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Servitizing manufacturers:

The impact of service complexity and contractual and relational capabilities

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The relationship between service complexity and contractual and relational capabilities

Abstract:

Processes of servitization will lead providers to change their service delivery structures but they also need to transform broader organisational attributes including contractual and relational capabilities. Based on case studies in the European healthcare sector, we investigate the influence of increasing levels of service complexity on this transformation. Our findings are potentially counter-intuitive; suggesting that contractual capabilities do not increase with service complexity. Instead, we observed increased levels of relational capabilities; manifest in the visibility of the provider on the customer site, the number of 'non-requested' site visits and increasingly informal information exchange.

Keywords: Servitization, service complexity, product-service system, contractual and relational capabilities, multiple case studies

1. Introduction

Many manufacturing companies evolve from a product-focused business orientation to a Product-Service System (PSS). Business models for PSS usually grow around the physical asset where the PSS provider offers the asset's use or additional support (Tukker, 2004; Baines et al., 2009). Currently, most PSSs in industry focus on the latter option, i.e. the product is owned by the customer and the PSS provider ensures the performance and availability to add further value (Wise and Baumgartner, 1999; Gaiardelli et al., 2007). In other words, the PSS is often provided under conditions of asset specificity which locks the choice of PSS providers and their technical knowledge and skills necessary for the service provision. In these cases, the PSS offerings can be classified according to their level of service complexity as many PSS providers offer agreements of different levels of complicatedness and difficulty (Benedettini and Neely, 2012). Maintenance or after-sales services require less complexity with regard to the operational processes and the delivery system than performance-based services. Thus, it can be expected that the contractual and relational capabilities required to offer and receive PSSs differ depending on the level of service complexity. For example, Grundfos, a globally operating manufacturer of water pumps and pump systems, offer services ranging from basic support in terms of repair and exchange to improved reliability and performance of their equipment. Another example is Vestas, a manufacturer of wind turbines, who offers services of varying degrees of complexity ranging from spare parts to availability contracts guaranteeing the performance of their turbines. Both companies needed to build up strong working relationships, based on contracts and trust, to offer PSS offerings to its customer base.

To support their service business, servitized manufacturers need to develop and implement appropriate capabilities to realise such a shift and to offer different levels of

service complexity. However, the majority of manufacturing companies who aim at following a servitization strategy fail in their attempts which can be due to missing or underdeveloped capabilities (Reinartz and Ulaga, 2008; Kreye et al., 2013). In particular, the development of contractual and relational capabilities is important for the success to meet new market conditions and realise emerging business opportunities (Martinez et al., 2010). Without appropriate contractual and relational capabilities, PSS solution providers are not able to write, interpret and manage complex contracts govern these integrated solutions. Moreover, without appropriate relational capabilities, organisations would not be able to co-create value with their customers when delivering and managing these PSS solutions. Building up strong inter-personal and inter-organisational relationships is vital in PSS settings and depend on the complexity of the service delivered in order to, for instance, increase information exchange, address occurring problems and disagreements in a speedy manner and to jointly realise innovation in product/service offerings. Contractual and relational capabilities are also important for managing the closer relationship between PSS provider and their customers to successfully deal with uncertainty, the risk of opportunism and jointly solve problems (Williamson, 1985; Kreye et al., 2014; Roehrich and Lewis, 2014). Thus, PSS providers and their customers need to acquire the relevant resources, knowledge and skills to create value from PSS solutions.

Current literature offers limited empirical insights into the issue of service complexity and relationship management in terms of contractual and relational capabilities for PSS providers and customers. More specifically, the following two issues remain under-researched and are empirically addressed in this study. First, the majority of prior studies adopt a purely seller-based viewpoint investigating different aspects of delivering PSSs (e.g. Mathieu, 2001). Very limited research adopts a dyadic perspective incorporating buyer and

provider. However, as value of PSS offerings is created during their use (Vargo and Lusch, 2008), it is the inter-organisational relationship between buyer and provider that plays a vital part in determining the benefits of integration. Second, prior studies do not distinguish between different levels of service complexity (notable exception Neely et al., 2011). As service complexity determines the operational processes necessary to deliver and receive accompanying services, it also influences the relationship between service provider and customer. Thus, the level of contractual and relational capabilities can be expected to vary depending on the level of service complexity.

We address these limitations by positioning the following research question (RQ): How does service complexity impact (i) contractual capabilities and (ii) relational capabilities when providing and receiving PSSs? We investigate our RQs by presenting two case studies of one manufacturing company, which we call 'PSS provider' for confidentiality reasons, and its customers. The case studies focus on the European healthcare sector as this was an ideal context to investigate the influence of service complexity. The PSS provider had traditionally been a provider of complex engineering products and made deliberate steps to introduce servitization strategies, offering a variety of services with different levels of complexity. Gaining this in-depth understanding of a PSS provider offered the possibility to study the issue of contractual and relational capabilities in an organisational context to compare the influence of service complexity. Thus, we contribute to the literature in the field in two ways. First, the investigation of both PSS provider and customer offers insights into the service relationship from a dyadic perspective which helps to draw a more comprehensive picture of the PSS and relationship management. Second, we offer a theoretically-grounded and empirically-tested framework of service complexity in the context of servitization that will offer an in-depth understanding of characterising the different levels of service

complexity and their links to contractual and relational capabilities. This will form a guideline for industry and managers to strategically plan and develop their service offerings and the necessary contractual and relational capabilities (Cavalieri et al., 2007; Legnani et al., 2009).

