

The Role of Universities in Building Dense Triple Helix Ecosystems in Sparse Regional Environments

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Abstract

University-industry-government relationships driving regional innovation are often discussed by using the shorthand of the 'triple helix', referring to any arena where these partners come together. This rapid expansion of the idea's use risks it becoming a 'policy concept' whilst potential tensions of collaboration can be ignored. Instead of 'happy family stories' of well-functioning regional partnerships, we seek to explore how triple helix mechanisms may stimulate regional innovation systems in places that have traditionally not had a long history of collaboration. Whilst universities are often dominant drivers of innovation in these 'sparse' regional innovation ecosystems, they may not be fit to respond to the identified regional needs. We address this by using empirics from five regions with relatively sparse triple helix environments and present evidence on the ways in which the universities have sought to play the role of *tertius gaudens* – honest broker – helping to address the stalemates that emerge between partners with very different goals, norms, values and intentions around regional innovation. We identified several processes through which universities can play this role and thereby contribute to densifying sparse innovation environments, increasing agglomeration and diversity whilst helping to address the tensions and problems that densification brings.

Keywords: regional innovation systems, peripheral regions, entrepreneurial universities, university regional engagement, innovation barriers, institutional diversity

JEL: I23, R11, R15

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Introduction

It has become increasingly common to talk about university-industry-government relationships stimulating innovation using the shorthand of the 'Triple Helix'. In Europe, the terminology has been used to refer to any arena where these partners come together to stimulate better co-operations. But the rapid expansion of the idea's use risks it becoming a 'policy concept' (Böhme & Glørsen, 2010), something that creates consensus by hiding disagreement. In effect, triple helix collaborations are agreed to be good despite different visions of what constitute good relationships, and specifically obscuring tensions in arising collaborations between public, private and civil society partners. In the original Triple Helix model (THM) of Etzkowitz and Leydesdorff (2000) the underlying mechanism was the *tertius gaudens*, the honest third party, helping to address the stalemates that emerge between partners with very different goals, norms, values and intentions around regional innovation. In much of what is written about triple helix partnerships, there is a risk that these tensions are ignored and the mechanisms by which they are addressed shift into the background behind 'happy family stories' of well-functioning regional partnerships (Lagendijk and Oinas, 2005).

We bring these two trends together to explore how triple helix mechanisms build up in places lacking long histories of collaborative relationships between partners, and therefore lack the experience in addressing these problems. We focus on places with 'sparse' regional innovation ecosystems, where a university may be a dominant innovation driver but without necessarily meeting regional partners' expressed needs. Although all partners would benefit from denser interaction, these mismatches between partners' capacities and goals inhibit building closer relationships and thereby addressing these mismatches, trapping the regions in a sparse triple helix vicious circle. We therefore ask the research question: "what roles do universities play in sparse environments in building up

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triple helix relationships stimulating regional innovation processes?”. We use empirics from five regions with relatively sparse Triple Helix environments where universities played leading roles in attempting to build up relationships between Triple- and Quadruple-Helix partners¹. Applying the empirical material to the conceptual framework derived, the chapter presents evidence from these five regions on the ways in which the universities have sought to play this *tertius gaudens* role, of the honest broker, to address the tensions that can arise, specifically using their global connections to help build better local interactions. The chapter identifies several processes through which universities can play this role and thereby contribute to densifying sparse innovation environments, increasing agglomeration and diversity whilst helping to address the tensions and problems that densification brings. This chapter therefore helps understand the ways in which universities can help build more fertile innovation and entrepreneurial ecosystems, thereby contributing to driving regional growth and wellbeing.

Literature Review

The problem of sparse innovation environments

Solving the innovation challenge in ways that produce socially equitable as well as economically efficient solutions requires understanding how innovation processes occur. This is particularly applicable to peripheral regions, that face materially different challenges to those of the most successful regions from which examples are most frequently drawn (Eder, 2019). While diverse sets of challenges for these groups of regions have been identified by various authors (for an overview see Nieth and Benneworth (2018)), Tödtling and Trippl (2005)

¹The Quadruple Helix refers to the fact that civil society organisations can be considered as a distinct sector of regional innovation networks and therefore deserve their own separate inclusion.

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highlight that peripheral regions lack structural density, with insufficient actors to achieve critical mass; old industrial regions may become “locked-in”, incapable of creating new pathways or interactions, resulting in “ties that blind” (Grabher, 1993).

These challenges have been addressed in practice in weak(er) regional innovation ecosystems in diverse ways. One approach can be linking the peripheral region to urban areas on a national or even international scale (Eder, 2019, Isaksen and Karlsen, 2013). Firms and universities can become important regional actors using international contacts to facilitate knowledge exchange and learning. Isaksen and Karlsen (2013) even argue that “less emphasis [should be placed] on the endogenous development capacity” of the region, with other geographic scales (national, international) potentially being equally important for innovation. These approaches nevertheless assume that a region has assets, actors and capacities that are sufficiently attractive to external partners to develop these wider linkages.

