Use-oriented product service systems in the early industry life cycle

Existen pocas pruebas empíricas sobre las capacidades y recursos necesarios para prestar servicios en la fase inicial del ciclo vital de la industria. Utilizando entrevistas y estudios de casos desarrollamos un marco de recursos-capacidades para los servicios en el ciclo inicial de la industria. Existen cuatro recursos críticos para desarrollar los servicios con éxito en esta fase: (1) recursos financieros (externos), (2) recursos tecnológicos, (3) capital social y (4) recursos de servicios. Para tener éxito en la prestación de servicios, las empresas despliegan estos recursos a través de una amplia serie de capacidades. Estos recursos y capacidades permiten a las empresas tener éxito con los sistemas de productos-servicios orientados al uso (PSSs). Nuestros hallazgos ponen en cuestión el supuesto de que las empresas orientadas a productos pasan de PSSs orientados a productos a PSSs orientados al uso únicamente en la fase de madurez del ciclo vital de la industria.

Froga enpiriko gutxi daude industriaren bizi-zikloaren hasierako fasean zerbitzuak eskaintzeko beharrezkoak diren gaitasunei eta baliabideei buruz. Elkarrizketak eta kasuen azterketak erabilita, industriaren hasierako zikloan zerbitzua eskaintzeko baliabideen zein gaitasunen esparru bat garatu dugu. Lau baliabide kritiko daude zerbitzua garatzeko arrakastaz epe honetan: (1) baliabide finantzarioak (kanpokoak), (2) baliabide teknologikoak, (3) kapital soziala eta (4) zerbitzuen baliabideak. Zerbitzuak eskaintzen arrakasta izateko, enpresek baliabide horiek erabiltzen dituzte gaitasunen sorta zabal baten bidez. Baliabide eta gaitasun horiei esker, enpresek arrakasta lor dezakete erabilerara bideratutako produktuen zein zerbitzuen sistemekin (PSSs). Gure aurkikuntzek ezbaian jartzen dute uste hau: produktuetara bideratutako enpresak produktuetara bideratutako PSSs izatetik, soilik erabilerara bideratutako PSSs izatera pasatzen direla, industriaren bizi-zikloaren heldutasun-fasean.

There is little empirical evidence on the resources and capabilities needed to provide services in the early phase of the industry life cycle. Using case studies and interviews, we develop a resource–capability framework for services in the early industry life cycle. There are four critical resources to developing service successfully in this phase: (1) (external) financial resources, (2) technology resources, (3) social capital, and (4) service resources. To succeed in the service provision, companies deploy these resources through a broad set of capabilities. These resources and capabilities enable companies to succeed with use-oriented product-service systems (PSSs). Our findings jeopardize the assumption that product-oriented companies move from product-oriented to use-oriented PSSs only in the maturity phase of the industry life cycle.

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Palabras clave: Sistema servicio-producto, producto-servicio orientado al uso, ciclo de vida industrial.
Keywords: Product-service system, use-oriented product-service, industry life cycle.
JEL codes: L10, O31.

1. INTRODUCTION

Product-oriented companies tend to shift from designing, manufacturing, and selling products to offering innovative services (Davies *et al.* 2007 Jacob & Ulaga, 2008; Oliva & Kallenberg 2003, Tukker 2004, Wise & Baumgartner, 1999). They increasingly combine products and services into customer-specific solutions, with services becoming the main source of competitive advantage, revenue, profit, and customer satisfaction. Scholars conceptualize this shift as moving towards a hybrid offering (Ulaga & Reinartz 2011), service-led growth (Kowalkowski *et al.* 2015), servitization (Vandermerwe & Rada, 1988), product service systems (Tukker 2004), integrated solutions (Davies 2004), or service business development (Fischer *et al.* 2012). These conceptualizations classify service offerings and describe the shift from products to services as a step-wise extension of the service portfolio. The product service systems literature distinguishes, for example, between product-oriented, use-oriented, and result-oriented PSS. Along these three PSS, services become an increasingly important part of value creation. Hybrid offerings shift the nature of a company's value proposition from performing a deed (input-based) to achieving performance (output-based).

While scholars use multiple conceptualizations, the empirical focus is on companies whose products have reached maturity in the industry life cycle. In this phase, products face cost competition, commoditization and eroding product margins. The shift towards services is a rational strategic response in the maturity phase (e.g., Cusumano *et al.* 2015, Davies 2004, Gebauer *et al.* 2005, Oliva & Kallenberg 2003, Sawhney *et al.* 2004, Tukker 2004, Ulaga & Reinartz 2011, Tuli *et al.* 2007). Research generally neglects services in the early industry life cycle (*ferment phase*). In this phase, companies could, for example, offer use-oriented or result-oriented PSS. Such PSS replace the product purchase with selling the actual result and/or letting customers pay only for the product usage (Cusumano *et al.* 2015). This means that customers pay for a service such as product performance or usage, rather than the products and services individually. An illustration is Xerox when it introduced the plain paper copier in the 1960s. Xerox remained responsible for maintenance, repair, and insurance, while users primarily paid for copier usage (e.g., paying for copies). Xerox's use-oriented PSS accelerated the market penetration in the early phase of the industry life cycle (Cusumano *et al.* 2015).

Surprisingly, there is little empirical evidence on the resources and capabilities needed to provide services in the early phase. Resource and capability descriptions are restricted to the conditions specific to the maturity phase in industry life cycle. For example, in the ferment phase, companies just start with the provision of products and generate product demand. Therefore, companies cannot take advantage of resources such as a high installed base and intimate knowledge of product usage. They can neither rely on an existing product sales force, spare part distribution network, nor on field service organization (Oliva & Kallenberg 2003, Ulaga & Reinartz 2011). Rather, they need to build such resources from scratch. In addition, at the beginning of the industry life cycle, companies might still have the freedom to develop a corporate culture without the risk of a clash between a product-oriented and service-oriented culture. Companies that have focused on products and considered services as an add-on throughout the industry life cycle, find it difficult to become more service-oriented. They might even face internal inertia that hamper a shift from products to services (Fang *et al.* 2010, Gebauer *et al.* 2005, Mathieu 2001). Such inertia might be less likely if companies replace the product purchases with services already in the early phase of the industry life cycle.

Generalizations on required resources and capabilities derived in the maturity phase are not applicable to the early phase or, at least, not in the same way. Rather than merely transferring existing resource-capability frameworks, we use a grounded theory approach for exploring what are critical resources and capabilities in the early industry life cycle. Our empirical focus is on companies in the emerging industry of decentralized water treatment technologies. We focus on product-oriented companies that manufacture water treatment equipment. We investigate the following two research questions:

1. What resources must companies develop to provide PSS in the early phase of the industry life cycle?
2. Which capabilities are needed to deploy these resources successfully?

By answering these questions, we extend our knowledge about services in product-oriented companies to the early phase of the industry life cycle. This extension of knowledge is theoretically driven through applying the resource-based view of the firm. The resource-based view enables us to identify resources and capabilities that go beyond a generic list of capabilities to focus on resources and capabilities that are essential to success. We integrate those resources and capabilities into a framework describing the critical stages in company development.

