

Smart Specialization in less developed regions of the European Union: A Systematic Literature Review

Eristian Wibisono¹

¹ University of Pecs, Pecs, Hungary

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Abstract. This paper reviews the literature on Smart Specialization implementation in less developed regions of the European Union (EU). Using a systematic literature review research protocol, I critically explore the content of selected relevant papers, examine the challenges in the Smart Specialization implementation in less developed regions of the EU, and raise critical factors that could potentially enhance the success of its implementation. The first finding of this study shows that research on related topics published in leading journals has increased significantly in recent years. Furthermore, as an essential contribution, I categorize the selected papers according to diversity in research design and methodology. Finally, I summarise three key issues of Smart Specialization implementation in less developed regions of the EU: RIS capacity and governance, local and extra-regional collaboration, and regional administrative and financial governance.

Key words: Smart Specialization; regional innovation; innovation policy; less developed regions, European Union

1 Introduction

The Smart Specialization innovation policy concept emphasizes specialization based on a region's resources or assets, using those resources to enable the discovery of new and innovative competitive advantages to drive regional economic growth and transformation (Foray et al. 2011). However, the theory and concept underpinning Smart Specialization (Foray et al. 2009) have undergone a certain degree of criticism concerning its application in both developed and less developed regions (LDRs) (Hassink, Gong 2019, Krammer 2017). According to empirical evidence so far, the implementation of Smart Specialization in less-developed countries has been characterized by several barriers, including, for example, the lack of entrepreneurial dynamism to strengthen the existence of new domains of excellence (Morgan 2013) and the indistinct roles between the central government and foreign companies (Radosevic, Stancova 2015). All the while, the focus on wider territorial context has become an essential concern in Smart Specialization innovation policies (Barca 2009).

Criticism has also been raised about the relevance of Smart Specialization in addressing problems in developed regions (e.g., Kroll 2017a,b), and its implementation in LDRs has been recognised as an area of particular academic focus (Capello, Kroll 2016). Various issues and phenomena related to the implementation of Smart Specialization in LDRs have emerged in the course of the process of designing or developing Regional Innovation

Systems (RIS) at the regional level, especially issues related to structural problems in organisations and institutions, and funding or budgeting issues (Tripl et al. 2019). As more and more regions implement Smart Specialization innovation policies, the knowledge base on Smart Specialization implementation is also growing (Sörvik et al. 2019).

Numerous studies on Smart Specialization in the European Union (EU) have been conducted in the context of both developing countries and underdeveloped regions. However, there is arguably still scope for further systematic and in-depth research addressing Smart Specialization implementation, specifically in less developed regions of the EU. While previous research has yielded several systematic studies dealing with innovation and implementing Smart Specialization, those focusing on less developed regions are still very limited. Pires et al. (2020) is one such study, which reviews many papers and analyzes the Territorial Innovation Model (TIM) in LDRs. Eder (2019) previously conducted a similar systematic literature study to look at the state and evolution of innovation in peripheral regions in Europe. Lopes et al. (2019) is perhaps the closest systematic literature study to this topic – Research and Innovation Strategies for Smart Specialization (RIS3) – which summarises and categorizes several specific sub-themes of Smart Specialization studies. These studies, however, do not systematically examine research design, methodological diversity, and critical issues in Smart Specialization studies.

This study aims to achieve two main research objectives. Firstly, to systematically analyze current studies focusing on the implementation of Smart Specialization in less developed regions (LDRs) in the European Union (EU). Second, it aims to comprehensively examine the experience and implementation of Smart Specialization in LDRs of the EU while raising several critical issues, challenges, and recommendations that can contribute to understanding how the concept can be successfully implemented in the future. Applying protocols appropriate to a systematic literature review, the study selects key papers as a focus for a three-stage analysis. Firstly, the study systematically assesses the source and nature of the selected papers. Secondly, an analysis is applied to the diversity in research design and methodology. Thirdly, the study considers an evidence-based analysis of the challenges in implementing Smart Specialization in less developed regions of the EU. With a systematic and consistent protocol, this paper theoretically enriches the study of Smart Specialization in LDRs of the EU. It provides greater insight and experience perspectives to increase the chances of successfully adopting and implementing Smart Specialization.

The remainder of this paper is presented as follows. The theoretical background on innovation and Smart Specialization is outlined in the second section, both in the context of the region in general and the specific region. The third section outlines the systematic sequence and protocol of the systematic literature review of this paper. The fourth section discusses the key findings. This section is further divided into three subsections. The fifth section summarizes and concludes with some limitations explicitly stated.

2 Literature background

2.1 Regional innovation and Smart Specialization policy concept

A country's international competitiveness can be achieved by producing goods or services most efficiently and can also be achieved through a dynamic process of learning and innovation (Freeman 2004, Porter 1990). In international trade theory, increasing competitiveness is considered a more promising approach when compared to the more static cost approach. Current theoretical and practical implications of innovation emphasize the involvement of many actors and organizations in innovation activities, while innovation itself is also understood to be a product of learning processes aimed at creating centres of long-term growth. The innovation system concept – which arose in the context of the 'second normative turn' in innovation studies in the latter decades of the twentieth century – is a competitiveness-focused approach (Asheim 2019). The innovation system concept marked a step-change in the way the drivers of innovation were understood – moving away from the 'static', linear process of applied research activity to develop a new process or product which dominated previous science and technology policies (Lundvall, Borrás 2005). Innovation policies that support innovation systems accordingly emphasize

stakeholder' or innovation actor dynamics, and the systemic relationships that characterize these actors' roles in promoting innovation and competitiveness.

Actors in the innovation system form a relationship or 'node' which promotes innovation in their environment. That is, they are the main components of the innovation system. The innovation system, therefore, constitutes a collection of all innovation actors and can be grouped into two subsystems: exploration and exploitation (Asheim 2019). Exploration subsystems, such as research institutes and universities, are generally those which generate or introduce new knowledge, while exploitation subsystems, such as firms or industries, are those which utilize this new knowledge for innovation purposes. These two subsystems then interact systematically over the long term to form an innovation system. In innovation systems, the government or public institutions play a crucial role in the planning process – as in some Western European and Nordic countries – which have a more coordinated market economy system, as opposed to, for example, traditional Anglo-Saxon model, where the role of the private sector as the capital provider is much more important than the role of government or public institutions. The latter tends to be less systematic and arguably applies over shorter time periods.

The regional innovation system (RIS) therefore represents an important approach to regional economic development. RIS is hence aimed at the dynamic goal of regional economic growth in the long term through innovation-based economic development. This innovation-based regional policy can also be used as an instrument to analyze regional economic development, and to measure the effectiveness of planned and implemented regional development. Therefore, the concept of RIS can be seen in terms of its function as an instrument for policy analysis, as opposed to its primary purpose of fostering innovation (Asheim et al. 2017, Asheim 2019).