The remainder of the paper is structured as follows: Based on the literature in the field, we develop an initial conceptual framework relating service complexity to contractual and relational capabilities of a PSS provider and their customer (section 2). We then test this initial conceptual framework using two industrial case studies with different levels of service complexity. In section 3, we detail the research methodology before section 4 describes the empirical findings. In section 5, we discuss our findings before drawing conclusions and providing implications in section 6.

2. Theoretical background

2.1 Service complexity and servitization

Servitization, i.e. the shift towards providing and receiving PSSs, is typically undertaken gradually (Tukker, 2004; Smith et al., 2012). In other words, manufacturing companies provide support services with different degrees of service complexity (Batista et al., 2008). Complexity in the context of services can have varying definitions depending on their focus (Neely et al., 2011). Reviewing the literature in the field, Benedettini and Neely (2011; 2012) found that service complexity can be differentiated into complicatedness and difficulty. Complicatedness refers to the high number of components and their interrelation within the service provision. Difficulty is defined as the high amount of resources that are needed to achieve the intended outcome. In other words, a complicated service offers many different functions while a difficult service delivers sophisticated functions (Benedettini and Neely,

2012). However, this does not seem to be a distinct differentiation as a service that delivers sophisticated functions often also delivers many different functions. As such, complexity can be connected to the engineering system necessary to fulfill the requirements (Ng et al., 2011) and the interaction between the service stakeholders (Tien, 2008). Complexity can further arise from the dynamic nature of services due to the 'open' nature of services, i.e. the constant adaptation to context and conditions (Badinelli et al., 2012).

In this paper, we use a definition of complexity associated with the characteristic of the services. As such, we do not relate our understanding of service complexity to the amount and interaction of the people involved in the production and consumption of a service (Tien, 2008) or the dynamic change of the service to adapt to new situations and conditions (Badinelli et al., 2012). We agree that these are important aspects that can create complexity and need to be considered in a coherent understanding of this topic. However, the purpose of this paper is to draw the connection between service complexity and contractual and relational capabilities and thus we use service complexity to characterise the different agreements. As such, we utilise the definition of service complexity provided by Shostack who states that complexity is "*the number and intricacy of the steps required to perform it*" (1987: 35). This definition relates to the service system used in the literature (Ng et al., 2011; Badinelli et al., 2012) and seems to also incorporate both categories of service complexity presented by Benedettini and Neely (2011; 2012). It further highlights the activity-centered process of services (Gadrey, 2000).

The assumption is that the path towards offering PSSs is connected to an increasing level of service complexity. The shift towards providing and buying PSSs means that the activities and processes of provider and customer become increasingly integrated which has also been described as a service ladder (Neely et al., 2011) or transformation staircase

(House of Commons Defence Committee, 2009). Processes relate to information sharing, planning and undertaking of the activities to deliver the availability of a range of products (Tukker, 2004; Neely et al., 2011). The higher the level of integration, the more activities and processes are necessary to provide and obtain PSSs, i.e. the higher the service complexity.

2.2 Capability development for PSS delivery

A capability is the ability of an organisation to perform coordinated activities utilising resources to achieve a goal and to purposefully create, extend or modify its resource base (Helfat and Peteraf, 2003). As such, it refers to the ability to deploy resources or transfer input into desirable outputs (Menguc et al., 2014). In this context, resources refer to both tangible entities such as raw materials or equipment and intangible entities such as tacit knowledge which can be embodied by knowledge workers such as service engineers (Henard and McFadyen, 2012). The transition towards PSS is an external stimulus, that arises through pressures from globalisation to reduce product prices and stay competitive. It can also arise from internal stimuli with PSS providers to aim for increase revenue, stabilise cash flow and improve the company's market share (Baines et al., 2009). To provide and receive PSSs, organisations need to restructure their product-service delivery, including the formation and management of new contractual and relational capabilities.

Contractual capabilities refer to an organisation's ability to write, negotiate, monitor and enforce contracts (Argyres and Mayer, 2007). They ensure the implementation of the contractual agreement with regards to the recognition of contingencies to ensure an effective and efficient service delivery. Contractual safeguards and rules are established to minimise cost and performance losses from relationship hazards (Joskow, 1988). The aim is to protect the own organisation from opportunistic behaviour of the cooperating partner, to

reduce uncertainties and to specify roles and responsibilities of partnering organisations by relying upon legal rules, standards and remedies (Achrol and Gundlach, 1999). As such, contracts are important planning and incentivisation tools particularly for long-term business relationships (Deakin et al., 1997) as they form the legally enforceable instrument and control mechanisms (Williamson, 1985). Bijlsma-Frankema and Costa (2005) argue that formal control through contracts depends on three underlining conditions – codification, monitoring and safeguards - which are seldom met in an inter-organisational relationship. In practice it is rarely visible or practical to write complete contracts because of the complex nature of product-service offerings, asymmetric information situations and substantial costs and time efforts (Lyons and Mehta, 1997). Inter-organisational relationships are mostly governed by incomplete contracts characterised by some degree of uncertainty that makes these contracts unenforceable in their entirety (Roehrich and Lewis, 2010). Gaps in the existing contract are filled when contingencies arise, allowing some degree of flexibility to deal with unforeseen contingencies (Klein Woolthuis et al., 2005).

