the "Spazio Attivo" project, this new regional network of innovation hubs involves large meeting spaces, open to cooperation between individuals and local authorities, providing access to different services for businesses, start-ups, training and work. In these places, entrepreneurial training, business incubation, coworking ("Talent Working") and FabLab activities to transform an idea into a real object ("Diffused FabLab") co-exist for a cross-fertilisation context, divided into three areas: training, digital and interactive. Another important element is that all the services offered (courses, machines and the majority of materials) are entirely free of charge for citizens-users, as they are financed by the regional administration. Currently there are ten Active Spaces in the Lazio Region in addition to digital platforms. Each of which is characterized by a prevalent specialization: Rome Casilina – fashion and design; Rome Tecnopolo – applications of space technologies; Viterbo – cultural and creative industry; Rieti – electronics and environmental sustainability; Bracciano – agrifood and forestry systems; Ferentino – mechanics and automation systems; Colleferro – energy efficiency and environmental sustainability; Latina – life sciences and economics of the sea; Civitavecchia – tourism; Zagarolo – game, culture and tourism, Roma Casilina – fashion and design.

## 5. Conclusions

This research aimed to study the current level of R&I ecosystem development in the Lazio Region by analysing the main sectors and activities covered by the R&I institutions in this geographical context region. The study reveals that universities are the most active among all R&I institutions in Lazio region; there is sound presence of universities in all the S3 areas of the region and in all provinces. The high level of engagement of these universities in research and innovation is a fertile ground for better knowledge shar-

ing and promotion of the entrepreneurial activities among citizens. This outcome is in line with previous studies on the role of the universities in regional development (Fonseca & Nieth, 2021; Brekke, 2021). Moreover, the existence of DIH and Competence Centers in the territory of the region, as well as a wide range of R&I institutions, provide SMEs and the public sector with better accessibility to their services and efficient cooperation (Cotrino *et al.*, 2021). DIH and Competence Centers, as well as the network created by Lazio Innova, represent a fertile ground for companies' cooperation. It is known that overlapping professional networks and science-based boundary objects are the building blocks for the companies to endorse the UN Sustainable Development Goals (Williams *et al.*, 2019) that therefore can support local development. At the same time, R&I institutions' activity in Lazio region is currently unevenly distributed and covers unequally the S3 areas. A transversal nature of some S3 areas supports the overflow of knowledge and skills in contiguous areas and can help to overcome this problem by increasing the number of R&I in the provinces of Latina, Frosinone, Viterbo and Rieti, and strengthening the activity of R&I institutions in Digital creative industries and Agrifood S3 areas.

### *5.1. Implications*

The abovementioned findings contribute to both theoretical evidence and managerial practice. Concerning the theoretical implications, given that there is not much evidence on the role of R&D institutions in regional development, this research will significantly contribute to scientific progress in regional science and smart specialisation studies, in particular.

Managerial implications consist in better understanding of the role of R&I institutions in regional development that will help policy makers and other stakeholders involved in such context to adjust their activity for more effective contributions to the regional ecosystem development. Despite the fact that it is not possible to design the all-purpose regional policy by copying the best practices and each region has its own assets (Asheim *et al.*, 2011) the approach applied in this paper can be taken into consideration by policy makers when drawing up a new S3 strategy of Lazio or other regions.

The role of R&I institutions in regional development is becoming sounder over the years. R&I institutions become an advantage and a spin for entrepreneurial ecosystem building and further digital innovation of the regions across Europe. Lazio region represents a best practice in the Italian context, concerning investments and polices dedicated to the S3 implementation for regional development and the digital transformation of the local ecosystems.

For this reason, it can be taken as a benchmark for many other regional contexts. However, as emerged from our results, some areas still need to be developed through ad hoc resources and projects. The ongoing progress undoubtedly represents a solid base for the new Cohesion Policy 2021-2027 under review. The main new element compared to the 2014-2020 Strategy concerns the introduction of two new Areas of Specialization: Automotive and Smart mobility, as well as Economy of the Sea. This review process is carried out through focus groups for each of the 9 areas of specialization, involving all economic operators and knowledge actors active in Lazio region, whose contributions will be used to define strategic choices for the development of the regional economy. At the basis of an effective review of the S3 for Lazio can only be the identification of the most competitive areas and sectors of activity of the region and gaps on which to focus and invest. Thus, our results provide a solid base for researchers, practitioners and policy makers to evaluate the current level of development, the value offered to the context in which they are embedded and foresee possible improvements. In addition, other tools established by the EU can support and facilitate the implementation of smart specialisation and digital transformation strategies. For instance, Interreg Europe projects share good practices and deliver concrete and transformative policy changes on regional policy challenges ranging from the Entrepreneurial Discovery Process (EDP) to S3 Monitoring, offering regional policymakers the possibility to learn from practices implemented in different regional institutional contexts across Europe. Such an interregional exchange approach, by finding the most effective policy solutions for S3, makes it the ideal space for policy learning.

### *5.2. Limitations and Future Research*

This study is exploratory in nature and based on a specific case of the Lazio region, hence the generalization of the results could be constrained. Although the authors have carried out an attentive triangulation of data published by reliable sources, another limitation of this study is its reliance on secondary data. Future research in this field, by drawing on the evidence presented so far, can collect and analyse primary data through in-depth interviews or a quantitative approach concerning the actual development and synergies among the R&I regional ecosystem, by directly involving the representatives of the main institutions. This presents an opportunity to strengthen the present results, obtain further insights and draw more generalizable conclusions. Furthermore, it is also interesting to conduct a comparative analysis of the role of R&I institutions on the regional development in various Italian and European regions.

Another possible direction of future research is the evaluation and comparison of the role of particular R&I institutions (e.g., universities, DIHs, competence centers, technological parks etc.) in regional development. Another impetus to continue the study of this topic will come when a new S3 strategy for the Lazio region will be developed and actually implemented.

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