Regional Sustainability (2024) 5(4) 100175

Contents lists available at ScienceDirect

Regional Sustainability

journal homepage: www.keaipublishing.com/en/journals/regional-sustainability

Full Length Article

Smart specialization, public authorities, and innovation intermediaries in developing regions

Hugo PINTO[a, b, c, *], Manuel LARANJA[d], Elvira UYARRA[e]

[a] Faculty of Economics, University of Algarve, Faro, 8005-139, Portugal
[b] CinTurs-Research Centre for Tourism, Sustainability and Well-being, University of Algarve, Faro, 8005-139, Portugal
[c] Centre for Social Studies, University of Coimbra, Coimbra, 3000-995, Portugal
[d] ISEG Lisbon School of Economics and Management, University of Lisbon, Lisbon, 1200-781, Portugal
[e] Manchester Institute of Innovation Research (MIoIR), Manchester, M139PL, the United Kingdom

ARTICLEINFO

Keywords:
Governance
Smart specialization strategy
Public authorities
Innovation intermediaries
Developing region
Brazil

ABSTRACT

Despite a growing body of literature on smart specialization, the role of public authorities and innovation intermediaries, particularly in developing regions, remains understudied. This research examines one of the first attempts to apply the smart specialization framework to the development of an innovation strategy outside Europe, specifically in the Pernambuco State, Brazil. We focus on two priority areas (clothing and high-tech automotive components) identified by the state government as key targets for pilot policy experimentation and use different methods, such as social network analysis and content analysis, to interview strategic innovation actors for studying the promotion of innovation and regional development in Pernambuco. Findings highlight how regional governance, collaboration, and trust are shaped by public authorities and innovation intermediaries. The study identifies three key challenges in implementing smart specialization strategy in developing regions: i.e., achieving effective decentralization, cultivating an innovation culture, and establishing participatory governance mechanisms. The public sector actors act as crucial knowledge brokers and policy intermediaries, facilitating the linkages and partnerships necessary to overcome these challenges.

1. Introduction

Smart specialization is a policy framework that aims to help regions and countries identify and focus on their unique strengths and potential areas of competitive advantage in order to stimulate innovation, productivity, and growth (Rocchetta et al., 2022). Specialization does not refer to the concentration of the regional economy in specific industries or sectors, but to the discovery and development of new niche specialties based on existing knowledge and competences (Foray, 2016). Smart specialization is thus regarded as an effective way for regions and countries to leverage their unique strengths and assets to drive economic growth (Barbero et al., 2021).

While there seems to be a consensus that a smart specialization strategy (S3) requires a new governance of innovation policy, namely a decentralized 'incremental' approach (Foray, 2014) with governments acting as

* Corresponding author.
E-mail address: hpinto@ualg.pt (Hugo PINTO).

https://cstr.cn/32279.14.REGSUS.2024002
https://doi.org/10.1016/j.regsus.2024.100175
Received 23 October 2023; Received in revised form 04 September 2024; Accepted 24 November 2024

facilitators rather than top-down planners (Aghion et al., 2009; Laranja, 2021), this is particularly challenging in developing regions with limited institutional and entrepreneurial capabilities (Foray, 2014; Kroll, 2015). However, the role of public authorities as facilitators rather than drivers of the strategy and its relationship with the issues of multi-level governance are far from having been adequately discussed, especially in developing regions (Trippl et al., 2020). While there is a growing literature on smart specialization in developing regions, this is not the case in developing countries and regions outside Europe (Gómez Prieto et al., 2019). Examining policy transfer and challenges to institutional capacity in these contexts offers valuable insights, as there is limited empirical evidence on the design and implementation of S3 outside Europe.

This study discusses the role of public authorities and innovation intermediaries in the design and implementation of a smart specialization inspired initiative in the Pernambuco State, Brazil. The main aims of this study are to discuss how S3 can be transferred to developing regions, particularly outside Europe, and to explore the role that public authorities should play in a context of less innovation capabilities and institutional thinness. Namely, whether public authorities should compensate for possible entrepreneurial discovery failures and adopt a more centralized approach, focusing support on the capacitation of policy intermediaries and local technology infrastructures.

This study is inspired by previous research on S3 (Laranja et al., 2019). In recent years, S3 has been applied in several regions outside Europe, some of them directly supported by the European Commission. In Pernambuco, S3 was viewed as an initiative at the regional level, aimed not only at transforming the productive fabric but also at reshaping the social and institutional dimensions (Torre, 2019). This study uses empirical materials and lessons learned from the experiment in S3 policy in Pernambuco to provide insights into how developing regions outside Europe can pursue development through regional innovation policies. In this study, we try to illustrate the difficulties of policy transfer and the crucial role played by public authorities in structuring innovation networks in developing regions outside Europe.

2. Governance of smart specialization strategy (S3)

2.1. Smart specialization framework

New industrial policies, such as S3, suggest that building a regional advantage can only be achieved through policies that focus on "what you are good at producing" (Hausmann and Rodrik, 2003, 2006). Innovation strategies anchored in the principles of S3 represent an important cornerstone in research and innovation policy-making practice in Europe, promising to address a number of recognized weaknesses in previous approaches, namely, the fragmentation and duplication of public research systems across the European research area and the need to strengthen the role of evidence-based policy (Barca, 2009).

The application of S3 is justified by the constraints on resources and the limited budgets typically faced by regional governments and local actors (Capello and Kroll, 2016). Thus, innovation policies need to define priority areas in line with explicit or latent place-based capabilities and market demand. Such focused agglomerations of related actors and projects are expected to catalyze creativity and innovation, fostering local spillovers. In addition, the definition of priority areas also helps regional authorities and governments to focus on relevant commons and infrastructures that are specific to their priority areas. As argued by Hausmann and Rodrik (2006), governments cannot address all innovation-supporting infrastructures and services in all markets and activities. Smart specialization prescribes a process for each region to discover and explore which priority domains of specialization can yield the highest potential for transformation (Foray, 2016). This process is known as the entrepreneurial discovery process (Pinto, 2018).