The Triple Helix Approach

The THM conceptualises the partnering of regional actors for boosting regional innovation capacity (Etzkowitz and Leydesdorff, 2000, Leydesdorff and Etzkowitz, 1998), focusing on the interactive innovation dynamics between three main cooperating actors: industry, government and university. Bilateral relationships concatenate and drive their regional innovation environments forward, in a heuristic of a helical model of overlaid and reciprocal exchanges (sometimes depicted to resemble the DNA double helix). In its initial formulation, its tryptic form was proposed in consideration of emerging tensions and contrasts stemming from dualistic collaborative arrangements. In the introduction of a third element, cooperative actor relationships could be better managed.

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The THM was developed from a relatively limited set of paradigmatic cases (e.g. Silicon Valley), assuming a spontaneous emergence of these cooperative links and the development of functional regional partnerships (Lagendijk and Oinas, 2005). However, the original model saw that conflict was a potential driver of innovation: in the *tertius gaudens* mechanism, the “third who benefits”, this refers to a third party that can work to create balance and address emerging tensions when otherwise productive innovation relationships founder. This third party would act as an “honest broker”, moderating these different intentions, values, goals and norms between actors, mediating rigidities and compensating for any absences, enabling the potential of those innovation relationships otherwise held back by those tensions.

The THM of various stakeholders is part of a much wider family of Territorial Innovation Models (Moulaert and Sekia, 2003). The Triple Helix model is similar – although not identical – to concepts of ‘regional innovation coalitions’ (Benneworth, 2007), ‘regional innovation networks’ (Rodrigues and Teles, 2017) or ‘multi-level partnerships’ (Morgan and Nauwelaers, 2003), all-encompassing the idea of different stakeholders coming together and providing potential solutions to varied problems (Wilgaard Larsen, 2017). While the idea of partnerships becoming regional “possibility-making machines” (Åkerstrøm Andersen, 2008) is attractive, it obscures the fact that different partners have different aims, motivations, desires and goals. Harmonious and uncomplicated cooperation in ‘happy regions’ (Lagendijk and Oinas, 2005) cannot be seen as the status-quo, as a variety of stakeholders “each with their own assumptions, ideas, goals and expectations” (van Drooge and Spaapen, 2017, “7 Discussion & Conclusion”, para. 1) need to be aligned, while facing different tensions (Nieth, 2019).

In this chapter we combine these two literatures to ask whether these regional partnerships can drive densification processes in these sparse innovation

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environments, thereby addressing an important lacuna in the literature: moving beyond thinking of sparse innovation environments in terms of processes that operate in successful/ dense innovation regions. We specifically address the role of different actors in triple helix partnerships, how they play different roles to address tensions and create new innovation assets. We ask the research question: “what roles do universities play in sparse environments in building up triple helix relationships that stimulate regional innovation processes?”.

Methodology & Case Studies

Methods

To answer this research question, this study comparatively analyses five universities in sparse innovation environments across varying national and regional contexts: the five universities are all located in sparse innovation environments, and all have actively sought to manage their contributions to regional development. The study draws on desk-based research and data from a total of 194 semi-structured interviews, split as following throughout the case-studies: 35 interviews in Satakunta (FI), 36 in Lincolnshire (UK), 40 in Twente (NL), 38 in Aalborg (DN), 45 in Aveiro (PT). These were conducted between 2017 and 2019 with academics, local authorities and other relevant stakeholders (e.g. businesses, intermediary and civil organisations) exploring how universities contributed to supporting regional innovation and entrepreneurial co-operative environments. Questions addressed engagement activities and collaborative projects of relevance undertaken with external stakeholders, emerging tensions and opportunities and the effective or foreseen impact these had on the region and the institutions involved. Interviews were recorded, transcribed and translated into English where applicable.

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Cases

The University of **Aveiro** has played an active and relevant role in the entrepreneurial ecosystem of Aveiro (NUTS III) and Centro region (NUTS II), evidenced in previous studies (Fonseca, 2019, Rodrigues and Teles, 2017). Despite its location in a less developed region, it benefits from a unique lagoon setting in the Portuguese coast, and its positioning between the major metropolitan areas – Lisbon and Porto – creating opportunities to develop its innovative assets in the areas of environment, agro-food, ICT and others related to the local industry. UA has boosted regional innovation by engaging in inter-institutional collaborations with both big, medium and small businesses, but especially with its continued work with local (municipalities) and regional government (intermunicipal community of Aveiro and Centro region's commission) in the support of development initiatives, like the incubator network, the science park and the technological platforms.

