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Smart Specialization and Capabilities for Offshore Wind Services around the North Sea

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Abstract: This paper addresses a growing gap between the policy practice of "Smart Specialization strategies" and its theoretical base. The concept of Smart specialization has attracted a high level of policy interest and has been adopted widely in policy circles in Europe. However, Smart Specialization lacks an empirical and theoretical foundation that can help guide its application in practice. This paper develops a framework based on two strings of literature, namely the fields of evolutionary economic geography and innovation systems. Subsequently the framework is applied on a regional mapping exercise conducted in an EU funded 'Regions of Knowledge'-project that focuses on the Offshore Wind Service sector in four regions around the North Sea. The purpose is to illustrate how a strategy-making process can be guided by a few theory based principles in pursuing the goals of smart specialization. The findings support that regions differ in terms of knowledge assets, capabilities and capacity in different parts of the value chain and consequently build on different starting points for Smart Specialization strategies.

Keywords: smart specialization; innovation systems; regional branching

1 Introduction

The European economy struggles to recover from the financial crisis. Evidence mounts that the present recession cannot be reduced only to structural problems of the monetary union or failure in financial markets (Overbeek 2012; Anon 2009), but also to changes in industrial production and globalization, implying the need for existing industries or sectors to reinvent themselves (Foster & Stehrer 2013; van Ark et al. 2013). The need for structural change is relevant to all European economies, from relatively low tech economies that need to develop their innovation capabilities, to high tech economies that struggle with international or global competition.

Regional Smart Specialization is one of the initiatives under the umbrella of EU2020 strategy and particularly the 'Innovation Union' Flagship Initiative. The broad aim of Smart Specialization is to support the European Cohesion target by enabling regions to identify their relative strengths and leverage them, while avoiding imitation or duplication and head-on competition with other regions (Foray et al. 2011; McCann & Ortega-Argiles 2013). However the smart specialization concept lacks a theoretical basis, that is, an explanation why such smart specialization would be beneficial and how it should be implemented (Foray et al. 2011).

The European Regional Development Policy, or 'Cohesion Policy', has been generally at least a lukewarm success (for a review, see McCann & Ortega-Argiles 2013). However the present architecture has been essentially the same since 1980s and is undergoing a significant change to balance between institutional focus and focus on economic geography (Ibid.). The concept of smart specialization was brought about by an expert group of academics (Knowledge for Growth, K4G) that was established by the Commissioner for Research Janez Potočnik to help him reinvigorate the Lisbon Strategy (McCann & Ortega-Argilés 2013). The concept was first introduced in 2008 and has rapidly been adopted at the highest level of policy and is now one of the key stones in the EU2020 strategy. However, this development has almost taken place without building on theoretical and empirical insights and consequently smart specialization strategies seem to be characterized by a lot of wishful thinking and hopes for what the future can bring. Smart specialization represents new thinking, but as discussed, it lacks a framework that would explain and predict the effect of smart specialization to the economy. One of the specific gaps in the research is insight into the complex institutional coordination failures that result in poor economic development of regions, but more practically selecting specialties lack an analytical insight to the strengths of the region (Foray et al. 2011).

Taking on this perspective, we build on two strings of literature: First, an emerging literature in the field of evolutionary economic geography, namely the literature on regional branching (Boschma & Frenken 2011). Second, we build on the so-called functions of innovation systems (Bergek et al. 2008) to explain the macro-level processes that drive Smart Specialization and to develop policy recommendation to support these processes.

The research mission for the paper is twofold. Firstly it is to discuss and contribute to the theoretical underpinning of the so-called smart specialization literature with an aim to elucidate how Smart Specialization can contribute to regional growth and how it should be implemented. Secondly, it is to present a critical analysis of a regional specialization and competence mapping exercise with a view to raise lessons learned in terms of theory and practice.

The paper presents a retrospective analysis of a regional mapping exercise conducted in an EU funded 'Regions of Knowledge'-project that focuses on the Offshore Wind Service sector in four regions around the North Sea.

