The emergence of collaborative partnerships between knowledge intensive business service (KIBS) and product companies: the case of Bremen, Germany

Abstract

Regional science research is silent on how collaborative partnerships between KIBS and product companies emerge. Our paper addresses this theoretical gap by examining the role played by KIBS firms and by their interactions with product companies. We propose a typology of territorial servitization—namely *knowledge gap, regulation gap,* and *capacity gap*—wherein KIBS firms respectively play the pivotal roles of *knowledge brokers, intermediators,* and *integrators* in driving collaborative partnerships. By conducting qualitative case studies, this paper explores the mechanisms by which product companies located in a high-tech multi-industry cluster in Bremen, Germany, collaborate with KIBS firms in fostering regional competitiveness.

Keywords: territorial servitization, KIBS, product companies, collaborative partnerships, Germany, case studies

Introduction

Territorial servitization, defined as the symbiotic relationship between knowledge-intensive business service (KIBS) and traditional manufacturing firms, can contribute to local economic competitiveness by means of the virtuous cycles generated when resilient local manufacturers attract or stimulate the creation of complementary KIBS firms; virtuous cycles that, in turn, facilitate the creation of new local manufacturing and business opportunities. Recent studies have begun to illustrate the benefits of territorial servitization for both the manufacturing industry and regional development (Lafuente, Vaillant, & Vendrell-Herrero, 2017). The existing territorial servitization research holds the assumption that the collaboration between KIBS and manufacturing firms generates multiple benefits both for the involved firms and for regional development. However, there is a lack of understanding of how this collaboration emerges.

Furthermore, previous research in regional science seems to suggest that the geographical co-location of KIBS and product or manufacturing firms gives rise to linkages and virtuous circles (Baines et al., 2017; Vendrell‐Herrero & Wilson, 2017). However, the research is silent on how these benefits are generated and spill over to society. In particular, the ways in which collaborative partnerships between KIBS and product companies emerge and evolve is unclear. Thus, this paper aims to address this important theoretical gap by examining the role played by KIBS and by their interactions with product companies in the context of a multi-industry cluster.

As it focusses on the collaboration between KIBS and manufacturing firms, territorial servitization particularly emphasizes interactions and relationships. As the key actors in territorial servitization, KIBS firms play an important role in developing and revitalizing multi-industry clusters for regional competitiveness. For instance, the interaction between manufacturing and KIBS firms increases overall regional exports and turnover (Kamp & Ruiz

de Apodaca, 2017). Furthermore, cluster dynamics, development, and evolution are closely related to government policies (Boschma & Fornahl, 2011); the role played by governments in regional development differs depending upon the local conditions and geographical and regional characteristics (Spencer, Vinodrai, Gertler, & Wolfe, 2010). Conceptually, multi-industry clusters embrace the collaboration between co-located KIBS and manufacturing firms, which, more generally, could be conceived as a new way of organizing industrial clusters. By incorporating the collaborative partnership literature stream into territorial servitization, this paper may generate useful theoretical underpinnings suited to illuminate the nuanced interactions between KIBS and product companies.

In this study, we identify three conceptual models of territorial servitization by examining three representative cases located in Bremen, Germany. We articulate the close collaboration by which product and KIBS companies engage to enhance their product-service portfolios. The city-state of Bremen is among the top ten industrial hubs in Germany and is home to several high-tech clusters including: automotive (the largest Mercedes-Benz plant in Germany), aerospace (Airbus, OHB), logistics, wind power, and industry 4.0. Bremen has the highest national servitization intensity within German SMEs (Aquilante & Vendrell-Herrero, 2017). Therefore, our study may provide important insights for other regions in Germany striving to enhance their competitiveness. To describe the three identified territorial servitization models, we analyse three cases in which KIBS firms closely collaborated with product companies in the IT, machinery, and wind power industries.

This study makes three important theoretical contributions to the research on territorial servitization. First, by proposing three conceptual models of territorial servitization through which KIBS firms interact with product companies, it provides a nuanced understanding of territorial servitization. Second, our findings highlight the roles played by KIBS firms—namely, *knowledge brokers, intermediators,* and *integrators*—in collaborating with product

companies in different industry sectors. Third, our study highlights the role played by government policies and their influence on fostering regional competitiveness on the evolving relationship—in the form of collaborative partnerships—between KIBS and product companies in a multi-industry cluster.

This paper is organized as follows: We first review the theoretical underpinnings of territorial servitization, KIBS and collaborative partnerships, government policies, and multi-industry clusters. We then present our research methodology and findings. Afterwards, we propose a typology of three territorial servitization models. We conclude by discussing this paper's theoretical contribution and implications for policy and managerial practice, and future research directions.