To manage these gaps or incompleteness of contracts, relational capabilities are important tools to ensure a successful business relationship in practice. Relational capabilities are an organisation's ability to perform in and benefit from inter-organisational relationships (Srivastava et al., 2001; Bititci et al., 2003). In other words, relationally capable organisations focus on creating relationship-specific assets and effectively create, exchange and exploit knowledge and skills through the application of social routines and behaviour (Dyer and Singh, 1998). This form of capability is derived from values and processes in the exchange relationship (Macneil, 1980) and incorporates: trust and commitment, relational capital, information sharing routines and informal exchange (Lui and Ngo, 2004). Any unforeseeable contingencies in these relationships are safeguarded by flexibility, fostering a

joint approach to solving problems and disagreements through solidarity and information sharing (Poppo and Zenger, 2002). One of the most important aspects to develop relational capability is the establishment and maintenance of inter-personal and inter-organisational trust (Lui, 2009). Building up relational capital between partnering organisations or individuals from collaborative firms is vital to deliver PSSs. Thus, relational capabilities complement contractual capabilities to address conflict resolution quickly and to mitigate adversarial behaviour (Carey et al., 2011). Despite the importance of relational capabilities for strategic decision making in servitized manufacturers, the insights in this area are still in their infancy, especially when considering different PSS offerings and varying levels of service complexity (Newbert, 2007).

2.3 Capability development for service complexity

Relating the development of contractual and relational capabilities in PSS relationships to the issue of service complexity, we expect to see differences depending on the level of service complexity. Based on the literature, we expect that higher levels of service complexity will need to be supported by a higher level of both contractual and relational capabilities in order to coordinate between the PSS provider and its customers. In other words, we expect our case characterised by higher service complexity to show a higher number of contractual arrangements in the form of a longer and more detailed contract, consisting of more paragraphs and clauses to safeguard against possible future contingencies and to mitigate potential opportunistic behaviour. We further expect the agreement of higher service complexity to be characterised by a higher level of interaction between PSS provider and customer.

3. Research method

3.1 Research approach and case selection

To investigate the research question: What is the impact of service complexity on (i) contractual capabilities and (ii) relational capabilities when providing and receiving PSSs?, we adopted a multiple case study method. Despite the issue of generalisability, case studies offer the ideal research method for investigating our research question for the following reasons. Servitization is a very context-specific issue, meaning that company- and relationship-specific issues need to be included in the analysis. Thus, case-study research is a suitable method to gather practical insights into the issue by collecting rich primary and secondary datasets (Flyvbjerg, 2006). An in-depth discussion of exemplar cases offers the opportunity to identify the empirical evidence needed to improve understanding (Siggelkow, 2007). In addition, the investigation of one solution provider offered the advantage of selecting a polar extreme in the field, hence offering guidance and new insights (Eisenhardt, 1989). Especially for research in servitization, case studies are a suitable method to analyse the researched issues in-depth based on empirical observations (Kreye et al., 2013).

We present two case studies of different levels of service complexity within one provider to gather an in-depth understanding of the issue (Stake, 1995; Yin, 2009). Studying one provider is appropriate in our context as different levels of service complexity can pose varying levels of difficulty to different companies, depending on their experience and capabilities. Focusing on one provider mitigates this challenge, but offers deep insights into the impact of service complexity on capabilities. Our case company, which we label 'PSS provider', operates within the European healthcare industry and offers support services for

their equipment. The company's service offerings can be categorised into three levels of service complexity. These three levels are described in Table 1. To study the impact of service complexity on contractual and relational capabilities, we purposefully selected two service agreements from the extremes of the service offering spectrum from the PSS provider. Thus, we selected an agreement from level 1 (case A) and an agreement from level 3 (case B) for our analysis.

<Please insert Table 1 about here>

3.2 Data collection and analysis

Our unit of analysis is the PSS, encompassing contractual and relational capability developments within two service agreements between the case company and two of their customers. The customers were hospitals providing different health services to private patients. In 2013, we conducted 25 semi-structured interviews with 21 interviewees both on the provider and customer sides to obtain insights from 'both sides of the story' (some of the interviewees from the PSS provider side were interviewed for both cases). Respondents were drawn from multiple functions, such as service managers, account managers, service engineers, strategic buyers and physicists. The respondents were chosen based on their involvement in the service agreements and stood in direct relationship with the customer(s) or PSS provider respectively. The differences in service complexity between both cases influenced the set-up of the relationship, as in case A, the customer hired first-line engineers to deal with initial repairs of the hospital's equipment when possible. In contrast, in case B, first-line engineers did not exist as the PSS provider took full responsibility of these issues. Thus, the respondents for case A included first-line engineers, while the respondents for case B focused on equipment operators such as physicists. Further

discussions of the set-up of the service relationship is presented in section 4.3. Table 2 depicts interviewees for both case studies.

<Insert Table 2 about here>

The interviews addressed retrospective and current activities of the service agreements. The interviews were semi-structured and followed a pre-defined protocol to ensure completeness and comparability between respondents and were complemented by individual spontaneous questions based on the interviewees' individual discussions and comments. The questions focused on the following topics: the rationale for moving to PSS offerings, changes in the organisational strategy and structure, the development of the dyadic relationship and the importance and development of contractual and relational capabilities. Interviews lasted between 45 and 120 minutes and were tape-recorded and subsequently transcribed. Our data collection stopped when conceptual saturation was achieved. Data was triangulated to mitigate common method bias and improve validity and case study rigour (Lewis and Grimes, 1999). This included the service contracts, information on the tendering process, marketing material and other publicly available information such as announcements on webpages.