In LDRs with some structural institutional and organizational weaknesses, the innovation learning and competitiveness approach can be used to achieve regional economic transformation through the Entrepreneurial Discovery Process (EDP). EDP constitutes the core process of the RIS3 policy approach, adopted by the European Commission as part of the reformed Cohesion Policy in 2014 (McCann, Ortega-Argilés 2014, 2016). This policy approach has been used to help regions construct their RIS in the early stages (Asheim 2019, Ranga 2018). Gustavsen, Ennals (1999) put forward the concept of "learning regions" for regional development, where a region draws necessary knowledge from outside their region then processes and disseminates it to the external environment around them (e.g., firms or industries) or uses that knowledge for their internal benefit (e.g., private R&D institutions). This process circulates within the RIS through horizontal collaboration (or a bottom-up approach). Such an innovation policy approach requires strong ties between organizations and critical actors in the innovation network. It also requires that local innovation actors should have the necessary capacities and capabilities (Lundvall 2007).

There is a dichotomy which dominates the concept of innovation within the framework of economic geography. First, economically more developed regions are considered more innovative than LDRs. Second, innovation is heterogeneous, following the region where it occurs (Edquist, Chaminade 2006, Rodríguez-Pose, Wilkie 2019) – i.e., institutional and socio-economic factors drive innovation success in more developed regions. It is because more developed regions generally have more skilled human resources, established physical capital, and supportive technological infrastructure (Bettencourt et al. 2007, Feldman, Florida 1994, Florida 2005). Developed regions also leverage agglomeration and externalities to bring private firms or institutions closer to regional public organizations or institutions. They also benefit economically from diversification and knowledge flows (Andersson et al. 2005, Anselin et al. 1997). The concentration of economic activity or agglomeration is suitable for innovation, especially from the institutional side. Even though institutions active in innovation are complex systems in themselves, they are essential factors in the process of knowledge diffusion and transfer, as well as in shaping collaboration for innovation (Fitjar, Rodríguez-Pose 2011, Rodríguez-Pose 1999). Unfortunately, a lack of these aforementioned conditioning factors often represents a significant challenge for LDRs. Structural problems are very likely faced by LDRs, such as socioeconomic conditions, local institutions, geographical location, the quality of human resources, and

skilled workforce composition (Bathelt et al. 2004, Lee et al. 2010, Ozgen et al. 2012, Pater, Lewandowska 2015, Rodríguez-Pose, di Cataldo 2015). Some of these limitations have a direct impact on the process of absorbing external knowledge or exploiting external knowledge from other regions, which is crucial for developing the innovation capacity of the region (Moreno et al. 2005, Rodríguez-Pose, Crescenzi 2008, Sonn, Storper 2008). In essence, the factors supporting innovation or innovation capacity in LDRs lead to stark contrasts with developed regions. Rodríguez-Pose, Wilkie (2019) state that conducive institutional conditions significantly distinguish these two types of regions besides their socioeconomic structure.

In this regard, some important questions arise about how these factors relate to Smart Specialization-centred place-based innovation policies. Tripl et al. (2019) explain that the existing approaches in RIS, such as institutions and organizations in a system, have a special place in the Smart Specialization policy framework, especially from the point of view of supporting innovation and entrepreneurship (Tripl et al. 2018) and from a governance perspective of innovation policy (Asheim, Isaksen 2002, Tödtling, Tripl 2005). In other words, the implementation of Smart Specialization in a region is influenced by the RIS.

Furthermore, the success of innovation policy governance in regions can be said to be determined by the competence of a region in designing its regional innovation policy, which will duly affect a region's ability to adopt Smart Specialization (in this case, called a Smart Specialization Strategy (S3)). Therefore, decentralization of power (regional autonomy), including decentralization of regional finance, is an issue that often arises in implementing Smart Specialization at the regional level (Tripl et al. 2019). On the other hand, decentralization affords a particular wiggle room to regions, allowing a degree regional manoeuvrability in formulating regional innovation policies. However, this discretion is highly dependent on the structure and quality of local government institutions, the capacity and capability of innovation actors, and the administrative and governance capabilities (Kroll 2015, 2017b, Rodríguez-Pose, di Cataldo 2015).

Other factors – often related to past policies – can hinder the adoption and implementation of this new type of innovation policy at the regional level (Aranguren et al. 2019, Morgan 2017). More developed regions are generally more prepared to adopt S3 because they have already overcome this problem in their area. More developed regions are generally more prepared to adopt the Smart Specialization approach because they have already overcome the more structural problems in their area. However, LDRs are still struggling with some of these problems. Smart Specialization requires multilevel arrangements and governance where coordination is crucial (Aranguren et al. 2019, Kroll 2017b). LDRs may face complex coordination challenges to create good governance of S3. However, because of these experiences, it can be argued that LDRs will benefit more from S3 than more developed regions (Kroll 2017a).

The adoption process of RIS3 at the regional level is strongly influenced by the organizational factors of RIS, especially in terms of the organizational structure of regional innovation, level of regional specialization, density, and diversity of firms and industries, as well as support from local knowledge institutions (Tripl et al. 2019). Regions can differ significantly due to economic structure, industry heterogeneity, and firm/industry innovation and diversification capabilities (Balland et al. 2019, Isaksen, Tripl 2017). However, this opens up opportunities for implementing Smart Specialization regarding regional priority selection – a process that can become a developmental project given solid stakeholder buy-in and engagement. Accordingly, the skills of the innovation actors are necessary for the success of the prioritization process. On the other hand, certain regions may face difficulties mobilizing these actors to engage in the RIS3 process, particularly when balancing their roles in the priority selection and decision-making process. Tripl et al. (2019) explicitly explore the adoption practices of RIS3 as influenced by the characteristics of RIS in the region.

3 Methodology

The first protocol of this study is underpinned by a preliminary scoping search process based on a number of pre-established research questions. Based on the preliminary study conducted prior to the research's commencing – as well as the background and motivation outlined in the introduction – two research questions are formulated, namely, “how does regional innovation take place in less developed regions (LDRs) of the EU?” and “how is Smart Specialization implemented in less developed regions (LDRs) of the EU?”.

The initial scoping strategy was conducted using the PICOC concept (de Barcelos Silva et al. 2020, Mengist et al. 2020, Roehrs et al. 2017). This study's population (P) was specifically chosen to be only those regions in European Union (EU). The chosen intervention (I) was implementation and experience. The Smart Specialization and regional innovation strategy explain the comparison (C) element. Outcomes (O) expected at the end of the study are findings or analysis results related to problems, challenges, obstacles, opportunities, and recommendations. The context (C) of the study is expressly limited to specific regions, namely less developed regions, lagging regions, peripheral regions, and less-innovative regions.