Literature Review

Territorial servitization

The notion of territorial servitization can be applied to regional studies beyond the firm-level, whereby the symbiotic relationship between KIBS and manufacturing firms is understood as an engine for enhanced territorial resilience, manufacturing renaissance, and competitiveness, as well as regional development (Lafuente et al., 2017). An early study demonstrates that territorial servitization can contribute to local competitiveness through the virtuous cycle generated when a resilient local manufacturer attracts or stimulates the creation of complementary KIBS businesses, which, in turn, facilitates the creation of new manufacturers (Lafuente et al., 2017). Territorial servitization pushed the recent theoretical advancements in servitization research by categorizing an internal and alternative approach (Vendrell-Herrero & Wilson, 2017). Territorial servitization may serve as a springboard concept suited to guide research endeavours to investigate alternative approaches to servitization, especially servitization through partnerships.

Some recent work has empirically demonstrated the benefits of territorial servitization. For instance, the local presence of KIBS companies can help manufacturing ones to internalize the cost of offering value-adding services (Jacobs, Van Rietbergen, Atzema, Van Grunsven, & Van Dongen, 2016). One study conducted on India has revealed how the presence of an active KIBS sector fosters the renaissance of local manufacturing (Arnold, Javorcik, Lipscomb, & Mattoo, 2016). Furthermore, the interplay between servitization and digitalization drives supply-chain interdependency and, hence, the collaboration between manufacturing and KIBS firms (Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2016). The benefits derived from territorial servitization attest to the potential of alternative approaches. However, the existing research on territorial servitization offers little understanding of the emergence of the interactions between KIBS and product companies. In particular, the question of the mechanisms through which KIBS and product companies interact is not satisfactorily answered. In the following, we will review the literature streams on collaborative partnerships and governmental policies as building blocks for theoretical development.

KIBS firms and collaborative partnerships

KIBS firms develop and provide advanced business services mainly for small and medium-sized (SMEs) manufacturing companies (Muller & Zenker, 2001). KIBS firms play an important role in developing and revitalising multi-industry districts and clusters. A recent study has examined the role played by local KIBS firms in increasing competitiveness and enhancing employment to revitalize local manufacturing sectors (Lafuente et al., 2017). Furthermore, KIBS firms can serve as actors of knowledge transformation, contributing to regional and innovation systems (Muller & Doloreux, 2009; Muller & Zenker, 2001). Recent research found that collaborating with extensively experienced external partners may offer

opportunities to create bundles of products and services without the need for large investments (Bustinza, E., Vendrell-Herrero, & Baines, 2017).

However, the existing territorial servitization literature holds the assumption that the collaboration between KIBS and manufacturing firms can benefit regional development by creating, developing, and delivering value; however, how these relationships trigger the interaction between KIBS and manufacturing firms and who is the main actor remain unknown. Our paper aims to address the focal research question of how collaborative partnerships between KIBS and product companies emerge? This relates to the notion of collaborative efforts and partnerships (Liu, Sarala, Xing, & Cooper, 2017). Collaborative partnerships constitute an important organizational form covering a wide range of research topics, such as mergers and acquisitions, strategic alliances, joint ventures, and entrepreneurial partnerships. The essence of collaborative partnerships lies in the interactions and interdependences among the actors that enter into them. A recent study found that collaborative partnerships can positively affect product-service innovations and performances (Bustinza et al., 2017). Furthermore, collaborative partnerships within supply chain networks can mitigate risk perception in servitization (Bigdeli, Bustinza, Vendrell-Herrero, & Baines, 2017). As territorial servitization emphasizes interactions and relationships between KIBS and manufacturing firms, this paper will focus on how collaborations between KIBS and product firms emerge.

Government policies and multi-industry clusters

Government policies constitute an important factor influencing regional and cluster development in the regional science domain (Cruz & Teixeira, 2010). Importantly, the role played by governmental policies in regional development varies depending upon local conditions and geographical and regional characteristics (Spencer et al., 2010). A recent study found that government interventions aimed at purposefully designing industry parks and

attracting new universities is conducive to building environments favourable to fostering interactions among governments, industries, and universities to enhance regional competitiveness in China (Liu & Huang, 2018). Another study revealed the evolving role played by local governments in initiating new regional policies initially aimed at attracting highly skilled talent, then evolving into public-private entrepreneurial partnerships when diffusing new policy initiatives for regional development (Xing, Liu, & Cooper, 2018).