We analysed the interview transcripts and the additional material, adopting systematic combining to inform our data analysis (Dubois and Gadde, 2002). We coded our data into major thematic categories informed by our research question and comprehensive literature review (Strauss and Corbin, 1990). More specifically, categories emerged from our theoretical framing while others were derived from our empirical data analysis. Our rich datasets were summarised and written up as case reports to be presented to the case company for verification. As part of our coding and analysis process, the authors travelled

back and forth between analysis, collection and extant studies, hence facilitating theory building (Miles and Huberman, 1994).

4. Findings

Both contracts were based on a long-standing relationship between the PSS provider and two customers. However, interviews highlighted that this relationship changed driven by the shifts in the business context. We describe the context for the PSS relationship before highlighting findings with regards to contractual and relational capabilities.

4.1 Contextual setting

The investigated service contracts included support services for products that had been acquired by the respective customers before. In other words, the investigated service relationship focused on a context of asset specificity where the PSS provider and customer had previously been involved through the sales of the product, its installation and maintenance through a warranty period of one year. The customers in our cases were hospitals that offered healthcare services to patients. The acquisition process in the European healthcare sector had changed within the years before the data collection as it had been formalised in a European-wide tendering process. For the tender, the customer had to publish their requirements for the requested product and the communication between the customer and the competing PSS providers (i.e. bidders) was also formalised. This meant that any informal communications or exchanges were constrained by these tendering regulations. All of the submitted bids are evaluated objectively based on predefined and published criteria such as the price, fulfilment of the requirements, performance and workflow. Thus, the level of competition at the asset acquisition stage had

increased as more providers within Europe could participate in the tender. This was expressed by the service manager (PSS provider, both cases): *“You have the tender business that means that everybody from the EU can go in and make an offer. We are all evaluated objectively.”* This increased the complexity and length of the product acquisition process which meant that: *“It tends to be quite substantive. The work load and so on. You almost need to have a legal department nowadays to handle these things”* (Physicist 2, customer, case B).

Once the product was acquired and installed, the customers were locked to the manufacturer for providing the support service. This meant that the PSS provider put a lot of effort into preparing competitive bids because *“if you win, you win a lot. If you lose, you lose a lot. It is important to win because you can actually lose a whole region just in one tender”* (Account manager, PSS provider, case B). Once the product sales were won, the customer had to rely on the PSS provider for the necessary support services. This simplified the negotiation of the service agreements as highlighted by the Service manager (PSS provider, both cases): *“In fact, a lot of the service agreements we finalise by mail. I do not visit the customer anymore, we just send an email and they come back to me.”*

The cases we investigated focused on the relationship between PSS provider and customer once the asset specificity was in place and the customer locked to the manufacturer for providing the support service. This gave a clear context for the case studies and the service relationship between PSS provider and customer. In this context, the PSS provider described changes in the customers’ demands as highlighted by the Service manager (PSS provider, both cases): *“The customer asked for higher uptime of the equipment use and then you could not live with the fact that the equipment can be down for 1, 2 or 3 days. That could happen quite often if you do not do proper maintenance and if you*

do not learn from the past and use this experience to develop solutions that would avoid downtime.” As such, the service components have become vital for the survival of European manufacturers in the healthcare industry. This means that the PSS providers have changed their offerings in accordance with the customer demand to secure additional revenue and secure customers.

4.2 Contractual capabilities

The contextual setting of our case studies with asset specificity and the locking to one manufacturer as the PSS provider simplified the contract negotiations for the support services. The agreement of contract-specific performance indicators was clearly stated from the outset of the tendering process. The Strategic buyer (Customer, Case A) highlighted: *“It is the complexity of the equipment, their [the hospitals’] needs for uptime. During the EU tender, we have some requirements about different levels of service.”* Thus, at the time of negotiating the service agreement, both PSS provider and customer had an idea about the service activities to be included in the agreement. This reduced efforts and time for the negotiation and the need of the PSS provider to develop contractual capabilities to deal with additional uncertainties introduced through the additional activities and their interdependencies of services with higher complexity.

As such, we did not observe a higher level of contractual capabilities in terms of writing, negotiating, monitoring and enforcing contracts for the service agreement of higher service complexity (case B). This can be explained with the fact that both investigated cases were governed by contracts consisting of three pages with the following content: (i) a title page that listed the serviced product(s) with its specifications such as product type and model number; (ii) one page describing the service activities and (iii) one page of contract

specific information such as agreed response time, telephone numbers in case telephone support was part of the agreement, the contract date and the signatures of contractual partners. As such, only marginal differences could be found in the PSS provider's contractual capabilities depending on the level of service complexity.