Based on this PICOC concept, selected keywords are applied to the subsequent search phase, namely “less-developed, lagging, less-innovative, regions” (explaining the “who” element), “innovation, Smart Specialization” (to cover the “what” element) and “implementation, experience, problem, challenge, recommendation” (for the “how” element). All these keywords are henceforth combined in the literature search process through four primary databases (Web of Science, Science Direct, Wiley, and EBSCO), based on inclusion criteria which must be included in the literature search process.

Exclusion criteria control for papers deemed not to contain the above elements. Firstly, “China, US, UK” represent the “who” exclusion element. This literature was not considered because this study focuses on EU regions where Smart Specialization policies are implemented. Second, “tourism, environment, sustainable cities, universities”. This literature was also excluded due to the study's specific focus on regional innovation policies rather than subtopics or specific sectors. Thirdly, “semi-autonomous” is applied as an exclusion criterion as it is judged that the term might not represent the specificity of “less-developed, lagging, less-innovative, regions”.

The second protocol constitutes a search for papers in the four databases by applying the terms and criteria defined in the first protocol. Table 1 shows the details of the paper search applied to the four primary databases. The papers are sorted with certain restrictions such as language, year of publication, subject areas, article type, number of citations, and geographic region.

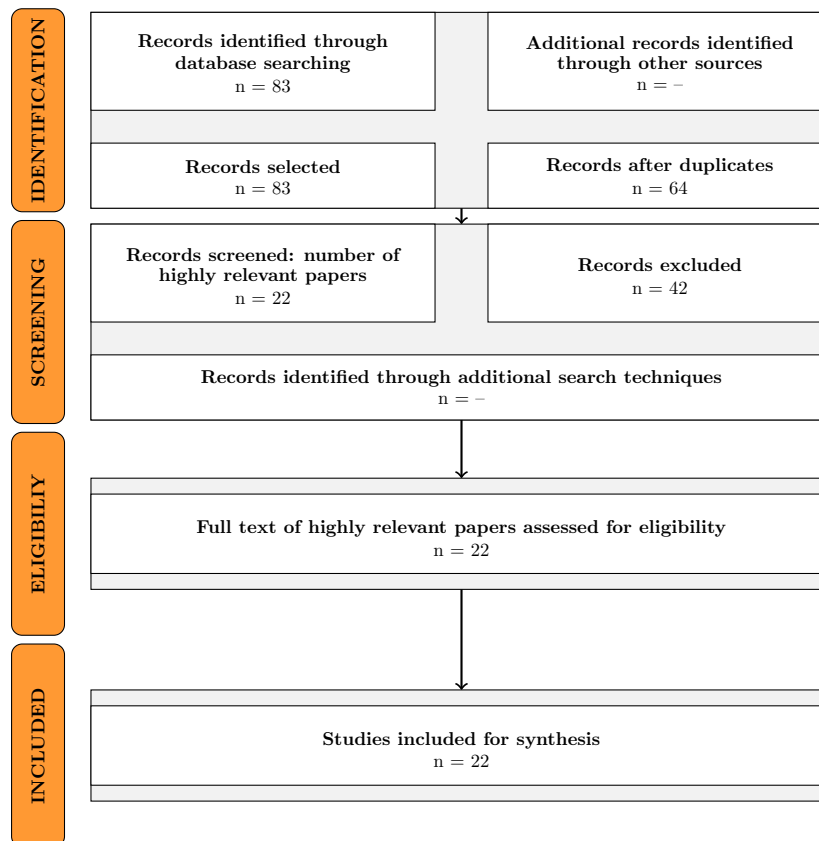
A total of 83 potentially relevant papers were collected and tabulated. This process found that some papers were duplicated on different database sources and are thus removed. At this stage, the number of potentially relevant papers is reduced to 64. Following further refinement based on exportable parts of the database (title, keywords, abstract, and conclusion 22 papers were finally selected as most relevant to the research objectives. These papers are screened based on details such as research question or objective, location and subject of the study, paradigm and discipline, theory, methods, data, and important research findings. This selection process affirmed these 22 papers as the main papers to be systematically analyzed in this study. The selection process flow is summarized in the PRISMA diagram in Figure 1.

The third protocol analyzes and reviews 22 papers systematically. Three steps are applied. First, articles are grouped based on their nature and origin, i.e., analyzing the number and trend of articles published in a certain period and grouping them based on their publication source (publication journal). This section aims to look at the research patterns related to Smart Specialization in LDRs of the EU, the widely discussed sub-topics, to identify which type of journals discuss or publish articles on this particular topic. Second, the selected papers are analyzed based on the research design and methodology. It identifies the kind of research approaches widely applied in the study of innovation and Smart Specialization policies and which make a significant impact and contribution to the development of the concept, theory, and practice of innovation and

Table 1: Search queries process

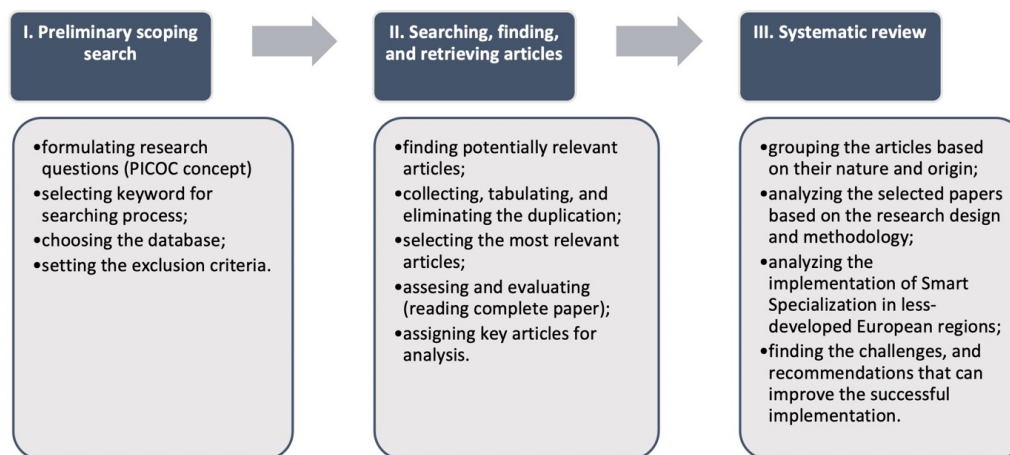
Database	Search queries detail	Potentially relevant papers
Web of Science	<i>Topic:</i> (SMART SPECIALIZATION INNOVATION LAGGING LESS) <i>Timespan:</i> All years. <i>Indexes:</i> SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC. (24 results)	24
Science Direct	<i>Key terms:</i> “Smart Specialization” AND “innovation” (311 results) <i>Years range:</i> 2010 - 2021 (311 results) <i>Subject areas:</i> Economics, Econometrics and Finance (75 results) <i>Titles:</i> smart speciali(s)(z)ation; innovation; implement*; monitor*; less’ (19 results)	19
Wiley	<i>Key search:</i> “Smart Specialization; innovation; less; lagging” (1253 results) <i>Applied Filters:</i> 2010 - 2020; Journals; subject: Business & Management <i>Titles:</i> smart speciali(s)(z)ation; innovation; implement*; less; lagging (5 results)	5
EBSCO	<i>TS=</i> (“Smart Specialization” AND “innovation” AND “less” OR “lagging”) <i>Geography:</i> Europe; Poland; Spain; Italy (70 results) <i>Choose by Title</i> (35 result)	35
TOTAL		83