The University of **Twente** has been contributing to the regional innovation environment through diverse channels, such as teaching entrepreneurship courses, as well as contributing to regional strategy platforms and supporting a start-up/spin-out system which encourages students and researchers to contribute to regional development (mainly in the high-tech sector). Established in 1961, it was created with the aim to revitalise the regions lagging industry and creating a knowledge-based environment that would attract students, researchers and companies alike. It has been working with governmental actors such as the 14 municipalities of Twente, cities (especially Enschede and Hengelo) and the Twente region, as well as with industrial partners and societal stakeholders (Nieth, 2019). The region as well as the university have been focusing on expanding as well as supporting high-tech related projects, activities and sectors.

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Aalborg University, opened in 1974 after active lobbying of diverse regional interest groups, is situated in the most Northern part of Denmark and combines 11 municipalities. The city of Aalborg constitutes the centre of the region, with the university and much of the industry being located there. Since its creation the university has been an integral part of the regional innovation ecosystem through its active involvement in joint initiatives and platforms (especially internationally known clusters). At the same time, AAU has adopted the problem-based approach for teaching, learning and research, allowing active interaction of students (and to a lesser degree also academics) with the private and public regional stakeholders. The regional industry, which is heavily based on SMEs, used to be dominated by traditional and labour-intensive industries, counts on more growth-oriented knowledge industries today.

University Consortium of **Pori**, coordinated by the new Tampere University², is a network of three Finnish universities. Altogether, there are six university consortia scattered across the country in more peripheral regions otherwise lacking access to HE. UC-Pori is located in the Satakunta region in the Southwest of Finland, where the former Tampere University of Technology has offered degree studies in engineering since the late 1980s. It was officially established in 2003, and later on the position of the university consortia was legitimised in 2009 (Ministry of Education and Culture, 2009) to reinforce the societal role of higher education. Currently, the UC-Pori contributes to building a regional innovation ecosystem not only by increasing the local skills-level with local access to higher education, but also by engaging with regional authorities in policy design and evaluation processes, and supporting local SMEs through ERDF funded activities

² University of Tampere and Tampere University of Technology merged in January 2019.

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(Salomaa & Charles, 2019). It is active in all regional priority sectors such as energy production, offshore process industry, ports and logistics.

University of Lincoln, located in the rural region of Lincolnshire in North East of England, has had a strong regional mission since its establishment in 1996. Since then, it has expanded rather quickly and become an important driver of regional development, especially through intensive collaboration with regional authorities (Salomaa, 2019). UoL has strived to support regional economic growth by focusing on large-scale, collaborative infrastructure initiatives such as the establishment of Lincoln Science and Innovation Park together with the Lincolnshire Co-Op to attract more large-scale companies to the area. It has also sought to serve the local job market by providing tailored degree education e.g. in engineering, but also increasingly in other local priority sectors, namely in agri-food and food manufacturing, through National Centre for Food Manufacturing at the Holbeach campus and the Lincoln Institute for Agri-Food Technology at the Riseholm campus.

The dynamics of university collaboration activities in sparse innovation environments

In this chapter we focus on a set of concrete collaborative projects that fulfilled our criteria in that they involved actors from all three sectors, represented an increase in the density of the regional innovation environment, and actors played different roles in each of these sectors. Four of the cases represent efforts to create density by the development of new networks between different partners, the network for sustainable business development & matchmaking schemes in North Denmark, Aveiro's Network for Innovation and Collaboration and health sector and robotics collaboration in Pori. Four of the cases involved developing specific physical infrastructures for improved collaboration, the living lab for lighting in Aveiro, rural campuses and technology hubs in Lincolnshire, and

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Enschede's smart city infrastructure in Twente. A final example was the University of Twente's Professional Doctorate of Engineering scheme, P.D. Eng, which contributed to raising high-level innovation skills in the region.

Network for Sustainable Business Development (North Denmark)

The Network for Sustainable Business Development (NSBD) is a collaboration between various municipalities of North Denmark, local business centres, Aalborg University, a local energy firm and several companies (Aalborg Kommune, n.d.), aimed at managing different activities in the area of green and sustainable development. The municipality of Aalborg, which secured the network's initial developments, was already engaging actively within the field of sustainability and has been "recognized as a pioneering municipality for crafting local authority commitment to sustainability initiatives" (Normann et al., 2017). Today, the network is managed by two municipalities, Aalborg and Hjørring, with a secretariat involving actors from municipalities, university and different technological experts. It is primarily financed by municipalities, but also received some EU Structural Funds, and - reflecting the national priority for green and sustainable development in Denmark - there have also been national funds. A NSBD researcher claimed that the idea to create the network emerged in 2008 as a result of an ongoing between researchers at Aalborg university and their municipal counterparts. A project participant noted that this initiative was a "a very collaborative effort between the three main partners" (public, private and university) aiming to create tasks and benefits for everyone: The municipality drove the "environmental rationality aimed at monitoring and adjusting operational practices in polluting industries", the university acted as knowledge specialists promoting technical advancements (Normann et al., 2017). A member argued the network was important for experience and knowledge transfer:

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“building up the capabilities of the municipality, and teach the people how to transform from being regulators to being advisors or dialogue partners. We are upgrading both the industry but also the public organizations”.