The main findings relate first of all to the Smart Specialization construct and its theoretical underpinnings. This paper contributes to explaining the idea of Smart Specialization by applying the thesis of regional branching and the functions of innovation systems. Through this analysis, the paper shows how the Smart Specialization approach can contribute to regional economic development. Further, the paper describes how regional Specialization can be backed by solid analysis of strengths and weaknesses.

Additionally we will present an analysis of one effort for developing Smart Specialization in four regions in a collaborative setting that will serve to refine the theory and contribute practical insights into the concept.

This research will reinforce the theoretical understanding of the Smart Specialization construct, and on the other hand deepen understanding of functions of innovation systems. Economic geography helps develop and explanation why and how regions grow in terms of regional branching and how Smart Specialization can contribute to the growth.. This understanding will have further implication for policy making in terms if institutional structure and policy design. Additionally the empirical element will contribute to a better understanding of the theoretical elements of regional diversification processes. Thus the paper contributes to innovation systems and innovation management research as well as to economic geography.

2 Theoretical framework for Smart Specialization

In this section we discuss literature on regional branching and functions of innovation systems to develop an explanation why and how Smart Specialization enables regional growth. We use this literature to explain the knowledge dynamics driving the process of specialization. The core of our argument is following the regional branching thesis that regional knowledge bases have bearing on the capabilities and absorptive capacity of the local actors, in the same way as knowledge and skills of employees have on the capabilities of individual organizations. On the other hand, the key functions of innovation systems help us understand how the regional capabilities are expressed and what will be the outcome of regional branching.

Regional branching

It is argued in this section that the idea behind smart specialization can be understood in theoretical terms by applying the concept of regional branching. The regional branching thesis proposes that regions tend to diversify into new industries that are related to the preexisting industrial base of a region. The logic is that learning and knowledge spillover is more likely to take place between economic activities that are cognitively related than activities that are unrelated. Since knowledge production is a key element in processes of innovation, learning across existing economic activities function as the base for developing new economic activities at the regional level. The main mechanisms that drive processes of regional branching are firm diversification, entrepreneurial spinoffs, labour mobility and networking, which all tend to have a local bias.

Regional branching has empirically been confirmed for the long-term economic evolution of regions in Sweden (Neffke, Henning and Boschma 2011), the emergence of new industries in regions in Spain (Boschma, Minondo and Navarro 2013) and in the case of the emerging fuel cell industry across regions in Europe (Tanner 2011).

The notion of “relatedness” can be understood in different ways. There is technological relatedness between two industries when both industries share a common or complementary knowledge base and rely on common scientific and/or engineering principles (Breschi, Lissoni and Malerba 2003). However, industries can also be related in the sense of an input-output relationship, where one industry’s products can be applied in another industry. Input-output relatedness is often the case when an industry applies new general purpose technologies (e.g. nanotechnology or ICT) in the production of existing products.

Common for the regional branching thesis and the smart specialization concept is their starting point. Both focus on the current situation (strengths) of a regional economy and on how to complement the regional economy in the direction of new or expanded economic activities. In sum the regional branching thesis, by its focus on understanding evolutionary economic developments of regions proposes a theoretical basis that is able to explain the mechanisms behind smart specialization.

Functions of innovation systems

Innovation systems (NIS) are often defined in quite broad terms as "the set of institutions whose interactions determine the innovative performance of ... (national) firms" (Nelson 1993, 4, parenthesis added). The OECD (2005, p. 34) conceptualizes a (national) innovation system as a bundle the economic actors, that is enterprises; education and research system; infrastructure and institutional framework that sets legal and regulatory framework and enables communication; the market demand for products and services; and innovation policies set forth to support RDI activities. The behavior of the system arises as these actors work within boundaries set by the framework conditions, infrastructure and cultures (Nelson 1993). The same largely applies for regions and regional innovation systems (Cooke et al. 1997) as well as sectoral innovation systems (Malerba 2002; Malerba 2004).