The concept of clusters was developed by economic geographers and economists to understand local industrial agglomeration and specialization and for policy-makers to design appropriate interventions (Cruz & Teixeira, 2010; Delgado, Porter, & Stern, 2014). Previous research examined the relationships between industrial clustering and corporate growth (Duschl, Scholl, Brenner, Luxen, & Raschke, 2015), and clusters and regional growth policies (Pessoa, 2014), and the dynamics of cluster evolution (Boschma & Fornahl, 2011). Increasingly, scholars and policymakers have begun to recognise the value of multi-industry clusters (Aranguren, Maza-Aramburu, Parrilli, Vendrell-Herrero, & Wilson, 2014; Boix, Hervás-Oliver, & Miguel-Molina, 2015; Dei Ottati, 2018). Multi-industry clusters can trigger synergistic effects among different industry sectors (Venables, 1999); therefore, governments may purposefully invest in multi-industry clusters, or take supportive and responsive approaches during their emergence and development (OECD, 2007). Therefore, multi-industry clusters deserve special attention, especially in regard to the interaction among firms, governance, and development (Tomlinson & Robert Branston, 2017). Through their collaborations with product companies and local customers from multiple industry sectors, KIBS firms may play an important role as a means of servitization in the development of multi-industry clusters (Baines et al., 2017). Therefore, another research question is: what role do government policies play in the emergence of collaborative partnerships between KIBS and product firms?

Research methodology

Research Context

The research context of this study is the city-state of Bremen, Germany, where the three cases analysed are based. Our choice can be justified by the following two salient reasons. First, Bremen serves as a benchmark for servitization in Germany. As acknowledged by a recent study, Bremen has the highest nationwide servitization intensity with a focus on German SMEs (Aquilante & Vendrell-Herrero, 2017). Furthermore, one recent study found that, in 2014, 44% of all manufacturers in Bremen could be classified as servitized—in comparison to an average of only 9.8% across other German cities (Gomes et al., 2017). Therefore, a nuanced understanding of the collaborative partnerships between KIBS and manufacturing firms in Bremen may shed some revealing light on servitization in Germany. Importantly, the interaction mechanisms underlying the emergence of KIBS companies collaborating with product firms in Bremen may provide a benchmark for other German regions aiming at achieving local competitiveness by enhancing and developing servitization endeavours.

Second, in terms of demographic structure, purchasing power, media usage or advertisement, and industry structure, Bremen is representative of Germany. Hence, it is commonly chosen as a typical test case for strategic market research. Importantly, the city-state of Bremen is home to multi-industry clusters, comprising automotive (the largest Daimler AG plant in Germany), aerospace (Airbus SE, OHB-Systems AG), logistics, wind power, and industry 4.0. We argue that the characteristics of multi-industry clusters provide an empirical setting suited to explore the complex relationships and interplay among servitization, collaborative partnerships, and governmental policies. In so doing, our study provides novel and interesting insights to regional science. In this study, multi-industry clusters involve the collaboration of KIBS and product firms in the same region; however, more generally, they could also be conceived as a new way of organizing industrial clusters.

Data collection and analysis

To answer our research questions, we chose three KIBS case studies and focussed on the interaction between these and product companies. To choose three representative KIBS companies belonging to multi-industry clusters, we applied theoretical sampling techniques. The involvement of KIBS companies in an ongoing academic research project – led by one of the researchers of this paper- enabled us to collect rich data from the case companies. The project was partly funded by the German Ministry of Research and Education, thematically linked to the broad topic of Design Thinking and Industry 4.0 in Germany. We purposefully chose three different companies, including IT/software, renewable energy, and digitalization and technical documentation. The companies selected were part of a multi-industry cluster in Bremen. An overview of the three cases is presented in Table 1, which contains basic information about the case companies and the interviewees.

--- insert Table 1 about here ---

To prompt the interviewees to reflect on the role played by KIBS firms, we first presented an easy-to-understand supply chain model. This consists of three actors—namely, product company, end customer, and service provider—as shown in Figure 1. We introduced the typical scenario of purchasing and maintaining a car by articulating the relationships between the three actors. The scenario goes as follows: A car manufacturer (e.g., VW) sells a car to an end customer. Should the car have technical issues, the end customer can choose to go to a dedicated VW garage (normally expensive) or to a generic car-repair service provider that deals with VW cars. In the basic model, VW may not normally directly interact with either the end customers or the generic car-repair service providers. This scenario serves as a departure point for interviewees to reflect upon, describe, and explain the role played by KIBS in their respective industries.