Source: processed data, own work



Source: processed data, own work – PRISMA diagram refers to Moher et al. (2009) and Page et al. (2021)

Figure 1: PRISMA diagram of the paper search process



Source: processed data, own work

Figure 2: The research protocols

Smart Specialization in LDRs of the EU. Third, it analyzes the implementation of Smart Specialization in LDRs of the EU. This critical section aims to find constraints, barriers, challenges, and recommendations which can improve the successful implementation of Smart Specialization in LDRs of the EU. A systematic and evidence-based analysis is applied to the most relevant papers and contributes to the research objectives. This section's critical information is summarized through graphs, figures, and tables. This research process is outlined in Figure 2:

4 Study findings

4.1 Systematic assessment of selected articles

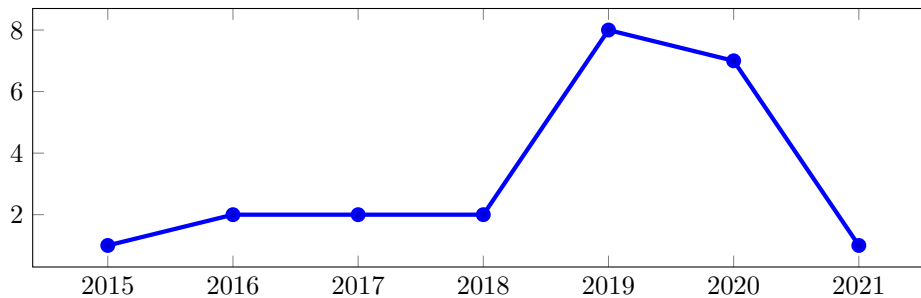
This subsection assesses the 22 selected papers based on two groupings. First, the source and nature of the articles, and second, the diversity in research design and methodology. Of the selected articles, the study finds that studies on Smart Specialization policies published in top leading journals started in 2015 – the first period of Smart Specialization implementation – which took place from 2014-2020 in the context of the EU's corresponding Multi-annual Financial Framework (Becic, Svarc 2010). The last article found was in 2021 (Serbanica 2021), during which time this study was ongoing. The distribution of articles from 2015-2021 shows that the trend of research on the chosen topic has increased significantly, although when working on this study in 2021, only one paper was captured on this topic from a leading journal.

In 2016-2018, five articles related to innovation and Smart Specialization were published: papers examining the linkages, design, and development of regional innovation systems (RIS) related to the new policy concept of RIS3 (e.g., Healy 2016, Krammer 2017, Ranga 2018) and papers examining the subfields of innovation research related to Smart Specialization and the transition and transformation processes of less developed regions in preparing their regions to adopt the Smart Specialization policies (Doloreux, Porto Gomez 2017, Wojnicka-Sycz 2018). The 2019-2020 period saw the most studies on Smart Specialization policies in less developed regions. There were 15 articles found in this period. The territorial context is an essential issue in the studies of these years, for instance, studies on implementing innovative programs, strategies, or policies in less-developed, rural, peripheral, and sparsely populated areas. Furthermore, there are also studies on the economic impact of Smart Specialization at the firm, regional and national levels, the potential of less developed regions in developing the innovation strategy RIS3, the implementation and factors affecting the success of S3, and future research opportunities which focus on S3 in less developed regions. This kind of research trend has dramatically expanded in the last five years. The number of articles and publication trends over time

Table 2: Number of articles published over time

No.	Year of publication	No. of articles
1	2015	1
2	2016	2
3	2017	2
4	2018	2
5	2019	8
6	2020	7
7	2021	1

Source: processed data, own work



Source: processed data, own work

Figure 3: Publication trends over time

are summarized in Table 2 and Figure 3.

Regarding the publication sources (Table 3), nine articles were published in two top leading journals, namely *European Planning Studies* and *Regional Studies*. Another five articles were published in *Growth and Change* and the *Journal of Knowledge Economy*. The remaining eight articles were published in top leading, reputable, and high-impact journals. The paradigms and scientific approaches in the selected articles also show a close relationship. The subject areas and subject categories of these publications are Geography, Planning and Development (eight articles), Social Sciences (five articles), Economics and Econometrics (three articles), Environmental Science (three articles), Public Administration (one article), and Management of Technology and Innovation (one article).

4.2 Diversity in research design and methodology

In this subsection, the selected articles are further analyzed following the research design and methodology diversity. First, the papers are categorized into two research methodology traits: non-empirical and empirical research. Non-empirical research has the common trait of using theoretical data and making logical assumptions about the research subject, whereas empirical research leads to hypothesis testing to conclude valid and verified findings (Dan 2017).

From the selected papers, research of a non-empirical nature is research that conducts a study in the form of a systematic literature review. In general, one of the critical objectives is to find the theoretical and practical gaps in the analyzed research topic and to identify research opportunities or crucial issues to be tackled in future studies.

Pires et al. (2020) systematically review 99 papers and conduct in-depth inductive analysis of the contents of their selected papers. This paper explores the theoretical and practical gaps in the TIM research agenda in LDRs. The study constructs some theoretical bases and opens up new horizons regarding TIM research and how policy practice relates to it in the less-developed European region. The findings of this study demonstrate the evolution of innovation policy over time with clear literary evidence and

Table 3: List of publication sources/journals

No	Journal name	Quartile (2021)	No. of articles
1	European Planning Studies	Q1 - Geography, Planning and Development	5
2	Regional Studies	Q1 - Social Sciences	4
3	Growth and Change	Q3 - Environmental Science	3
4	Journal of the Knowledge Economy	Q3 - Economics and Econometrics	2
5	International Regional Science Review	Q1 - Social Sciences	1
6	Transylvanian Review of Administrative Sciences	Q3 - Public Administration	1
7	Innovation: The European Journal of Social Science Research	Q2 - Geography, Planning and Development	1
8	Cambridge Journal of Regions, Economy and Society	Q1 - Geography, Planning and Development	1
9	Papers in Regional Science	Q1 - Geography, Planning and Development	1
10	Agricultural Economics (Czech Republic)	Q1 - Economics, Econometrics and Finance	1
11	Technological Forecasting and Social Change	Q1 - Management of Technology and Innovation	1
12	Journal of Common Market Studies	Q1 - Economics and Econometrics	1

Source: processed data, own work

based on science and technology-based concepts and theories of innovation for economic development. The second thrust of this study is on the factors which influence the pattern of innovation in less developed regions and the impact of innovation on the region. The third substantial tenor, related to innovation policy, relates to the critical role of various actors as subjects or actors of innovation in formulating innovation objectives based on proven innovation theories and practices, such as through the entrepreneurial discovery process.