Matchmaking Scheme (North Denmark)

Aalborg University (AAU) and the North Denmark Region created a new cooperation infrastructure in 2007/08 seeking to facilitate cooperation with the existing business infrastructure in the region, particularly in the region's remoter rural areas and with SMEs. The original idea of this matchmaking scheme was creating new access points for university knowledge; one of the scheme's initiators describing this as a “no wrong door policy” (Nieth and Benneworth, 2019). The project was constructed to match regional needs, thereby ensuring funding from the regional Growth Forum, the body distributing European and national economic development funds. The new scheme involved two elements: the first was a matchmaking secretariat responsible for project management and organising matchmaking activities, and the second were the “matchmakers”. There were three varieties of matchmaker created to stimulate knowledge exchange and build up new connections: internal matchmakers (academics and managers from different faculties), external matchmakers (employees of municipalities, business associations or similar institutions), and students matchers (individuals facilitating connections between students and regional businesses). These matchmakers were identified and connected to each other, and as they were usually well connected, this extended many small networks into a large consolidated arrangement with more perspective of partners' different interests and needs. The secretariat also organised “municipality tours” and project fairs were initiated, creating new ways for engagement between researchers, students and companies. More recently, new university management decided to refocus the programme as part of a rationalisation of all

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university knowledge exchange arrangements, partly reflecting national policy shifts in Denmark, shifting the focus to student-business connections.

Network for Innovation and Competitiveness (Aveiro)

The Network for Innovation and Competitiveness, (Rede para a Inovação e Competitividade, RIC), was established in 2008 as a one-year partnership between Águeda municipality (in Aveiro region), UA and its Águeda polytechnic school, and firms and entrepreneurial associations. Funded by the EU's regional innovative actions programme, RIC's creation was a purposeful "introduction of the triple helix model into the political discourse" in Aveiro region (Rodrigues & Melo, 2013, p. 1681), following a belief that this arrangement would help boost local competitive capacity and innovative dynamics. The proposal was driven by the Mayor of Águeda's generally recognised innovative mindset. In turn, UA regarded RIC as an opportunity to implement its regional engagement discourse. Entrepreneurs and firms were enticed by the prospect of accessing and developing innovation assets. More than 100 ideas were proposed (CMA, 2009) although most were rejected due to their impracticality or lack of innovativeness. Six developed into projects, of which the Lighting Living Lab (LLL) was the most notable (see below). While RIC produced few tangible results, it represented the first step to connecting actors and legitimising the inclusion of academic resources in development efforts in Aveiro region. This was profited from in future projects and experiments (see e.g. Fonseca, 2019), including the RunUp network which sought to create more competence networks linking universities and local sectors (habitat, mobility, culture and tourism) in Águeda. National recognition for the RIC led to further similar projects including the Urban Network for Innovation and Competitiveness (RUCI) encompassing all 11 of Aveiro's municipalities.

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Lighting Living Lab (Aveiro)

The Lighting Living Lab (LLL) emerged out of the RIC and demonstrates the way that the network drove substantive collaboration between different stakeholders in Águeda. The mayor of Águeda first initiated the notion of the LLL in 2006/07 in articulating the desire of creating “an association to create open innovation” in lighting, one of his municipality’s most important industries (70% of Portugal’s lighting industry are located in Águeda). The concept of a living lab was then relatively innovative, and close cooperation between the public, private and research sector persuaded actors to undertake the experiment. From the outset, the municipality served as “the main testing environment” for new lighting solutions, with citizens involved “to explore the social and behaviour implications of the new technologies and co-design new solutions” (World Bank and ENoLL, 2015). The initiative sought to address regional problems of high energy consumption and local companies’ competitive challenges such as intense local competition along with technological challenges incorporating digital electronic technology in diverse lighting products. The LLL’s main activities involved organising conferences and workshops, technology development and demonstration, joint participation in exhibitions, joint development & implementation of projects, and (research) studies. The university was an important partner as a knowledge provider, but also serving as a neutral connector between the different, sometimes very conflicting stakeholders. More recently, challenges such as financing, severe competition between the companies, and a failure of the university to develop industry-specific training have led to a significant slowdown in LLLs’ activities.