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The data for this study were gathered through in-depth interviews conducted with 20 managers from the three companies. The interviewees included CEOs, heads of HR, and technicians. Although there is a triad relationship among KIBS, manufacturing companies, and end customers, the focal choice of this study was centred upon the role played by KIBS firms and the perceived relationship between them and the other two actors. Therefore, we argue that this approach has provided detailed data—from a process perspective—on the emergence of partnerships between KIBS and manufacturing companies. Furthermore, this method—focussing on the central actors and their perceived relationships with others—has been used in other international management research (Xing, Liu, Tarba, & Cooper, 2016).

The semi-structured interview questions consisted of two parts. First, we asked about the (internal) transformation from a pure service provider to a specialized KIBS firm. Illustrative questions included: (1) What triggered the collaboration between you, a service provider, and a product company? (2) Did this collaborative relationship evolve over time? If so, why? (3) What role did the end customer play in this process? (4) What was your involvement with the product company about? (5) What role did government policies and governmental intervention play? Second, we asked about external factors—i.e., government regulations and industry trends. All the interviews were transcribed and a comparative coding method was applied. In order to ensure the quality of our data, we triangulated them with publicly available information (e.g., bundesanzeiger.de).

Findings

Our case analyses indicate that manufacturing companies collaborate with KIBS ones in order to deliver a promised value proposition to end customers. The interviews revealed that, over time, the collaboration between product and KIBS firms intensified and that the services offered

became ever more specific. Hence, the KIBS and product firms learned and gathered knowledge by interacting over time. Importantly, territorial servitization was manifested by the KIBS firms' deep knowledge of regional characteristics, including end customers and local conditions. Thus, this learning and newly generated knowledge covered any complementary competencies between KIBS and manufacturing firms, service levels, and any potential for added value creation through collaboration (Jacobs, Van Rietbergen, Atzema, Van Grunsven & Van Dongen, 2016).

Importantly, our results show that KIBS firms interact with manufacturing ones in three different ways. Among these, KIBS firms must play a proactive role by triggering, interacting, and responding in dynamic and interactive processes with different stakeholders. The central function of KIBS firms is their close interaction with end customers and their in-depth understanding of regional and local conditions. This function enables KIBS firms to better connect with manufacturing ones by learning from them while fusing the requests stemming from end customers. We propose three conceptual models underpinning the processes and interactions for territorial servitization between KIBS and manufacturing firms—namely, the knowledge, policy, and capacity gaps. In Table 2, we provide a summary along key dimensions to characterize the three models. In the following, we will articulate each model by relating to the relevant case study from our empirical research.

Knowledge gap model

In this model, unlike product companies, KIBS firms possess knowledge pertaining to location-based characteristics. Thus, while interacting with manufacturing companies, KIBS firms play a knowledge brokerage role aimed at filling the knowledge gap between manufacturing companies and local customers. Due to their closeness to local customers, KIBS firms are able to disseminate knowledge and experience across multi-industry clusters. For instance, as an

IT/software service company, the case A KIBS firm had been hired by manufacturing companies or local customers to deliver IT solutions; these had initially been focussed on the implementation of specific software. The CEO explained:

> *"Our company started by delivering individual software solutions in the area of JAVA. Over time, we were able to gather more and more clients. Basically, we started like any regular programmer; by offering our services on online marketplaces and calling companies. Initially, we were primarily hired by end customers who wanted individual solutions in JAVA, and only one larger IT company. Upon recommendation of additional services, our clients never wanted anything."*

Based on the knowledge gained through multiple projects, the KIBS firm was able to extend its service portfolio not only by developing proprietary software, but also by extending existing applications and by specializing in implementing Microsoft products. In this case, the newly created services were successful, and Microsoft licensed the KIBS firm as an official Microsoft solution partner. Hence, the A-case KIBS firm had used the IT solutions projects to increase its own expertise and to offer new solutions (services) to local customers and a product company (Microsoft). The CIO elaborated on the development process of new services:

> *"Over many years, we specialized in primarily implementing Microsoft software solutions for our customers. Microsoft noticed our service and added us as a solution partner. This means that, whenever Microsoft receives a small service request, it forwards it to us. Microsoft has adequate knowledge about its products, that is obvious, but it does not have enough people who can leave their office and work at the customers' headquarters. That is why they refer some jobs to us; it is a win-win situation because Microsoft solves its customers' issues and we are able to generate revenue. Having Microsoft as a reference has generated trust and allowed us to successfully offer our customers more services whenever we have noticed an issue. We are consequently developing and improving our products in cooperation with Microsoft and our customers with an evenly distributed level of input."*

In this case, the evolution of a collaborative partnership between the KIBS and product companies had two triggers. First, the close collaboration between the product and KIBS companies—aimed at providing best and new services to local customers—fostered the delivery of innovative services. Second, the KIBS firm served as a knowledge broker to channel

the needs and requirements of local customers. The CTO explained the interactive process that was conducive to driving innovation as follows:

