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### Systematic Literature Review on Smart Specialization Future Prospects and Opportunities

Revisión sistemática de la literatura  
sobre especialización inteligente  
Perspectivas y oportunidades futuras

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# SYSTEMATIC LITERATURE REVIEW ON SMART SPECIALIZATION FUTURE PROSPECTS AND OPPORTUNITIES

## Revisión sistemática de la literatura sobre especialización inteligente Perspectivas y oportunidades futuras

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### ABSTRACT

Smart specialisation (SS) has been the new cohesion policy in the European Union during the last two periods. The present study aims to analyse the most relevant existing state-of-the-art literature on smart specialisation through a systematic and bibliometric review. Using the Web of Science bibliographic database, we analysed the content of 207 articles under the TCCM methodology and constructed a network of citations in order to summarize theories, characteristics, context and methods presented in existing studies on the topic. Our results show the theoretical and methodological gaps of the past, such as Entrepreneurial Discovery Process and SS indicators. These remain to the present day. The context analysis showed that the scope of smart specialisation extended beyond the frontiers of the European Union, given how it has been adopted by other countries as well. These results suggest the importance of developing a more robust theoretical, conceptual and methodological framework. Consequently, the guides need to be more accurate and should be continuously updated. Our results are valuable for the EDP actors and have policymaking implications.

**KEYWORDS:** SMART SPECIALISATION, REGIONAL INNOVATION STRATEGIES, SYSTEMATIC LITERATURE REVIEW, SMART SPECIALISATION METHODS.

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## RESUMEN

La especialización inteligente ha sido la nueva política de cohesión durante los últimos dos periodos en la Unión Europea. Este documento tiene como objetivo analizar la literatura académica más relevante existente sobre la especialización inteligente a través de una revisión sistemática y bibliométrica. Utilizando la base de datos bibliográfica *Web of Science* (Red de Ciencia) analizamos el contenido de 207 artículos bajo la metodología TCCM y creamos una red de citas para conocer las teorías, características, contexto y métodos de la literatura que se ha generado hasta el momento. Los resultados sobre las teorías, características y métodos, evidencian que, las brechas teóricas y metodológicas que existían, como sobre el Proceso de Descubrimiento Empresarial (EDP, sus siglas en inglés) y los indicadores de especialización inteligente, aún existen. El análisis del contexto muestra que el alcance de la especialización inteligente se extendió más allá de los límites de la Unión Europea, ya que su idea ha sido adoptada por otros países. Estos resultados sugieren la importancia de desarrollar un marco teórico, conceptual y metodológico más robusto sobre la especialización inteligente. Por consiguiente, las guías deben ser más precisas y actualizarse continuamente. Los resultados obtenidos son valiosos para los actores del EDP y tienen implicaciones en la formulación de políticas.

**PALABRAS CLAVE:** ESPECIALIZACIÓN INTELIGENTE, ESTRATEGIAS DE INNOVACIÓN REGIONAL, REVISIÓN DE LITERATURA SISTEMÁTICA, MÉTODOS DE ESPECIALIZACIÓN INTELIGENTE.

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## INTRODUCTION

Cohesion policies in the European Union have had the purpose of closing the existing national and international productivity gap. It is generally known in economics, that differences between nations are often due to the innovation capacities of each country. This proved to be the motivation for the emergence of the National Innovation Systems (NIS). The NIS function as social learning systems in which actors interact to spread new knowledge, creating virtuous circles and cumulative causation (Lundvall, 2010) within the borders of a nation.

The historical context of Europe gave rise to the need for a theoretical model that could be operationally translated to understand the economy of regional innovation and thus formulate policies around it (Landabaso, 1997). For this reason, the NIS were reinforced with the Regional Innovation Systems (RIS), so that innovation policies were further adapted to the specific environments of the different regions. In general terms, a difference between the Regional Innovation Systems and the National Innovation Systems is how studies of different territories are no longer presented as unique cases. Rather, by accepting the heterogeneity of the EU regions, they could be outlined (Cooke, 2001) and different approaches to regional innovation could be presented, i.e. the cases analysed by Cooke, Uranga & Etxebarria (1997), in Japan, Germany, France, Baden-Wurttemberg and Wales.

Since 1994, there have been six-year investment plans called cohesion policies aligned with regional innovation strategies. Cohesion policies, as well as regional innovation systems, aim to promote economic growth and reduce the gaps between regions through regional innovation strategies. This is how the concept of smart specialisation emerged.

It's been 15 years since the term *smart specialisation* was used for the first time. The concept can be traced back to the summary of a report on public policies with the title: *Smart specialisation in a truly integrated research area is the key to attracting more R&D to Europe*, authored by Foray & Van Aark (2007) as members of the expert group *Knowledge for Growth*. Although the concept is not explained elsewhere in said paper, the document highlights the need to find modern areas of specialisation through cooperation and coordination via the European Union's investment plans. Essentially, public policies should implement areas of

specialisation in the *correct* industries, i.e. industries that do not particularize their basic knowledge, but find new applications, thus improving their innovation capabilities and developing competitive advantages for new areas of knowledge.

Later the European Commission (2012) created the *Guide to Research and Innovation Strategies for Smart Specialisations (RIS3)*. We want to emphasize that the RIS3 Guide differed from the previous Regional Innovation Systems adopted because the RIS3 Guide is aligned with the needs of each region and has the participation of all those involved, promotes the efficient use of public investments and helps countries and regions strengthen their innovation capacity.

The term spread rapidly as it became part of the European Union's cohesion policy 2014-2020. The Union's main investment policy aiming to improve job creation, business competitiveness, economic growth, sustainable development and standard of living in all countries, regions and cities of the European Union. In regards to the aforementioned investment policy currently the 2021-2027 strategy is in force.

Smart specialisation is a policy that has been integrated into a set of previously known theories. Its essential objective is to improve both weak and strong regions through diversification, therefore reducing the productivity gap between them. Being part of a new regional innovation strategy, processes have been exploratory raising considerable doubts from the parties involved in the implementation processes. Some of these doubts were pointed out by Hassink & Gong (2019). For example, the term is confusing, smart specialisation actors find it difficult to fully understand the true difference between smart specialisation strategies (S3s) and the previous literature and policies, and there is little standardization to measure the effects of smart specialisation. Likewise, Benner (2020) affirms that there is no clear understanding of its appropriate spatial scope and it focuses too much on the creation of policy documents.

