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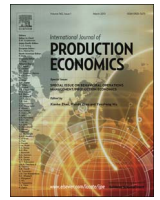
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## Exploring the managerial dilemmas encountered by advanced analytical equipment providers in developing service-led growth strategies



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### ABSTRACT

This paper examines the dilemmas encountered by manufacturers of advanced analytical equipment in developing service-led growth strategies to expand their business in pursuit of more attractive revenue models. It does so by adopting a case-based research approach. The findings detail the challenges faced in providing advanced services to customers' R & D functions, while simultaneously attempting to scale up these services for a production context. The emergent complexities of operating in multiple arenas in order to explore and exploit technologies in different contexts—along the three trajectories of serviceability, scalability and solutions—with a view to expanding markets and developing solution-based business models, are discussed. It is argued that manufacturers of analytical equipment encounter certain dilemmas, as managing the different trajectories involves different needs in the technological sophistication of equipment. This does not necessarily mean that one context is less complex than the other, but rather suggests that the role of integration is qualitatively different and that the relationship between product and service varies when developing solutions in these different arenas.

### 1. Introduction

The motivations for implementing service-led growth strategies in manufacturing are argued to vary depending on product complexity across different sectors (Raddats et al., 2016). Numerous examples of organizations, operating across a range of sectors such as aerospace, engineering and construction, are presented as attempting to make the 'shift' towards implementing services (see, for example, Johnstone et al., 2009; Baines et al., 2009a; Leiringer et al., 2009). These cases depict a change in the underlying business model in support of services (cf. Visnjic Kastalli et al., 2013; Vendrell-Herrero et al., 2014), referred to in the literature by various terms such as 'servitization' (Vandermerwe and Rada, 1989), 'product-service systems' (PSS) (Mont, 2002), 'solutions' (Tuli et al., 2007) and 'integrated solutions' (Davies, 2004). Generally, this trend means providing services to support product offerings, including fully fledged customizable solutions that address specific customer needs (Tuli et al., 2007).

It is advocated that organizations develop strategies in support of such trends, and the subsequent need to develop new capabilities in order to exploit opportunities in old and new marketplaces is emphasized. However, it is somewhat surprising that the literature is relatively sparse about the complexities of the relationship between products and services. The assumption seems to remain that moving

along the product-service continuum is primarily about changing the relative importance of goods and services (Tukker, 2004; Oliva and Kallenberg, 2003). This seems to neglect that developing more advanced forms of service can, in some contexts, require more sophisticated products, while in others it may involve reducing the sophistication of products. In addition, Spring and Araujo (2016) recently challenged the tendency in the servitization context to treat products as stable entities. Thus, we argue, managers face a number of dilemmas when the relationship between products and services is about more than characterizing their relative importance.

Consequently, research is required to understand service strategy configurations, the alignment of service with business strategy and service transition opportunities. Not enough attention has been devoted to analyzing the dynamics of strategy in which different service transitions occur concurrently as part of a differentiated business model. Only recently has some attention been given to the implications of pursuing multiple trajectories simultaneously in support of servitization (see, for example, Kowalkowski et al., 2015), in which the role and complexities of product and service offerings are vastly different, depending on the type of offering. Capturing such dynamics requires rich empirical material and a theoretical foundation, alongside a sensitivity and openness in order to capture the contextual complexity of such dynamics (Alvesson and Karreman, 2007).

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To this end, we focus on the context of advanced analytical equipment, where the complex nature of the product and the extensive knowledge embedded in the equipment provide opportunities for developing advanced services, yet at the same time reveal a complex relationship between product and service. The high levels of competence typically residing in organizations providing analytical equipment further add to the interesting nature of this context for study. In this paper, then, we take as our point of departure the case of three advanced analytical equipment providers who are each attempting to move towards service provision and solutions for different markets. Analytical equipment providers represent an ‘ideal’ case for studying the dilemmas faced in moving towards services, as although the dilemmas they may encounter can be said to arise in an unlikely context, it is then *probable* that those, or similar, dilemmas, will appear elsewhere, in more likely contexts (Flyvbjerg, 2006).

Therefore, the aim of this research is to understand the ways in which providers of advanced analytical equipment configure for service, and the dilemmas they encounter in pursuing multiple service strategies in different contexts. We adopt the following research question:

*RQ: How do providers of analytical equipment attempt to address dilemmas of product and service configuration encountered in pursuing advanced services?*

This paper is structured as follows: Section 2 provides the theoretical background and framework for this study. Section 3 discusses the adopted research methodology. Section 4 then presents the findings of the study by reference to the framework presented. This is followed, in Section 5, by a discussion of the findings and then we conclude, in Section 6, by outlining the contributions of the study, its managerial implications, limitations and avenues for further research.