> *"In our industry, there is not just one driver of innovation. The end customer always has certain needs and wishes in regard to how software should work. The end customer has an impact on how products are developed; but, sometimes, he cannot describe it precisely due to a lack of IT know-how. We can say that the end customer has an input of 1/3. Then, of course, there is the specialized service provider, like us, with a lot of knowledge in certain IT areas. We have also 1/3 of innovation input. Then there are the large IT giants with more technical knowledge then we have and larger research departments, they also add 1/3 to the innovation of our products."*

Our research reveals the ability of KIBS firms, which—unlike product companies, which may not have direct access to the locality—can serve multiple local customers, to bridge knowledge and experience across multi-industry clusters. Thus, by collaborating with KIBS firms, knowledge may be transferred among multiple sectors in a specific region. The CEO articulated:

> *"We serve many companies from different industry sectors here in Bremen. The good thing is that we are close to these companies and understand what they need, ranging from aerospace to logistics. Then, we can work with Microsoft to create suitable solutions for different companies. Sometimes, we are able to apply the lessons learned from one sector to another. Microsoft can provide the product, but we can deliver the tailored services suited to the different industries in our region."*

In our case analyses, the manufacturing companies often lacked knowledge of the local industries and clusters. In the knowledge gap model, when collaborating with product companies, the KIBS firms play an important role in transmitting their location-based experience and knowledge across multi-industry clusters. Local companies from different industries may benefit from collaborative partnerships between KIBS and product companies. Also, our analysis highlights how the *knowledge broker* role played by KIBS firms evolves over time when they interact with local customers and product companies.

Regulation gap model

In this model, KIBS firms capture the opportunity that is associated with new government regulations fostering the appearance of new entrants into the sector. Thus, KIBS firms play active roles in responding to government policy changes while assisting manufacturing companies to align themselves with new regulations through collaborative partnerships. Because KIBS firms engage closely with local customers, they are able to craft appropriate solutions together with them. This model can depict the value provision of product-service bundles created through the close collaboration and interaction of product companies, KIBS firms, and local customers.

Case B deals with the technical documentation (TD) legally required for complex machinery to ensure worker health and safety. In this case, the product companies tasked the KIBS firm with developing the relevant TD, including a description of how to properly handle the machines, legally binding security requirements, etc.

TD development requires specific skills and legal and technical expertise that are normally not found in small and medium sized product companies. The CEO stated:

> *"Currently, German law requires TD to be included on paper with every product. On the one hand, this has created our TD industry; on the other hand, it is stalling our development by not yet allowing TD to be provided in a digital version, which would indeed open possibilities to showcase TD with augmented or virtual reality."*

Initially, the KIBS firms only contributed parts of the legally required TD. As developing TD can sometimes take years—due to upgrades of and changes in the product—over time and through close collaboration, the KIBS firms gained an in-depth knowledge of the underlying products, of the product companies' corporate cultures and workflows, and of any knowledge gap in the product companies. The sales representative shared:

> *"We started by offering parts of the TD* [instead of developing a comprehensive TD] *as separate services to product companies. After three to four projects with different manufacturers, we realized that it would be more profitable to offer comprehensive TD with all of its components, such as collecting the raw information, translating it into*

different languages and developing a well-organized database for the creation of online manuals."

Based on their expertise and on their knowledge of new technologies, customer needs and demands, legal TD requirements, and proper handling procedures for machines, KIBS firms can provide additional services and even new products that go beyond the provision of the legally required written TD that is normally requested by product companies. Only close collaboration over time enables KIBS firms to offer additional services to manufacturing companies. This is because KIBS firms gather knowledge about manufacturing company workflows and products to identify any expertise gaps and to create new services.

The CIO explained the evolving nature and process of his firm's industry sector as follows:

"There is a shift from government-required information to end customer-needed information occurring in the TD industry. This is because end customers need qualified employees who can also perform maintenance work on a machine without paying for technicians from the product companies. Plus, product companies only employ limited numbers of technicians who can repair a machine; that is why the cost for product company maintenance is rising. TD is becoming end customer-needed information. We also see TD as a way for the product companies to stand out. In order to make the process of, for example, machine maintenance easier for end customers, new technology such as Augmented Reality or Virtual Reality can be applied."

Some services provided are consulting to improve or manage the entire TD process for product companies, including health and safety and security training. The CEO explained the provision of new services as follows:

"We are still not happy with the status quo and we want to change things in order to offer more services to our customers. That is why we extended our service to consulting. We consulted the manufacturers on how their TD creation processes could be optimized in terms of time and costs. Due to our cooperation with large customers, we have agreed to manage their TD departments fully because they regularly release products. Furthermore, we have noticed that the machines were not being handled safely. Therefore, we have decided to hold safety measure workshops for our customers."