2. THEORETICAL BACKGROUND

To answer our research questions, we draw on three literature streams: product service systems, industry life cycle and resource-based view of the firm. Given the rich body of existing literature, we summarize only most the important contributions.

2.1. Product Service Systems

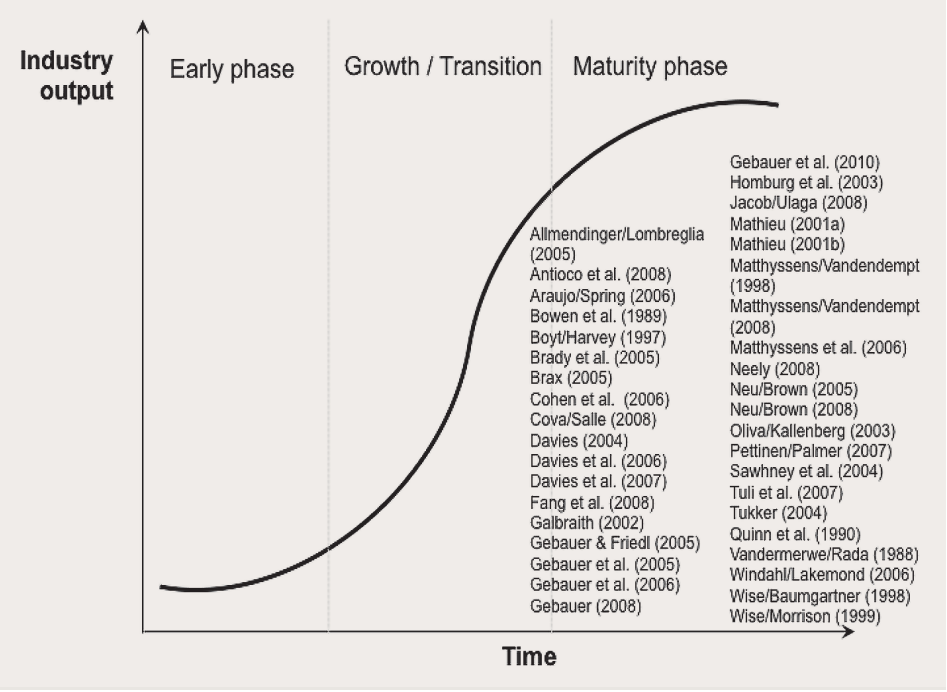
Product service systems consist of 'tangible products and intangible services, which are combined to fulfill specific customer needs (Tukker 2004). There are three types of PSS: product-oriented, user-oriented, and results-oriented. Product-oriented PSS are still mainly geared towards product sales, with some basic services as an add-on. In this archetype, services merely support product sales and ensure product functionality (Samli *et al.* 1992, Mathieu 2001b, Tukker 2004). In use-oriented PSS, product ownership remains with the provider. Product usage is made available as a service to actual users (Ulaga & Reinartz 2011, Tukker 2004). For example, Xerox remains responsible for operation & maintenance, while users pay for plain paper copies (Cusumano *et al.* 2015). Rolls-Royce's power-by-the-hour service, where customers pay a fixed fee for actual usage rather than paying for jet engines and maintenance services individually, is another example of PSS (Koudal 2006). Result-oriented PSS means that customers and providers agree on a result and/or performance, and there is no pre-determined product involved. Here, the value proposition focuses on the promise to achieve a certain customer performance. As a performance provider, companies build a profound knowledge of the customer's core processes in order to manage customer operations (Helander & Möller 2008).

Use-oriented PSS –which show a parallel with the concept of «software as a service»– have been widely used in the software industry (Timmers 1998). Customers pay for the software features they are actually using. The software industry actually has an advantage in pay-per-use business models, since the actual software production costs are relatively low. Main costs are in the software development and software upgrades. To refinance the development costs, software companies aim for reaching scale relatively quickly. They attempt to lock-in the customers with the software usage fee rather than demanding up-front payments from the customers (Timmers 1998, Weinhardt *et al.* 2009).

2.2. **Industry life cycle**

The early (ferment), *transition*, and m*aturity phase* represent the three main industry life cycle phases (Cusumano *et al.* 2015). The *early phase* represents the beginning of an industry life cycle, and it is characterized by a high level of uncertainty, since the focal technology and/or product is still being developed. Customers and producers are uncertain as to how the technology will perform. Companies often experiment with different technical designs and business models to find the most suitable technologies in markets where both technology and customers are in a state of a flux. The *transition phase* describes the period from ferment to maturity, during which a dominant design emerges. Companies experience growing market demand around stabilized technologies and customer needs. The *maturity phase* is characterized by low levels of technology and market uncertainty. Companies face an increasing product commoditization with the associated cost-based competition.

Figure 1. **EMPIRICAL ANALYSIS**[1]



[1] Note: Figure 1 positions selected empirical studies along the industry lifecycle. For the selection, we searched the SCOPUS database for key words related to the services in manufacturing companies. To select the articles, we used a threshold of 30 citations. In each of these articles, we investigated the unit of analysis. We used typical attributes describing the industry lifecycle such as maturity of the technology, company growth, and uncertainty of customer needs (inverse) to decide whether the empirical focus was on the Ferment, Transition, and Maturity phase. For three articles, we were not certain about the position in the industry lifecycle. Thus, we contacted the authors and ask them about the position of their studies in the lifecycle.

Source: Own elaboration.

Previous research concentrates mostly on services as a countermeasure to product commoditization in the maturity phase (Cusumano *et al.* 2015). In Figure 1, we have positioned extant research (e.g., Davies 2004, Gebauer *et al.* 2005, Oliva & Kallenberg 2003, Sawhney *et al.* 2004, Tukker 2004, Ulaga & Reinartz 2011, Tuli *et al.* 2007) vis-à-vis the industry life cycle phases. Existing empirical work focuses mostly on the maturity phase. The general argument is that companies should shift from product-oriented to user-oriented and, finally, performance-oriented PSS in the later phases of the industry life cycle (Tukker 2004).

2.3. **Product service systems and industry life cycle**

Cusumano *et al.* (2015) propose the following relationship between industry life cycle and PSS. Under extreme cases of uncertainty and high costs, some product firms will offer use-oriented PSS and are much more likely to offer product-oriented PSS during the early phase. Use-oriented and performance-oriented PSS would play only a minor role.

For the transition phase, Cusumano *et al.* (2014) proposes that use-oriented PSS, in which product-oriented companies own the product and sell product-usage as a service, becomes more prominent, while a result-orientation plays an even more minor role than in the ferment phase. During the maturity phase, companies would increasingly substitute the purchase of the product and services with use-oriented and result-oriented PSS gain terrain. In the maturity phase, use-oriented and result-oriented PSS are argued to extend the product demand into new customer segments.

Naturally, companies in the early phase of the industry life cycle are mostly start-up companies, or in some cases incumbent companies tapping into such new industries. Resource endowments of start-up companies have to consider financial constraints, access to technologies, social capital and so on (Brush *et al.* 2001). The resources and capabilities discussed later have to consider these specificities.