The evolution or regional systems can be attributes largely to learning by actors and institutions and corresponding changes in structures (Cooke et al. 1997; Cooke 2001). In parallel to regional branching literature, local knowledge base and capabilities is attributed as the source of regional development (Asheim & Coenen 2005; Asheim & Isaksen 2002; Fritsch & Slavtchev 2011).

Taking the level of analysis towards the framework conditions that enable using these capabilities, Bergek et al. (2008) have proposed a set of functions that assist the analysis of innovation systems. The core of the argument is that well functioning innovation systems have these key functions, or processes, that actually make it a system, rather than an arbitrary collection of organizations. The functions are originally discussed in the context of technological innovation systems, but the functions, or drivers, have been applied to sectoral systems as well (K. Piirainen et al. 2013). According to this approach there are six functions that make an innovation system a system (Table 3).

Table 1 Functions or drivers for innovation systems

Functions	*Elaboration*
Market formation	Creating a market or a learning space; identification of customer segments pilot installations and reference cases, educating potential customers; development of (industry) standards
Entrepreneurial experimentation	Experimentation with new technologies, products, services and business models
Influence in the direction	Dynamic co-opetitive search for new markets, technologies and

of search	business models; possibly also negotiation and/or intervention; priorization between technologies and business models
Knowledge development and diffusion	Fundamental and applied research and development of new technologies, diffusion of technology and knowledge
Resource mobilization	Gathering capabilities and intangible/human, financial and tangible resources; ensuring relevant training to support availability of resources
Legitimation	Creating a ‘space’ for the new innovation system within the institutional framework; securing social acceptance/license

Source: (Bergek et al. 2008; K. Piirainen et al. 2013)

Even though Bergek et al. (2008) are noting their framework is descriptive only, the implicit prediction is that if the functions exist and the processes work, they enable growth and evolution of an innovation system by feeding the individual actors and (co-opetitive) networking between them. The underlying theme is that, within a given national and international framework, innovation systems compete with each other. Entrepreneurial experimentation may be one key way to start an innovation system, and experimentation keeps evolution going. When a systems starts to emerge, it need to create a legitimate space in terms of a market for the products and services, value chain and resources, often by capturing markets and resources from existing innovation systems. As the system emerges and starts to mature, it needs to keep that space through evolution and fend off other incumbents and new systems through knowledge development, search of new directions and experimentation.

Theoretical framework

The regional branching thesis predicts that new industries emerging in a given region build on the existing knowledge base and capabilities built during previous activities. This thesis is consistent with the Resource Based View of the form (RBV), which also predicts on the enterprise level that organizations rarely take leaps to businesses and markets that require completely different capabilities, but rather build on their existing knowledge assets that have cumulated and branch new businesses around their capabilities that they update (Kortelainen et al. 2011). The branching thesis is that the same co-evolutionary process happens on the regional level between enterprises and industries.

From the standpoint of (regional) smart specialization, the challenge of creating or encouraging regional branching is that an emerging industry or an innovation system needs an environment that is conducive for scaling up from embryonic few start-ups or business units to a functional network of organizations that have their own markets. The proposed functions of innovation systems -framework predicts that a new industry needs not only resources, but also certain framework conditions to grow and scale up. Economically weak regions can be weak for a variety of reasons, many of which boil down to the functions (McCann & Ortega-Argilés 2013). The functions on innovation systems serve as further ‘buttons to push’, i.e. targets for designing policy interventions for smart specialization and regional development.

Thus we argue that smart specialization hinges on two pivots: 1) Leveraging the existing assets towards new markets and applications and developing new ones to reinforce the new path within enterprises and their networks. 2) Providing suitable framework conditions for the new industry to build on. Within the framework of smart specialization, the focus of action is on the latter, but literature generally recognizes that for interventions to be effective, they need to recognize the former aspects, as well as the specific weaknesses in the system of framework conditions that hinder the development of innovation (Bergek 2014).