In the regulation gap model, our analysis also elucidates the critical role played by KIBS firms, which are the main drivers of service innovation in this scenario, collecting and combining

knowledge from product companies and end customers to creatively innovate services. This is possible because, for the innovation process, KIBS' firms CEOs task highly skilled professionals who combine knowledge from product companies and end customers with their own expertise. Government regulations are critical in opening up opportunities for KIBS firms to enter the market as intermediators.

Capacity gap model

In this model, KIBS firms, in essence, extend the capacity of product companies by responding to local customer requests. In the process of collaborating with manufacturing companies to serve local customers, the roles played by KIBS firms may evolve. Because KIBS firms can gain specific knowledge from manufacturing firms—in addition to their closeness with local customers—this interactive and evolving process may enhance the KIBS firms' ability to deliver more complex services.

Case C illuminates this process within the wind power industry. The traditional process chain in this industry is as follows. End customers purchase wind turbines from manufacturing companies. Subsequently, manufacturing companies hire KIBS firms to maintain and—in those cases in which only a few wind turbines are involved—construct wind farms. However, our analysis reveals an alternative approach largely shaped by the analysed KIBS firm. Initially, the KIBS firm in case C supplied workforce to wind turbine companies (the service part) to assist in the on-site construction and implementation of wind farms. The Vice President HR expressed:

> *"We emerged out of a large German workforce leasing company that had been lending workforce for wind farm construction. Initially, this had been our only business. However, our CEO realized that providing workforce was not enough to remain competitive and that we needed to have highly qualified, trained and specialized professionals."*

Through its close collaboration with the wind turbine producer, the KIBS firm had gained specific domain knowledge. Moreover, because of its closeness with the end customers, the KIBS firm had gained in-depth insights into their needs. Thanks to this newly created knowledge, the KIBS firm had expanded its service offering from leasing workforce to providing complex services such as rotor blade maintenance, quality control, and cooling system maintenance innovation. The KIBS firm's CEO elaborated on the genesis of these new services:

> *"We needed to specialise our employees for the tasks needed by our customers. That is why we observed how the wind farm construction process works in order to understand how we could expand our portfolio with specialized services for our customers. We noticed that the large manufacturing companies were unable to provide annual wind turbine rotor blade maintenance due to worker shortages. This was our first specialized service for the manufacturer—rotor blade maintenance. Later, we moved on to upgrading rotor blades by replacing them with new ones—rotor blade innovation has been very important in recent years. However, we wanted to keep developing and realized that there was no third company quality control for wind turbines. With all of our knowledge, we have been able to train our most sophisticated technicians for quality control. These are trained professionals who evaluate the quality of a constructed wind turbine and report to the end customer. In order to replace their cooling systems, wind turbines have to be turned off, rotor blades have to be removed to disassemble the cooling system and replace it, and wind turbines can be turned on again; this takes over three hours. We are offering a quicker alternative by replacing the cooling aggregate by means of a lifting ramp within one hour.*"

For a niche customer segment (wind parks with less than ten wind turbines) the KIBS firm had even taken over marketing, contracting, and sales services for those wind turbine producers that could not serve this customer segment because of their (too large) internal organizational structures. The CIO explained this evolving process as follows:

> "*Large wind turbine manufacturers have massive administration processes and that is why they do not offer sales of wind turbines below a certain amount. Based on our successful and long-term cooperation with the manufacturers, we are perceived as a reliable service provider and that is why we have been put in charge of the process of selling wind turbines in small amounts and constructing them as well. We take care of customer acquisition, wind turbine sales, project management, and construction of the wind turbines. Without integrating us as a solution partner, large wind turbine*

manufacturers would not have been able to sell small amounts of wind turbines and generate profit."

Hence, in the capacity gap model, KIBS firms extend the service portfolios of product companies by exploring new knowledge (customer needs) in formerly loose business relations between product companies and end customers. Due to the knowledge shared between KIBS and product companies and end customers, KIBS firms are able to co-create new services, and hence create value for both product companies (extending business models) and end customers (serving customer needs).