Almost ten years after the start of the regional innovation strategy 2014-2020 first stage, the research objective of our study is to analyse the content of the scientific literature generated around the topic of *smart specialisation*.

This analysis will be carried out via a systematic literature review and aims to identify and analyse theories generated on smart specialisation. It will attempt to measure its effects as well as produce examples of regions where it has already been implemented and their specific characteristics. Our conclusions reaffirm the importance of creating new and unified protocols for smart specialisation implementation. This systematic review will extend the current understanding of existing research on smart specialisation and could help to identify knowledge gaps to be filled.



This paper calls into question the foundation of smart specialisation. Our results are valuable for the actors of Entrepreneurial Discovery Process (EDP) and have policymaking implications. Our findings suggest that not only is there a theoretical and methodological gap but also a mismatch between policy documents and practical implementation.

Section 2 describes the methodological approach of our study. The third section presents and analyses the results of our bibliometric analysis of the consulted scientific studies following the TCCM method. Finally, Section 4 offers some concluding remarks.

## METHODOLOGICAL DESIGN

The present study aims to analyse the most relevant existing state-of-the-art literature on smart specialisation through a systematic and bibliometric review. Based on the objective of the study, our research question was: What have the theoretical and methodological foundations been for the implementation of smart specialisation policies?

To answer this question, we have carried out a systematic analysis of existing literature. According to Jesson, Matheson & Lacey (2011) systematic literature reviews allow us to collect, synthesize and evaluate study findings on a particular topic in an orderly and transparent way. Hence, we considered it to be the most appropriate method to review the existing information. We used the Web of Science bibliographic database as it contains peer-reviewed and high-quality academic journals which guarantee high academic standards in any scientific articles included here (Morais & Ferreira, 2020). Additionally, the database allows us to meet the criterion of literature relevance assumed in our objective.

We carried out our research in April 2022. Our initial application criterion was that the abstract include the words “smart specialisation,” “smart specialization” and “smart spezialisation.” However, this first search returned 1,032 articles, a considerable amount of them unrelated to the topic of smart specialization. Therefore, following Morais & Ferreira (2020) and to ensure that the articles found were relevant, we applied search criteria demanding the title of the article include the words “smart specialization,” “smart specialisation” and “smart spezialisation.” Furthermore, no filter of any kind was used for the selected article’s publication dates. Our search yielded 207 documents on smart specialisation, of which three papers were corrections to previously published documents.

Subsequently, we carried out a bibliometric analysis as well as a content analysis of the selected documents. Bibliometric analysis was conducted “to unpack the evolutionary nuances of a specific field” (Donthu, Kumar, Mukherjee, Pandey, 2021, p. 285). To systematically analyse our findings on the subject, we used the methodology known as the Theory-Context-Characteristics-Methods (TCCM) review framework (Rosado-Serrano, Paul & Dikova, 2018; Singh & Dhir, 2019). This methodology generally allows for a better understanding of consulted literature.

Following the TCCM methodology, our secondary research questions were:

- Which theories form the basis for smart specialisation?
- What are the common characteristics of the studies reviewed?
- Under which contextual framework has research on smart specialisation been conducted?
- What scientific methods have been adopted within studies on smart specialisation?

To answer the second sub-question, we specifically employed the VOSviewer program to establish a citation network, in which the relationship of the articles is analysed according to the number of times they are cited within each other.

## BIBLIOMETRIC AND SYSTEMATIC ANALYSIS

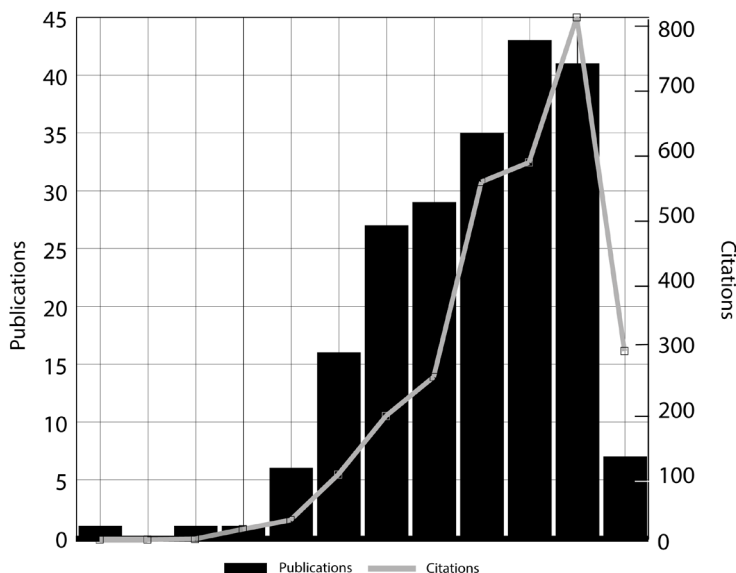
As already mentioned, the present study does not filter according publication dates. Therefore, Figure 1 shows all the articles published and cited on an annual basis. In total, 207 articles have been published from 2011 – the year when publications began – to April 2022. The term smart specialisation was used for the first time in 2007 and can be traced back to a publication by Foray & Van Aark (2007).

This explains why literature relevant to smart specialisation started to emerge beginning in 2007. Nevertheless, it took until 2011 for the first scientific article to be published. Between 2012 and 2014, the increase in number of articles was relatively slow.

Furthermore, the first citation on the topic was not found before 2012. This coincides with the year of publication of the new regional innovation strategy of the European Union for the period 2014-2020. As of 2015 there is an important change in the publication of articles and citations, with 6 publications and 25 citations.

The year 2020 was the year with the highest number of published articles (43) while 2021 had the highest number of citations (809). As of today the total number of citations is 2,768.

FIGURE I. EVOLUTION OF THE NUMBER OF ARTICLES AND CITATIONS



Source: Authors's own work. Data from Web of Science database.

Table 1 lists journals with at least three articles published under the title smart specialisation. These 13 journals account for 50.24% of all the publications on the topic, while the top six journals account for 40.10% of contributions.

TABLE I. BIBLIOGRAPHIC INFORMATION OF THE ARTICLES

Journal names	Citations	Articles
Regional Studies	32.3% (872)	16.91% (35)
European Planning Studies	20.1% (542)	10.14% (21)
Sustainability	1.9% (51)	4.3% (10)
Journal of the Knowledge Economy	1.7% (46)	3.86% (8)
Environment and Planning C: Politics And Space	4.8% (129)	2.42% (5)
Technological Forecasting and Social Change	3.6% (96)	1.94% (4)
Innovation: the European Journal of Social Science Research	1.7% (46)	1.45% (3)

TABLE I. BIBLIOGRAPHIC INFORMATION OF THE ARTICLES

(cont.)