3 Empirical context and data

The platform for data collection is a project called European Clusters for Offshore Wind Servicing (ECOWindS, 2012-2015). The project focuses in developing OWS in four regions, East Anglia in the United Kingdom, North West Germany, Denmark and Møre in Norway (see www.ecowinds.eu for details). The project itself is modelled after the European guidelines for creating Regional Smart Specialization Strategies. The findings herein are based on the second and third work packages of the project which comprise a regional mapping analysis that is a descriptive stock-taking of present day capabilities, strengths and weaknesses, as well as a development of strategic objectives and specialization strategies for the regions.

The data collection is based on a template common for all regions that includes questions concerning the industry structure, resources and organizations as well as their relations. The data is a mix of objective surrogate measures, interviews of stakeholders and self-evaluations within the regional cluster management organizations. Collection was executed by ECOWindS partners, each in their own region and aggregated and analyzed by one of the partners. The findings presented herein this paper are the authors' reinterpretation of that data and descriptive results.

Part of the ECOWindS project is concerned with mapping the technical competencies of each region involved in the project. A patent analysis was used to achieve this, using the patenting of a technical invention as an indicator of a specific technical competence being present in a region. We use the OECD Regpat database (Maraut et al. 2008), which connects patents submitted to the European Patent Office to regions using NUTS3 regional codes. Working with technical experts within wind energy and OWS, we identified 7 distinct technology areas relevant to OWS; *Cranes & lifting*, *Foundations*, *Grid connection*, *Jack-up barges*, *Positioning & Anchoring*, *Support structure* and *Vessels*. Patents in Regpat is assigned to these 7 technology areas using the relevant IPC codes, and in combination with the regional codes found in Regpat, provide the basis for mapping the technical competencies present in each region.

The empirical context for this research is the Offshore Wind Service (OWS) industry around the North Sea. OWS is a subset of Offshore Wind industry and comprises the value chain from the factory door, Balance of Plant i.e. (within the wind power industry) "everything but the turbine", including onshore logistics of components, installation, as well as operations and maintenance (O&M).

Offshore wind is driven from the top largely by the EU SET Plan and renewable energy targets. Additionally as, wind energy (onshore) is beside hydropower among the most cost-competitive renewable energy form, offshore wind is a natural extension as onshore sites are beginning to saturate. Additionally offshore wind includes the promise of superior wind resource. (Bilgili et al. 2011)

A combination of a drive for energy security and environmentalism has driven wind energy in Denmark and Germany before many other EU member states. It is often casually mentioned that Danish history of wind power starts with the 1970s Oil Crisis, which lead to a pressure for seeking energy independence through renewable sources. By the end of 1990's over 10% of Danish electricity was generated by wind power and by 2012 above 30% (Anon 2014). However, the utility-scale uptake of wind energy in general outside Denmark is a decade-old phenomenon, since the EU renewable energy targets were being set.

Although the first offshore wind farm was erected in 1991 in Denmark, offshore wind has emerged only during the last five years or so as a serious commercial alternative, as installed capacity in Europe broke the 1 GW in 2007 and annual addition of new capacity has been 300MW or more every year since (Corbetta 2014). The long history of utility scale wind power generation and relative importance in energy mix may explain why Denmark is so prominent in the turbine segment. Also Germany has a long history with wind energy, and similar position in the value chain. In fact over 80% of worlds installed offshore capacity have been delivered by Danish Vestas and German-owned Siemens Wind Power (Corbetta 2014).

However, despite the early mover status in Denmark, half of Europe's and in fact almost half of the whole world's installed capacity reside in the UK. This also explains why they are rated a strong in the O&M part of the value chain. Due to abundant hydro and fossil energy, Norway has next to none installed capacity at the moment. However, Norway and the More region has a history in servicing Offshore Oil & Gas operations, which contributes to the capabilities of installing offshore wind farms at least to an extent.