2.4. **Resource-based view**

According to the resource-based view, competitive advantages emerge if a firm is able to develop a strategy that exploits the uniqueness of its resources and capabilities (Barney 1991). Resources are assets that a firm owns, but they do not necessarily confer competitive advantages. Capabilities are a firm's capacity to deploy resources to achieve a desired result (Helfat and Lieberman 2002).

Resources and capabilities for PSS in product-oriented firms

Resources include financial investments in the service business, devoting management attention and developing human resources. Investments trigger changes in organizational structure, such as separating the product and service business, and enabling the innovation of new services. Separation means that services become a strategic bu-

siness unit (SBU) in product-oriented companies. Investing financial resources in the service business are argued to pay off, only if companies reach a critical mass (Fang *et al.* 2008). Human resources are about recruiting, developing, and retaining service-oriented employees (Homburg *et al.* 2003). Managerial attention ensures the efficient development and implementation of a service-orientation within the business strategy (Gebauer 2009). Management attention is an important resource, since product-oriented capabilities can be 'sticky' and restrict the strategic options for developing and implementing service-oriented business strategies (Ceci and Masini 2011).

Capabilities for deploying these resources successfully include service-oriented corporate culture, such as service-minded employees and managers understanding the strategic importance of services. Further capabilities refer to the ability to promote, sell, and deliver services to customers (Gebauer *et al.* 2005), and to manage relational processes with customers (Tuli *et al.* 2007).

Managing relational processes with customers requires the ability to define customer requirements, customize and integrate products and services, deploy them, and offer post-deployment customer support. Capabilities for managing these processes are mandatory, in order, to meet customers' business needs (Tuli *et al.* 2007). These capabilities involve product-oriented companies themselves, as well as their customers. Product-oriented companies should be able to ensure an organizational contingency, where different organizational functions organize themselves in such a way that they solve customer problems. Companies should be able to formulate internal incentives for defining customer requirements, for customizing and integrating products and services and for deploying them, in order to offer post-deployment customer support. Finally, companies should be able to articulate the relational processes, so as to initiate stable customer interaction. Similarly, customers should adapt their own processes to a certain degree to the solution, through counseling product-oriented companies (Tuli *et al.* 2007).

Companies aim at converting service ideas into commercially successful services. Such success depends on the ability to be cost-efficient in service delivery and to charge for services. Cost-efficiency requires a certain balance in the standardization and customization of the service offerings. Charging for services needs to depart from giving them away for free to charging (Ulaga and Reinartz 2011, Witell *et al.* 2013).

Similarly, Storbacka (2011) discusses capabilities for solution development, demand creation, solution selling and solution delivery. Capabilities need to ensure the commercial success of bundling products and services into solutions, as well as cost efficiency. Cost efficiency relates to industrialization, which requires capabilities for modularizing services, implementing enterprise resource planning (ERP) systems or for pricing services according to *value-based* rather than *cost-plus* principles. Capabilities driving commercialization relate to the quantification of customer value, to matching customer segments with different value propositions, and to measuring customer profitability (Storbacka 2011).

Ulaga and Reinartz (2011) discuss specialized resources and capabilities for hybrid offerings, such as: installed base, product usage and process data, product development and manufacturing assets, product sales force and distribution network, and field service organization. To deploy these resources successfully, companies need distinctive capabilities such as service-related data processing and interpretation, execution of risk assessment and mitigation, design-to-service, hybrid offering sales, and hybrid offering deployment.

2.5. **Resources and capabilities in the early phase of industry life cycle**

These descriptions of resources and capabilities have been revealed mostly by empirical studies of companies facing the maturity phase in the industry life cycle. Therefore, they are most likely restricted to the special conditions of this phase. Resource endowments of companies in the early phase are different to established companies in the maturity phase. There is no opportunity to take advantage of a high installed base and intimate knowledge about product usage. Such companies have just started to sell products, so that there is a small number of product «installations». Such a small installed base makes it difficult to establish a cost-efficient spare part distribution network and field service organization. Continuous technological changes limit the knowledge of product reliability and usage, which makes it difficult to define spare parts and service requirements. Under these circumstances, the sales force faces frequent changes in customer needs, making it difficult to gain experience in sales practices for products and services.

Since customer needs are in flux and companies experiment with technologies, there is little product usage and process data, which makes the scheduling of maintenance activities difficult. Companies in the ferment phase might also be too small to reach the critical mass needed to provide services successfully (Fang *et al.* 2008).

While companies are still in their early stage, and provided they would focus on services from the beginning, they can develop a corporate culture in which a product and service orientation is balanced. Contrary to what may happen to companies that focus on products alone in their early life stage, the former companies would not need to overcome inertia (or turn back the clock) to become more service-oriented. Since no dominant design of the service portfolio and fixed business model has yet emerged, they can even avoid the tendency to offer services for 'free', as is frequently seen among product companies once they enter a stage where also services are demanded (Fischer *et al.* 2010).

These arguments show that generalizations on resources and capabilities derived from the maturity phase are not in the same way applicable to the early phase. We contend that we face a limited understanding of resources and capabilities for successfully providing services in the early phase of the industry life cycle. Therefore, we investigate the following research questions: What resources must companies develops to provide services in the ferment phase? and What capabilities are needed to deploy these resources successfully?

3. RESEARCH METHODOLOGY

3.1. Data sample

Given the relatively sparse literature on the shift from products to services in the early phase of the industry life cycle, we use a qualitative, discovery-oriented research approach (Glaser & Strauss 2009). The only exception is Sousa and Cauchick (2015) research on exploring and comparing the sustainability of PSS in the water treatment businesses. Similarly, our context is the emerging industry around decentralized water treatment technologies, such as: reverse osmosis, ultrafiltration, ultraviolet disinfection, chlorination, media filtration, and electrocoagulation (see Figure 2).

Our units of analysis are the product-oriented companies that develop, manufacture, and sell water treatment equipment. These companies are mostly start-ups and pioneering firms. They are in the water treatment business, which as such is a mature and established industry. What is new, however, is the down-scaling of these technologies into decentralized water treatment equipment, which provide safe and affordable water to people who have no access to the main water grid. Companies specializing on such decentralized water treatment equipment form a new industry branch within the water treatment industry.

Decentralized equipment of this kind is small scale, with a water volume corresponding to 1000 to 5000 households (2 to 100m^3 water per day). Communities (e.g., villages, small towns or urban districts) are customers for these systems. We use both terms «communities» and «customers» synonymously, with households being end-customers for the water. As long as the water is in line with the WHO guidelines for safe water, communities consider water as a public good (paying fixed prices as in a commoditized market), and are not willing to pay a higher price for higher water quality.

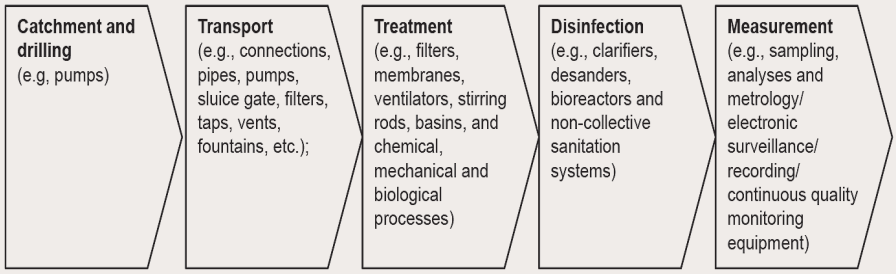
Companies market these technologies in emerging countries. In India, for example, the potential market size is estimated at 140 million households, which effectively have no access to the water grid. Currently, about 2000 systems have been installed in that country, providing water to approximately 6 million households. The former implies the industry life cycle is at an early stage.