## 2. Literature review

### 2.1. Expanding the market through services in search of resilient revenue

Manufacturers are argued to adopt a servitization strategy in light of economic, demand and competitive arguments (Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Baines et al., 2009a; Fischer et al., 2012; Raddats et al., 2016). It is a frequently espoused view in the servitization literature that such a strategy provides resilient revenues (Baines et al., 2009a; Baines and Lightfoot, 2014; Cusumano et al., 2015), as well as opportunities to expand the market base (e.g. Visnjic-Kastalli and Van Looy, 2013; Raddats et al., 2016) and reposition in the value chain in order to achieve competitive advantage (Bustinza et al., 2015; Elfving et al., 2015). Research would, however, suggest that a ‘critical mass’ needs to be reached in terms of services provided before firm value is impacted (Fang et al., 2008). Coupled with this, as pointed out by numerous scholars, there is the issue of the ‘service paradox’ that needs to be considered, whereby manufacturers may increase revenues but profits may not equally augment (Gebauer et al., 2005; Visnjic-Kastalli and van Looy, 2013).

Recently, the motivations for servitization have been discussed, with Raddats et al. (2016) suggesting that “manufacturers of complex products appeared more focused on stabilising revenue streams and increasing profitability through services” (p. 585). They provide an interesting distinction, highlighting that it is not only the non-core operational activities that some customers are willing to outsource to manufacturers providing services, but also parts of the core operational activity. This is particularly significant for providers of complex equipment who seek new means of expanding their markets through the provision of advanced services.

The literature is replete with different terms to describe the offerings that manufacturers provide when deploying a servitization

strategy to expand their market base (cf. Tukker, 2004; Baines and Lightfoot, 2013, 2014; Cusumano et al., 2015). These terms include ‘product-, use- and result-oriented services’ (Mont, 2002; Tukker, 2004), or ‘smoothing, adapting and substituting services’ (Cusumano et al., 2015) and ‘base, intermediate and advanced services’ (Baines and Lightfoot, 2013, 2014). Classifications such as those presented in the PSS literature are argued to assume a linear trajectory along a continuum from product to service and do not adequately account for service being multifaceted and multidirectional (Kowalkowski et al., 2015). It has been suggested that it is important to consider that the different categorizations used to describe services may “differ in terms of processes and key capabilities required to deliver them” (Story et al., 2016, p. 2). Moreover, the processes and capabilities required for implementing advanced services might themselves differ, depending on the context.

### 2.2. Multiple trajectories in support of advanced service

A great deal of the literature discusses at length the drive among manufacturers to move towards the provision of services to complement their core product offerings (e.g. Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Baines and Lightfoot, 2014). Within the literature on service-led growth, emphasis is increasingly placed on the strategic role of services (Gebauer, 2008; Lightfoot and Gebauer, 2011). This includes the formulation of service strategies (Gebauer et al., 2010) and the transition trajectories of manufacturing firms (Matthyssens and Vandembemt, 2010).

While there is a growing literature on how to organize for service-led growth, there remains scope for a better understanding of the diversity of product-service configurations and the business context in which different business models appear to be viable and the types of capabilities required. It may be that organizations are required to operate multiple business models within different arenas (Raja et al., 2010; Windahl and Lakemond, 2010; Kowalkowski et al., 2012, 2015). Firms may concurrently perform different roles and enact service strategies and thus pursue parallel business models. For example, companies may seek to expand their market through exploiting customized solutions by ‘becoming an industrializer’ (Kowalkowski et al., 2015), whereby opportunities for repeatability and scalability are sought (Davies & Brady, 2000; Davies et al., 2006; Storbacka and Pennanen, 2014). Such offerings are typically aimed at targeting alternative parts of customers’ value chains. This requires the ability to concurrently reconfigure operating routines for vastly different contexts (cf. Teece et al., 1997; Teece, 2007).

It is not uncommon for firms to consist of multiple business units, comprising distinctive arenas within which ideas of strategy are continuously contested by reference to different market sectors. Each arena will be characterized by differing priorities and institutionally-embedded modes of operating. The recognition that different business units are shaped by different path dependencies and, in response to an ongoing process of mergers and acquisitions, are in a process of continuous adjustment, is an important consideration (Leiringer et al., 2009; Raja et al., 2010). Such mergers and acquisitions may, in part, reflect a planned intent to acquire new capabilities for advanced services. It may be that it is not simple and straightforward to translate the capabilities of externally acquired businesses that emphasize services into other, different contexts. There is a need, then, to understand the alternative trajectories which an organization may adopt in moving towards advanced service provision. Moreover, in order to fully realize the benefits of any mergers and acquisitions, intra-organizational integrative capabilities need to be understood, in order to ensure the effective amalgamation of knowledge bases (Valtakoski, 2016).