Journal names	Citations	Articles
Regional Studies, Regional Science	1.3 % (36)	1.45% (3)
Growth and Change	< 1% (27)	1.45% (3)
Economics	< 1% (25)	1.45% (3)
Papers in Regional Science	< 1% (15)	1.45% (3)
European Journal of Sustainable Development	< 1% (4)	1.45% (3)
Baltic Journal of Economic Studies	< 1% (2)	1.45% (3)

Source: Authors's own work. Data from the Web of Science database.

By far, the most important and highest impact journals publishing articles on smart specialisation are *Regional Studies* and *European Planning Studies*. Together, these two journals account for more than 25% of the articles and more than 50% of the generated citations.

In the subsequent sections we will present our literature analysis based on TCCM methodology.

### *Theories on Smart Specialisation*

This section answers the following secondary research question of our study: Which theories form the basis for smart specialisation? This question is important as, according to Foray, David & Hall (2011), the concept of smart specialisation has been implemented without sufficient theoretical and empirical understanding.

The concept of smart specialisation was created by the expert group *Knowledge for Growth* in response to the economic crisis in the European Union at the beginning of the millennium (Mcann & Ortega-Argiles, 2015). Since then, attempts have been made to put the term into practice through its implementation into regional European Union innovation agendas.

The policies that emerge from this concept are different from previous ones and are based on the strengths and competitive advantages of their respective regions (Barzotto, Corradini, Fai, Labory & Santoalha, 2020; Valdmaa, Pugh & Müür, 2021; Virkkala, Mäenpää & Mariussen, 2017).

Moreover, smart specialisation policies are based on creating strategies that encourage regions to develop through new domain specialisation. They develop a plan specific to each region, so that, with the support of research, innovation and

knowledge, regional resources can be more efficiently exploited (Barzotto *et al.*, 2020; Capello & Kroll, 2016). According to Asheim (2019), the main purpose of smart specialisation policy intervention is to overcome any possible capacity constraints within regional innovation systems.

In order to implement strategies based on smart specialisation, each locality's priority innovation activities and regional innovation strategies must be defined so that all interest groups, such as, for example, the public and private sector, can participate in the process (Barzotto *et al.*, 2020; Bosch & Vonortas, 2019; Di Cataldo, Monastiriotis & Rodríguez-Pose, 2020). This is necessary as no single actor has a complete picture of the economy as a whole and its specific situational aspects (Varga, Sebestyén, Szabó & Szerb, 2020).

In short, the objective of smart specialisation is to diversify the structure of a regional economy by generating new capabilities and domains and, consequently, increasing its growth opportunities. According to Foray *et al.* (2011) the concept of smart specialisation should not be understood literally nor be associated with a simple strategy of industrial specialisation, since the ultimate goal of smart specialisation is diversification – in other words diversified specialisation, intelligent diversification (Hassink & Gong, 2019) or recombinant innovation (Foray, 2019).

According to Hassink & Gong (2019), the theoretical importance of specialisation as a concept in the area of economics created a lack of precision when employing the new term. This makes it confusing and conceptually chaotic for all parties involved. Furthermore, once the term was finally adopted, it was too late (Foray, 2019). In summary, smart specialisation is a perfect example of politics going ahead of theory (Foray *et al.*, 2011) and, consequently, this has caused a gap between theory and practice (Valdmaa *et al.*, 2021; Virkkala *et al.*, 2017).

Smart specialisation was initially a sectoral policy linked to a regional context and focused on the integration of specific activities meant to reinforce economic growth (McCann & Ortega-Argilés, 2013). According to Foray (2019) the innovation of smart specialisation lies in combining already existing concepts, and although its creators did not visualize its regional dimensions, experts in regional economics and policies, industrial policy and development quickly improved this approach. Hence, smart specialisation can be integrated into current concepts of agglomeration theory, evolutionary economic geography and specialisation, which include ideas such as the increasing returns of knowledge, the role of knowledge dissemination and market barriers that prevent changes in regional advantages (Mieszkowski & Barbero, 2021).

Based on the concept of agglomeration economics, it can be concluded that urban areas have a greater potential than rural areas to attract specialisation projects because cities can better facilitate the generation, dissemination and accumulation of knowledge (Mieszkowski & Barbero, 2021). However, this does not provide a solution for economically weaker regions. Here, smart specialisation is supported by evolutionary economic geography, as diversification through emerging industries can bring opportunities to underperforming regions to escape the vicious cycle of exclusion by central regions (Boschma & Lambooy, 1999).

Moodysson, Trippl & Zakauskaitė (2016), Asheim (2019) and Balland, Boschma, Crespo & Rigby (2019) incorporate concepts from evolutionary economic geography and explain that smart specialisation aims to create new paths of development, i.e. innovative economic directions for a specific region. This can occur through path extension, as a result of increasing innovation within an existing economic path. Furthermore, an existing industry could be turned into a more complex one (improvement of an existing path). Moreover, a region could diversify its path by combining knowledge or it could import new paths by establishing new industries in the region, unrelated to the present ones. Finally, a region has the option to create completely new paths by creating innovative industries based on new knowledge.

It is important to mention that within the search for diversification, the concept itself is not the most important issue, but rather the characteristics of specialised diversification fundamental to economic growth (McCann & Ortega-Argilés, 2015). According to Rocchetta, Ortega-Argiles & Kogler (2021) specialised diversification and technology combinations expand a region's technological capabilities. Consequently, regions take advantage of the new knowledge and skills they possess in order to improve other interrelated activities.

When looking at these patterns, researchers focus on the relationship between economic activities and how those impact regional development and the emergence of new capacities as well as new industries (Vlčková, Kaspríkova & Vlčková, 2018). Nevertheless, naturally new capabilities such as knowledge and technology are based on existing knowledge. Thus, the future economic strength of a region will always depend on its existing capabilities, for example, its core competencies, technology and complex knowledge (Balland, 2019; Balland & Boschma, 2021). Therefore, emerging new technologies and industries are a direct reflection of the current technological profile of a region.

In evolutionary economic geography, these knowledge relationships are also taken into account when creating specific patterns in each region and boosting regional development. The complementary aspects between different activities through knowledge recombination are very important for the creation of opportunities in a specific region. Different types of relationships positively influence employment and economic growth as well as other aspects of economic resilience at the subnational level (Rocchetta *et al.*, 2021).