We used a purposeful sampling process (Yin 1994). We screened international water programmes for promising providers of decentralized water treatment equipment. We contacted 11 equipment providers, of whom 9 agreed to participate in our study. We gathered data through in-depth interviews with, in total, 19 key decision makers. We used a 'replication' logic, rather than a 'statistical' logic. The total number of 19 interviews was considered as the point at which theoretical saturation is reached, since our results were upheld for the majority of organizations and made sense on the basis of prior research (Yin 1994). Our sample size is in line with those recommended for exploratory research (McCracken 1988). Eisenhardt (1989, p. 545), for example,

recommends that an ideal number of cases is «…a number between 4 and 10 cases». With more than 10 cases, it becomes to complex to manage the volume of the data.

Figure 2. **WATER TREATMENT EQUIPMENT MARKET**

Traditional value chain (products) for centralized, large scale water treatment plants



Market size

- Worldwide market for industrial and domestic water equipment is worth an estimated USD 187.5 billion USD
- *Equipment (22.3%*), On-Site Work (19.9%), Pipes (20%), Pumps & Valves (15.4%), Pipe rehabilitation services (15.3%) and Other (7.1%)
- Water equipment market (22.3%) is about 41,8 billion USD
- 41,8 billion USD is approx. standard process equipment (25.4%), mud treatment (16.5%), filtration systems and media (8.6%), disinfection (6.9%), diversion and screen (6,6%), meters (4,8%), and membranes (3,2%), others (28%)

Challenges jeopardizing the traditional value chain

- Increasing gap between water supply and water demand. Water demand is expected to increase from 4'500 billion cubic meter (2010) to 6'900 billion cubic meter (2030)
- Raising water quality issues
- Raising water scarcity

To cope with these challenges, alternative solutions are decentralized, small-scale, point-of-use water treatment equipment

- The increasing demand for clean drinking water and increasing awareness about the benefits of water treatment are some of the major factors for growth of the decentralized, small-scale, and point-of-use water treatment systems industry.
- Market was valued at USD 14.12 billion in 2014
- Growth rate is predicted to be 9.86% from 2015 to 2020 (e.g., reverse osmosis is the fastest growing technology in the water treatment systems market.
- In terms of application, the residential sector is the fastest growing segment, followed by the non-residential sector
- Technologies: reverse osmosis systems, distillation systems, disinfection methods, filtration methods, and others (adsorption, ion exchange, and electrolysis)
- Market segments: residential, non-residential, commercial, industrial, healthcare, educational Institutes, others (stadiums, railway stations, and airports)
- Geographical markets: Asia-pacific, Europe, North America, Rest of the World (RoW)

Source: Own elaboration.

We also aimed for diversity in terms of location, treatment technology, and organization type. The key sample characteristics in Table 1 show that the respondents represent social entrepreneurs and profit-oriented companies, which operate in geographical locations including Bangladesh, India, Kenya, Nepal, and Tanzania. The considered organizations still have a small number of installed equipment (2 to 405). In addition, they use different treatment technologies (e.g., ultrafiltration, reverse osmosis).

Table 1. **SAMPLE CHARACTERISTICS**

Interview number	Interviewee function	Case number	Type of organization	Installa-tions	Location	Treatment technology
1	CEO	1	Profit-oriented company	3	Nepal	Ultrafiltration for arsenic mitigation
2	Local entrepreneur					
3	Marketing manager					
4	CEO	2	Profit-oriented company	50	Senegal	Reverse Osmosis
5	Technical assistant					
6	CEO	3	Social business	164	India	Reverse Osmosis
7	COO					
8	CEO	4	Non-profit organization	44	Tanzania	Solar water disinfection system
9	COO					
10	Sales manager	5	Profit-oriented company	2	Tanzania	Saltwater desalination.
11	Project manager	6	Profit-oriented company	40	Kenya	No water treatment (safe water source)
12	Technical advisor					
13	Project manager	7	Social business	2	Bangladesh	Filtration (sand filter, chlorination)
14	Project manager					
15	Sales manager	8	Profit-oriented company	405	India	Reverse Osmosis, Ultra-Violet Disinfection (UV)
16	Regional manager	9	Profit-oriented company	125	India	Reverse Osmosis, electro-coagulation, UV, electro chlorination, ultrafiltration, ion exchange
17	Sales manager					
18	CEO					
19	Regional manager					

Source: Own elaboration.

3.2. **Data collection**

Since we relied on key informants, we interviewed decision makers who played a vital role in the scaling process. The interviews lasted 30 to 90 minutes each, and were semi-structured, providing a general framework followed up with additional questions requesting clarifications, examples, and more detail on potentially useful resources and capabilities. All interviews were transcribed verbatim.

In the first part of the interview, we asked for details on how companies provide services and how the whole PSS had evolved. Thus, we gained an understanding of each organization and its efforts to develop services. In the second part, respondents indicated the necessary resources and capabilities for the PSS. To facilitate the process, we asked participants to provide examples of specific successes, failures, and challenges in providing services. We attempted to understand how the capabilities and resources contribute to the success of the PSS, how the lack of capabilities and resources led to failures and how the capabilities and resources allowed overcoming certain challenges.

We phrased questions in an unobtrusive and non-directive manner, so as to avoid the pitfalls of excessively active listening (McCracken 1988). We facilitated the emergence of resources and capabilities, grounded in the managers' own language, rather than using pre-defined constructs. The interviews concluded with respondents describing themselves and their personal background.

3.3. **Data analysis and interpretation**

We used a grounded theory approach to identify capabilities and resources (Strauss and Corbin 1998). We relied on open coding, in which we first read through the interview transcript and then identified the critical resources and capabilities mentioned in the transcripts. We started with an analysis of each single interview, before conducting a cross comparison.

Specifically, we listed the resources and capabilities identified, defined each construct, specified its characteristics, and substantiated the construct with an example. Furthermore, we included only resources and capabilities which fulfilled the following criteria (Ulaga & Reinartz 2011, Tuli *et al.* 2007): (1) Is the insight into resources and/or capabilities applicable beyond the context of one participating firm (2) Did multiple participants mention the resource and/or capability? and (3) Does the resource and/or capability go beyond the obvious ones, so as to provide useful conclusions for theory building?

To ensure the reliability of our findings, two independent judges reviewed the interview transcripts, and verified the accuracy of the resources and capabilities we identified. Interjudge reliability (Perreault & Leigh 1989) was calculated at .83, which is above the .7 threshold recommended for exploratory research (Rust and Cooil 1994). To enhance content validity, we also provided the participants with summaries of the interviews and with the emerging resource-capability framework. Participants returned comments, indicating their agreement with the structure of our framework, and on several occasions, suggested small changes to the wording, to increase conceptual clarity. We kept all organizational names and participants confidential. Finally, we presented and discussed our resource-capability framework in a group discussion, in which participants shared their views on capabilities, resources, and scaling.