One of the reasons for this similarity of contractual capabilities (apart from the contextual settings of the two cases with asset specificity and provider lock-in) might be the development of service modularity. The PSS provider listed their offered service activities for the customer to "pick and choose". As such, contractual capabilities were developed both centrally and locally within the PSS provider. The business controller described this situation as follows: *"We have two forces. We have what the customer and what the headquarter is telling us."* The definition of the service modularity was undertaken centrally within the PSS provider and the different modules are the same for each customer. However, the contract negotiation including issues such as the combination of different service modules and response times were negotiated locally with each customer individually, meeting customer's needs. Table 3 gives an overview of the service modules included in the different levels of service complexity and optional add-ons. This modularity offered a very simple but also comprehensive list of service activities. During the tendering process, the customer publicised which service activities they would like to have included in the agreement. These were also modularised in form of six different service levels as clarified by the strategic buyer of Case B (customer);

"Service level 1 - preventive maintenance without call-outs, Service level 2: error-correcting and remote service without call-outs, Service level 3: error-correcting service with uptime guarantee, Service level 4: full-coverage, Service level 5: full-coverage with continuous upgrading of software for state-of-the-Art, Service level 6: full-coverage with continuous upgrading of hardware for state-of-the-Art, Service level 7: cooperation."

During the tendering process, the PSS provider could match the customer's modularised service activities against their own modules to achieve a close match between demand and supply. The Service manager of the PSS provider (both cases) highlighted: *"I then translate their service levels 1, 2, 3, 4, 5, 6 and so on into our service level understanding of [levels 1, 2 and 3]. That is important as I do not want the transparency to be too big. If they, for instance, have a [competitor's] scanner I can directly compare and if it is not the same I put in more modules to match and exceed their [the competitor's] service offering."* This statement highlights that despite the high level of regulations in the sector, strategic evaluations and contractual arrangements with the specific PSS providers are still important. The content of the service module with regards to for example frequency of the activities was further clarified in the Terms & Conditions (T&C). These T&C were enclosed with the service contract as an additional two pages and could be discussed further during the contract negotiations. However, as the Service manager highlighted (see quote in 4.1), these negotiations were often undertaken via email, face-to-face discussions were not necessary. The Service manager (PSS provider, both cases) stated: *"As a result of the tender they [customers] have defined all the service levels. I do not have to tell them what those services are because they decided themselves."*

<Please insert Table 3 about here>

In summary, our assumption of higher levels of contractual capabilities for services of higher levels of complexity was not empirically supported across our investigated cases. We found that the contextual setting of asset specificity and the modularity of the service offerings countered the need to develop high levels of contractual capability. Another reason could be the high level of regulations within the European healthcare sector. These tight

regulations had legal implications by themselves as it prohibits specific opportunistic behaviour . This was explained by the Account manager (PSS provider, case B) as follows: *“We cannot talk together. I cannot call the other company [a competitor] and say ‘Well, we don’t like this one going out in the summer. Why do not we all just ignore it?’ That’s illegal so not possible.”* In other words, the legality of possible opportunistic behaviours both on the PSS provider and the customer side was mitigated by European regulations. This means that rules to mitigate opportunistic behaviour, one of the main reasons for contractual capabilities, do not need to be included in each individual contract.

These findings illustrate that even though the contractual capabilities were not a distinguishing feature with regards to different levels of service complexity across the investigated case studies, they were still essential to ensure a high level of service quality to be delivered throughout the contract period. As such, the high level of joint understanding of service activities and the organisation of these in modules by both customers and PSS providers substituted the need to develop a high level of contractual capabilities. This ensured that occurring problems were addressed in a timely manner to avoid any escalation within the PSS provider-customer relationship.

4.3 Relational capabilities

Despite the high level of regulation within the healthcare sector, we found that relational capabilities were important across both cases. This was highlighted by the PSS provider: *“We are all evaluated objectively. That means the relations are not there at all on the paper. But of course in the real world, there are some relations that are still working. But not as it used to be”* (Service manager, PSS provider, both cases). The customer agreed to this evaluation as highlighted by Physicist 2 (Customer, case B): *“Personally, I think it is*

important that when you go out and you buy a new system, you are not allowed to take into consideration your previous experience. But of course somewhere, you always have that in the back of your head." This highlights that the customer's experience with PSS providers is an important influence on their decision during subsequent tendering processes.

The PSS provider used primarily their service engineers to build a strong relationship, characterised by, for instance, increased information exchange. This was expressed by the Service manager (PSS provider, both cases): *"For the service, relations are very important. (...) And these relations are built up over years by brilliant work of all the technicians. So it is very important that we have a good foundation from the customer services."* The customers echoed this importance of building up and maintaining relational capabilities particularly when managing the close relationship with service engineers. Customer A highlighted the importance of the availability of the service engineers when they are needed: *"We can call them [the engineers] directly. (...) We can call them on weekends. And so they definitely provide a bigger service than we pay for"* (First-line engineer, Customer, case A) and Customer B expressed the importance as the PSS provider's engineers as a first line contact: *"If you have a problem, you would call a technician. He will be here within half hour or an hour"* (Physicist 2, Customer, case B).