Boschma & Frenken (2018) mention three important contributions of evolutionary economic geography: first, challenging Marshall's externalities based on specialisation; second, providing a new vision of dynamic proximity that creates new networks of knowledge and, third, related variety, as smart specialisation has also been defined.

The theory of economic complexity focuses on the sophistication of a country's productive structure. Such complexity is reflected both in the diversity of products that a nation exports, and in their ubiquity, meaning, the number of countries that produce this same product (Hidalgo & Hausman, 2009). Regions are expected to become more complex and diversified. Thus, nations must have the ability to accumulate knowledge that allows them to diversify and improve the capabilities of their economic agents to produce more complex products (Balland, Broekel, Diodato, Giuliani, Hausmann, O'Clery & Rigby, 2022).

Recently, theories seem to meet and converge in contributions like those of Balland *et al.* (2019) and Balland & Boschma (2021). These attempt to unify both the existing concepts of evolutionary economic geography and economic complexity theory, to create a theoretical basis for smart specialisation. Although they have excelled in different areas, both theories seek economic diversity and the creation of new capacities for a region. Balland *et al.* (2019) confirm that regions are more likely to develop new specialisations and technological growth in technological activities that are related to their basic knowledge. Moreover, these specialisations and technological growth usually occur in complex technological activities when they are related to the region's basic knowledge (Rocchetta *et al.*, 2021).

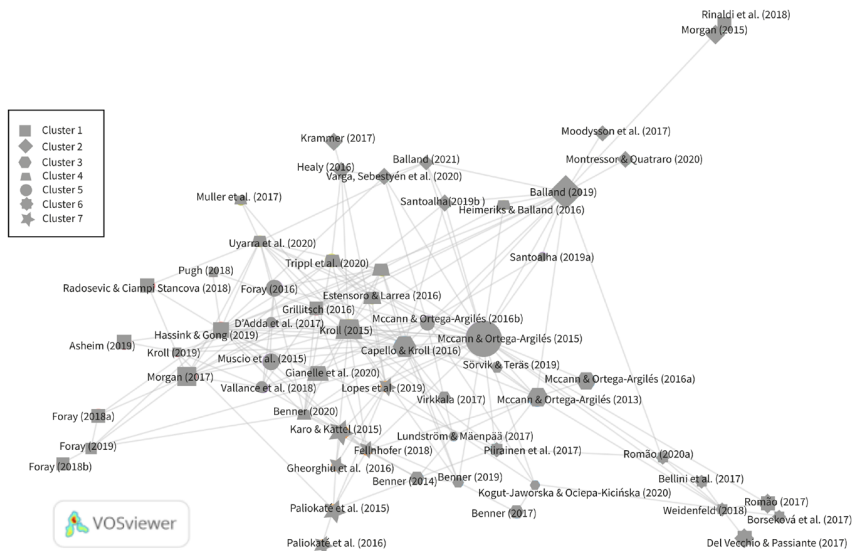
Thus, a whole territory can benefit from contributing to the knowledge base of a region. Prosperous regions that have related and unrelated diversification will benefit from different combinations of technology and sectors, and their greater adaptability (Rocchetta *et al.*, 2021). Whereas, lagging (underdeveloped) regions are expected to move directly towards diversification.

After reviewing its theories, we have concluded that, in line with many of our cited authors, smart specialisation has grown faster than its theoretical framework. However, it is clear that due to its characteristics, smart specialisation fits very well within the theory of evolutionary economic geography and the theory of economic complexity, one developed in Europe and the other in America. However, the aforementioned lack of a theoretical framework, compiled by the same creators of the concept, has led the academic field dedicate itself to work on said a theoretical base. We believe it would be appropriate for policy makers to provide a more robust theoretical framework as well.

### *Characteristics of Publications on Smart Specialisation*

The following section answers the subsequent secondary research question: What are the common characteristics of the reviewed studies on smart specialisation? For this, we used the VOSviewer computer program to establish a network of citations. In turn, we used this network to analyse the relationship of the 207 reviewed documents according to the number of times they are cited within each other. The applied criterion was that articles should be cited at least 10 times.

FIGURE 2. CITATION NETWORK



Source: Authors' own work. Data from VOSviewer.



Figure 2 shows the citation network, in which we identified seven clusters containing at least six authors. Within the seven clusters there were a total of 59 related articles. The greater the importance of a specific article, the larger the size of the geometric shape. Therefore, as can be seen, the documents of Mccann & Ortega-Argiles (2015) and Balland (2019) are the articles with the greatest importance. In addition, the lines that link the articles with one another represent the connections between two elements.

Each identified cluster covers a common topic on smart specialisation. These thematic clusters are presented below:

### **Cluster 1. Conceptual, Theoretical and Methodological Gaps (10 Authors)**

The first cluster presents existing criticisms on smart specialisation and its knowledge gaps. Asheim (2019) presented a theoretical framework providing new development paths for policymakers. Morgan (2017) analysed how to benefit from and boost regional innovation policies. Pugh (2018) discussed regional innovation policies in Wales, criticised the lack of congruence between their theory and practice and suggested being less dogmatic about their implementation. Grillitsch (2016) identified challenges in methodology as well as policy and suggested both qualitative and quantitative studies to analyse institutional diversity, smart specialisation dynamics and policymaking. Kroll (2019) surveyed stakeholders and reviewed factors hindering the implementation or clear articulation of regional innovation strategies. Foray (2018a, 2018b) described adequate policy design and discussed the fundamentals of the Smart Specialisation Strategies (S3) approach and its main characteristics that make it particularly suitable to solve the problem of sectoral modernisation. Hassink & Gong (2019) used six main questions to analyse the process that has led to smart specialisation and future research. Later, Foray (2019) answered Hassink & Gong's (2019) smart specialisation questions by focusing on what has been learned so far.

### **Cluster 2. Technological Capabilities (10 Authors)**

This cluster contains those who have found in the theory of economic complexity and the theory of evolutionary economic geography the theoretical basis for smart specialisation. Balland *et al.* (2019) and Balland & Boschma (2021) explained the importance of regional capacities and complementary capacities and provided a theoretical framework for the concepts of relatedness and interregional knowledge.