4. RESULTS

4.1. Use-oriented PSS in the early phase of industry life cycle

Surprisingly, all participants argued that they aim for a user-oriented PSS and not for product-oriented and/or result-oriented PSS, even if there would be rationales for the latter two.

These three PSS have been described from a conceptual angle in the section on product service systems. Within the empirical context of the present study, result-oriented PSS suggests that the equipment provider would agree to a certain treatment cost per cubic meter of water. Treatment costs could be allocated according to the contamination level. Product-oriented PSS would also seem rational, since selling the equipment to communities with no access to safe and affordable water would generate revenue directly. The communities organize the necessary capital and pay for the equipment. Despite these rationales, one participant explained why they went for a use-oriented PSS:

> «When we first discussed how to approach the market, we assumed that we should try to sell the equipment and support the communities with traditional after-sales services. However, we immediately recognized that our customers [community villages] are not interested in buying any of our equipment. Instead, they just wanted to benefit from the safe water produced by our equipment. …They are happy paying for each cubic meter of water the community consumes».

Result-oriented PSS would also be an interesting approach to water contamination. Equipment providers could guarantee mitigation levels for water contaminants and translate them into a pre-defined water mitigation fee. One participant explained:

> «We observed that water sources differ in their water contamination level. Why not offer performance-based water contracts, where we charge for every mg of fluoride, for which we mitigate a fixed fee. We saw attractive benefits in such performance-based contracts. Treatment costs depend directly on water contamination. Having a fee for the mitigation level of water contamination would correspond very well with the treatment costs, avoiding the risk of pricing failures for the water itself».

While participants were inspired by the idea of result-oriented PSS, customers were against the implementation. Communities argued that they cannot influence the water contamination. Communities with high water contamination do not want to pay a higher fee and higher water prices than communities with less contamination. As one participant explained:

> «Water is still a human right. The government regulates water prices to make sure that everyone pays the same price. Even in countries where water prices are

not regulated, water committees in the communities decide on the water prices. These committees favor similar water prices across different communities».

Despite certain rationales for product-oriented and result-oriented PSS, we observed that resource development and capabilities focus on use-oriented PSS.

4.2. **Resources and capabilities**

Our data suggest four relevant resources for implementing use-oriented PSS (see Table 2): financial, technology, social and service resources. The next paragraphs discuss each resource as well as the capabilities for deploying them.

Table 2. **RESOURCE-CAPABILITY FRAMEWORK**

Resources	Capabilities
Financial resources	Attracting and negotiating with investors Writing financial proposals Innovating appropriate financial mechanisms Collaborating with banks in innovating the financial mechanisms Risk assessment, evaluation, and management skills
Technology resources	Managing multiple technologies Extending the competences towards enabling technologies Combing enabling technologies for data aggregation and for risk management Outsourcing the development and manufacturing multiple technology assets to suppliers Integrating suppliers into the use-oriented PSS
Social capital	Engaging customers in a dialogue Exploring both recognized and unrecognized needs. Shifting the dialogue from water needs to more social ones Experimenting with the most promising target communities Reducing moral hazard problems
Service resources	Sharing operation & maintenance competencies between customers and equipment providers Standardizing services Prioritizing the sustained service operation in relation to customer demand Expanding the service network.

Source: Own elaboration.

Financial resources and capabilities for deploying them

We observed that use-oriented PSS influence financial resources in three different ways. First, use-oriented PSS are about selling a commodity, for which it is difficult to differentiate the equipment through the actual technology. One participant explained:

> «Water is a commodity with very low margins …As a provider of an innovative water treatment technology, with high investments in R&D, you would normally assume that you generate a high profit margin. You should achieve technical differentiation and a price premium. However, by providing water as a service, we are in a low margin business».

Second, these low margins lead to very long amortization periods. Companies need financial resources to pre-finance equipment and it takes a couple of years until the community pays it off. One manager explained:

> «Our equipment costs around 5000 SFr [USD 5400]. That does not sound like much. But consider that we still own the equipment and provide water as a service. Consumers do not pay more than a couple of cents for a 20-liter jerry can. It takes at least five years until we make enough money to cover our equipment costs. As a start-up, we don't have the financial resources to own and pre-finance much equipment».

Third, it is difficult to link costs and the water price. Water prices are fixed, and independent of usage (water volume) and performance (water treatment). Whether companies sell only little or a lot of water, or mitigate low or high contamination levels, the treatment costs differ, but the price for each m^3 is more or less the same. Differences in water volume and water treatment lead to different costs. Companies can only convert these cost differences into different amortization periods.

Low margins, pre-financing requirements, and a missing link between costs and prices explain the relevance of financial resources. These come from external, rather than internal sources. Tapping into external financial resources means that companies (need to) gain access to investors, government grants, or start-up funds. Companies need a certain set of capabilities to successfully deploy the external resources. One participant argues:

> «…we gained access to external capital from a foundation. This foundation acted as an intermediary finance partner, by paying us for the equipment and refinancing itself with the water sales. …we were in a better financial position. …But getting there was a challenge. We needed to learn how to access and manage such external finances, and take advantage of them».

In other words, companies build capabilities to attract and negotiate with investors and to write financial proposals for governmental agencies.e One participant explained the capability development as follows:

> «When we first approached an investor, we were a bit naive. We thought it would be easy for us to convince the investor to support financially us …After the first meeting, we realized that it was far from easy. We got critical questions about our business approach …Who is your customer? How do you want to improve costs?, What are the business risks?, Why should we in-

> vest? …You can read such questions in every business textbook. What we realized was that we were not able to answer them well. There was a strong need to develop skills for attracting investments».

There is also a kind of tension or non-alignment between the ability to attract supporting investments (and the kind of sources to get financial support from, on the one hand, and the subsequent funding issues that rolling out a use-oriented PSS, on the other, demands. One company explained:

> «Naturally, we found that capital needs were different in each stage of our early company development. Initially, we could finance R&D through a start-up fund. We also received some seed money for funding costs of prototype units and covered early operating losses. But, we were very surprised that these traditional start-up funds were not able to cope with the subsequent financial issues arising from selling water as a service».

Some external financial sources enable companies to finance investments in technology, production, and marketing, but do not deal with the high up-front costs of installing equipment and the long and uncertain timeframe for amortization. To cope with the financial requirements of use-oriented PSS, companies develop capabilities for engineering appropriate financial mechanisms, together with financial service providers. One participant explained:

> «Our idea was to convince banks to make the agreements, which we have with communities using our equipment, into a financial service …We would transfer the equipment ownership to the bank. The bank would pay us directly for the equipment. The community would have one contract with a bank and also one with us. The contract with us is about the equipment maintenance. Here, we would guarantee a certain fixed monthly maintenance fee. The contract with the bank is about paying back the equipment costs. Every month, the community pays back a certain amount. The community generates the payments for operational fees and for the bank through regular water sales. Behind this financial arrangement is the idea that we would keep selling water as a service, but reallocate our risks to the bank. The bank itself would charge a risk premium for taking over the risk and include it in the community payments».