Operating in multiple contexts presents challenges in the exploration of opportunities for advanced analytical services through pushing the boundaries of existing technologies, whilst, at the same time,

attempting to exploit these technologies in pursuing new market spaces (cf. O’Reilly and Tushman, 2008). For providers of advanced equipment, such as analytical equipment providers, this then presents the opportunity to expand their business and develop more attractive revenue models.

### 2.3. Proposed framework

In light of the above, the proposed framework set out below is one means by which the strategic intent of firms providing advanced analytical equipment may be captured. We have classified the strategic intent according to two dimensions:

- (i) A focus on resilient revenue from equipment-based and outcome-based sales, where customers are provided with longer-term contracts; and
- (ii) Expanding the market by selling to different parts of the customers’ value chain, thereby taking responsibility for customer operations.

In attempting to transition along the three trajectories indicated by the arrows in Fig. 1, we suggest that analytical equipment providers encounter certain dilemmas. Before we unpack these dilemmas, we explain below what each of the quadrants in the figure entails when moving from being primarily a product manufacturer, providing customer support services, towards the greater serviceability, scalability and solutions trajectories.

#### 2.3.1. Product manufacturer

This may be considered to be the position of most traditional manufacturers of advanced analytical equipment, with the majority of revenues from selling products being used for research and development (R & D), testing and quality assurance (QA) purposes. Due to the cost and complexity in the use of advanced analytical equipment, those revenues are primary applied within the R & D labs and QA functions of the product manufacturing organizations. Application often requires the specialist knowledge of engineers and equipment is accessed through purchase. For these types of organizations, the main capabilities lie in the technological and reputational assets built-up over time. Calibration and installation services are typically offered as after-sales activities and are ordinarily tightly integrated with the product characteristics. Such support is frequently a prerequisite to ensure the functioning of the products (Goffin, 1999; Goffin and New, 2001).

#### 2.3.2. Serviceability

As part of the strategic intent towards generating resilient revenue,

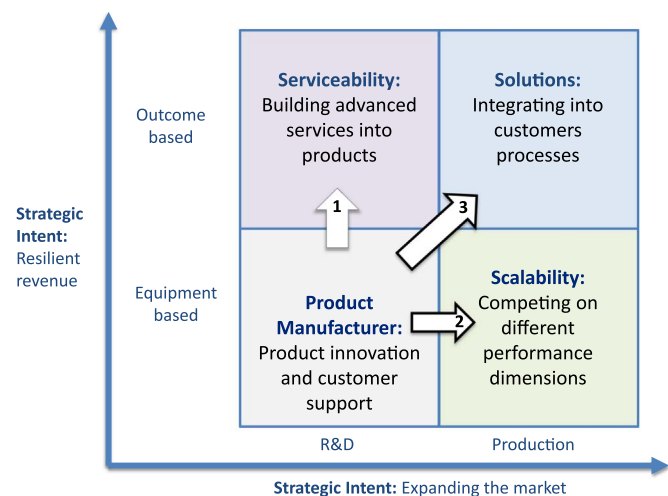


Fig. 1. Multiple trajectories for service-led growth.

the possibility of providing enhanced service offerings are enabled through remote monitoring capabilities, offered as smart or digital services (Baines and Lightfoot, 2014; Grubic, 2014). Part of the challenge for organizations is building services into their product offerings. Advanced services may involve access to equipment based on alternative ownership arrangements, such as fleet management solutions, pay per use arrangements (Baines and Lightfoot, 2013) or outcome-based contracts (Ng and Nudurupati, 2010; Ng et al., 2009). A key challenge is convincing customers to enter long-term service agreements, which involves developing the necessary capabilities and service mind-set among sales personnel (Story et al., 2016).

#### 2.3.3. Scalability

With an intent to expand the market by exploiting the product, the literature suggests targeting alternative parts of customers’ value chains. For manufacturers of analytical equipment, this implies using existing products and capabilities to develop a product market targeted at customers’ production lines. This involves facilitating the seamless integration of analytical equipment into production lines in order to meet the requirements of customers. A key strategic question when expanding the market is how the characteristics of the R & D activities and production differ, and the implications of those differences. Additional relevant questions relate to which customer segments to target, the degree of complexity of equipment for different contexts and differences in performance criteria upon which the organization is measured (Ostrom et al., 2015; Bititci et al., 2012).