Santoalha (2019b) studied the role of regional collaboration to explain technological diversification in developed and undeveloped regions and found that in the latter external collaboration is more important. Montresor & Quattraro (2020) analysed the sustainable diversification of regional technologies and their coherence using the logic of smart specialisation and related diversification.

### **Cluster 3. Smart Specialisation Actors (10 Authors)**

In this cluster, studies focused on EDP. Enterprise discovery is a key dynamic process for smart specialisation in which advantages and activities that should be prioritised are revealed through stakeholder interaction (European Commission, 2012). It is essential because each region is different and therefore, the processes for discovering priority areas will be different as well. Benner (2014, 2017) proposed intelligent experimentation and the development of sectoral policies that include interactions between institutions, companies and different levels of government. Benner (2019) also analysed the role of institutions in the process of institutional discovery. Moreover, Virkkala *et al.* (2017) focused on agent relationships within the institutional discovery process and Lundström & Mäenpää (2017) explained such relationships using game theory. In their specific model, actors must recognize the perverse side of their actions and become aware of how strategies must take everyone into account and seek to create dialogue. Mccann & Ortega Argilés (2013) examined the nature as well as the justification and logic of EU cohesion policy reforms. Finally, Mccann & Ortega Argilés (2016a) analysed how European regional policy has been reshaped to take advantage of the role of entrepreneurship.

Since the transformative hope of smart specialisation is the entrepreneurial discovery process (Foray, 2015), it is important to understand how that process occurs. Hassink & Gong (2019) made a criticism of the EDP. Beyond theory, the interaction between stakeholders is also a social and political process. In it the interaction of the stakeholder interested parties can be combined with the search for income and any ensuing corruption and, therefore, turn out unfavourably for the region. In this regard, Foray (2019) admitted that although we must acknowledge possible that there are vested interests, the only answer is to wait for transparent processes to exist.

### **Cluster 4. Implementing Smart Specialisation (9 Authors)**

Gianelle, Guzzo & Mieszkowski (2020) analysed how innovation policies become strategic and found that the concept of smart specialisation was only partially

implemented. Kroll (2015) demonstrated how Southern European countries benefited from new smart specialisation practices and innovation policies, while the countries of Eastern Europe had to invest substantially to change their routines. Muller, Zenker, Hufnagl, Héraud, Schnabl, Makkonen & Kroll (2017) analysed the implementation of innovation agendas and their prioritisation options. Trippel, Zukauskaitė & Healy (2020) examined how the regional and institutional characteristics of regional innovation systems shape smart specialisation practices and how smart specialisation facilitates, reorients and transforms policies in the more advanced regions.

#### **Cluster 5. Policy Differences in Advanced and Non-advanced Regions (7 Authors)**

This cluster is made up of comparative studies on the implementation of policies in different contexts. Mccann & Ortega-Argilés (2015) examined the concept of smart specialisation and the challenges of applying a sectoral concept to a regional environment. Mccann & Ortega-Argilés (2016b) discussed policy prioritisation options that were applied in different regions and found evidence of the extent to which weaker regions are limited in their prioritisation options. D’Adda, Iacobucci & Perugini (2022) reviewed the characteristics of sectoral funds allocated to different types of regions to see if lagging regions actually changed their strategy. Foray (2016) discussed the types of vertical policies needed in smart specialisation activities, which differ from horizontal policies. Finally, Muscio, Reid & Rivera-Leon (2015) concluded that the gap between regions cannot be closed because lagging regions did not have a virtuous cycle.

#### **Cluster 6. Concept of Smart Specialisation (7 Authors)**

Piirainen, Tanner & Alkærsg (2017) contributed to the theoretical basis of smart specialisation with a typology including: diversification, transition, radical foundation, and modernisation. Bellini *et al.* (2017), Del Vecchio & Passiante (2017) and Weidenfeld (2018) added to the theoretical concept of smart specialisation in the tourism sector and the relevance when integrating tourism into regional innovation strategies. Romão (2020b) analysed the dynamics of tourism in a region and the positive influence of innovation on its competitiveness. Additionally, Borseková, Vaňová & Vitálišová, (2017) synthesised the theoretical and empirical research on competitive advantage, innovation, tourism and spatial development.

## Cluster 7. Prioritisation and Strategy Development (6 Authors)

It is evident that there are numerous possible instruments for the elaborating strategies, but a general model is still needed. Gheorghiu, Andreescu & Curaj (2016) described different instruments used for the forecast of smart specialisation and, Paliokaté, Martinaitis & Reimeris (2015) and Paliokaté, Martinaitis & Sarpong (2016) presented a methodological approach for the preparation of strategies based on the European Commission (2012).

In short, when classifying these documents into thematic clusters, the authors's principal topics of interest became apparent. Clusters 1, 2 and 6 are concerned with the gaps between theory and practice based on a deficient theoretical framework for smart specialisation, the factors that influence the diversification of regions and their application in different economic sectors. Clusters 4 and 7 focus on the methods for selecting priority regions and for the implementation of strategies. Cluster 3 deals with the participation of actors involved in the entire regional process of smart specialisation and Cluster 5 concerns itself with the differences between regions when applying smart specialisation strategies (S3).

### *Context of Studies on Smart Specialisation*

The present section answers the following secondary research question of our paper: Under which contextual framework has research on smart specialisation been conducted? On the left side of Table 2, we presented the distribution of locations addressed by the 207 reviewed articles. It is not surprising that 87.13% of them were carried out in European countries, since smart specialisation first emerged in Europe. The right part of Table 2 shows that 63.64% of the articles that used the case study method were carried out using regions of Europe, while only 36.36% used other continents. Case studies are based on testing the implementation of S3s in cities as well as on determining whether there is a relationship between the policies and priorities used.