Our assumption of the initial framework was that more relational capability is needed for services characterised by higher complexity. This assumption was confirmed across the investigated cases. As such, the PSS provider utilised centrally defined procedures in connection with customer-specific experiences. In other words, service activities are defined as formal routines and procedures prescribing the customer interaction and are implemented through the specific service engineer and service manager based on the specific customer needs, skills and knowledge. Both parts of the service relationship –

centrally defined and locally implemented activities – define the PSS provider’s relational capabilities and depend on the level of service complexity. Case A (low service complexity) was characterised by four annual visits for preventative maintenance activities where the system was inspected and recommendations made. For these visits, appointments were agreed with the customer. *“Then we go on site. And we have a protocol that we have to fill out. And we go step-by-step and perform all the things that need to be done”* (Service Engineer, PSS provider, case A). This protocol is sent to the customer with a list of faults or recommendations for repairs and/or upgrades. *“There is a common field that we could fill out. ‘We will recommend you do this and that.’ Or we can say ‘The system has this fault which we have to find a solution to’ because they have to pay for the spare parts. So it might be that they want to leave this fault and if it is not security or safety, then they can live with that”* (Service Engineer, PSS provider, case A).

In addition to the lower level of service complexity, the customer of case A employed own engineers for the first-line service activities. This meant that some repairs could be done by these engineers as highlighted by the first-line engineer (Customer, case A): *“Because our knowledge of the scanners is very high, they can use us in instead of sending an engineer.”* This strategic decision to keep some service capabilities insourced may in turn have influenced the customer’s acquisition of a service contract with a low level of service complexity; however, it also meant that the PSS provider needed to have low level of relational capability.

In contrast, case B (high complexity) was characterised by a much closer relationship between the service engineers and the customer. In order to develop and maintain such close relationships, the PSS provider needed to build up strong relational capabilities. When the engineers are on site for the preventative maintenance inspections, they also consider

whether there are additional issues they could solve during their visit. Service Engineer 2 (PSS provider, case B) explained *“Before getting started, I will ask if they [customer] have any problems that they did not report to us. Sometimes they have a small problem that they think is not important. They write it in a notebook and they ask me.”* In addition, the customer receives much closer attention even if they do not have any issues with the product. This was highlighted as follows: *“But sometimes I am just going to the customer site and have a chat. To see if they have any problems or just to follow up on how it goes”* (Service Engineer 2, PSS provider, case B). This point was also supported by Service Engineer 1 from case B. This engineer had worked with the customer for more than 30 years and thus knew the site very well and had a very close relationship with them.

“It is always nice to go there. Always when I go there, there are almost all the time some questions that I can look at. Maybe it is not my equipment but also something else, like a PC is not working or something else. It is like I am working in the hospital.(...) Many of them I know personally. Not privately but I have been so many time times they know me and I have 5 km to the hospital. So they just call me. They call me directly” (Service Engineer 1, PSS provider, case B).

This high level of relational interaction between PSS provider and customer was confirmed by the customer of case B. Physicist 1 (Customer, case B) explained *“I would say that our relationship with this technician is informal and it works fine for us. (...) I think it worked well if we have a problem we can call (PSS provider) and have a fast and efficient reaction.”* Physicist 2 (Customer, case B) confirmed this: *“The most important thing when you call them they react reasonably quick. They are typically here within an hour; so that is the main thing. And when they come here they solve the problem really fast.”* This highlights that the customer perceived the relational capabilities in terms of providing high levels of service quality. They did not comment on the fact that the service engineers of the PSS provider

would sometimes be on site without being called in, but they focused mainly on their perception that when they did have a problem, it would be solved quickly and effectively. This suggests that high relational capability was translated by the customer into perceived service quality.

This seemed to also add to the competitiveness of the PSS provider as the service quality, as perceived by the customer, gave them an advantage over competing PSS providers. The fact that local support was available and that they had a high level of relational capability already built up, gave the PSS provider a competitive advantage to other PSS providers within the European community. This was highlighted by one of the physicists as follows:

“Some of the other manufacturers rely on support from [other European countries] and I think that might be a bit too far away in some cases, when you need to get things up and running quickly. And also the communication might not flow as easily. But that is a good thing with [the PSS provider]; they’ve got quite a huge, local department (...). That is an advantage”
(Physicist 2, customer, case B).

This development of high levels of relational capabilities was part of the operational strategy of the PSS provider. Building a close working relationship between the service engineers and the customer was emphasised as an important aspect that was crucial when, for example, selling additional services in the future.

“When we have that [good relations], of course, it is much easier for me to approach the customer because they know our good service. And I do not have to present our organisation, I do not have to present our concept because they know it” (Service Manager, PSS provider, both cases).

Including the relational capability in the operational and sales strategy of the PSS provider was particularly important for the contract with a high level of service quality. One of the

physicists of case B highlighted:

“It’s nice to know that he’s not on the clock. So when he’s here, we can actually discuss things and maybe have a cup of coffee. If that wasn’t the case, we’d have to stand beside him and watch ‘is he working now and is he doing this fast?’ It’s more relaxed the other way. And then we get the time to discuss other things. (...) I mean if we want to start something new, we can discuss it without worrying about spending [this money]” (Physicist 2, Customer, Case B).

Thus, our case findings suggest that relational capabilities are influenced by service complexity: The agreements with low level of service complexity (case A) showed lower levels of relational capability development than the agreement with a high level of service complexity (case B). This is summarised in Table 4 depicting the relational capabilities for the two investigated cases. As such, the difference in the relational capabilities could be observed particularly in the identification of additional maintenance activities and the relational capabilities for non-requested visits and discussions.