Eder (2019) and Lopes et al. (2019) also conduct systematic literature reviews but use different analytical approaches. Eder (2019) conducts a study which draws on an earlier study by Webster, Watson (2002) to review in-depth studies on innovation in peripheral European regions. The findings of this study first suggest that the designation of peripheral regions as the subject of study should be more explicitly emphasized, for example, from the perspective of geography or functional areas. It is found that research results can be compared between specific regions and countries. The innovation studies that have developed so far generally focus on successful experiences in developed and innovative regions, while such innovation success factors are considered biased for peripheral regions. Studies on the evolution of innovation in peripheral regions are still insufficient, even though an evolutionary perspective is vital to trace how these peripheral regions innovate over time. The study finally shows that regional ties to the urban core are fundamental for firms in peripheral locations to innovate amidst the many other challenges and constraints they face. Lopes et al. (2019) systematically analyze the literature to find challenges and opportunities in RIS3, which could be helpful for future studies. The method used is a bibliometric analysis which leads to the conclusion of six topic clusters related to RIS3 research to help future researchers build theoretical bases and design research related to innovation policy in the context of Smart Specialization.

The second category of the research approach is empirical research. The empirical research found in the selected group of papers is generally qualitative, applying much analysis to strategy or policy documents and analyzing the behaviour of stakeholders or policymakers as innovation actors. In addition, the primary papers of this study also specialize in their studies on quantitative research approaches and a mixture of qualitative and quantitative research approaches.

Healy (2016) explores the constraints and challenges of implementing Smart Specialization in one of Europe's least developed regions, Northeast Romania. The qualitative data was obtained from observations and interviews of local stakeholders, including local governments, council members, universities, companies, and selected correspondents who work within the Smart Specialization innovation policy scope, and then analyzed by means

of a qualitative approach. The development of regional RIS3 was promoted after Romania launched the national RIS3. The Smart Specialization policy approach has provided opportunities for regions to explore their spatial potential further while at the same time providing learning benefits for regions, in that it has encouraged researchers to build and develop RIS3 in their regions actively. The study concluded the importance of solid institutional structures in supporting the effective implementation of Smart Specialization in regions such as Northeast Romania.

A subsequent study by [Kolehmainen et al. \(2016\)](#) also employs a qualitative research approach to analyzing the actor's role in the business sector, higher education institutions, government organizations, and community groups (quadrupole helix) in economic and social development in less developed or marginalized regions. The study finds that innovation in urban areas is often considered a benchmark in designing and developing RIS3 in less developed regions and assumes that the same policies can be applied in their areas. The study finds that underdeveloped, peripheral, or rural areas with a triple helix base will benefit more from the involvement of the fourth actor, namely social groups, and communities (quadruple helix concept), in the knowledge-based development process in less developed regions.

A study by [Ranga \(2018\)](#) sheds light on evidence from the implementation of RIS3 in eight regions in Romania. Again, through a qualitative research approach, the study reviews how the innovation policy of Smart Specialization triggered the accelerated development of RIS which were previously relatively low. Accordingly, this is found to have been no easy feat, given Romania's centralized innovation system. This paper is the result of two years of research conducted in 2017-2018, consolidating many stakeholders from national authorities involved in formulating RIS3. The research started with forming working groups, conducting workshops, and analyzing the research project's progress. The research finds that strong and coordinated multilevel governance at the regional level is needed by regions in countries with a centralized national innovation system like Romania. Industry dynamics and a conducive regional research and innovation climate are created through appropriate national and regional innovation policy interventions at the institutional level. Thus, there is no "golden rule" for implementing innovation policy in the region, but rather the region must learn to understand its actual conditions and characteristics in formulating and implementing RIS3.

From several examples of these studies, data collection in the qualitative research approach is generally obtained from interviews and observations. Qualitative studies can be preceded by an initial review of strategy documents or policy documents and then further observations by gathering information from local stakeholders (e.g., [Healy 2016](#), [Ranga 2018](#), [Sörvik et al. 2019](#)). Some scholars also apply longitudinal studies to complement these two methods by distributing questionnaires to those considered capable of providing more information or explanations if they are reluctant to convey some information during the interview or observation process (e.g., [Kolehmainen et al. 2016](#)).

In addition to primary data directly obtained from respondents, secondary data readily available from various reliable sources is also widely used in innovation policy studies, such as socio-economic and financial/budgetary data. The data can be obtained online from the offices or official websites of state or regional statistical agencies or other institutions that publish specific data in the public interest. Secondary data can also be obtained with special procedures or permissions at the company level. This kind of data is the main empirical research data with a quantitative approach.

[Rodríguez-Pose, Wilkie \(2019\)](#) apply the econometric analysis method using the Organization for Economic Co-operation and Development (OECD) regional statistical data to analyze the factors affecting patenting in less developed regions in America and Europe. The study finds that innovation in lagging regions in North America is directly related to regional Research and Development (R&D) investment in higher education institutions, regional human capital quality, location concentration of economic activities, and local population size. However, in less developed regions in Europe, regional innovation capacity depends on the R&D investment of firms present in the area, the availability of skilled human resources, and the economic structure of the regions, all

of which are closely linked to economic agglomeration. As a result, variations in the knowledge transfer processes contribute to building innovation capacity in lagging regions in North America and Europe.

Varga et al. (2020) use complex quantitative data to build an economic impact model with Geographic, Macro, and Regional (GMR) Hungary economic impact modelling. This study is closely related to Smart Specialization policies in Hungarian regions. Economic impact modelling is expected to provide a reliable picture of the economic impact of Smart Specialization policies from various dimensions, namely industry, regional, and national levels, so that this study can help policymakers implement Smart Specialization in the region. The study utilizes statistical data from three types of selected regions, namely developed regions (Budapest), industrial regions (Győr-Moson-Sopron), and less developed regions (Baranya). Economic impact modelling leads to conclusions about the potential for regional economic development with policy interventions related to smart specialization tailored to local resource factors. Developed regions are synonymous with the service sector with high added value and knowledge intensification embedded in the regional economic system. Industrial estates spread across several sub-regions contribute to high regional economic growth. Meanwhile, less developed regions are still dominated by the agricultural sector with limited regional capital, and much effort is still needed to develop the regional economy.