In this regard, in the case of Europe, we have the following studies: Lisowska (2018) in Poland; Kotnik & Petrin (2017) in Slovenia; Paliokaté *et al.* (2016) in Lithuania, Andryeyeva, Tiutiunyk, Burkynskyi, Khumarova & Kupinets (2020) and Shevtsova, Shvets, Kramchaninova & Pchelynska (2020) in Ukraine; Rinaldi, Cavicchi, Spigarelli, Lacchè & Rubens (2018) and Eklinder-Frick, Perna & Waluszewski (2020) in Italy; Chrysomallidis & Tsakanikas (2017) in Greece; Morgan (2017) in Wales; Müür (2022) in Finland; Vlčková *et al.* (2018) and Rehfeld

TABLE 2. LOCATIONS ADDRESSED BY REVIEWED ARTICLES

Total of Articles		Case Studies	
Locations	Percentage	Locations	Percentage
Europe (multiple regions)	37.44%	Europe <sup>d</sup>	63.64%
Europe (specific countries)	42.86%		
NUTS 2a	5.42%		
NUTS 3b	0.49%		
Multiple countries	0.99%		
Other continents <sup>c</sup>	12.81%	Other continents <sup>c</sup>	36.36%

Note: a According to the Nomenclature of Territorial Units for Statistics, these are the regions eligible for cohesion policy interventions. b Small regions for specific diagnostics. c Includes: 4 in Africa, 4 in Oceania, 10 in America and 8 in Asia. d Includes the following countries in two articles: Finland, Germany and Ukraine, and the following countries in one article: Croatia, Wales, Greece, England, Italy, Lithuania, Poland, Portugal, Romania, Slovenia, Spain and Sweden. e Includes: Australia, Brazil, Canada, United States, Iran, Mexico, Peru, Russia and Tunisia.

Source: Authors's own work.

& Terstriep (2019) in Germany; Bosch & Vonortas (2019) in Romania; Sarkar, Bilau & Basílio (2021) in Portugal; Bukhari, Dabic, Shifrer, Daim & Meissner (2021) in Croatia; Pugh (2018) in England and, Madeira, Vale & Mora-Aliseda (2021) in Spain.

The following research projects cover regions outside of Europe: Benner (2017) and Kruse & Wedemeier (2021) in Tunisia; Esposto, Abbott & Juliano (2019) and Veldhuizen (2020) in Australia; Naghizadeh, Allahy & Ranga (2021) in Iran; Esparza-Masana & Ipanaque (2021) in Peru; Pinto *et al.* (2019) and Bosch & Vonortas (2019) in Brazil; Bevilacqua, Anversa, Cantafio & Pizzimenti (2019) in the United States; Healy (2017) in Canada and Villareal Gonzalez, Mack & Flores (2017) in Mexico.

We expected that most of the research on smart specialisation would be based on areas of Europe: some dedicated to specific regions and others making comparisons between regions. However, it is interesting that 36% of the studies we analysed were carried out in areas that are not within the European Union. This is a sign of how great a reach these politics have had in different regions of the world.

The following section discusses the methods used in studies on smart specialisation.

### *Methods Used in Smart Specialisation Studies*

This section answers the following secondary research question: What scientific methods have been adopted within studies on smart specialisation?

Table 3 provides a detailed description of the different research methods used within the reviewed papers. This includes both their main topics and their respective authors. As can be seen in the table, the most commonly used methodology is *review and discussion* based on content analysis and literature review on the applied strategies of smart specialisation. The goal is to, for example, amplify the theoretical and contextual framework or define future agendas.

Usually, the methodology of *case studies* focuses on reviewing smart specialisation regional innovation strategies that have been implemented in different contexts and regions. The *calculation of indicators* measures the degree of diversification and localisation indices in order to quantify specialisation based on the structure of sectoral classification systems. These ratio measurements allow researchers to understand the complementarity or proximity between, for instance, knowledge domains, capacities and functions that characterise a regional technological structure (Rocchetta *et al.*, 2021). For example, Dzemydaitė (2021); Deegan, Broekel & Dahl Fitjar (2021); Wojnicka-Sycz, Kaczyński & Sycz (2020) and Crawley & Hallowell (2021) use the revealed comparative advantage, the location quotient, the Herfindahl index, indicators of related and unrelated diversification as well as the density ratio. Rocchetta, *et al.* (2021) and Ženka, Chreneková, Kokešová & Svetlíková (2021) use related and unrelated variety. Some studies (Di Cataldo *et al.*, 2020; Nilsson, 2017) use patents as measures of technology and innovation. However, other authors admit that patents are an imperfect measure of regional innovation capabilities (Hassink & Gong, 2019; Rigby, Roesler, Kogler, Boschma & Balland, 2022), and that regional technological trajectories may not be fully captured by them (Rocchetta *et al.*, 2021).

Using *regression models* as methodology, studies measure relationships between technology indicators and a region's performance. Furthermore, interviews and surveys are conducted with multiple participants in the smart specialisation process such as, for example, stakeholders, experts, researchers, government and companies.

Other methods include the *Geographic Macro and Regional (GMR) Model* and fuzzy modelling. The GMR model allows one to analyse the impact of policies with regional, geographical and macroeconomic dimensions through the mutual interactions of three submodels: total factor productivity (TFP), spatial computable general equilibrium (SCGE) and the macroeconomic model blocks (MACRO). With

*fuzzy cluster analysis*, it is possible to classify regions according to an index that is not mutually exclusive. Thus, a region belongs to more than one class (Markowska, Kusterka-Jefmańska & Jefmański, 2016).

Finally, the official methodology for implementing smart specialisation is the *RIS3 Guide* (European Commission, 2012). The RIS3 Guide proposes six steps to implement the S3s. These include analysing the regional context, governance and stakeholder cooperation, developing the future vision, defining policies and action plans, and evaluating and monitoring them. Additionally, Gianelle, Kyriakou, Cohen & Przeor's (2016) *Smart Specialisation Implementation Handbook* addresses key milestones of the implementation process: Entrepreneurial Discovery Process (EDP), principles of good governance, selection criteria for priority projects and monitoring.

Furthermore, the *RHOMOLO model* allows one to geographically disaggregate the impacts of policies at the national level and evaluate regional policies. Thus, the model identifies those regions where the benefits or losses will be concentrated and separates the impact of political interventions from the impact of indirect effects (Barbero, Diukanova, Gianelle, Salotti & Santoalha, 2021).

As can be seen in Table 3, a large number of methods have been used to analyse smart specialisation. This is one of the reasons why the lack of an adequate solid methodology has been criticized (Santoalha, 2019b). Its guidelines do not provide a complete and general model (Gheorghiu *et al.*, 2016) based on clearer instructions describing the expected results, applied methods, stakeholders involved, principles and other criteria (Fellnhöfer, 2017). However, according to Foray (2019) it is not necessary to have rigid guidance on how to implement smart specialisation. In fact, it is more important to be aware of what is being measured and to discover new solutions to existing problems through experimentation.

Recalling this section's opening question, evidently, without standardized guidance, several different methods ended up being used. The approaches considered quantitative, based on indicators, econometric studies, surveys and other methods such as the GMR model and the RHOMOLO Model represent about 41% of used methods. While the methods considered qualitative such as reviews and discussions and interviews represent about 39% of the studies. Finally, the case studies in which there are quantitative cases that use indicators, as well as qualitative review cases represent 15% of the studies.