UC-Pori’s Collaboration with Healthcare Institutions (Pori)

The University Consortium of Pori (UC-Pori) launched several projects together with local healthcare institutions supported by the Satakunta Regional Council and European Regional Development Funds. The consortium was extensively

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funded by the city council, and researchers felt that that wanted to 'give something back to the community'. These initiatives built on individual connections, as UC-Pori researchers were required to actively search for partners to find ways to contribute to regional priority sectors (e.g. (Salomaa and Charles, 2019)). One project sought to assist healthcare professionals using mobile robots with specific functions targeted to elderly people with memory illnesses. The researchers had contacted a local healthcare institution to explore how robotics could be applied in elderly care, and the challenges they faced in their daily activities. One issue was that dementia patients easily get lost and need constantly assistance, for example, in navigating out of their room. A set of such repetitive tasks were identified with healthcare professionals and then partly automated, with engineers developing a mobile assistance robot to assist the demented patients. The researchers also invited local businesses to take part in the pilots and creating a new ecosystem through implementing open-source software. A second project together with local hospitals aimed to assist surgery patients discharged from the hospital through gamification. In this case, researchers developed a game that measured whether patients understood the instructions for treatment during home-based convalescence. Both these pilots, producing academic outputs as well as new healthcare innovations beyond regional boundaries, were also potential steppingstones towards larger, international research projects.

Rural Campuses Riseholm and Holbeach (Lincoln)

The University of Lincoln (UoL) aimed to support regional priority sectors, notably agri-food, by establishing satellite campuses located in more rural areas of Lincolnshire. The Holbeach campus, previously a satellite campus of an agricultural college, officially joined UoL in 2002 with a strong support from the local government. The campus subsequently grew rapidly increasing collaboration with local industries (Salomaa, 2019). Following the UoL takeover,

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the Holbeach campus provided “a higher level of technical science based skills that the industries didn’t have before,” an access point for agricultural industries to academic knowledge, alongside helping researchers with relevant expertise for the food sector, such as life and computer science, to better engage. Since 2008, the Holbeach campus hosted the National Centre for Food Manufacturing (NCFM) offering apprenticeships and short courses for food industry employers, as well as state-of-the-art R&D facilities used by both local and bigger international food producers, e.g. Nestlé and Heineken. Following the NCFM’s opening, UoL has been actively working with regional partners to develop the food sector (Salomaa, 2019). In 2016, the Lincoln Institute for Agri-Food Technology (LIAT), located at the Riseholm campus, was established to coordinate and enhance UoL’s contributions to food production and agriculture. Collaboration between LIAT, School of Science and NCFM secured large-scale projects from both national and European funding sources, notably in agri-robotics, where UoL’s management identified a possible strategic opportunity: “when you think about the alignment with the regional need and the agricultural sector, and our understanding of where the technological maturity is, we could see agro-robotics would become a bigger thing”.

Lincoln Technology Hubs (Lincoln)

Lincolnshire County Council (LCC) has used European Regional Development Funds (ERDF) to deliver business support programmes: one such initiative sought to encourage local SMEs to apply cutting edge technology by showcasing modern technology in “Digital Hubs” located throughout Lincolnshire. These would demonstrate how modern technology, for ex. motion capture cameras, could be applied in manufacturing processes, such as fault detection in production lines. As LCC lacked capacity to operate the equipment and hubs, they were contracted to third parties, with one being located at the University of Lincoln. University

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personnel contacted LCC during LCC's search for partners, suggesting that UoL could host a hub:

"I think I submitted a proposal to them to say what kind of equipment we'd want and what kind of support we would offer companies in return for that equipment, in return for the council investing in us".

There were originally five hubs across Lincolnshire, but a review saw this reduced to three as not all hubs were performing equally well: the UoL hub was perceived as running smoothly having engaged with more businesses than expected. One LCC interviewee noted: "the university uses the hub in a more advanced way I would suggest, tending to use it in a more in-depth-way with businesses looking for technological support". The problem for the university was in persuading academics to engage with the project as the funds only cover capital investment, the UoL interview noting: "I have to work sometimes on some goodwill and I have to do quite a bit of persuading to help to get people engaged with this". However, the collaboration through UoL Digital hub has been beneficial for all parties: it has generated PhD research projects and long-term knowledge transfer partnerships with regional partners.

Smart City (Twente)

In Twente, the municipality of Enschede has adopted the smart city concept in the hope of stimulating the creation of new knowledge resources, attracting funding and promoting international cooperation. Several initiatives have emerged, led both by the municipality and other major regional institutions. The Smart City Enschede project was started in 2017 by the municipality, involving companies, residents and knowledge institutions, proposing Enschede as "a city where entrepreneurs can test and demonstrate their new concepts, products and services in an open field lab" (Novel-T, 2019). Simultaneously, the University of Twente (UT) launched its own Smart City Initiative, in close cooperation with

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Enschede's municipality and, later, with the province of Overijssel. Despite UT's initiative being predominantly focused on internally coordinating strategic interdepartmental research and education activities and funding attraction on smart city topics, these two initiatives intersected to generate projects involving both UT and the municipality. The UT's Smart Campus project sought to create a living lab for advanced technologies involving other institutes and local companies. There has also been a focus on involving civil society actors in these partnerships, with one project addressing flooding in a city district using citizens to self-measure and report local groundwater levels. These initiatives were relatively small and lacked longer-term, deeper impacts, in part because of financial pressures. One interviewee noted: "Despite smart city being very important, there is hardly capacity or money to really make it successful". Therefore, albeit a strategic focus area of UT, smart city is not a priority area within the regional strategy, hindering its development and upscaling.