Companies reported that banks initially lack the skills for such services. They need to build the capabilities for developing and managing such financial services in collaboration with equipment providers and communities. The following anecdote from one participant illustrates the difficulties in developing such services:

> «When we first started to talk with banks about developing such a financial service, the bank managers did not really understand it. They were still thinking of traditional banking services. After our presentation, they ask:

> -'So, you want to offer a leasing model? Ok. Let's assume your equipment is leased. Your equipment costs are 100,000 RS (just over USD$2,000), the community pays 10% down and finances the other 90% of the cost; the lease term is 90 months. After 60 months, the community owns the equipment. Do you want us to calculate a leasing fee?'-. We needed to argue that this is not what we want. Our communities do not want to lease equipment, but want to have water as a service...».

To develop such financial services in collaboration with banks, companies need to manage the risks, or uncertainty about whether treatment equipment providing water as service will become financially sustainable. Risk management skills are critical, since companies are operating existing, and investing in new equipment installations. Companies ensure that investments in new equipment are not too risky to jeopardize existing installations. They have to enable banks to assess and evaluate the risks of each installation. Companies aggregate the individual risks into portfolio management for equipment. One organization, for example, systematically obtained information on the financial performance of each piece of equipment. It became evident that one out of three did not make enough money to amortize the investment costs, another third just amortize the costs, and one third actually made a profit. Similar to financial portfolio theory (Markowitz 1987), companies started to pool their risks across multiple systems. They built effective risk evaluation skills based on an in-depth analysis of previous projects. They are now able to select less risky equipment installation for their future portfolio. Interestingly, banks develop only a limited set of risk management skills, whereas companies themselves develop a broad set of risk assessment and evaluation skills. Banks restrict competence development to the pricing of risks for the financial schemes between bank, equipment provider, and community.

Technology resources and capabilities to deploy them

Companies -of course- need technology resources, particularly since the early phase is still about experimenting with the technology solutions. Companies build technology resources for multiple treatment technologies, rather than a single one. They also build resources for enabling technologies. The former means that companies focus not on one single treatment technology, but engage in multiple technologies developing multiple technology assets. While investing in a single water treatment technology has certain cost advantages, it does not allow dealing with all contaminations. One participant explained:

> «Our reverse osmosis technology removes …microbial and chemical contaminants reliably in a single process. It is modular and compact, but nevertheless, the technology costs [up to $17000 capital costs and monthly operational costs up to $330] are higher than other technologies. It is cost-efficient only in a certain context».

The market size for a single technology can be too small in the early phase. Companies, therefore, tend to focus on multiple water treatment technologies. Depending on the water source (ground water or surface water) and contaminants (fluoride, arsenic, iron, bacteria), companies offer a technology portfolio (e.g., reverse osmosis, ultrafiltration, ultra-violet disinfection). Such a broader technology portfolio is costly and means developing more technology assets. To cope with the costs, companies focus only on a narrow set of the assets for each technology. Most technology assets are manufactured externally. Companies typically stated that the technological value they create internally is only around 10% of the total.

Resources for enabling technologies go beyond the actual water treatment technologies. They include remote monitoring for water treatment, electronic water payment systems, and enterprise resource planning systems. The low level of installed equipment and scattered locations pose difficulties for viable maintenance support services. Remote monitoring systems are necessary to predict breakdowns, which reduce unscheduled maintenance costs. The relevance of electronic water payment systems was explained by one of the participants in the following way:

> «Since we offer water as a service, it is essential to track the water consumption. We could simply use a water meter, but we assumed that it is much more viable to deploy an electronic payment system, where each household gets a Radio Frequency IDentification-card to pay at our water distribution points. This would enable tracking the water consumption of individual households and the market penetration in terms of the percentage of households buying and consuming water …Such data would help communities to provide promotion activities for buying safe water. Therefore, each item of equipment now includes an electronic payment system».

Our data suggest several important capabilities for deploying the technology resources, such as multiple water treatment technologies and enabling technologies, successfully. Companies need to align use-oriented PSS with the business model of suppliers so as to more easily refinance the water treatment systems. One participant explained:

> «To reduce our financial risk, we asked our suppliers to deploy similar business models. Our pump provider was asked to charge for every m^3 of water pumped through the system, rather than selling us the pump …we minimized our own financial commitment and integrated the suppliers into our pay-per-use business model».

The data obtained through the electronic payment and remote monitoring system should be aggregated in enterprise resource planning systems. ERP systems can monitor service delivery costs and calculate whether an agreement on water as a service achieves the defined cost and revenue targets.

Social capital and capabilities for deploying it

Social capital plays a vital role in any business venture. Social capital is a generic resource capturing industry contacts, relationships with customers, or finance partners (Brush *et al.* 2001). In our context, building the relationships with communities is decisive, since participants expressed moral hazard problems with water as a service (Ulaga & Reinartz 2011). One organization emphasized that it observed by chance that one water kiosk was not keeping to the agreed opening times. Community members queued, but no water was sold. Naturally, members were complaining and as a result, water revenues that the community was expecting were not obtained. Apparently, there was a social conflict among the community members, of which the company was not aware.

Building such social capital only succeeds if companies deploy the following capabilities. Both companies and communities need to build mutual trust, which is a prerequisite for gaining access to households living in the communities, observing their practices, and exploring their preferences and needs. Without such information, companies cannot estimate water volume, water treatment costs, and, finally, decide whether it makes sense to approach the communities to install water treatment equipment. The ability to build trust has to be mutual, which means that customers have to ensure that the company does not face moral hazard problems. Building mutual trust faces certain barriers to customers. One participant reported that its customers often argued:

> «Organizations come to us and say that they are going to solve our water problems. But how can they solve our problems when they don't even know us? A number of times they don't even understand our social hierarchies and what we do on a day-to-day basis. Committing to a certain water price and volume requires a lot of trust …how do we know the organizations won't overcharge?».

Following the mutual trust building, companies need to select customers, who are promising in terms of water consumption and contamination. One participant explained:

> «India has a market capacity of some 140 million households. Approximately 100'000 villages could demand our small scale water systems. Even by focusing on one Indian state, there are still plenty of potential customers to choose from. Our challenge is how to select promising villages. We knew that we need villages where at least 1000 households commit to buy water continuously. We could achieve this by focusing on small villages, where the social pressure would help us ensure that close to 100% of the households would buy the water, or alternatively, bigger villages where only 20% of the households are required to commit to buy water. In that case, we would be less independent on social pressure».

Companies need to experiment with different community sizes until they reach the most promising ones. This is similar to the argument that companies need to understand how customers use the treatment equipment (Tuli *et al.* 2007). In one company, we observed that the initial target segment were villages with 1000 households, but among these households, only approximately 30% buy water on an ongoing basis. This was not sufficient to finance the maintenance and the investment in water treatment equipment. Companies learned that larger villages of about 4000 households are a better target market. However, such larger villages are less dense and more difficult to serve, since the installed base would be more scattered. As a result, companies need to link the customer selection to providing the service infrastructure, which is explained in the next section.