Crescenzi et al. (2020) use quantitative data at the firm level to analyze the impact of the implementation of the Collaborative Industrial Research (CIR) programme on several Italian firms during 2007-2013. Collaborative Industrial Research (CIR) is a research and competitiveness program scheme within the framework of the EU Cohesion Policy 2007-2013 that is jointly funded by the Italian national budget and the European Regional Development Fund (ERDF). The CIR program aims to support R&D activities carried out by industrial firms in less developed Italian regions such as Sicily, Campania, Apulia, and Calabria. The program is also seen to have essential features that are compatible with the Smart Specialization Strategy (S3). The study's objective was to evaluate the impact of the CIR program in driving value-added, investment, and employment across all beneficiary firms. The evaluation results showed a minimal impact on the CIR beneficiary firms. Even greater funding support has as yet not managed to increase the effectiveness of the firm's R&D projects. Interestingly, firms from low-tech industry sectors have seen greater benefits from this program. According to the study, significant reforms are needed to create effective regional innovation strategies and policies. In addition, it is also necessary to develop specific policy tools that can encourage collaboration in innovation programs to optimize the impact of implemented policies.

Mixed methods which combine qualitative and quantitative research approaches seem to be more successful in contributing to innovation studies related to Smart Specialization. For example, Krammer (2017) employs mixed methods to analyze and propose RIS3 policy tools in less developed regions in Bulgaria. The study is complemented by an innovation system framework which can improve common economic indicators such as economic growth and regional competitiveness. The study utilizes industry-level export data from The United Nations Comtrade national statistical data, and international patent data from the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO). The study results identify economic sectors that have the potential to be adapted into Smart Specialization policies at an early stage. Some obstacles in implementing S3 in less developed regions are also discussed in this paper. The paper recommends a multi-level policy instrument in the management of S3 in less developed regions such as Bulgaria, which is a multi-level policy instrument that links economic sectors, regional governance elements, and systemic national policies.

Trippl et al. (2019) apply a mixed methods approach by analyzing secondary data, conducting a desk-based analysis of regional innovation policy practices, and analyzing and evaluating regional innovation policy documents. The study addressed several key research questions. First, how can European regions with diverse geographical conditions adopt and implement Smart Specialization while identifying the main opportunities and challenges of Smart Specialization implementation in European regions? Second, how RIS's organizational and institutional factors influence the implementation of Smart

Table 4: The diversity in research design and methodology

Nature of Research Methodology	Research Method Approach	Selected Papers
Non-empirical Research	Systematic Literature Review	Pires et al. (2020), Eder (2019), Lopes et al. (2019)
Empirical Research	Qualitative methods	Healy (2016), Kolehmainen et al. (2016), Ranga (2018)
	Quantitative methods	Rodríguez-Pose, Wilkie (2019), Varga et al. (2020), Crescenzi et al. (2020)
	Mixed methods	Krammer (2017), Tripl et al. (2019), Ghinoi et al. (2021)

Source: processed data, own work

Specialization in three different types of regions: developed regions, intermediate regions, and less developed regions. Third, how Smart Specialization provides crucial lessons for regions in realizing better regional innovation systems and policies (RIS and RIS3). Furthermore, Ghinoi et al. (2021) recently applied a mixed method in analyzing the implementation of S3 in peripheral regions with a data triangulation approach, namely by reviewing the RIS3 document belonging to the Lapland region (Finland), followed by in-depth interviews with stakeholders active in the formulation of RIS3, and finally circulating an online survey to obtain more complete data from stakeholders in the region. Both studies are complex and very interesting, so I consider them for a further and more in-depth discussion in the following subsections. The diversity in research design and methodology outlined in the sample papers is summarized in Table 4:

4.3 Challenges in implementing Smart Specialization in less developed regions (LDRs) of the EU

This section summarizes the findings of studies related to the implementation of S3 in LDRs of the EU. Selected case examples are taken from the selected papers which thoroughly analyze the challenges or obstacles in implementing S3 in LDRs of the EU. Meanwhile, the literature review section has previously discussed the literature on regional innovation systems (RIS) and their relationship with the adoption of Smart Specialization (Section 2).

Tripl et al. (2019) specifically discuss the influence of RIS development in 15 regions on implementing the S3 and the opportunities and challenges it faces. The 15 regions are categorized into advanced, intermediate, and less developed regions based on diverse spatial characteristics. The positive role of S3 in LDRs raises new challenges for regions to improve their RIS to be better prepared to participate in Smart Specialization policies. The development of S3 enhances mutual trust, which has the potential to increase mutually beneficial relationships and collaboration between research institutions and industry. The bottom-up approach that characterizes S3 has also led to changes in the governance of policymaking at the local level and created better coordination with higher levels of government.

The two main points of emphasis in this paper in terms of S3 implementation include the determination of priority domains and the involvement of stakeholders in the innovation policy formulation process for Smart Specialization. LDRs have a tough challenge in the prioritization process. This process does not seem to work well due to intrigues within the policy-making environment and past inherent problems in governance. The LDRs have significant tasks in forming a broad consensus of stakeholders and determining their S3 prioritization mechanism. Stakeholder engagement is essential in S3 policy while it is new to LDRs. It is not easy for LDRs to mobilize all interests under conditions of institutional thinness, cooperation culture, and weak policy capacity.

In the prioritization process, the identification process in some regions focuses on strengthening established priority areas. In contrast, in other regions, the identification process is geared towards increasing the contribution and role of existing resources or

the growth of entirely new pathways. Unfortunately, the creation of new pathways is arguably the least preferred prioritization mechanism in the LDRs, because exploiting these new growth pathways requires a good institutional infrastructure and research organization, which has been partly responsible for the failure of new growth pathways in the past. In addition, there are many limitations in diversification and innovation potential in existing domains, some of which are due to limited linkages between industry and universities and a less dynamic entrepreneurial ecosystem. Another critical issue in successfully implementing LDRs is the limitation of regional financial autonomy, which ultimately limits budget allocations for regions. The problems mentioned earlier also contribute to the ability of regions to use their budgets optimally. Similarly, to participate in S3, multilevel coordination and governance between regional and national governments in managing regional budgets for innovation seems to be very much needed.

Some of the problems discussed have led to three challenges in implementing S3 in LDRs. Overcoming these challenges and problems has the potential to support the successful implementation of S3. These challenges include increasing RIS capacity, transparency and accountability of funding and budgets, and resource allocation in the innovation policy governance system. It is also essential to understand that S3 is not a parallel policy process. S3 is a process embedded in RIS, so addressing these three critical solutions will not only improve the regional innovation system but also guide the region in successfully implementing S3.