However, the concentration of actors, activities, and projects in a few priority areas should not be confused with the concentration of funding in the most important regional sectors or in scientific and technological fields. Moreover, areas of concentration are not necessarily high-tech areas. In fact, they can also be low-tech and non-technological innovation domains, making S3 a framework that can be used by all regions, including those with lower capacities for science-based innovation (Foray, 2016; Marinelli et al., 2016; Balland et al., 2019). While focusing on priority areas may have many virtues, it may also create difficulties for balanced regional development. S3 is potentially hampered by several heroic assumptions that may limit its effectiveness in promoting regional development (Marques and Morgan, 2018), particularly in developing regions.

2.2. S3 in developed and developing regions

S3 represented a significant leap in the way European innovation policy has been implemented in previous

decades. With the benefit of hindsight, the implementation of S3 in different European regions has been diverse (Kroll, 2015). Evidence suggests that concentrating and mobilizing local actors around the priorities defined through entrepreneurial discovery process yields positive outcomes, making innovation policy more place-specific and evidence-based (Pessoa, 2014; Polverari, 2017; Trippl et al., 2020; Natalicchio et al., 2022). It also seems to contribute to increasing the number of university-industry collaborative projects and generating impacts that spread throughout the country, stimulating employment and value chains with higher added value (Muscio et al., 2015; Vallance et al., 2018).

The differences in the ability to implement and benefit from smart specialization in different regions have been well documented in the literature (Trippl et al., 2020). While S3 has been relatively more successful in developed regions than in transition or developing regions, its implementation poses major challenges for both developed and developing regions (Foray et al., 2021; Marrocu et al., 2022; Mora et al., 2023; Papamichail et al., 2023).

For developed regions in Europe, the implementation of S3 requires both national and regional governments to adopt a more decentralized multi-level governance structure, combining large and broad initiatives of national scope with region-specific and specialized initiatives at the local level (Ruhrmann et al., 2022). In addition, the governance of S3 is not only about multi-level decision-making structures, but also about the need for both national and regional governments to play a less directing role. National or regional governments do not own an S3, nor do they direct the collaborative process underlying entrepreneurial discovery. Both at national and regional levels, public authorities need to change their role from policy designer and principal agent to facilitator (Aghion et al., 2009).

The governance of S3 therefore requires a new way of public policy design and implementation. It means breaking with pre-conceived notions of strategic planning as the only mode of strategic thinking and redefining the role of government away from mere owner of the plan and controller of its implementation. Changing this role means that public authorities must accept that their role is very different and is likely to change over the strategic cycle, depending on the characteristics of the region and existing institutions (Trippl et al., 2020). To transition from strategy driver to facilitator, regional and national governments and their intermediaries should focus on removing barriers to discovery, experimentation, and innovation exploration. The governance of such a process must be based on a complex dialogical process involving public sector organizations and regional actors who possess the requisite business and entrepreneurial knowledge for market exploration and experimentation (Laranja, 2021).

The governance of S3 in developing regions faces greater challenges (McCann and Ortega-Argilés, 2016). These regions face an apparent contradiction, previously referred to as the regional innovation paradox (Oughton et al., 2002): regions that appear to be most in need of innovation have fewer opportunities to foster innovation. This is because they find it more difficult to use resources for innovation, even when these resources are provided by governments, because innovation actors, especially firms, have limited capacity to absorb the benefits (Capello and Kroll, 2016).

In economic terms, developing regions have a less diversified business fabric and fewer skilled human resources. In addition, there are also fewer opportunities for related variety, that is, fewer opportunities for the co-location of firms in related sectors, mainly of medium and high technological intensity, with a cognitive proximity that facilitates collective learning and collaboration (Content and Frenken, 2016).

Due to their lower entrepreneurial capacity, developing regions are also ill-equipped to focus on the processes of niche discovery. As a result, the phases of defining and exploring priority areas may end up being misaligned with endogenous capacities, focusing on broad scientific agendas and high-tech fantasies, or on defining priorities that emulate other regions that are doing well (Gianelle et al., 2020).

Institutionally, developing regions tend to have formal operating rules that are immature or inappropriate for innovative and entrepreneurial dynamism, and they may also have lower political capacity, e.g., coordination, cooperation, and trust problems that lead to misalignment between actors. In addition, developing regions tend to receive a larger share of their resources through funding and transfers from central governments and other public resources, creating dependencies on other levels of government. Uncertainty surrounding the investments in innovation, an unclear mission of the public sector in charge of S3, limited intermediation mechanisms and networks, and weak entrepreneurial settings are aspects particularly mentioned about lagging regions (Papamichail et al., 2023).

The implementation of S3 may also require a more structuring role for intermediary bodies, particularly to ensure the coherence and integration of S3 with other regional policies. In this respect, the role of public authorities as knowledge intermediaries in peripheral areas is crucial, in particular institutions of higher education and other public research organizations. However, their heterogeneity must be considered, as well as the different stages of institutionalization of regional innovation dynamics (Pinto, 2023). In developing regions, innovation policy is

characterized by a historically limited level of stakeholder involvement and therefore the introduction of S3, that demands a break with past top-down policy practices, represents a significant challenge (Trippl et al., 2020). Another key aspect is that the design and implementation of S3 requires leadership. This is even more important because leadership is not always there, either in the public sector or in the private sector, particularly in contexts of institutional thinness as in many regions of Latin America (Iga-César, 2022). In this regard and unlike in more developed regions, public authorities and other public innovation intermediaries may have to take the leadership position to promote consensus on an initial broad direction for capacity building (Sotarauta, 2018). In other words, public authorities may have to take a prominent role in supporting socio-institutional change towards a more positive perception of innovation and entrepreneurship on the part of regional actors (Morisson and Panetti, 2020).

3. Methodology

S3 is becoming a popular policy framework in various regions of the world (Gómez Prieto et al., 2019). The European Union's international cooperation mechanisms, the European Union and the Community of Latin American and Caribbean States (EU-CELAC) summits, and other mechanisms, such as the European Union-Brazil sectoral dialogues, have allowed Latin American countries to pilot S3 as an opportunity to experiment with further decentralized innovation policies (Barroeta et al., 2017).