<Insert Table 4 about here>

5. Discussion

The studied PSS provider showed high levels of contractual and relational capabilities that depended on the level of service complexity. We found that the PSS provider’s contractual capabilities, i.e. their ability to write, negotiate, monitor and enforce contracts (Argyres and Mayer, 2007), concluded in relatively short service contracts that included only three pages. This was influenced by their ability to define and implement service modules that guided the customer-specific negotiations. Furthermore, the PSS provider’s relational capabilities, i.e. their ability to perform in and benefit from their inter-organisational relationships (Srivastava et al., 2001; Bititci et al., 2003), included their visibility to the customer, the nature of the interaction (requested and non-requested service visits) and the character of

the information exchange (formal and informal). Table 5 summarises the results of both cases with reference to our initial expectations.

<Please insert Table 5 about here>

Our initial assumptions were only partly confirmed through the investigated cases. Both cases illustrated that contractual capabilities did not differ to a high degree between the two levels of service complexity. Different possible reasons for this observation were described. First, the context of asset specificity and thus the link to one specific manufacturer as the service provider meant that the contracts were negotiated based on an existing relationship. Second, the high level of formalisation of the tendering process for the asset including an indication of required service activities meant that customer needs and the provider's ability to meet these needs had been communicated and agreed at the time of product acquisition. Third, the modularity of the service activities both by the PSS provider and the customers ensured that the viewpoints were compatible and service activities could be mixed and matched according to individual needs and requirements. Fourth, the high level of regulation in the European healthcare sector meant that international legal bonds were established and respected by the industry. These regulations include possible opportunistic behaviours of PSS providers and customers which would otherwise be controlled through contractual capabilities. Due to these reasons, we did not observe an increase of contractual capabilities by the PSS provider with increasing levels of service complexity.

In contrast, relational capabilities were found to be an important mechanism and distinguishing feature for the investigated cases. We found that relational capabilities were dependent on the level of service complexity, especially with regard to the visibility of the

PSS provider on customer site, the nature of the interaction between PSS provider and customer and the nature of the information exchange. The investigated case of low service quality (case A) showed a lower visibility of the PSS provider on the customer site through less frequent visits, the nature of the interaction was purely based on requested service visits and the information exchange was through formal channels such as sharing the service report. In contrast, the investigated case of high service complexity (case B) was characterised by a higher level of visibility by the PSS provider on the customer site through more frequent visits, including requested and unrequested visits and the information exchange was often informal through discussions between the service engineers and product operators (physicists). We found that the level of relational capability was vital and influenced the perceived service quality by the customer which in turn impacted on the success of future sales.

Prior studies further suggested that relational capabilities are a governance mechanism to create relational routines (Dyer and Singh, 1998), prevent conflicts and solve problems as well as exchange information (Carey et al., 2011). These insights were confirmed through our case studies as services with high relational capability were characterised by strong relational routines and a high level of frequent and regular information exchange between PSS provider and customer. In addition, we showed that a high level of relational capability can also be a mechanism to create competitive advantage as it creates a high level of perceived service quality for the customer through short response times and effective problem solving (Grönroos, 1984; Parasuraman et al., 1988). This was further found to influence the possibility of future sales both of the product and of future service agreements in the context of competitive bidding (Kreye et al., 2014).

The limitations of this research lie in the nature of case study research as we offered an in-depth analysis of a PSS provider and two of their customers. Thus our case findings are context specific for the European healthcare sector and for the presented servitized manufacturer (Siggelkow, 2007). Further research is needed such as additional case studies in different business and company contexts to triangulate the research findings (Lewis, 1998). Business conditions in other industrial settings may differ significantly from the ones described in this paper which means that insights and conclusions may not be applicable. Similarly, different PSS providers may have a different understanding of their service business, particularly with regards to service modularization. As such, we demonstrated a successful PSS provider in their field and how their understanding of their service business influenced their contractual and relational capabilities for service provision.

6. Conclusions and implications

This paper described the relationship between service complexity and the development of contractual and relational capabilities within the buyer-supplier relationship for product-service systems. We presented two industrial cases of one PSS provider and two of their customers, which differed in the level of service complexity. Our empirical study offers two distinct, but inter-related, contributions. First, we found that service complexity did not impact on the development of further contractual capabilities. Different reasons for this observations were found such as the modularity of the service offerings and requirements which allowed a simplified negotiation process with clear communications and joint understandings between PSS provider and customer. Second, our cases showed that increasing levels of service complexity increased the level of relational capability development between PSS provider and customer. Developing and maintaining relational

capabilities can be considered a vital distinguishing feature for PSS relationships. In particular, we found that the visibility of the PSS provider on customer site increased with higher level of service complexity, that the nature of the interaction differed to include non-requested research visits by the PSS provider to check-up on the customer and that the information exchange differed between a predominately formal communications via reports and standardised processes to informal communciations such as discussions over a cup of coffee.

Thus, we contribute to extant literature by extending previous findings to the concept of service complexity and investigating the dyadic PSS relationship. This is important as manufacturing companies tend to increase the level of service complexity of their offerings when shifting to being a provider of PSSs. Our findings suggest that when realising a servitization shift, manufacturing companies need to improve particularly their relational capabilities such as establishing relational routines and behaviour, exchanging knowledge and information and building up inter-personal and inter-organisational trust. While developing contractual capabilities is important, it is the development of relational capabilities that can function as a distinguishing feature in PSS relationships.