Sörvik et al. (2019) explore the implementation of S3 in five sparsely populated regions (SPAs) in Europe, representing many of the challenges of implementing S3, such as in LDRs. The implementation of S3 in their regions positively impacted their regional innovation policies. I draw three points that should concern S3 policy practitioners related to improving the quality of human capital, access to external knowledge, and developing or renewing growth paths. In this case, access to external knowledge and the quality of human capital are interrelated. One of the successes of S3 can be realized by imitating the success or excellence of other regions and making it a benchmark. Therefore, competent, talented, and committed personnel are indispensable for absorbing external knowledge and enhancing regional innovation capacity. In addition, a conducive innovation environment is necessary to motivate the region's critical mass to shape a better future innovation environment. In mobilizing such competent resources, intermediaries are also needed whose role can be to mediate various dialogues or socialization among stakeholders as well as to mediate between regions or countries, between public sectors or private sectors, and between public research institutions or universities and industries in creating local and extra-regional collaboration opportunities or engaging extensively in global innovation networks.

Improving the quality of human resources is not only focused on those in formal organizations, but workers with weak skills are equally essential to improve the competence of a critical mass of innovation actors. Research incentives can be provided to researchers in universities and industries to improve motivation and performance. However, for low-skilled workers, it is essential to improve their skills to enhance their role in innovation. For example, vocational training and education for young workers can be proposed as an innovation strategy in regional innovation policies whose budgetary support can also be proposed in the S3 funding framework.

Furthermore, the link between pathway development and new pathway creation. In formulating regional innovation policies, results-oriented innovation development programs focus on the effectiveness of program implementation and the efficient use of resources. Because S3 is a place-based policy concept, it is imperative to consider the region's socio-economic conditions and institutional character. Although each region has advantages in certain areas or domains, its relationship with other areas or domains must also be considered.

SPAs are subject to global competition which can change the direction of demand in the region. In the S3 policy, many stakeholders are involved in the EDP process. In this case, private actors, industries, and companies understand these conditions best, as they are the main actors in the market. The proper EDP practices and periodic evaluations of prioritized domains should be carried out consistently. Stagnant or not

growing domains should be discontinued and replaced by exploring opportunities for new, more transformative activities. In the course of implementing S3, the region will look at its economic development from a broader perspective and realize new opportunities that have the potential to improve its competitiveness globally.

The problem of collaboration in LDRs is the focus of [Barzotto et al. \(2019\)](#). One case study is the Italian region of Puglia, one of the poorest regions in Italy, with high unemployment and many socio-economic problems. Initially, the region implemented strategic sectoral policies encouraging substantial public investment in state-owned companies in the steel and aerospace sectors. However, this policy failed to address the region's numerous problems. The region has finally focused on developing local industries and EU-funded projects in the last two decades, although their effectiveness has also been limited. Puglia has typical LDR characteristics: poor quality of governance, high levels of corruption, low levels of public trust, and limited social capital. Public trust is challenging to gain under the existing conditions, making the implementation of S3, particularly for EDP processes, in the region very challenging.

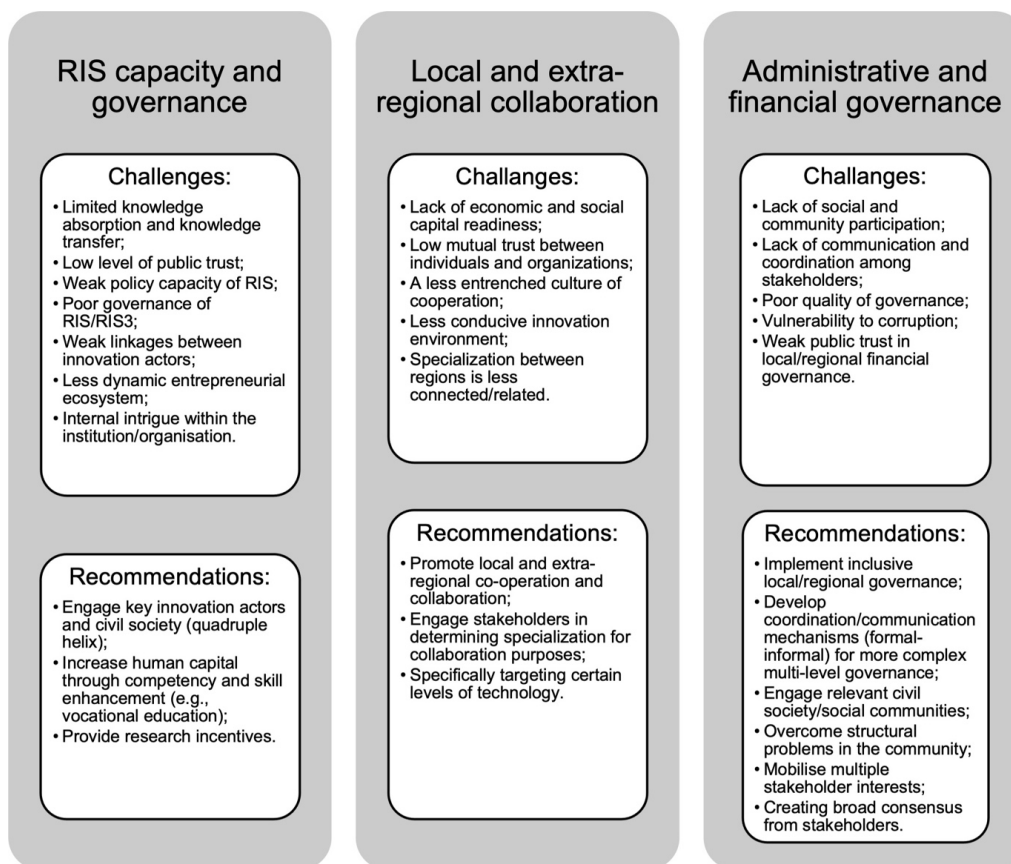
The problems in Puglia began to be overcome when the government began to develop traditional sectors and try to find new, more dynamic opportunities through increasing research and education capacity in manufacturing, digitalization, ICT, and aerospace. RIS3 in the region is evolving with a focus on the technology domains they have identified. Various stakeholders are involved in these activities, the network of innovation actors in the region is growing, and they are also engaged in extra-regional collaborations that strongly support innovation development.

The most fundamental challenge in the study region before they go far into successful extra-regional collaboration is to find new specializations that fit the character of their region and overcome deep-rooted innovation capacity weaknesses that are difficult to change. [Barzotto et al. \(2019\)](#) recommend three critical policies. First, extra-regional collaboration should focus on adopting new technologies and opportunities to discover innovation domains. Second, regional participation in RIS3 should lead to policy learning in governance administration, which is crucial in the design and implementation of S3. Third, lagging regions should have an industrial strategy that can address the region's structural problems, such as HR quality issues, network access, and social capital, which opens up new investment opportunities and broader involvement in extra-regional collaboration.