TABLE 3. RESEARCH METHODS USED IN STUDIES ON SMART SPECIALISATION

Method	Main Topic	Articles
Review and discussion 22.2% (46)	Interest groups	Colletis-Wahl (2018)
	Bottleneck analysis	Fellnhofer (2017)
	Evaluation process	Meyer (2020)
	Framework and context	Kopczynska & Ferreira (2020); Mccann & Ortega-Argilés, (2015)
	Review and discussion of strategies	Esparza-Masana (2021)
	Future agendas	Polido, Pires, Rodrigues & Teles (2019)
	Development and implementation	Ranga (2018)
	Definition of priority sectors	Kruse & Wedemeier (2021) in Tunisia; Villareal Gonzalez <i>et al.</i> (2016) in Mexico; Vlčková <i>et al.</i> (2018) in Germany; Kotnik & Petrin (2017) in Slovenia; Kaivo-Oja <i>et al.</i> (2017) for the Finnish manufacturing sector.
Literature review	Benner (2014); Lopes <i>et al.</i> (2018); Hassink & Gong (2019); Fellnhofer (2017, 2018) who analyse the knowledge gaps on smart specialisation.	
Regression models 18.7% (38)	To analyse relationships	Bhadury & Pandey (2020) and Brumen <i>et al.</i> (2016) influence of ICTs on sustainable tourism; Biagi <i>et al.</i> (2021) and Caragliu & Del Bo (2018) priority activities and tourism, regional intelligence and economic performance; Crawley & Hallowell (2021) priority sectors and job growth; Crescenzi <i>et al.</i> (2018) and D'Adda <i>et al.</i> (2022) industrial collaboration and investments, value added and employment, S3s and the distribution of regional funds, technological proximity; De Noni <i>et al.</i> (2021) the ability to generate opportunities; Zarate-Miron & Serrano (2021) the S3 and efficiency; Romão (2020) regional tourism and tourism competitiveness; Rocchetta <i>et al.</i> (2021) regional productivity and technological diversity; Santoalha (2019b) cooperation between organizations and technological diversification; Nilsson (2017) business networks, related and unrelated diversification and company performance; Muštra <i>et al.</i> (2017) smart specialisation as it relates to regional economic resilience.
Case studies 15.8% (32)	Review of innovation strategies based on different contexts	Pugh (2018) in Wales; Sarkar <i>et al.</i> (2021) in Portugal; Esparza-Masana & Ipanaque (2021) in Peru.
	Region comparison	Healy (2017) in Norway and Sweden; Morgan (2017) in Wales and Spain; Trippl <i>et al.</i> (2020) compare 15 European regions; Benner (2019) in Croatia and Slovenia; Eklinder-Frick <i>et al.</i> (2020) in Italy and Sweden.



TABLE 3. RESEARCH METHODS USED IN STUDIES ON SMART SPECIALISATION (cont.)

Method	Main Topic	Articles
Interviews 9.9% (19)	Microbusinesses	Polishchuk, Ivashchenko <i>et al.</i> (2020)
	Interest groups	Madeira <i>et al.</i> (2021); Farinha <i>et al.</i> (2021); Ghinoi <i>et al.</i> (2021); Healy (2016).
Calculation of indicators 6.9% (14)	Revealed comparative advantage	D'Adda <i>et al.</i> (2020) as degree of relatedness; Santoalha (2019b) and Deegan <i>et al.</i> (2021) as technological specialisation; Dziembala & Talar (2021) industrial specialisation.
	Location quotient	Dzemydaitė (2021); Deegan <i>et al.</i> (2021); Wojnicka-Sycz <i>et al.</i> (2020) and Crawley & Hallowell (2021) as relative specialisation.
	Herfindahl index	Dzemydaitė (2021) and Ženka <i>et al.</i> (2021) as concentration.
	Related and unrelated diversification	Rocchetta <i>et al.</i> (2021) and Ženka <i>et al.</i> (2021) as relationship measure
	Density ratio	Heimeriks & Balland (2016)
	Average relatedness index	Whittle (2020)
	Patents	Nilsson (2017) technology and innovation; Di Cataldo <i>et al.</i> (2020) technological capacity; D'Adda <i>et al.</i> (2020) technology relationships; Muštra <i>et al.</i> (2017) smart specialisation; Balland <i>et al.</i> (2019) technological complexity
	New indicators	Haukioja <i>et al.</i> (2018) determine a smart specialisation indicator; Santoalha (2019a) proposes two new indicators of related diversification; Kulik <i>et al.</i> (2021) uses maturity indicators to adapt smart specialisation to agriculture.
Surveys 5.4% (11)	Interest groups	Borseková <i>et al.</i> (2017); Bukhari <i>et al.</i> (2021); Jacobsen <i>et al.</i> (2022); Kroll (2015); Muller <i>et al.</i> (2017); Polishchuk, Kornyluk <i>et al.</i> (2020); Uyarra <i>et al.</i> (2018); Vallance <i>et al.</i> (2018); Virkkala <i>et al.</i> (2017); Vidmar (2019).
Other methods 17.73% (36)*	GMR Model	Used for the entire European Union in a study by Varga, Sebestyén <i>et al.</i> (2020) and for Hungary specifically by Varga, Szabó <i>et al.</i> (2020)
	Fuzzy cluster analysis	Markowska <i>et al.</i> (2016); Martín, Orden-Cruz & Zergane (2020)
	RIS3 Guide	Reimeris (2016); Naghizadeh <i>et al.</i> (2021); Paliokaté <i>et al.</i> (2015); Paliokaté <i>et al.</i> (2016); Vakhovych <i>et al.</i> (2021)
	RHOMOLO	Barbero <i>et al.</i> (2021)

Note: We put the number of documents involved for each method in n brackets. \*Content analysis, statistical analysis and correlation analysis, comparison of methods, mapping, fuzzy method, guide method for Regional Innovation Strategies, GMR model, RHOMOLO model, general equilibrium model and project.

Source: Authors's own work.