Furthermore, the wind power sector is an emerging industry and a prospering part of the German renewable energy industry; over the past two decades, it has been heavily subsidized by the German government in order to trigger investments. The CEO explored the importance of government regulations:

> *"At first, the German government had financed many wind farms to trigger the shift towards renewable energies. At that time, the market was growing very quickly. Currently, it is still subsidizing many projects but in different ways. It is offering a fixed price per kilowatt-hour for a specified time-span. It is comparable to a grant in which different end customers can apply and present their projects."*

In this capacity gap model, the KIBS firms function as integrators, as they generate service innovations and new market segments. Without the proactive involvement of the case C KIBS firm, small wind turbine projects could have not been implemented due to the capacity constraints of large wind turbine manufacturers. Furthermore, government regulations supporting renewable energy are conducive to fostering the process and interaction patterns of partners involved in the wind power industry—i.e. the KIBS firms, the wind turbine manufacturers (product companies), and the wind farms (end customers).

Although these three models emphasize the key drivers variously underpinning the collaborative partnerships between KIBS and product firms, our analysis highlights the importance of government policies and related regulations in enabling and fostering such

partnerships. As for the knowledge gap model, the multi-industry sectors in any particular region have been historically influenced by government policies and industry strategies. The capacity gap model demonstrates the extent to which government policies on renewable energy may significantly enable KIBS firms to explore new business opportunities by filling any product company capacity gaps through collaborative partnerships. Governments thus play a crucial role in the realization and implementation of territorial servitization across the three models proposed in this study.

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To summarize, Figure 2 provides an overview of the three types of territorial servitization. In the knowledge gap model, KIBS and product companies closely engage and interact, whereby the former serve as knowledge brokers to bridge knowledge from multiple industry sectors. Product and KIBS companies jointly serve end customers in multiple industry sectors through collaborative partnerships. In so doing, they contribute to enhancing regional competitiveness by fostering the development of multi-sector clusters. In the regulation gap model, KIBS firms serve as intermediators complementing manufacturing companies in delivering their products. KIBS firms are able to capture the opportunities that stem from policy frameworks while proactively interacting with product companies. Thus, KIBS firms tend to drive collaborative partnerships. Collectively, manufacturing and KIBS companies may serve end customers who have preferences in relation to using different technologies. This may contribute to the adoption and diffusion of technologies, as in the rising trend of virtual reality illustrated by Case B. In the capacity gap model, KIBS firms serve as integrators to extend the capacities of product companies. Jointly, KIBS and manufacturing companies can serve different customer segments in their pertinent industry sectors. Importantly, KIBS firms may not initially possess the required capabilities but, in order to serve new market segments, they may attain them over

time through collaborative partnerships and interactions. This can contribute to regional competitiveness by capturing new market opportunities—as shown by the wind farms example in case C. In a nutshell, Figure 2 suggests plausible variations of collaborative partnerships between KIBS and product companies, with implications for regional competitiveness enhancement. This typology can contribute to regional science by providing a nuanced understanding of the various interactions occurring between product and KIBS companies, thus serving local customers with different characteristics. As for additional evidence, Table 2 illustrates the characteristics of the three types of territorial servitization along key dimensions.

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Discussion

Theoretical contribution

Our study contributes to the territorial servitization literature by proposing three conceptual models through which KIBS firms interact with product companies. While examining the role played by KIBS and government policies, our study also contributes by articulating three different interaction pathways between KIBS and product firms. It further contributes by highlighting the antecedents of and processes underpinning collaborative partnerships. Our findings show three possible pathways that may deliver territorial servitization, depending upon the triggering and responding processes that occur among manufacturing and KIBS firms, and upon the latter's knowledge of local customers and industry characteristics. All three approaches are closely linked to the role played by KIBS and to government regulations. While the existing literature assumes that the collaboration between KIBS and manufacturing firms exists, this paper sheds light on the question of how such collaboration emerges. Importantly, our findings demonstrate the plausible variations of KIBS-product company collaboration and

their implications on territorial servitization in advanced industrial economies. This lends support to our understanding of the role played by collaborative partnerships affecting product-service innovations (Bustinza et al., 2017).

Although territorial servitization highlights the symbiotic relationship between KIBS and manufacturing firms with potential benefits for regional development and competitiveness enhancement, there is a need for a nuanced and contextualized understanding of the variations of territorial servitization whereby the underlying mechanisms are explored. We argue that our findings are generalizable at the theoretical level for territorial servitization. Thus, they may help to further advance our understanding of development and interaction in multi-sector clusters.