Companies need to engage in an intense dialogue with customers. It is not just about listening to them and trying to estimate the water demand and understand the technical skills for operating the equipment. A serious dialogue is necessary, since communities are frequently not fully cognizant of their own requirements and cannot easily articulate them. For this reason, companies need to ask the right questions so as to identify both recognized and unrecognized needs. An intense dialogue with customers is necessary to generate valuable information (Tsai and Ghosal 1998). Such a deep dialogue should not stop at water needs either, but go beyond them. A participant asserted:

> «A solution for our customers is when we propose bringing in value beyond the water provision. Rather than saying «here is water for .4 cents for a liter», it's more about finding what a community really needs, figuring out an adequate water distribution model, marketing campaigns for water, payment systems, and water pricing. We have to make sure these things are around to ensure that communities take advantage of water as a service».

Requirement definition is not just about asking customers for functional specifications of water volume and treatment. It is also about understanding broader social needs, including internal community dynamics processes or community hierarchies. One participant explained:

> «The community leaders often lamented suppliers' failure to understand the obvious need to minimize maintenance expenses and to manage water sales uncertainties».

To summarize, social capital can only be deployed by developing capabilities for engaging customers in a dialogue, in order to explore both recognized and unrecognized needs. This dialogue then shifts from water needs to more social ones, for experimenting with the most promising target communities and to reduce moral hazard problems.

Service resources and capabilities for deploying them

Water treatment equipment embedded in use-oriented PSS is a complex combination of hardware, software, and services. These combinations are customized according to the local conditions. A challenge in the ferment phase is that the number of installations is still too low to create economies of scale, especially for creating a service support structure. Relevant service resources cover the development of use-oriented PSS, the associated demand creation, as well as its sales and delivery. As the following explanation by one participant shows, service resources are at the core of success for use-oriented PSS:

> «Retaining the ownership, but not operating our equipment can become an Achilles heel in our strategy for water as a service. We can come, install our equipment and sell water as a service, …but what happens when there are problems in the equipment operation? We need to ensure operational support».

Service resources refer to human resources in terms of dedicated service teams usually consisting of technicians, electricians, water experts, and technology experts. Service resources are shared with the communities, which operate the equipment and in some cases, do some basic maintenance. The idea is to minimize service costs for the company and to build operation and maintenance competencies at the customer. One participant explained:

> «We train local community members to become responsible for operation and maintenance activities. The training generates local employment. For example, when community members became responsible for maintaining filters, some were able to find work doing pump maintenance».

Sharing service resources can increase the efficiency of the maintenance activities. One participant explained:

> «Water as a service requires regular maintenance… which costs significantly less than repairing a major breakdown during which operations have ceased. Regular maintenance ensures that all equipment required for treatment operates with minimal breakdowns. When our customers perform short daily inspections e.g. cleaning, timely backwashing, lubricating, and small adjustments), minor problems can be detected and corrected before they get worse and stop operations. Our own service employees can concentrate on more complex failures».

Such service resources need to be deployed through the following capabilities. Companies need to provide assistance in system setup and in training the customers to perform operations and basic maintenance. This includes providing incentives for the ongoing operation of equipment, building local capacity, creating and main-

taining household interest in safe water, and identifying and training technical service support at the customer level.

Companies need to expand the network of service stations, the number of the service employees, and service competencies. The network configuration of the service centers depends on the location of the customers, which is governed by the presence of water contaminants. Our participants argued that customer locations should not be the only driver for expansion and configuration of the service station network.

> «We have currently 52 equipment installations in one region. This region has a difficult terrain that limits the extent of viable operations and maintenance support services. If we were simply to fulfill the demand of every community facing contaminants, we could easily end up in a situation with excessively scattered locations, making it too cost-intensive to actually provide operations and maintenance support services».

Companies need to balance the locations of new equipment installations with other factors such as infrastructure availability, general size and terrain, viable scale of operation and maintenance support services. Among these factors, priority is given to sustaining service operations, rather than just satisfying the demand.

Related to prioritizing the sustained service operation, rather than customer demand for service network configuration, is the ability to build a specialized hierarchy of service teams consisting of technicians, electricians, water experts, and technology experts for providing the necessary customer support. To take advantage of such resources, companies must estimate the number of equipment installations that a service technician can realistically serve. They also need to estimate how reliably the customers operate and maintain the equipment. Since companies offer multiple water treatment technologies, each has different service requirements. Some technologies require regular maintenance activities, and others almost none. These factors lead to a wide range in the number of equipment installations that can be maintained by one service team.

Further capabilities for deploying service resources emerge along with the relational processes on customizing services and offering post-deployment customer support (Tuli *et al.* 2007). Companies reported building capabilities through advising customers on water delivery services. In some communities, water might be only available at the water points, whereas in some others, water is delivered and sold by retailers or micro-entrepreneurs distributing door-to-door or building a small network of water pipes. One participant explained:

> «The door-to-door delivery model increases the final cost of water, as the service provider must recover the cost of transportation in order to earn a profit. Developing the water distribution model is a knowledge-intensive

> service. Our employees built their knowledge from project to project, so as to understand what elements in the distribution work in which context and how they should configure the elements».

Even if water as a service seems highly standardized, there is a strong need to customize the operations and maintenance elements. One participant explained:

> «Remember, communities have very different competencies for operating and maintaining the equipment... There is no …one-size-fits-all solution.... Customizing operation and maintenance activities require employees who are open to that idea ...Customizing might be costly ...but if we do it right, it really can save money …in system operation and maintenance».

As the last part of the argument suggests, companies need to be able to deliver operation and maintenance support services cost-efficiently. This relates back to the previously mentioned ability to share operation and maintenance responsibilities and competencies between customers and equipment providers. In addition, companies should take advantage of enabling technologies. Remote monitoring can predict operational failures and assist customers in the operation and maintenance. Electronic payment systems support customers in analyzing the water consumption of individual households. Such a data analysis enables companies to provide advice services for water distribution to the communities.

To summarize, service resources can only be deployed by sharing operation and maintenance competencies between customers and equipment providers, standardizing services, prioritizing the sustained service operation in relation to customer demand and by expanding the service network.

5. **DISCUSSION**

5.1. **Theoretical implications**

Our findings extend the existing knowledge on services in product-oriented companies. Use-oriented PSS have been articulated as a promising approach to generating demand in the maturity phases of the industry life cycle. Our findings on use-oriented PSS (based on our research around water as a service) are similar to the idea of software as a service (Timmers 1998, Weinhardt *et al.* 2009). Here, use-oriented PSS are one option within the total offering. Companies can also offer other types of services and use them to leverage the financial risks of use-oriented PSS. The literature rarely reports on companies that offer only use-oriented PSS while they are in the early phase of the industry life cycle. In that respect, our providers of water treatment equipment are a unique unit of analysis, since they focus only on use-oriented PSS during the ferment phase of their industry's life cycle.