UT's PDEngs (Twente)

The University of Twente (UT) created a professional doctorate in engineering (PDEng) to raise local skills levels through a practically-oriented training programme targeting the needs of industry partners, supported by the Cluster Smart Industry East Netherlands project partly funded through European Regional Development Funds (ERDF). There were lengthy discussions with local stakeholders on smart industries and manufacturing, with UT staff preparing an ERDF bid proposing to transfer scientific knowledge on smart industries to local SMES via 18 individual research projects. Another project motivation was identifying mechanisms to use a long-term ongoing training programme to bring together different regional actors more closely together, particularly business partners. The ERDF subsidy cover half the training costs paid by companies, although most PDEng candidates are university employees because that is most cost-effective for the companies. Because firms had no previous experience in

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accessing ERDF programmes or PDEngs, thus the whole process seemed rather daunting to firms, slowing their recruitment onto the programme, despite the university employing that recruitment to a third party. To facilitate this, regional funds paid for the university to employ PDEng candidates to work on projects of local relevance where there are no identified funding companies, thereby contributing to raising high-level skills in the field of smart industries and manufacturing.

Discussion

In this paper, we are asking the question of “which roles do universities play in sparse environments in building up triple helix relationships that stimulate regional innovation processes?”. We are specifically interested in the ways in which universities become involved in projects that have wider benefits other than being purely bilateral knowledge transfer activities. Rather, the focus is on the sharing of knowledge assets that also help other companies to access innovation resources. Although universities are not necessarily interested in generating a profit from their activities, collaborative innovation must nevertheless make sense from their own perspective, and they must derive advantages from it. It is clear from these examples that in regions with sparse innovation environments there are challenges for universities in participating in these collective activities. In the nine examples presented above, universities have had to play their regional roles in rather different ways to address these issues and ensure that they can benefit from undertaking those activities.

Universities' roles in stimulating triple helix collaboration in sparse innovation environments

One of the main issues identified was that, where universities were interested in stimulating new industries and adoption of new technologies, there were not always regional partners capable of absorbing this knowledge to create new industries and improve competitiveness. What emerged in the examples was, in

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the case of a mismatch or tension between universities and firms, that the role for government was to help foster interaction by attuning interests and objectives for greater potential. This can be clearly observed in the case of the LLL initiative in Aveiro, where there were both knowledge assets in the university and a set of lighting firms. The intense competition between the companies and within their markets meant that there were no attractive propositions for the university to engage with individual companies, but the LLL initiative created a set of activities, often further subsidised, which helped the university and companies to build up their linkages. We here see one possible *tertius gaudens* mechanism, namely purposeful mobilising actors' voices and aligning different stakeholders through networking activities to create links for further collaboration, and even pilot projects.

A second issue that arises here is that universities in more peripheral areas sometimes face a rather marginal existence. Therefore, external collaboration and societal contributions are regarded internally as a form of existential risk: a badly loss-making collaboration could potentially threaten the continuity of the HEI activities. In the case of rural campuses, support and demand from government can help stimulate the university to prioritise – or value – engaging with regional industrial partners. In Pori's case, local authorities provide substantial financial aid to the UC-Pori campus, which partly steered researchers towards bilateral interaction between local industries and public sector actors. In these collaborations, UC-Pori sought to develop pragmatic solutions to other parties' problems, alongside seeking external funding to support those activities. In this case, it is the university that the government partners must cajole to undertake regional engagement, again with the same potential results of building up incidental relationships some of which then concatenate into more long-lived and sustainable regional innovation activities. In the case of Pori we also denote the exercise of agency by researchers, rather than institutional leadership. This

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second *tertius gaudens* mechanism could be considered as government enrolling university capacities to persuade university leaders to embrace engagement more systematically.

A third issue arose in the lack of well-expressed regional demands from partners for knowledge resources, making it hard for government to steer those activities strategically. What we see in both the cases of the Matchmaking Scheme and the rural campuses of UoL is that the universities undertook efforts to make their offer clearer to firms. Part of this involved better coordinating their internal knowledge resources, such as linking allied sectors such as manufacturing and computer science to food technology – as in the UoL case. But this also involved creating linkages outward, from the university to business contacts, to create pathways by which potentially interested business partners would be made aware – by matchmakers – of the existence of these concrete pathways into the university. In this case, the universities' agency helped resolve tensions between government and business, where there were no instruments that government could use to steer firms towards collective behaviours. In the Matchmaking Scheme, there was even the explicit involvement of matchmakers from the local municipalities to stimulate collective innovation activities. This third mechanism is the activity by the university to mobilise pathways to business users that then allowed government to steer policy to better aid businesses.