Our study highlights the varying roles played and functions carried out by KIBS firms in the processes and interactions between KIBS and product companies and regional industry characteristics. Our findings illuminate how KIBS firms may variously serve as knowledge brokers, intermediators, and integrators depending on industry and regional characteristics. By illuminating the underlying processes, our study supports the recent findings pertaining to the critical role played by cross-border strategic partnerships between KIBS firms and manufacturing multinational enterprises in enhancing product-service innovation (Vendrell-Herrero, Gomes, Bustinza, & Mellahi, 2018). Additionally, by focussing on the role played by KIBS firms and their interactions with product companies in territorial servitization, our research adds to the understanding of the benefits derived from collaborative partnerships in servitization (Bigdeli et al., 2017). Therefore, by empirically providing evidence with theoretical underpinnings, our research is among the first in the territorial servitization literature to identify the roles played by KIBS firms and the underlying interaction processes.

Recent research in servitization has begun to emphasize the importance of KIBS firms for regional competitiveness in multi-industry clusters (Baines et al., 2017). In examining KIBS

firms and their role in territorial servitization in the context of regional development, our study extends this line of reasoning by offering empirical evidence and a contextualized understanding of servitization. By focussing upon the collaboration of KIBS and product companies' in the context of regional development, we extend the previous work on territorial servitization and suggest KIBS firms as important actors triggering territorial servitization; future researchers could extend the body of knowledge on this conceptualization of territorial servitization. Our study also reveals the importance of government regulations and regional characteristics in orchestrating and enabling the constitutive components of territorial servitization.

Policy and managerial implications

This study offers several implications to KIBS and product companies, and policy-makers. Product companies should recognize and pay close attention to KIBS firms and to their role in driving territorial servitization in regional contexts. The unprecedented pace of global economic competition and industrial development causes policy-makers and business leaders to be confronted with uncertain business environments (Liu & Vrontis, 2017). In this context, territorial servitization may provide a competitive edge by offering an alternative approach connecting KIBS, product, and manufacturing firms in collaborative partnerships in a regional context (Lafuente et al., 2017). Territorial servitization and its constitutive dimensions can strongly affect the regional competitiveness of product and manufacturing firms and their contribution to regional development. Regional contexts and situations provide multiple opportunities to a wide spectrum of stakeholders, including local end customers, KIBS and manufacturing firms, and policy-makers.

The diversity of government policies and regulations linked to industry specific characteristics can variously affect the collaborative partnerships between KIBS and product companies.

Governments can attract KIBS firms to their regions, which may facilitate the interactions between them and product and manufacturing firms in developing regional competitiveness (Aranguren, Magro, & Wilson, 2017). Policy-makers can support product-based SMEs by encouraging their close interaction with KIBS firms in order to develop and offer new products and services. In so doing, the collaboration between KIBS and manufacturing firms may create jobs, thus enhancing regional competitiveness and fostering regional development. Our findings in the context of multi-industry clusters especially elucidate how the benefits stemming from the geographical co-location of KIBS and product or manufacturing firms are generated and spread to society. Hence, our study may shed some lights on policy-making, implementation, and evaluation to refine regional development and industrial policies (Bailey & Tomlinson, 2017).

Our results support the association between long-term reciprocal relationships and better innovation performance in the context of collaborative partnerships (Collinson & Liu, 2017). They also provide evidence that it takes time for regional multi-sector clusters and the pertinent industry sectors to emerge and evolve (Boschma & Fornahl, 2011; Delgado et al., 2014). Hence, government policy design and implementation should take a long-term perspective and include regional development and industry characteristics. Our study provides some insights into the actions of governments from the supply-side policies perspective, and highlights the varying roles played by governments in steering industry development for regional competitiveness.

Limitations and future research directions

By exploring the roles played by KIBS and product companies and by governments, this paper represents an early attempt to address the question of how the collaboration between KIBS and manufacturing companies emerges. Although our conceptualization is supported by case studies of three KIBS-manufacturing firms in Bremen, Germany, we view our findings as

tentative and suggest future research efforts aimed at validating our conceptualization by using a quantitative approach to advance territorial servitization research. Furthermore, our evidence is based on interviews conducted only with managers from KIBS firms; therefore, further research would need to triangulate this evidence with other relevant agents, including end-users, policy-makers, and product firms. Further, we encourage any future quantitative research to empirically evaluate the economic consequences of each of the various types of territorial servitization identified in this article. Specifically, our three models of territorial servitization may serve as a departure point from which future research could investigate the antecedents and processes underlying the collaboration between KIBS and product firms. In addition, future research could compare Germany with other developed or developing economies to gain a comparative understanding of territorial servitization whereby country profiles are associated with specific industry sectors. In addition, we argue that our conceptual model may serve as a proxy for other regions in the DACH countries (Deutschland, Austria and Switzerland), such as Munich. The interaction and integration of local governments and other actors could be more complex. Incorporating other actors, such as SMEs (small and medium-sized enterprises) or larger associations (e.g., Frauenhofer) into the analysis of the interactions may provide additional insights into territorial servitization.

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