4 Findings

The findings are organized mainly in terms of regional branching with some discussions on functions of innovation systems and implications for developing smart specialization strategies. We assume an exploratory stance and highlight the findings that have relevance to the theoretical proposition, in order to develop propositions for further, confirmatory, study.

One of the key findings in terms of ECOWindS was that indeed the four regions have different profiles in terms of knowledge assets, capabilities and capacity in different parts of the value chain. This finding reinforces the original rationale of the project, which was to find synergies between the regions and recognize them when contributing to smart specialization strategies. The following figures illustrate the different profiles of the regions.

Starting from the overview to value chain focus, it is apparent that the regions with most installed capacity are most focused on the chain from assembly to O&M. Manufacturing and planning are strongest in DK and DE, as the world's largest offshore wind turbine suppliers reside in Denmark, one being a Danish enterprise and the other German owned Danish-German enterprise. Also the strength of the chain from installation to O&M correlates with installed capacity, UK and DK being the strongest.

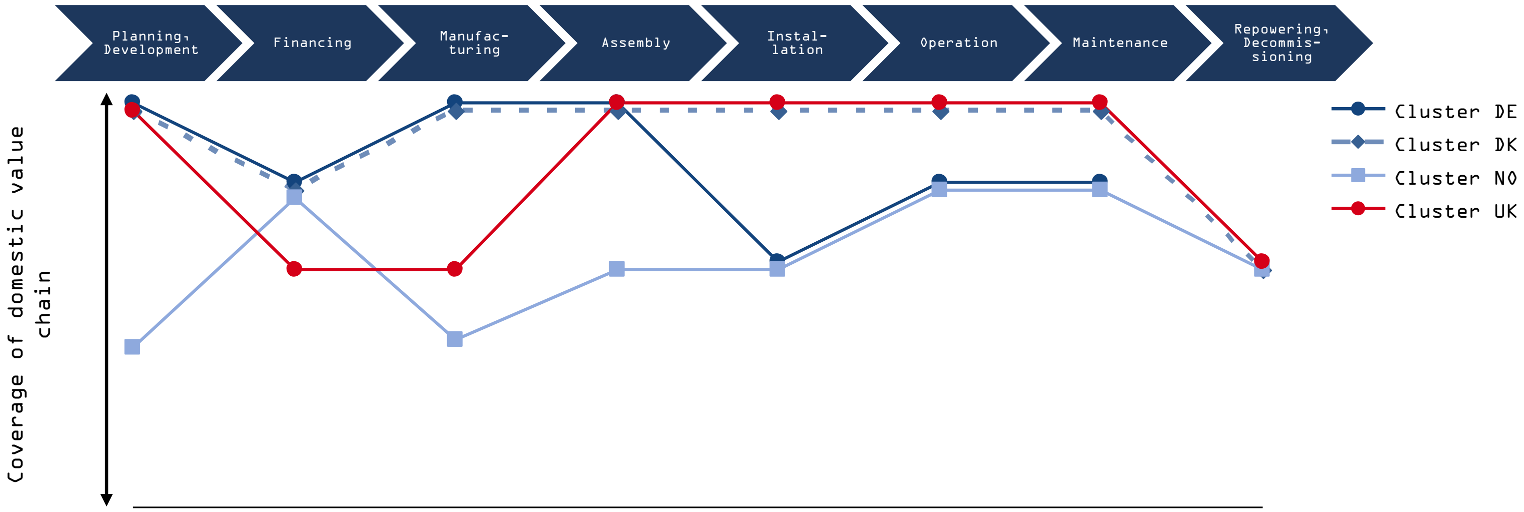

Figure 1: Coverage of OWS value chain in the regions (actors' self assessment)

Going deeper into the regional branching hypothesis, we use patent activity in OWS related areas and related industries as surrogates. While the validity of patents as an indicator for competence is debated, we argue that in this context, together with the qualitative assessment, it measures accumulation of knowledge assets, which then in use turn to competence (for discussion, see e.g. Kortelainen 2011). The bulk of offshore wind -related patenting is focused on turbine-related technologies. This search focused specifically on OWS-patents, and thus we see results that may not correspond to assumptions in terms of number and focus of patents.