Another variety of this mechanism was evident where universities helped articulate the needs of sophisticated industrial sectors to government, encouraging government to use their strategic tools and resources to better support those sectors. Three examples showed universities and businesses working together to create a dynamic set of innovation activities, with these sectors then becoming adopted by regional governance partners as priority sectors. UoLs rural campuses helped identify a high-technology future for the

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agricultural sector by linking it to automation and company science technologies; UC-Pori used its links to local healthcare providers to mobilise an open-access cluster of robot developers which reinforce robotics' role as a strategic priority sector within the region. In the case of the LLL in Aveiro, the successful 'triple helix' collaboration - although initiated by the Mayor of Águeda - was able to win national recognition and become distinguished at the regional level. This also applies to the National Centre for Food Manufacturing located in the Holbeach campus (UoL), successfully bringing together university knowledge and local businesses through strategic collaborations, whilst mobilising national and international companies. The fourth mechanism is therefore that universities and firms work together to win external resources, in this case often European Structural Funds, that represent a recognition of those sectors' innovative potential, and which then see them becoming stronger in regional strategic agendas.

A final mechanism is in the role that universities can play in providing a sense of continuity to partners and provide an ongoing search and matching facility for complementarities between partners. In a sparse environment where resources are difficult to access and develop, the potential to build the concentration of certain capacities by bringing actors together whose assets can complement the needs of the others is an important step to systematising, potentiating and making innovation processes more effective. This is evident in the Aveiro cases of RIC and LLL as well as the case of the NSBD, where knowledge from the university, administrative and financial resources from the municipality, and needs, ideas, contacts and experiences from businesses and citizens combined to originate wider benefits. The third party, as can be the university or the municipality in these cases, creates a kind of system of deferred exchange, i.e., providing assets without expecting an immediate return on investment. Thus, while complementarities can imply a mutually beneficial transaction, particularly in the

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case of sparse environments there seems to be a need to have a stakeholder that can envision long-term effects and generate the effort to fulfil that potential. While creative turnover was relatively weak in the RIC case, possibly characteristic of the element of sparseness in such environments, the capacity to generate a degree of permanence of value is thus desired in the *tertius gaudens*.

Key barriers to constructive triple helix relationships in sparse innovation environments

The cases also provide some interesting insights into some of the issues that universities face in functioning constructively in triple helix partnerships in sparse innovation environments; we here identify four main issues. Firstly, universities are very complex actors and engage in these triple helix partnerships in various ways, as strategic leaders through to a kind of surreptitious individual interaction. Secondly, these elements do not interact in a straightforward way, in that researchers remain important in the delivery of the benefits, and strategic frameworks, on their own, are not enough to align universities towards delivering regional contributions. Thirdly, there is an issue of scale in these triple helix activities, in that it is possible to mobilise small activities, but it is much harder to then build those up into something that has a more general regional benefit. Finally, these change processes are extremely long-term, whilst the short-term benefits are not always evident or can even be costly, so there is the issue of who can persuade universities to engage for persistent regional good. It is not clear to us whether these problems are a function of the sparseness – for example that the issue of the complexity of universities as actors is less material in denser innovation environments where there are more actors in general. But nevertheless, they seem to serve to constrain the contributions the universities can make to these dynamic forward-moving partnerships.

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The first issue regarding universities' organisational complexity cements that the activities that support the triple helix development do not necessarily always originate at the leadership level of the university, nor is it that the university leaders lead in solving tensions in triple helix relationships. These issues were observed in the case of UC-Pori, where the roles of the 'honest broker' were played by researchers and not the university as an institution. This means that universities lack a single set of interests and goals and, in turn, can undermine developing relationships with other actors through this process of attuning divergent interests. Diverse projects in North Denmark, were dependent on the network of matchmakers. However, university (and student) matchmakers were restricted in their capacity to connect external partners to their own networks. What they could not always provide was an access to 'university networks' more generally, because they negotiated their participation based on their immediate contacts' interests – interests that were not necessarily those of other academics elsewhere in the university. Likewise, the PDEng programme was designed by a single individual within the UT, and although it could have potentially served to create engaged studentships across the university, its alignment to those particular university interests hindered its diffusion across the institution.