The research results have multiple implications for management practice. PSS typically increase the (relative) complexity of the service offering (cf. pre PSS arrangements) and therefore they require providers to develop and maintain additional service capabilities. For practitioners, this research clearly highlights that, in addition to getting better at 'the service work', they need to develop capabilities in two complementary directions. First, there is a need for relational capabilities to complement service capabilities, in particular at higher levels of service complexity, because enhanced relational capabilities improve the customer's perception of service quality. This might include for instance, increasing the

visibility of the PSS provider on the customer site (e.g. through formal as well as informal service engineer visits) and/or improving the quality of provider/customer interactions (e.g. increasing levels of appropriate information exchange). Second, there is a need for contractual capabilities to complement the relational ones. Without such capabilities, PSS arrangements can lead to the creation of over-long contracts (i.e. extended lists of clauses and remedies) that are time-consuming and expensive to create and monitor, and typically ineffective. Contractual capabilities on the part of the provider can lead to the development of advanced forms of exchange governance (e.g. service modularity, influencing industry regulation to shape clear norms and joint understandings). In other words, the presence of contractual capabilities allow for the (relatively) simple governance of increased levels of service complexity.

Our study paves the way for future research within the area of service complexity and service relationships. Future research needs to investigate the influences on the customer's decision to purchase agreements of specific levels of service complexity. Such influences could be the customer's strategic decisions to outsource specific capabilities but keep for example first-line services insourced or the customer's perception of the product quality. Identifying these influences and their interconnections will yield insights for PSS providers to customise their offerings and target the individual needs of their customers. Future research further needs to investigate the development of contractual and relational capabilities in dependence on PSS complexity. Our study focused on service complexity after the asset had been purchased by the customer. Extending these insights to the purchase of the complete PSS including the product and its through-life support will yield important insights for management research and manufacturing companies. In particular, the

evolvement of the relational capabilities at the time of PSS purchase through formalised and regulated tendering processes offers an interesting area for further investigation.

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Tables and Figures

Table 1: Service offerings of the case study company

Service level and complexity	Preventive maintenance Regular inspections depending on asset specifications to ensure safe and efficient operation. This included documentation, quality assurance, security and software inspections.	Emergency support Emergency support via telephone and corrective maintenance activities. This included further regular updates of the equipment.	Additional support Guaranteed availability of the product through delivery of spare parts and regular updates of the software systems to enhance productivity and availability	Case
1 - Low	X	-	-	Case A
2 - Medium	X	X	-	
3 - High	X	X	X	Case B

Table 2: Interviewees for both cases

	Case A	Case B
Service complexity	Low	High
PSS provider	<p>Both cases:</p> <ul style="list-style-type: none"> • Service manager • Business controller • Invoice administrator 1 • Invoice administrator 2 	
	<ul style="list-style-type: none"> • Sales manager • Service engineer 1 • Service engineer 2 	<ul style="list-style-type: none"> • General manager • Sales manager • Account manager • Service engineer 1 • Service engineer 2
Customer	<ul style="list-style-type: none"> • Service manager • First-line engineer 1 • First-line engineer 2 • First-line engineer 3 	<ul style="list-style-type: none"> • Strategic buyer • Chief physicist • Physicist 1 • Physicist 2 • Physicist 3

Table 3: Service modules as offered by PSS provider for the different levels of service complexity

		Service level and level of complexity		
		1 - low	2 – medium	3 - high
Basic service modules	Preventative maintenance	X	X	X
	Quality insurance	X	X	X
	Security inspections and support	X	X	X
	Product upgrades	X	X	X
	Telephone support		X	X
	Emergency calls		X	X
	Spare parts			X
	Guaranteed response time [hours]	8	4	4
Additional options	Software upgrades		O	O
	Extended asset uptime		O	O
	After office hour support		O	O

X – included in the service level agreement

O – possibility for optional inclusion on service level agreement

Table 4: Relational capabilities for agreements of low and high service complexity

	Low level of service complexity	High level of service complexity
Regular visits	Preventative maintenance inspection visits as per product specifications	Preventative maintenance inspection visits as per product specifications
Additional maintenance activities	Recommendation of additional maintenance activities such as repairs or replacements by service engineers of PSS provider	Identification of additional service activities such as problems of asset operation through the customer
Further relational capabilities	-	Additional non-requested, informal visits “to follow up how it goes” (Service Engineer 2, PSS provider, case B)

Table 5: Summary of findings of contractual and relational capabilities for contracts of different service complexities

	Low level of service complexity	High level of service complexity
<i>Contractual capability</i>	<p>No difference for different level of service complexity observed. The contractual arrangements were agreed on three pages including:</p> <ul style="list-style-type: none"> • Title page with equipment specifications, • Modularity of offered service activities for the customer to choose, • Contract specific information including date and signatures. 	
<i>Relational capability</i>	<p>Low level of relational capability for lower level of service complexity, evidenced by e.g. the following;</p> <ul style="list-style-type: none"> • Lower visibility of the PSS provider on customer site, i.e. less frequent service visits. • Formal interaction only through requested service activities, such as additional repairs or replacements. • Information exchange mostly through formal channels such as service reports with recommendations 	<p>High level of relational capabilities for higher levels of service complexity as evidenced by e.g. the following;</p> <ul style="list-style-type: none"> • Higher visibility of the PSS provider on customer site, i.e. more frequent service visits. • Formal and informal Interaction through requested (e.g. repairs, replacements) and nonrequested service visits (such as discussions over a cup of coffee) • Information exchange mostly through informal channels such as discussions between service engineers and customer.