In the analysis summarized in the following figure, we see very distinct profiles between the regions, which reflect the history of the region in terms of wind industry in general and OWS in particular. As discussed Denmark in particular is a leader in turbine technologies, and thus the patenting is very sharply focused on those related technologies as well. Interestingly Norway has had strong patenting activity in related technology areas, however likely the lack of domestic offshore wind industry and on the other hand strong offshore oil and gas industry has driven the Norwegian development which has not hitherto made the connection OWS.

If we compare these findings against the short history of offshore wind, the different competences are linked to the history and path of development. Overall this analysis illustrates concisely that there is a usually a rich history behind observed regional differences. A history that includes choices made in policy framework, in this case starting from energy policy to industrial and innovation policy and industrial development of regions. We may hypothesize that the early interest and gradual scaling of wind power in general and components manufacturing overall has shaped Danish and German paths differently than UK, where the (offshore) wind has scaled up more rapidly, and Norway which has been dominated by offshore oil and gas industry..

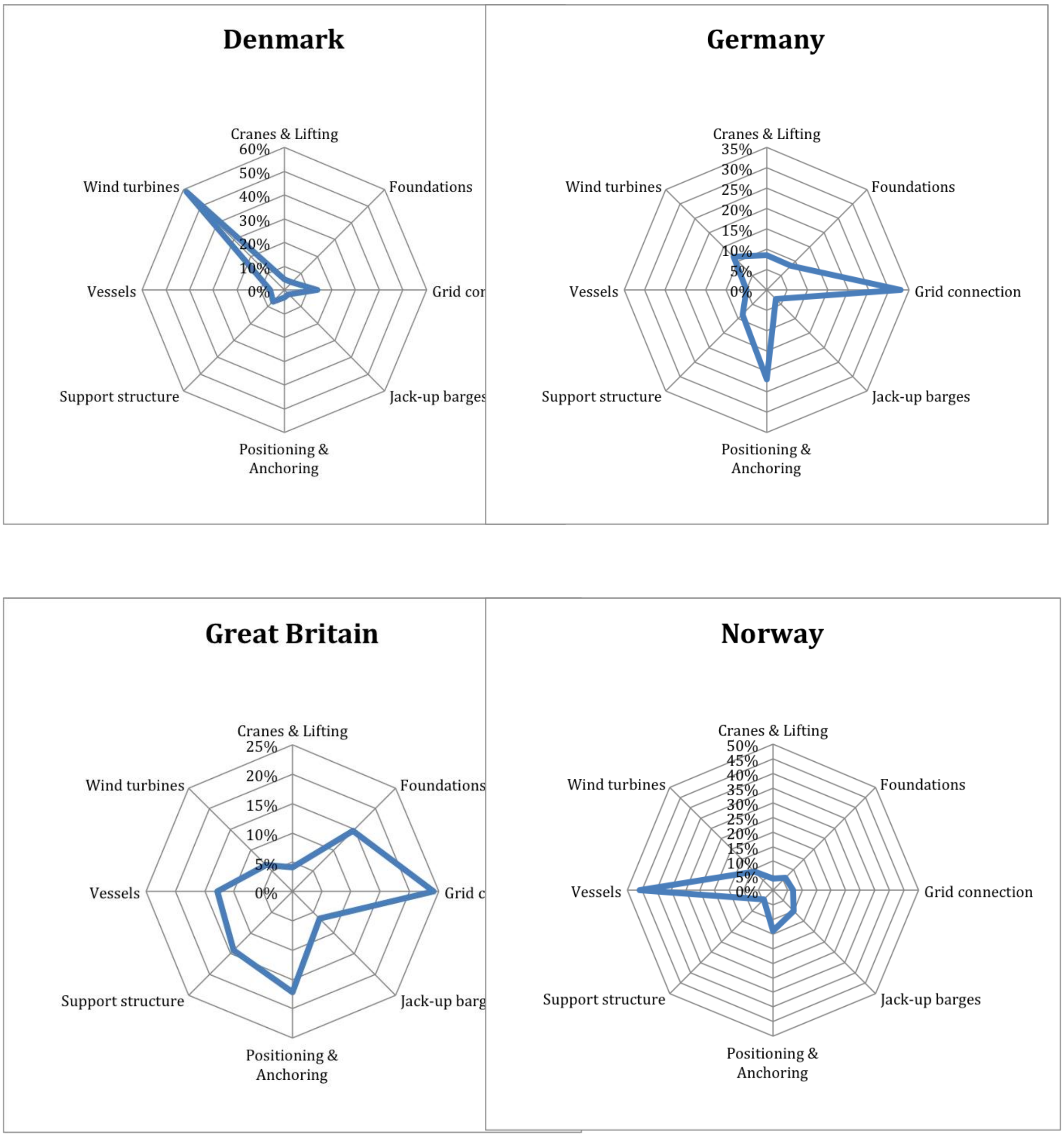

Figure 2: Related technology fields, by region (percentage of total number of related patents)

Table 1: Number of offshore wind service relevant patents, by region

	Related technology prior to 2000	*Wind turbine technology prior to 2000*	*Related technology from 2001*	*Wind turbine technology from 2001*	*OWS technology from 2001*	*Total patents until 2000*	*Total patents from 2001*
DK	126	39	291	544	230	8,256	11,946
DE	3,766	112	6,160	1,183	522	255,012	250,705
GB	851	15	1,127	120	109	74,474	49,777
NO	250	3	320	54	72	3,837	4,427

Table 2: Share of OWS relevant patents compared to total patenting, by region

	Related technology prior to 2000	*Wind turbine technology prior to 2000*	*Related technology from 2001*	*Wind turbine technology from 2001*	*OWS technology from 2001*
DK	1.53%	0.47%	2.44%	4.55%	1.93%
DE	1.48%	0.04%	2.46%	0.47%	0.21%
GB	1.14%	0.02%	2.26%	0.24%	0.22%