The second issue is that there are constructive relationships between different elements of universities allowing support to be demonstrated for regional activities, but these are not always available when regional partners demand them. With the case of UoL's technology hub, a highly committed individual can autonomously initiate projects with potential long-term effects, but it is not always possible for universities to align their strategic, infrastructure and academic interests in all potential opportunities. University managers may resist engagement – as an existential risk – or prioritise other areas, such as teaching or research quality, and unless engagement contributes to those, engagement cannot achieve an internal institutional traction. University managers are also far

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more exposed to the exigencies of other kinds of policy-making, so although the Matchmakers in Aalborg were generally satisfied with the role of the scheme, a change at the national level meant that it was necessary to reconfigure the whole scheme internally.

This leads to the third problem, which is that it is not simple to upscale from the basis of individual successful projects in the university to a situation where the university contributes more generally constructively to regional collaborative projects. The PDEng addressed one particular long-standing problem that firms, and government had been unable to address: that of high-level skills for smart industries and manufacturing. But, despite creating a new accreditation structure, it was difficult to use that PDEng mechanism to create new pathways for all regional partners to access applied high-level skills within the university. One approach noted here is the creation of dedicated strategic spaces, such as Riseholm and Holbeach campuses, the LLL in Aveiro or the Lincolnshire Technology hub, in which universities are committed to invest in these sites that have a wider regional benefit. But this simply promotes a small activity to become strategically important by increasing the dependence of the university on that activity. It does not find ways to upscale and make more open-facing the universities' knowledge activities that could potentially create regional benefit.

The final issue relates to both the preceding issue of upscaling as well as the role universities may play in providing a long-term source of stability for complementarities in innovation actors and resources. Whilst small projects may have a very clear cost-benefit logic for universities at the individual level, universities, as much as other actors, may find it difficult to see a profitable way to stimulate engagement more strategically in the present, in order to produce longer-term regional benefits that will ultimately strengthen the university. Universities face urgent pressures on their resources and may therefore lack the

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freedom to systematically prioritise regional collaboration activities except in those conditions where they are organised as these stable, economically sustainable projects. This risks universities overlooking the informal interactions that their employees have with other triple helix actors, and hinder concatenating them to achieve the upscaling.

Conclusion

This chapter has asked the question of “what roles do universities play in sparse environments in building up triple helix relationships stimulating regional innovation processes?”. We have traced out a set of triple helix partnerships and relationships in five different sparse regional innovation environments and are able to identify the ways in which universities might constructively contribute to improving regional innovation environments. In all these different kinds of relationships, universities and local authorities increase collaboration with the private sector, but the changes emerge through a complex ‘spiral’ model where both internal and external dynamics of the parties influence one another (Rodrigues and Melo, 2013). In these cases where there is not a ‘natural’ critical mass of interaction as a consequence of this sparseness of interaction – existing connections may slowly build sustainable mechanisms to improve the density of the innovation environment. However, nurturing these partnerships into regional success stories requires a lot of work from all parties (Wilgaard Larsen, 2017), as they tend to be fragile and dependent upon the present support environment (Åkerstrøm Andersen, 2008).

A challenge for universities is in linking informal, functional relationships to more formal, strategic relationships in ways that allow universities to maximise their stability and minimise their exposure to volatility. Regional partners can play different kinds of roles to encourage universities to undertake those internal integration activities that can help with the upscaling of triple helix activities to

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drive these longer-term processes of regional shift. Government can play a regional leadership role, encouraging university leaders to acknowledge their academics' research strength; regional firms can create collectivities to engage with academics to build up a critical mass of interaction activities. In some cases, where necessary, governmental partners may even directly subsidise university leaderships, so they permit their academics to take the risk and create regional contributions responding to business needs. Although universities may have complex internal dynamics, our paper suggests that the *tertius gaudens* principle may apply to these tensions within the university, with external partners helping university internal actors to resolve their tensions and to align strategic priorities with the activities being delivered by their knowledge workers.

We acknowledge that this is a relatively small study of five universities in sparse regions, using research that has been repurposed from other studies to provide a retrospective comparative dimension. This constraint demands a degree of modesty in the claims that we make, and we are unable to claim that the repertoires that we find universities playing are universally present or represent a best practice for universities seeking to maximise their triple helix contributions. Concomitantly, we note that the study provides a nuancing of the original model – that of universities playing a *tertius gaudens* role with respect to government and industry actors to facilitate developing collective regional innovation assets.

There are a range of different repertoires and barriers to be observed here. In some cases, the role of the university is as one of the partners who become trapped through tensions with another, and it is the third partner that plays the honest broker role. In other examples there is more of an orchestration, as solving one problem between partners leads to a development and new tensions between different partners, with the necessary roles shifting as the innovation environment becomes denser. And it is this modified innovation model that is our

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contribution regarding the understanding of triple helix relationships in regional innovation contexts, as a diverse and dynamic process between actors with diverse internal and external interests. This issue of the role of internal diversity in shaping triple helix dynamics is not something currently addressed in the literature and we contend that more reflection is needed to ensure that triple helix approaches retain their analytic salience and applicability to understanding contemporary regional innovation-based economic development processes.

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