Latin America suffers from many challenges due to fragile governance based on embryonic and often informal processes that take place in contexts with weak institutional capacity and low levels of social capital (Montero and Chapple, 2019; Iga-César, 2022). Transferring S3 to the Latin American countries therefore requires policy learning and adaptation (del Castillo and Paton, 2016). While the tropicalization of S3 can be a beneficial phenomenon for both Latin America and Europe, the translation of a policy concept derived from the European countries raises important conceptual and strategic issues (Pinto et al., 2019a). One such challenge relates to the significant differences in multi-level governance in Latin America, where decision-making and budgeting remain highly centralized and controlled by federal governments. In terms of networks and synergies between actors, challenges include the lack of trust between private actors and universities and other public research organizations. Additionally, there is often a mismatch between the initial motivation of local actors during the pilot experience phase and their ability to mobilize during the implementation phase. These issues are further exacerbated by inadequate technical capacity and human capital, as well as limited financial resources. These challenges significantly hinder the design and implementation of a transformative agenda such as S3 (Barroeta et al., 2017).

Taken together, the aspects mentioned above can constitute a structural limitation, since the cooperation and involvement of actors is a key point in the implementation and development of S3. Other factors that require in-depth analysis and reflection are the political will of the (federal) authorities to promote truly decentralized development strategies, especially in the field of science, technology, and innovation (STI), and the tendency to weaken regional innovation policies by embedding them in other policies (such as export, education, and employment). In addition to these factors, the lack of information at national and regional levels on the results and impact of innovation policies is also a challenge in the implementation of these strategies (Barroeta et al., 2017).

This study draws on the experience gathered from the EU-CELAC cooperation project on Territorial Cohesion - Regional Innovation Systems in the State of Pernambuco (Brazil), hereinafter referred to as RIS3-PE (Pinto, 2018), in particular phase 2 developed during 2017–2018. This project, inspired by the principles of action research (McNiff, 2013), had several objectives: to analyze the regional resources for STI in Pernambuco, to identify the actors and their functions in the regional innovation system, to understand the knowledge and innovation needs in selected sectors, to orient the regional debate and build consensus through the entrepreneurial discovery process on the vision and priorities for the regional strategy, and to propose specific actions to support regional innovation.

Phase 1 of the project involved the Ministry of National Integration identifying which Brazilian state would first implement and adapt S3 within regional policy development. Pernambuco was chosen, and the Secretariat for Science, Technology, and Innovation at the Government of the Pernambuco State (SECTI) selected two sectors—clothing and high-tech automotive components—for the pilot. Phase 2 focused on implementing S3 using the concept of innovative territories, inspired by the Territorial Innovation System (Morgan, 2004), which adapts the innovation system model to a sub-regional scale by integrating clusters, technological districts, and innovative environments. This framework was particularly relevant in Brazil, allowing for a nuanced understanding of varying scales of innovation and intervention (Fernandes, 2016).

The project involved key participants, including researchers from European and Brazilian universities and public

authorities. The researchers' involvement enabled them to understand how S3 was adapted to support industrial development in different socio-economic contexts related to the selected sectors in the RIS3-PE project. In addition, the researchers could also assess possible failures in regional innovation system, participate in regional debates on self-discovery, and examine results of entrepreneurial discovery activities associated to the generation of ideas-partnerships in the sectors chosen for the S3 in Pernambuco, namely clothing and automotive information technologies. The selection of these sectors guided the identification of potential partnerships and ideas, but the choice of sectors reflected a lack of understanding about the importance of public-private cooperation in S3 design. This issue was also highlighted in the European countries, where Dominique Foray, a key figure in the development of S3, emphasized the need for stronger collaboration (Foray et al., 2009, 2021; Foray, 2018). Unlike sectoral policies, S3 aims to create synergies and complementarities within a region, fostering connections between related initiatives that focus on shared transformation goals.

The first sector chosen is clothing, primarily located in the Agreste region around Caruaru City. This sector spans 14 municipalities, employs about 1.0×10^5 workers (80.00% of whom are informal), and produces nearly 7.2×10^8 garments annually (CGEE, 2015). It is characterized by low-skilled labor, low technological intensity, and a high degree of informality, with micro and small enterprises dominating the landscape (IBGE, 2017). Despite limited innovation capacity, this sector has a supportive ecosystem of universities, incubators, and science and technology parks (SECTI, 2017).

The second sector is high-tech automotive components, concentrated around Recife City. The automotive industry, led by Fiat Chrysler Automobiles in Goiana City, is supported by a network of specialized information technology (IT) suppliers. This sector spans 11 municipalities, employing 8.5×10^3 workers and producing 2.5×10^5 cars annually, mostly for export (Pinto, 2018). Recife City, a global research and development hub, houses significant innovation actors, although the number of automotive IT suppliers remains relatively small, mostly clustered in the Recife Technology Park.

The RIS3-PE project included several other activities (Table 1), such as the discussion and proposal of a governance model or study visits to key industrial sites both in Pernambuco and in European countries.

This study leverages previously collected survey and interview data to conduct two novel analyses that serve two key objectives. The first objective is to map the structure of the innovation networks to identify whether the role of public authorities and innovation intermediaries is central. Network analysis contributes to the understanding of territorial governance (Crevoisier, 2011), highlighting a relational turn, with the relevance given to institutional mechanisms that go beyond the mere productive sphere and market interactions, connected with social capital (Moulaert and Sekia, 2003). Networks represent the ways in which territorial actors cooperate, thus expressing a logic of reciprocity, belonging, and similarity that facilitates social interactions and trust, which is in line with the idea of organized proximity (Torre and Rallet, 2005). Although the links within an innovation network may or may not be territorialized (Ter Wal and Boschma, 2009), regional development is closely linked to the local capacity to create strategic links between different actors. Crespo and Vicente (2015) argued that the formulation of innovation policies would benefit from finding the structural holes within networks (Burt, 1992) and providing targeted support

Table 1
Phases of the Regional Innovation Systems in the State of Pernambuco (Brazil) (RIS3-PE) project and key learnings.