NO	6.52%	0.08%	7.23%	1.22%	1.63%

5 Discussions and Conclusion

This paper set out to discuss underpinnings of regional smart specialization in terms of regional branching and drivers of innovation systems. The findings presented above have some evidence for regional branching, i.e. that related and relevant industries spur the growth of new ones. We argue that a better understanding of regional diversification processes understood as regional branching contributes to clarifying what one need to focus on in developing SS strategies.

This proposed framework is tested in the case of the Offshore Wind Service (OWS) industry around the North Sea. The platform for data collection is a project called European Clusters for Offshore Wind Servicing (ECOWindS, 2012-2015).

We investigate the current assessment of knowledge assets, industrial competences and coverage of the value chain in order to assess the SS claim about building new economic activities around existing industrial activities and strengths. The analysis finds that the regions have different starting points and have followed different trajectories (DK, DE turbine manufacturing based, UK installed capacity and Norway offshore oil and gas) These findings support the proposal that regions build on strengths in related technologies, in different ways, these findings contribute to extend the Smart Specialization concept further by highlighting the possibilities of regions to collaborate with other regions in discovering synergies. The example of Norway in this context also illustrates that there are potentially significant synergies between regions that need to be taken into account in designing strategies for regional smart specialization and growth.

However as discussed the emergence of OWS has been partly a top-down process driven by energy policy, which can mean that the emergence of the industry and associated capabilities is likely affected by 'pull' or demand as well as certain 'push' from the related industries to branch out to new areas. What we can derive from this exploratory investigation is that, as proposed, regional branching and innovation systems literature are viable models to develop a link between smart specialization construct and regional growth.

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