[Ghinoi et al. \(2021\)](#) applied the triangulation research approach in Lapland (Finland), which was also used as a study region by [Sörvik et al. \(2019\)](#). The research took a data triangulation methodology approach by examining RIS3 early in the process, followed by in-depth interviews with stakeholders directly involved in RIS3, and finally, collecting data through an online survey of various regional stakeholders. This study aims to improve the understanding of good governance practices related to regional participation in S3 innovation policy.

[Ghinoi et al. \(2021\)](#) focus further on several dimensions, such as EDP, decision-making, and discovering new domains. The study only focuses on governance, the most glaring regional network studies issue. Firstly, like the case of LDRs by [Tripl et al. \(2019\)](#), the most significant S3 governance issues in the studied region started from the entrepreneurial discovery process (EDP), which he then linked to the diversity and intensity of organizational networks. Two factors can explain this phenomenon: the ability of innovation networks to absorb external knowledge (absorptive capacity) and the limitations of local resources in the knowledge transfer process (transfer capacity). Both factors were incapable of creating the entrepreneurial activity required for S3 implementation. Secondly, the interaction of stakeholders involved in the decision-making process is strongly supported by inclusive governance. This inclusive governance environment, formally and informally, is indispensable in encouraging good communication and cooperation between actors. Third, in the domain development process, the role of human resources is crucial (competency). The participatory methods applied in the region are a testament to the success of inclusive governance in creating a better innovation environment, even if it has not fully encouraged the emergence of new technology domains.

This study is interesting because [Ghinoi et al. \(2021\)](#) emphasise that regions can rely



Source: processed data, own work

Figure 4: Key issues of S3 implementation in less-developed European regions

on informal coordination to strengthen formal linkages if they engage in multiregional relationships. Nevertheless, this should be tailored to the policy objectives and the stakeholders involved in the S3 formulation process. If in this process, the region also involves relations with the central government, such informal coordination can be applied. For example, if the region needs special access to specific centralized business associations, the central government can facilitate this. Informal approaches from the regions can be made to obtain such support. Next, in place-based innovation policies such as S3, civil society involvement in efforts to create inclusive governance can be sought to address governance weaknesses in the regions. This kind of bottom-up approach is one of the characteristics of S3.

Based on the findings of the studies that raised issues in the implementation of S3 in less-developed European regions, especially concerning the specific challenges and barriers faced in these regions, this subsection is summarized in (Figure 4).

5 Summary and Conclusion

In this paper, a systematic review of the literature on innovation and new place-based innovation policies of “Smart Specialization” in less developed regions (LDRs) of the EU is applied due to a preponderance of theoretical background and practical evidence in this space. This paper emphasizes and analyzes the selected papers on at least two main points. Firstly, on the systematic analysis of innovation studies and Smart Specialization in less-developed European regions. Secondly, the paper highlights the critical issues in implementing RIS3 in LDRs (such as problems, challenges, and recommendations).

The first finding of this study relates to the number and trend of studies in the Smart Specialization implementation period 2014-2020. At the beginning of the implementation

period, it is natural that empirical and theoretical studies related to this policy, especially in less developed regions, were insufficient. However, referring to previous regional innovation studies provides a great deal of insight in addressing innovation issues based on regional differences. Studies on Smart Specialization in LDRs of the EU emerged about two years after implementation began and have increased significantly in the last four years. This phenomenon shows that the implementation issues of Smart Specialization in less developed regions are receiving greater attention. Many researchers, scholars, and policymakers expect significant contributions from these studies.

The paper further analyzes the systematics of the research papers in terms of research design and methodology. First, research approaches are categorised based on non-empirical and empirical research. The research methods applied in these papers are then discussed in detail. Non-empirical research of the systematic literature review type helped design the study. Empirical research groups dominate the selected papers. Primarily, this empirical research thus uses a qualitative approach. It is prevalent considering that innovation studies concerning Smart Specialization require strategy and policy documents which can be reviewed or evaluated in depth by means of desk-based analytical approaches, interviews, observations, and questionnaires. As Smart Specialization emphasizes the importance of the role of innovation actors, many qualitative studies have been conducted involving multiple stakeholders. The use of secondary data in quantitative studies, or qualitative data which can be quantified, is equally essential in innovation studies. Applying appropriate analytical techniques to quantitative data can provide valid and verifiable evidence for the designed hypotheses. Processing and analyzing quantitative data and showing robust evidence can convince other researchers or policymakers to use the study results as a reference for future studies or to take specific policy steps.

Mixed methods combining qualitative and quantitative approaches have significantly contributed to regional innovation studies related to Smart Specialization. Mixed methods can propose specific frameworks for regional innovation in less developed regions of the EU. The combination of several analytical methods aims to obtain complementary information, establish coherence between cases, and present a significant result. Given the complexity of the methods, the process is also balanced by the number of resources required. It is characterized by such studies being carried out over a long period (more than one year), being a collaborative research project involving several parties, and requiring adequate financial resources.

The final subsection of this study analyzes the implementation of Smart Specialization in less developed regions (LDRs) of the EU. The critical point of this subsection is finding the key issues of Smart Specialization implementation, such as the challenges and barriers that many regions face and the study's recommendations. The three main issues from the selected papers constitute issues on RIS capacity and governance, local and extra-regional collaboration, and issues related to local/regional administrative and financial governance.

This study has also found that studies on Smart Specialization in LDRs of the EU are insufficient, implying that the literature sources to be selected were also limited. In the initial scoping search process to find the most relevant literature, exclusion factors entailed that over half the potentially relevant papers were omitted. Despite using desired keywords, many papers identified were too narrow and focused on specific fields, economic sectors, and regions without comparing them to other regions. Certain limitations in discussing this kind of literature and generalizing it as a subset of LDRs of the EU are therefore acknowledged. The present study does not intend to draw the conclusion that the three types of regions discussed in the fourth section (LDRs, SPAs, and peripheral regions) are homogeneous. The present study, therefore, argues that these three regions tend to differ in their characteristics, strengths, and weaknesses. It could be that certain regions are currently very intensively developing one or more of the three key issues of implementing S3, while other regions may still experience systemic difficulties. Therefore, discussing the challenges in implementing S3 according to different types of regions will open further insights in the course of future research. This paper has not covered such literature, so examining this issue in future studies is highly recommended and advisable.

This study has followed the research protocol as consistently as possible through a systematic literature review. However, previous studies have presented much more

complete systematic reviews, such as author performance, number of citations, networks between them, and clustering of specific topics or sub-topics. For the same reason, I acknowledge the limitations in pursuing or fulfilling such important analysis due to limited literature resources. Finally, the synthesis of the key issues in implementing Smart Specialization in LDRs of the EU at the end of this study is, of course, still very much open to investigation. The summary of these issues is based on the relatively few papers that are considered to have made the most significant contribution to this topic. Nevertheless, these findings are a significant contribution to this paper. It is hoped that the key points in each challenge or recommendation in the key issues will interest policy observers, policymakers, or other scholars to study them in future research.

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