Main step	Key learnings	Reference
Selection of priority areas	This was completed in the end of phase 1. An ex-ante selection of sectors with the defect of not having a real participatory process with a bottom-up component, generating sectors and not real priorities of productive activities.	Pinto et al. (2018)
Assessment of systemic innovation failures	Myriad failures were present, but actors demonstrated a preoccupation with the role of the state and public policy.	Nogueira and Pinto (2017); Pinto et al. (2019a)
An initial reflection on the governance model	Defining a governance model appropriate to the context was difficult. The proposed model replicated European experience, but was not implemented, even though some aspects of participation were already in place.	Laranja and Pinto (2017)
Evaluation of innovation needs and potential of strategic players in the selected priority areas	The questionnaires revealed important needs in terms of access to knowledge, in particular in companies from the clothing sector.	D'Emery et al. (2017a, b)
Co-creation sessions for the definition of a roadmap of transformative projects	Key stakeholders were involved in co-creation sessions for the development of action roadmaps. However, there was a bias towards the need for public financial support. Actors found it difficult to think about collective efforts that did not depend on access to large amounts of public spending.	Pinto et al. (2019b)

to overcome these obstacles, rather than only providing general support to specific industries. The second objective is to capture the perceptions of individual actors identified as central in the network about the role of the public sector. We believe that these two analytical levels provide important insights into the social structure in which the actors are embedded and the shared worldviews for regional innovation (Pinto et al., 2021). A survey was prepared and administered to a sample of 62 innovation actors. The survey was conducted between 6 June 2017 and 29 September 2017. We selected participants through convenience sampling based on an initial list of innovation actors provided by the Secretariat for Science, Technology, and Innovation at the Government of the Pernambuco State. The final sample obtained included different types of organizations from each priority area. Although the questionnaire included many other aspects (for complete results, see D'Emery et al. (2017a, b)), this study pay attention only to the analysis of relational data in order to highlight the innovation network. The social network analysis was carried out using Gephi software (Version 0.9.2, Gephi Consortium, Paris, France) and NodeXL software (Version 1.0.1.428, Social Media Research Foundation, Belmont, the USA).

The interview was implemented with a semi-structured script on key factors influencing innovation networks and dynamics. The data collection was conducted in the first half of RIS3-PE project, in April 2017, with 21 representatives of innovation organizations identified by SECTI. The full transcription of the interviews was analyzed using NVivo qualitative data analysis software (version 14, Lumivero, Denver, the USA). In order to reconstruct the main perceptions and expectations of knowledge brokers, this study does not focus on all the interviewees, but only on the actors occupying central positions in the network structure, thus providing a nuanced perspective (for complete results, see Nogueira and Pinto (2017)). The study carried out followed a latent content analysis and the quantification of qualitative information.

4. Results and discussion

4.1. Centralities and perceptions of public sector

The relational data obtained enabled the mapping of the innovation network (Fig. 1) and the understanding of the social and regional relations between the actors (Moulaert and Sekia, 2003; Crevoisier, 2011). This network consisted of 39 nodes and 200 edges, resulting in a network density of 0.135. Enterprises were the most numerous actors in this innovation network, making up 61.54% of the nodes, followed by innovation intermediaries (15.38%), government bodies (12.82%), and higher education and research institutions (10.26%). The size of each node reflected the total number of connections it has. Figure 1 shows that there were five actors at the core of the system:

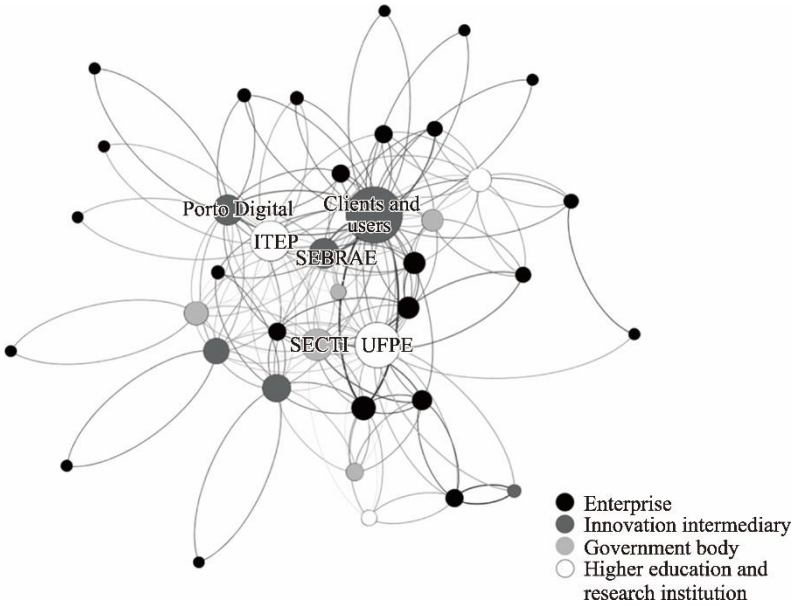

Fig. 1. Network structure in two priority areas (clothing and high-tech automotive components). ITEP, Pernambuco Institute of Technology; SECTI, Secretariat for Science, Technology, and Innovation at the Government of the Pernambuco State; UFPE, Federal University of Pernambuco; SEBRAE, Brazilian Micro and Small Business Support Service; Porto Digital, Porto Digital Technology Park. Node size indicates degree, and thickness of segments between nodes represent the number of reported collaborations.

SECTI, Pernambuco Institute of Technology (ITEP), Porto Digital Technology Park, Federal University of Pernambuco (UFPE), and the Brazilian Micro and Small Business Support Service (SEBRAE). These were all public sector actors who are at center of the relationships among the various innovative actors identified. In fact, these were the actors that stand out in the network in terms of centrality.

SECTI is the public body that has the legal authority to formulate, promote, and implement public policies for the development of science, technology, and innovation in Pernambuco, as well as to promote and support actions and activities for the promotion of higher education. The following actors are directly linked to SECTI: the Foundation for the Support of Science and Technology, the University of Pernambuco, and the Pernambuco Communication Company. SECTI also has a management contract with ITEP and Porto Digital Technology Park. In the policy experiment, SECTI is the body most closely involved in the implementation of the RIS3-PE project and closer to what is understood in Europe as the regional innovation policy authority. ITEP is a public institution of higher education and research, located in Recife City and founded in 1942. It is one of the most prominent technological institutes in Pernambuco and aims to develop specialized services and innovative solutions that contribute to the economic and social growth of the state. Porto Digital Technology Park is an advanced technology park, strongly supported and co-managed by public authorities and institutions, which are located in Recife City, with a branch in Caruaru City. Porto Digital Technology Park is considered the main regional hub of IT companies and its development is based on the need to improve the international position of Recife City and Pernambuco State in this field. SEBRAE is a private, non-profit organization created in 1972 on the initiative of the Federal Government and the Brazilian Development Bank. It is an autonomous Brazilian public service that aims to support the development of micro and small businesses and stimulate entrepreneurship in the country. With approximately 4.5×10^4 students, UFPE is considered one of the top 10 universities in the country in terms of teaching (undergraduate and graduate) and research.