## CONCLUDING REMARKS

The purpose of this article was to analyse the most relevant state-of-the-art literature on smart specialisation. For this reason, we carried out a bibliometric analysis, a citation network analysis and a systematic literature review using the TCCM methodology. We systematically monitored the literature because this methodology helps to highlight the relevant aspects in the evolution of a topic based on its theoretical development, context, characteristics and methodology. To support our understanding of the characteristics of this literature, we employed the VOSviewer software. With the applied method it was possible to analyse the reviewed articles according to theories involved, common characteristics and contextual framework as well as their methodological design. In the present section, we will summarise the principal results and suggest possible areas for further research.

Smart specialisation emerged as a sectoral policy aimed at developing regions through diversification. This is where the main confusion on the concept arose, since smart specialisation actually refers to related diversification.

However, the advantages of smart specialisation must be recognised. First, smart specialisation was born during a changing historical context in which a model for the implementation of policies based on regional innovation systems and their origin was needed. It provided that necessary theoretical model for formulating region-oriented policies in the years to come, as Landabaso (1997) suggested. Second, from the origin of the term smart specialisation to the last two periods in which it has been part of cohesion policy, efforts to close its knowledge gaps have resulted in an extensive literature. The scope of this policy and term inside and outside the European Union has helped achieve this. Fourth, a vast gray literature on smart specialisation implementation and implementation evidence has been created, which is practically accessible but lacks standardised measurement guidelines.

The first secondary question –Which theories form the basis for smart specialisation?– was addressed through those articles responding to theoretical questions about the origin and concept of smart specialisation. As far as theory is concerned, although the term *smart specialisation* originated more than 15 years ago, its appeal as a policy grew faster than its theoretical relevance (Foray *et al.*, 2011). Consequently, its conceptual and theoretical framework is still rather limited. Because of its similarity to the strategy of diversification for the development of regions, it is natural that the concept of smart specialisation can be related to agglomeration theory, evolutionary economic geography and economic complexity theory.

Thus, along with the implementation of the S3s, its creators and academics have turned to the task of creating a theoretical framework for smart specialisation policies, based on the combination of concepts and theories that already exist (Foray, 2019). Most studies have focused on the review and discussion of strategies. Among them, Balland *et al.* (2019) recently provided a theoretical framework that links evolutionary economic geography with complexity theory, providing another theoretical basis.

We consider it important to follow a theoretical unification of the concepts of smart specialisation and economic complexity as do Moodysson *et al.* (2016) and Asheim (2019), but mainly Balland (2019), Balland & Boschma (2021) and Balland *et al.* (2022). There they present a method to assess opportunities for diversification and complexity.

We built a citation network to answer the second question: What are the common characteristics of the studies reviewed? With the help of this citation network, we found seven common topics grouped into seven clusters among our consulted articles. These clusters show important gaps between theory and practice that their respective authors are trying to close. For example, Clusters 1 and 6 cover articles which discuss the theoretical framework of smart specialisation for different sectors, whereas, the articles of Cluster 2 are interested in the factors that influence the development of regions. Furthermore, Cluster 5 works on the differences between policies in various regions and Cluster 4 on the implementation of smart specialisation strategies. Our results confirm the conceptual and theoretical gap, hence, we emphasise the importance of a theoretical unification.

A fundamental and differentiating characteristic of the S3s with respect to other policies is the EDP, a relevant topic related to Clusters 3, 4 and 7. In the EDP, the collaboration of all those involved stands out in theoretical terms. In theory, and hopefully, it will encourage a cyclical process of feedback and learning on behalf of all the stakeholders interested in building growth in each region. But in a practical way, the process can be disturbed by different interests. In this regard, even Foray (2019) acknowledges the possible existence of vested interests.

Regarding the third secondary question, in terms of context, research on smart specialisation has mostly been carried out in Europe. However, due to the popularity of the term and the policies it implemented, almost 13% of the articles reviewed were not at all related to European countries, the European Union, or the regional innovation strategies of 2014-2020. In these (non-European) countries, policies on smart specialisation have attracted the attention of their governments

and researchers. Consequently, this resulted in initial analyses, feasibility studies or even processes of implementation. In this regard, future research could focus on feasibility studies of other nations with the intention of implementing policies on smart specialisation. Furthermore, similarities and differences between these regions and the original European countries could be interesting, so could the question of how those (new) countries could contribute to the theoretical framework of smart specialisation.

In regards to the fourth secondary question, the methods used in the reviewed documents, there are methods for categorising regions, for evaluating priority activities and for evaluating policies. Different studies use several common indicators to categorise regions and economic sectors as diversified or specialised and to reveal priority sectors or new emerging activities. Case studies based on document analysis are used to assess whether priority activities correspond to the adopted policies. In addition, regression models were applied to verify the effects of diversification and technology on a region's performance and to find out if the new policies have an impact on their respective areas. Moreover, interviews and surveys have been used to assess and discuss governance and stakeholder engagement.

In practice, the closest thing to a manual on smart specialisation is the RIS Guide, which is an official document that provides the steps for implementing smart specialisation. The categorisation of sectors, the evaluation of priority activities and policies adopted in the regions can be homologated with the steps provided by the RIS Guide. As the RIS Guide does not offer a detailed description of the methods to follow in each step to implement smart specialisation, the mentioned activities could even be accommodated in the specific steps of the guide (context analysis, vision elaboration, monitoring and governance, respectively).

It is possible that the guide's lack of precision is due to the fact that according to Foray (2019) smart specialisation should not be based on an immutable formula to which everyone should adhere. The guide is only a way to be inspired and it has worked. The massive exploratory exercise that was the 2014-2020 strategy has allowed for the improvement of the implementation process.

In this regard, we are aware of the argument that the EDP proposes a prioritisation of areas based on the direct participation of all stakeholders when identifying what works in a particular region and what does not. However, there is limited information on how these goals can be achieved and many unanswered questions remain. Therefore, we believe that the guides need to be more accurate and should be continuously updated in order to implement the S3s. Although measurement

is still a major challenge (Foray, 2019), the guide should provide a list of suitable methods to use during each stage of the implementation of smart specialisation strategies (Fellnhofer, 2017; Gheorghiu *et al.*, 2016; Santoalha, 2019b).

We clearly agree with Hassink & Gong (2019) on how future research could focus on addressing alternative measures or indicators, the ideal combination of quantitative and qualitative smart specialisation methods as well as integrating smart specialisation into a wider set of theories.

Finally, the present paper's scope remains limited since only studies from the Web of Science database were used. However, this was due to the fact that the Web of Science database guarantees high quality standards the considered journals and articles (Morais & Ferreira, 2020). This was important when looking for the most influential and relevant publications in the field of smart specialisation.

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