Our results -that use- oriented PSS dominate the early phase, question Cusumano *et al.*'s (2015) propositions that companies are not likely to offer use-oriented PSS, but rather product-oriented PSS while going through the ferment phase of their industry. Only under extreme cases of uncertainty and high cost, some firms will offer use-oriented PSS (ibid). We do not regard uncertainty and costs as relatively high for the water industry. We assume that the industry providing decentralized water treatment equipment is similar to other industries, such as decentralized energy generation equipment (e.g., biogas, wind power, solar panels). Uncertainty and costs can only be an explanation from a customer perspective. Customers demanding water as a service want to keep costs low and predictable.

We observed similarities between resources and capabilities in the ferment and maturity phase. Similarities occur at the resource level, but there are interesting nuances. For example, financial resources are needed for extending the service business in both the early and maturity phases. For the maturity phase, profit stemming from spare parts and field services provide the financial resources to invest in the service business. In the maturity phase, companies can thus finance use-oriented PSS internally. Accordingly, in the case of Rolls-Royce's power-by-hour service, the financial services are provided by internal finance departments (Gebauer *et al.* 2012). Observing that financial resources originate from external sources are, therefore, a theoretical advancement.

Collaboration between banks and product-oriented companies have been rarely reported and investigated in the literature. Our observation that banks are not prepared to finance use-oriented PSS is surprising. While there are no off-the-shelf finance solutions, it means that banks and product-oriented companies need to collaborate in developing the financial services to back up use-oriented PSS. This implies that banks have to go beyond their traditional financing concepts to be able to finance innovative start-ups or companies with novel business models.

Surprisingly, the ferment phase is not about a transition from products to services and a step-wise extension of the service offerings, even if services play a major role. On the contrary, once companies have developed all elements of a use-oriented PSS, they do not extend the service offerings, but rather «industrialize» the processes for selling and delivering use-oriented PSS, such as: demand creation, as well as sales and delivery of the use-oriented PSS. This confirms Storbacka's (2011) argument that companies need to focus simultaneously on commercialization and industrialization. Industrialization has been often neglected in the literature, since the emphasis has been on revenue generation, rather than cost efficiency. In line with Kowalkowski *et al.*'s (2015) argument that the transition should be coupled with activities for systemizing the services, our findings suggest that these industrialization activities occur even in the early phase of the industry life cycle. Normally, companies in an early phase of an industry life cycle are more likely to be concerned with revenue generation than cost efficiency.

Social capital and the need to deploy capabilities such as the ability to engage the customers in a dialogue on water needs and social needs substantiates Tuli *et al.*'s (2007) relational processes. Moral hazard as a potential challenge in use-oriented services, adds a new aspect to the relational processes. It follows Ulaga and Reinartz's (2011) argument that there is a classic moral hazard problem, where customer actions that the company cannot control, affect service performance. However, our finding suggests that both the product-oriented company (suppliers) and its customers can conduct moral hazard. Companies have to understand that customers also face moral hazard problems, since they cannot check if companies overcharge them.

Previous research has rarely discussed the role of technologies. Enabling technologies play a vital role for cost-efficient delivery (Kowalkowski and Gebauer 2012). Investments in such enabling technologies seem to pay off early in the phase of starting the service business. Remote monitoring and analyzing product usage is very valuable in the ferment phase. Remote monitoring and maintenance avoids high travel costs for sending service technicians to customers. When confronted with a few, regionally scattered, installed bases, such travel costs can comprise a major part of the service costs. As long as the equipment has not reached a dominant technology design, data on the actual technology usage, is very valuable for making technical changes and improving the equipment.

Our theoretical contribution is not limited to what resources and capabilities actually emerged in our data. It is also interesting to interpret, which resources and capabilities are not relevant for the ferment phase. As proposed in the literature section, building a service culture and avoiding a potential clash with product culture is not important in the ferment phase. Management attention is not a critical resource, since it does not require shifting attention from product strategy to service strategy. Managers seem to be initially aware of the use-oriented PSS as the adequate strategy in the early phase of industry life cycle.

5.2. **Practical implications**

Product-oriented companies trying to implement use-oriented PSS can visualize detailed facets of the capabilities we have identified, and assess their current strengths and weaknesses according to them. Our findings enable managers to take a close look at their existing capabilities and make strategic decisions for capability development. Practitioners can use our resource-capability framework as a guideline to make use-oriented PSS in the early phase of the industry life cycle more successful. We recommend building technology, financial, social and service resources and developing a broad set of capabilities for deploying them. While our discussion of resources and capabilities sounds rational, companies should understand that they differ from common practices in extending the service business. For example, relying on external financial resources and capabilities for co-

llaborating with banks to develop financial mechanisms to facilitate use-oriented PSS is new for most practitioners. However, practitioners need to understand that conventional banks are little prepared to finance innovative start-ups or companies with novel business models and are more into financing established firms and/or companies in conventional markets.

Practitioners need to understand the financial consequences of use-oriented PSS and develop adequate strategies for dealing with them. Similarly, practitioners should consider our findings in their sales strategy. Naturally, companies in the early phase of the industry life cycle are tempted to look for potential customers and might have a very opportunity-driven sales approach. However, while such an approach might lead to a situation, in which companies succeed quickly in recruiting a number of customers, this would not allow setting up a financially sustainable infrastructure for operation and maintenance support. To succeed in the ferment phase, companies need to balance the search for new customers with cost considerations for operation and maintenance support services. Similarly, practitioners should be aware that once they establish water as a service, there is a strong emphasis on cost efficiency, rather than commercializing services.

Considering insights into moral hazard problems, gaining a deep understanding of customer needs in terms of water demand and water treatment is important. However, without a systematic approach to building mutual trust, companies might get stuck in moral hazard situations. Organizations have to become more systematic in using customer insights for mutual trust building, before offering use-oriented PSS.

Altogether, our study identifies resources and capabilities that companies must develop to succeed with use-oriented PSS. Among the described capabilities, our experience shows that organizations may particularly fail to recognize the importance of enabling service technologies. Companies have their core competencies in water treatment technologies, and not in enabling ones. It requires significant investment to take advantage of remote monitoring, electronic payment or enterprise resource planning systems. Companies must ensure that they are not fully absorbed by daily improvements in core technologies, but deploy also initiatives to implement enabling technologies, which are an essential link to the issue of risk assessment, evaluation, and management competencies. These competencies are new for most companies, so that managers must recognize the importance of these competencies and develop them strategically.

5.3. **Limitations and further research directions**

Of course, our qualitative study has its limitations, although some offer promising directions for future research. A natural next step would be a transfer of our resource-capability framework to other industries in the early phase. For example, re-

searchers can apply our findings to decentralized energy systems using solar or biogas technologies to provide electricity services. Such an application of our resource-capability framework would provide a noteworthy contrast, revealing new insights, and also showing which elements in the framework could be generalizable. Furthermore, we mostly conducted interviews with key informants from the companies providing the water treatment equipment. Similar to Tuli *et al.*'s (2007) study, it would be interesting to obtain more information from the actual communities, in other words, the customers of the water treatment systems. Since one capability relates to adapting the business model of suppliers to the use-oriented PSS, it would be beneficial to triangulate with data from the supplier perspective. Although these limitations must be kept in mind, we are confident that our findings provide new insights for academics and practitioners alike.

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