Figure 2 provides a representation of the diversity of functions of the public sector based on the relations within the network. Many of these functions reflected some kind of knowledge brokerage. This visualization was generated though a hierarchical clustering process using the Clauset-Neuwman-Moor algorithm that grouped nodes based on dyadic (pairs of nodes) attributes (Xu et al., 2020). The biggest sphere, which grouped the larger number of dyads, represented market interactions, i.e., the set of relationships dominated by clients and users. This was the largest sphere because it grouped together several actors in the network and had relationships with SEBRAE and with other knowledge suppliers. The second largest sphere, on the other hand, was technological relationships, linking public innovation organizations and many other actors, in particular companies. It was in a central position in the network as it concerned the main links with innovation intermediaries, such as Porto Digital Technology Park, SEBRAE, and UFPE. The next sphere was research and development relations, dominated by Porto Digital Technology Park and UFPE. This sphere had a greater overall impact than the average, with links to ITEP, SEBRAE, and suppliers. Finally, another sphere, exploring knowledge, which was relatively central, represented the group of actors that had more connections than others, an effect also called popularity or tendency for main actions. This sphere had an above-average impact on the overall information flows within the community. Other smaller spheres mainly represented innovation collaborations based on business-to-business relations, supporting governance relations and research and development relations.

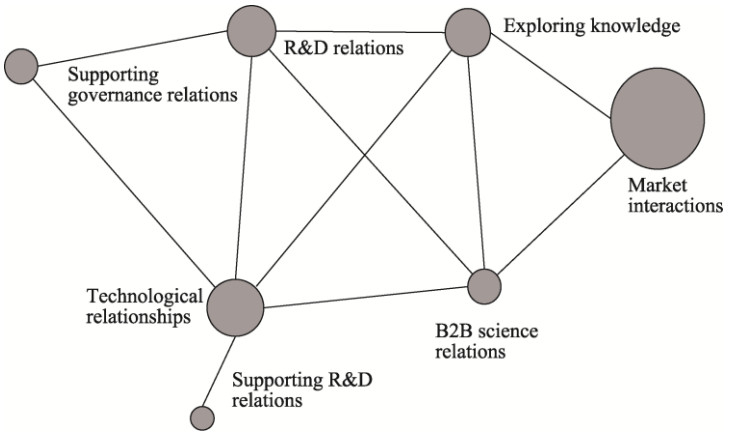

Fig. 2. Network core in two priority areas (clothing and high-tech automotive components). R&D, research and development; B2B, business-to-business. Node size indicates the number of original nodes included, and the line segments connecting the nodes represent the linkages among the various nodes.

To better understand the role of the public sector in Pernambuco, we also captured the perceptions of local central actors. In this way, we analyzed the content of the interviews with representatives of five organizations in terms of two specific key dimensions: the collaboration networks that these actors maintain and their perception about the role of the public sector in promoting innovation.

To examine the collaborative networks, we created categories for the duration of the existing linkages, including consolidated partnerships and occasional partnerships and projects. We wanted to understand which categories were the most recurrent. Comparing the nodes (types of partnerships with public authorities: projects, partnerships, or long-term cooperation) with the number of coded references, actors in the network reported to have developed long-term collaboration (90.00%). This means that long-term collaboration is a crucial feature for the central actors, probably by strengthening trust and reciprocity.

Regarding the role of the public sector, the representative of ITEP underlined the role of public financing for the support of innovation. The representative of SEBRAE believed this organization was perceived as the public entity that most present in partnerships to work with all businesses, not just in the clothing industry. Other actors, such as the public universities and other public research organizations, are also seen as crucial in the search for innovation.

Moreover, actors were asked to identify concrete actions that could help to overcome existing weaknesses, threats, strengths, and opportunities. Based on the information collected, new categories were created, i.e., emerging categories, which were subdivided in terms of the types of actors that could implement them. A common concern among these actors was the continuity of public policy, which they viewed as the most critical measure. Other frequently mentioned concerns included the need to develop university-business linkages, improve incentives for cross-sector collaboration, and speed up decision-making processes.

4.2. Learning from policy experimentation in Pernambuco

A strategy like S3 needs to link the initial top-down planning of priority areas with subsequent roadmaps and enterprise findings of concrete actions and projects that contribute to industrial transformation. This means that trust in the public authorities and in the continuity of the strategic endeavor strengthens the involvement of different regional actors, which is a fundamental success factor. In this regard, the interviews are clear, pointing to the importance of this dimension. More than regulation or financial incentives, S3 requires public sector to be committed as partner and facilitator and is able to promote policy continuity.

The network analysis provided evidence of the centrality of public authorities and other public institutions (Kauffeld-Monz and Fritsch, 2013). We found that for the design and implementation of S3 in developing regions, such as Pernambuco, public authorities and other public bodies need to maintain an interventionist and top-down function that is justified by the need to adapt policy-governance to local conditions of scarce entrepreneurial capabilities in the private sector and fewer opportunities for successful public-private strategic cooperation. Outside Europe, S3 is mainly used as a flexible framework to help the design of innovation strategy. Firstly, there is no guarantee that there will be a dedicated financial instrument to support the interventions designed by the strategy. Secondly, the implementation of the strategy itself should not follow the same (and already known) patterns as those established in Europe. Rather, an exercise of translation and adaptation to the different contextual conditions of these regions is required (Pinto et al., 2018). Lastly, the development of S3 itself implies a development and learning process. Therefore, countries and regions outside Europe may face different difficulties than those identified in Europe.

In any case, the European experience can indeed help other countries and regions to follow the path in a more informed way, without having to go through the process of trial and error. These results, although exploratory, provide interesting evidence to support this argument. The predominance of public innovation actors as key agents of knowledge exchange in the network indicates that these stakeholders must be consulted regarding the primary drivers of S3. In addition, they must act as intermediaries between the different regional actors. The understanding of the role of the state in improving the efficiency of innovation systems also confirms the governance bodies required by S3, which are often mentioned in literature, to ensure and adjust government tools and institutions as necessary to meet the needs of actors and innovation systems (Sotarauta, 2018; Morisson and Panetti, 2020). However, the interviews also showed that there are fears that the state may push the region towards a less efficient and competitive trajectory.

Table 2 summarizes key aspects in the design and implementation of S3 in developed and developing regions. They may involve significant differences, particularly in the role of public authorities, universities, and other intermediaries.

Table 2
Contrasts of smart specialization strategy (S3) in developed and developing regions.

S3 characteristic	Developed regions	Developing regions
Priority areas	Priority areas are understood as the directions for industrial transformation.	Priority areas are understood as sectors or clusters.
Innovation model	Science, technology, and innovation are the main drivers of S3.	Doing-using-interacting also needs to considered as a main driver to innovation
Governance	Governance is decentralized. Priority areas for niche-discovery and experimentation are co-created through public-private collaboration. The role of public authorities is to facilitate the process.	Governance is centralized. While public consultation processes may support public policy making, the top-down choice of domains for exploration and experimentation dominates. The role of public authorities may have to be driving the process.
Actors	Involving actors from the quadruple helix.	Stronger role of public authorities, universities, and innovation intermediaries.

In the priority areas analyzed—clothing and high-tech automotive components—there are different expectations of the capacity of public authorities to radically change the context, due to the existing imbalances in terms of entrepreneurial capabilities and infrastructure. In the high-tech automotive components, there is a deeper involvement, but also a lower belief in the ability of public authorities alone to influence regional change.

It is important to mobilize local actors and gain their trust, but it is also necessary to be very careful not to disappoint them (Gianelle et al., 2020). To this end, shared governance models must be used and must also play a role in the selection and allocation of resources. It is essential to train innovation actors and management bodies. Many of the problems in S3 also stem from shortcomings in the public administration. S3 does not happen by itself. In addition to the need for financial resources, public authorities must help to organize local S3 actors who can drive the entrepreneurial discovery process together with the main strategic projects and appropriate monitoring mechanisms (Foray, 2018). There are two main reasons for this. On the one hand, because S3 is a relatively new approach to innovation policy strategy in Brazil, it still needs to be studied and understood in order to improve its effectiveness. Most likely a series of adaptations, namely in terms of skills and the training of regional actors for the active role required by S3, will be necessary. On the other hand, S3 also implies changes in multi-level governance, with the articulation among regional, state, and national levels (Laranja et al., 2020). Moreover, as has been demonstrated, effective design and implementation of S3 requires a new role for the state, which should play a major role in establishing trust between parties and bridging the gap between them.

5. Conclusions

There is a significant gap between academic work and actual implementation of S3 in developing regions. This study discussed the role of public authorities and innovation intermediaries in the implementation of S3 in developing regions characterized by low human capital, institutional thinness, and difficulties in gaining trust and developing cooperation. This study focused on a policy experiment in Pernambuco, one of the first attempts to apply this framework in an innovation strategy outside Europe. The results showed that public authorities play an important role as knowledge brokers and policy intermediaries in S3. They contribute to the formation of linkages and partnerships, mainly with other public actors. S3 in developing regions faced significant challenges. First, the implementation of S3 may require greater decentralization, with particular attention to specific public sector capabilities. Second, it may also require a non-existing culture of innovation to promote higher added value processes. Third, it may require learning new governance processes to articulate public-private cooperation for entrepreneurial discoveries. While the governance of S3 would ideally have a top-down planning mode and a participatory mode, we have to recognize that, in developing regions, where leadership and entrepreneurial actors are limited, it may be difficult to implement a broad participatory process supporting the entrepreneurial discovery, and the public sector needs to change from being the main driver of the strategy to being a facilitator. For developing regions, the first step in the public sector to stimulate innovation may still be the strengthening of higher education, vocational skills, and public infrastructure, essentially building human capital and infrastructure, but in a certain direction in order to discover and scale up new specializations.

Authorship contribution statement

Hugo PINTO: conceptualization, investigation, formal analysis, methodology, software, and writing - original

draft; Manuel LARANJA: conceptualization, investigation, writing - review & editing, and validation; and Elvira UYARRA: conceptualization, writing - review & editing, and validation. All authors approved the manuscript.

Ethics statement

Ethics approval was obtained from the corresponding Committee of the Regional Innovation Systems Project in the State of Pernambuco, Brazil. In addition, the participants provided their informed consent in participating for the study.

Declaration of conflict of interest

Hugo PINTO is an Editorial Board member of Regional Sustainability and was not involved in the editorial review or the decision to publish this article. All authors declare that there are no competing interests.

Acknowledgements

This study is a result of the project "Regional Innovation Systems in the State of Pernambuco – Brazil" (2016CE160AT045 EU-CELAC), which was funded by the European Commission's Directorate-General for Regional Policy. The first author is supported by national funds of the Portuguese Foundation for Science and Technology (FCT) under the scope of the Research Centre for Tourism, Sustainability and Well-being and his individual research plan. The authors would like to express their gratitude to Mr. Raphael D'EMERY and Dr. Carla NOGUEIRA for their assistance in the implementation of the project. We are indebted to all the entities that participated in the survey and interviews.

References

Aghion, P., David, P.A., Foray, D., 2009. Science, technology and innovation for economic growth: Linking policy research and practice in 'STIG Systems'. Res. Policy. 38(4), 681–693.

Balland, P.A., Boschma, R., Crespo, J., et al., 2019. Smart specialisation policy in the EU: Relatedness, knowledge complexity and regional diversification. Reg. Stud. 53(9), 1252–1268.

Barbero, J., Diukanova, O., Gianelle, C., et al., 2021. Economic modelling to evaluate smart specialisation: An analysis of research and innovation targets in Southern Europe. Reg. Stud. 56(9), 1496–1509.

Barca, F., 2009. An Agenda for a Reformed Cohesion Policy: A Place-Based Approach to Meeting European Union Challenges and Expectations. [2023-09-19]. https://migrant-integration.ec.europa.eu/library-document/agenda-reformed-cohesion-policy-place-based-approach-meeting-european-union_en.

Barroeta, B., Prieto, J.G., Paton, J., et al., 2017. Innovation and Regional Specialisation in Latin America. [2023-09-19]. https://s3platform.jrc.ec.europa.eu/en/w/innovation-and-regional-specialisation-in-latin-america.

Burt, R.S., 1992. Structural Holes: The Social Structure of Competition. Cambridge: Harvard University Press.

Capello, R., Kroll, H., 2016. From theory to practice in smart specialization strategy: Emerging limits and possible future trajectories. Eur. Plan. Stud. 24(8), 1393–1406.

CGEE (Centre for Management and Strategic Studies), 2015. Socio-economic Characterization of Selected Regions in the State of Pernambuco, European Union. In: Brazil Sector Dialogues Support Project, Center for Strategic Studies and Management. Brasilia, Brazil (in Portuguese).

Content, J., Frenken, K., 2016. Related variety and economic development: A literature review. Eur. Plan. Stud. 24(12), 2097–2112.

Crespo, J., Vicente, J., 2015. Proximity and distance in knowledge relationships: From micro to structural considerations based on territorial knowledge dynamics (TKDs). Reg. Stud. 50(2), 202–219.

Crevoisier, O., 2011. Beyond territorial innovation models: The pertinence of the territorial approach. Reg. Stud. 48(3), 551–561.

del Castillo, J., Paton, J., 2016. Smart specialisation across the world: The case of Latin America. In: First Smarter Conference on Smart Specialisation and Territorial Development. Sevilla, Spain.

D'Emery, R., Pinto, H., Nogueira, C., 2017a. RIS3-PE towards a vision of the Smart Specialization Strategy in selected innovative territories of the State of Pernambuco – Knowledge and innovation needs STI Automotive-TI. In: Centre for Social Studies, University of Coimbra. Coimbra, Portugal (in Portuguese).

D'Emery, R., Pinto, H., Nogueira, C., 2017b. RIS3-PE towards a vision of the Smart Specialization Strategy in selected innovative territories of the State of Pernambuco – Needs for knowledge and innovation STI clothing. In: Centre for Social Studies, University of Coimbra. Coimbra, Portugal (in Portuguese).

Fernandes, A.C., 2016. Territorial innovation system or a dimension of analysis in contemporary geography. In: Sposito, E.S., Silva, C.A., Sant'anna Neto, J.L., et al., (eds.). The Diversity of Brazilian Geography. Scales and Dimensions of Analysis and Action. Rio de Janeiro: Editora Consequência (in Portuguese).

Foray, D., David, P.A., Hall, B.H., 2009. Smart Specialisation – the Concept. [2023-09-19]. http://ec.europa.eu/investinresearch/pdf/download_en/kfg_policy_brief_no9.pdf.

Foray, D., 2014. From smart specialisation to smart specialisation policy. Eur. J. Innov. Manag. 17(4), 492–507.

Foray, D., 2016. On the policy space of smart specialization strategies. Eur. Plan. Stud. 24(8), 1428–1437.

Foray, D., 2018. Smart specialization as a case of mission-oriented policy – A case study on the emergence of new policy practices. Ind. Corp. Change. 27(5), 817–832.

Foray, D., Eichler, M., Keller, M., 2021. Smart specialization strategies – insights gained from a unique European policy experiment on innovation and industrial policy design. Review of Evolutionary Political Economy. 2, 83–103.

Gianelle, C., Guzzo, F., Mieszkowski, K., 2020. Smart specialisation: What gets lost in translation from concept to practice? Reg. Stud. 54(10), 1377–1388.

Gómez Prieto, J., Demblans, A., Palazuelos Martínez, M., 2019. Smart Specialisation in the World, an EU Policy Approach Helping to Discover Innovation Globally. [2023-09-19]. https://s3platform.jrc.ec.europa.eu/en/w/smart-specialisation-in-the-world-an-eu-policy-approach-helping-to-discover-innovation-globally.

Hausmann, R., Rodrik, D., 2003. Economic development and self-discovery. J. Dev. Econ. 72(2), 603–633.

Hausmann, R., Rodrik, D., 2006. Doomed to Choose: Industrial policy as Predicament. [2023-09-19]. https://drodrik.scholar.harvard.edu/publications/doomed-choose-industrial-policy-predicament.

IBGE (Brazilian Institute of Geography and Statistics), 2017. IBGE Brazil in Brief – Pernambuco, Panorama. [2023-09-19]. https://cidades.ibge.gov.br/brasil/pe/panorama (in Portuguese).

Iga-César, A.C., 2022. The role of leadership capabilities in Smart Specialisation Strategies: Comparative case studies in two Latin American regions. Regional Studies, Regional Science. 9(1), 223–241.

Kauffeld-Monz, M., Fritsch, M., 2013. Who are the knowledge brokers in regional systems of innovation? A multi-actor network analysis. Reg. Stud. 47(5), 669–685.

Kroll, H., 2015. Efforts to implement smart specialization in practice – Leading unlike horses to the water. Eur. Plan. Stud. 23(10), 2079–2098.

Laranja, M., Pinto, H., 2017. Governance Model, RIS3-PE – Towards a vision of the Smart Specialization Strategy in selected innovative territories of the State of Pernambuco. In: Centre for Social Studies, University of Coimbra. Coimbra, Portugal (in Portuguese).

Laranja, M., Edwards, J., Pinto, H., 2019. Smart specialisation and the complex nature of governance: Perspectives from Portuguese regions for the Post-2020 Period. RSA Regions. 4, doi: 10.1080/13673882.2018.00001036.

Laranja, M., Edwards, J., Pinto, H., et al., 2020. Implementation of Smart Specialisation Strategies in Portugal – An assessment. Luxembourg: Publication Office of the European Union, doi: 10.2760/363370.

Laranja, M., 2021. Translating smart specialisation and entrepreneurial discovery into a process-oriented policy. Reg. Stud. 56(5), 853–865.

Marinelli, E., Boden, M., Haegemanm, K., 2016. Implementing the entrepreneurial discovery process in Eastern Macedonia and Thrace. In: Kyriakou, D., Palazuelos Martínez, M., Periáñez-Forte, I., et al., (eds.). Governing Smart Specialisation. London: Routledge, 132–155.

Marques, P., Morgan, K., 2018. The heroic assumptions of smart specialisation: A sympathetic critique of regional innovation policy. In: Isaksen, A., Martin, R., Trippl, M., (eds.). New Avenues for Regional Innovation Systems – Theoretical Advances, Empirical Cases and Policy Lessons. Cham: Springer, 275–293.

Marrocu, E., Paci, R., Rigby, D., et al., 2023. Evaluating the implementation of smart specialisation policy. Reg. Stud. 57(1), 112–128.

McCann, P., Ortega-Argilés, R., 2016. The early experience of smart specialization implementation in EU cohesion policy. Eur. Plan. Stud. 24(8), 1407–1427.

McNiff, J., 2013. Action Research Principles and Practice (3rd ed.). London: Routledge.

Montero, S., Chapple, K., 2019. Fragile Governance and Local Economic Development: Theory and Evidence from Peripheral Regions in Latin America. Abingdon: Routledge.

Mora, L., Panori, A., Deakin, M., et al., 2022. Digital meets smart: Towards a technology-enhanced approach to smart specialisation strategy development. Reg. Stud. 56(9), 1421–1428.

Morgan, K., 2004. The exaggerated death of geography: Learning, proximity and territorial innovation systems. J. Econ. Geogr. 4(1), 3–21.

Morisson, A., Panetti, E., 2020. Institutional entrepreneurs and socio-institutional changes in Medellín, Colombia. Regional Studies, Regional Science. 7(1), 35–51.

Moulaert, F., Sekia, F., 2003. Territorial innovation models: A critical survey. Reg. Stud. 37(3), 289–302.

Muscio, A., Reid, A., Leon, L.R., 2015. An empirical test of the regional innovation paradox: Can smart specialisation overcome the paradox in Central and Eastern Europe? J. Econ. Policy Reform. 18(2), 153–171.

Natalicchio, A., Mora, L., Ardito, L., et al., 2022. Evidence-informed decision-making in smart specialisation strategies: A patent- based approach for discovering regional technological capabilities. Reg. Stud. 56(9), 1442–1453.

Nogueira, C., Pinto, H., 2017. RIS3-PE towards a vision of the Smart Specialization Strategy in selected innovative territories of the State of Pernambuco – Assessment of resources and problems in the Pernambuco innovation system: Views of key actors. In: Centre for Social Studies, University of Coimbra. Coimbra, Portugal (in Portuguese).

Oughton, C., Landabaso, M., Morgan, K., 2002. The regional innovation paradox: Innovation policy and industrial policy. The Journal of Technology Transfer. 27, 97–110.

Papamichail, G., Rosiello, A., Wield, D., 2023. Addressing public policy implementation challenges in lagging regions through the analytical lens of smart specialisation. J. Knowl. Econ. 14(1), 356–381.

Pessoa, A., 2014. Smart Specialisation in the EU: Is it a Bridge between Innovation and Cohesion? [2023-09-23]. https://ideas.repec.org/p/wiw/wiwrsa/ersa14p989.html.

Pinto, H., 2018. RIS3-PE – For a vision of the smart specialisation strategy in selected innovative territories of the State of Pernambuco. In: EU-CELAC cooperation on territorial cohesion – regional innovation systems in the state of Pernambuco (Brazil). Coimbra, Portugal.

Pinto, H., Nogueira, C., Laranja, M., et al., 2019a. The tropicalization of smart specialization: Initial considerations and systemic innovation failures for the development of a strategy in Pernambuco (Brazil). Portuguese Review of Regional Studies. 50, 103–122 (in Portuguese).

Pinto, H., D'Emery, R., Nogueira, C., et al., 2019b. Smart specialization and entrepreneurial discovery in Pernambuco: Perspectives of apparel and automotive-IT innovation actors. Revista Brasileira de Inov. 18(2), 299–330 (in Portuguese).

Pinto, H., Nogueira, C., Cruz, A.R., et al., 2021. The social shaping of innovation: Networks and expectations as connecting dynamics in regional innovation systems. Int. Rev. Sociol. 31(3), 410–431.

Pinto, H., 2023. Universities and institutionalization of regional innovation policy in peripheral regions: Insights from the smart specialization in Portugal. Reg. Sci. Policy Pract. 16(1), 1–22.

Polverari, L., 2017. Smart specialisation in 2014–2020 ESI Funds Programmes: Not just a narrative. European Structural and Investment Funds Journal. 5(1), 20–31.

Rocchetta, S., Ortega-Argilés, R., Kogler, D.F., 2022. The non-linear effect of technological diversification on regional productivity: Implications for growth and smart specialisation strategies. Reg. Stud. 56(9), 1480–1495.

Ruhrmann, H., Fritsch, M., Leydesdorff, L., 2022. Synergy and policy-making in German innovation systems: Smart specialisation strategies at national, regional, local levels? Reg. Stud. 56(9), 1468–1479.

SECTI (Secretariat for Science, Technology, and Innovation at the Government of the Pernambuco State), 2017. ECT and I-PE–Strategy for Science, Technology and Innovation 2017–2022. In: Secretariat of Science and Technology of the State of Pernambuco. Recife, Brazil (in Portuguese).

Sotarauta, M., 2018. Smart specialization and place leadership: Dreaming about shared visions, falling into policy traps? Regional Studies, Regional Science. 5(1), 190–203.

Ter Wal, A.L.J., Boschma, R.A., 2009. Applying social network analysis in economic geography: Framing some key analytic issues. Ann. Reg. Sci. 43(2), 739–756.

Torre, A., Rallet, A., 2005. Proximity and localization. Reg. Stud. 39(1), 47–59.

Torre, A., 2019. Territorial development and proximity relationships. In: Capello, R., Nijkamp, P., (eds.). Handbook of Regional and Development Theories. Cheltenham: Edward Elgar Publishers, 326–343.

Trippl, M., Zukauskaite, E., Healy, A., 2020. Shaping smart specialization: The role of place-specific factors in advanced, intermediate and less-developed European regions. Reg. Stud. 54(10), 1328–1340.

Vallance, P., Blažek, J., Edwards, J., et al., 2018. Smart specialisation in regions with less-developed research and innovation systems: A changing role for universities? Env. Plan. C-Polit. Space. 36(2), 219–238.

Xu, G.N., Hu, W.J., Qiao, Y.Y., et al., 2020. Mapping an innovation ecosystem using network clustering and community identification: A multi-layered framework. Scientometrics. 124(3), 2057–2081.