#### 2.3.4. Solutions

Here, the strategic intent is to change the underlying business model of the manufacturer to one which will allow a customer to effectively outsource their operations to the manufacturer. This entails the manufacturer providing a customized solution that meets the specific need of a customer (Tuli et al., 2007) and, inevitably, requires integrating into the customer’s processes. Products form part of the solution offering which addresses the specific customer need. Opportunities to move into the production line of a customer may be constrained by the manufacturer lacking access to decision-makers at the right tier of the customer organization, or regulatory constraints. Other challenges may involve the extent to which the customer considers outsourcing operations a core activity of its business, though recent evidence would suggest even core activities might be outsourced (Raddats et al., 2016). The research literature discusses at length the need for relational capabilities in order to convince customers to acquire solutions (Oliva and Kallenberg, 2003; Penttinen and Palmer, 2007; Tuli et al., 2007; Raja et al., 2013). The ability to provide such an offering may require the manufacturer to cultivate its learning and development capabilities, or acquire them externally through mergers and acquisitions or partnering with other organizations.

Original equipment manufacturers (OEMs) then may, in moving towards increased service provision, select different or multiple trajectories, as indicated by the arrows in Fig. 1. This proposed framework is one way of illustrating the opportunities and challenges faced by OEMs of analytical equipment. Research is then required to understand the service strategy configurations, the alignment with business strategy and transition opportunities. The predominant view largely involves a change in business model towards one which is focused on more advanced forms of service strategies. Less attention is devoted to capturing the dynamics of strategy in which different transitions occur simultaneously as part of a differentiated business strategy.

### 3. Research methodology

Research in the servitization domain has, of late, steadily increased. However, understanding the dilemmas encountered by providers of

advanced services in the pursuit of more attractive revenue models requires further insight. As such, an in-depth qualitative case study approach (Flyvbjerg, 2006; Edmondson and McManus, 2007) was adopted in this study in order to understand how providers of advanced analytical equipment are attempting to ‘shift’ towards the provision of enhanced service offerings. Particular attention was given to understanding how the different business divisions within the firms studied enacted different service strategies. Advanced analytical equipment providers constitute an ‘ideal’ case to study, given the inherent complexities (Flyvbjerg, 2006).

An abductive approach was deemed appropriate, characterized by an iterative and ongoing process of engagement with both literature and empirical data (cf. Dubois and Gadde, 2002). The research followed a distinct approach, whereby initially a case study protocol was developed, based on the extant literature (Yin, 2009). The protocol included broad areas of potential interest to be explored within the case organizations, in order to understand the context in which they operated. It was deemed important not to prematurely emphasize any specific areas, but rather allow for issues of interest to emerge organically from the case organizations. As such, over time, the interview protocol was revised by reference to the issues and themes emerging from initial conversations and interviews. This allowed for questions to be clarified and any glaring omissions to be addressed, which, in turn, allowed for an increased sensitivity to the contexts of the case companies.

As the research progressed, the interview protocol was developed further to incorporate emerging themes, allowing for deeper exploration of the developing insights (Strauss and Corbin, 1990). This phase may be described as being highly abductive, given the continuous examination of the insights emerging from the empirical data and the theoretical insights evident from the research process itself (Lewis, 1998; Dubois and Gadde, 2002; Järvensivu and Törnroos, 2010). In this stage, the team of researchers was able to check their developing understandings against that of their colleagues. Lastly, the findings from the study were fed back to the case organizations in strategy workshops with senior management, allowing for validation and also providing a forum in which it was possible to glean additional insights and refine our understanding further.

### 3.1. Case selection and data collection

The three case organizations reported in this study form part of a wider, large-scale servitization research project being undertaken in Denmark. All three companies are OEMs producing advanced analytical equipment and represent a special case for which the provision of advanced services seems to be particularly promising, given the nature of the equipment and the analytical capabilities residing within the firms. These potentially positive prospects were important when selecting the three firms to be the focus of this study. Each is considered to be the market leader in their respective niche and is recognized as having invented its field and for being at the forefront in terms of the equipment they provide. It is only relatively recently that services have become a strategic commercial priority for these firms. Services were typically included as part of an equipment sale or sold separately with a substantial margin, yet without sufficient revenue to attract significant management attention. However, this approach is changing, particularly as advanced services are found to be both in demand by customers, financially attractive and in line with the firms’ capabilities.

R & D is important for all three companies and is tightly linked to their analytical capabilities on which they each rely to develop their respective advanced services. However, the intricate relationships between equipment, service and the context of equipment use, evident in each of the three cases, is demonstrative of the complex and dynamic relationship arrangements that exist in practice, which go beyond what the previous literature portrays. That dynamism also presents managers with the question of which trajectories to pursue in seeking to move into service provision. When pursuing multiple trajectories simultaneously, less sophisticated equipment may be required, which paradoxically can be a challenge in technology-driven organizations. Similarly, what in other situations may be called ‘base’ and ‘intermediate’ services, such as repair and calibration, can become part of a complex service delivery system which supports the expansion of equipment use into customers’ production process.

Table 1 provides an overview of the data collected in each firm—that being, Brüel & Kjør Sound & Vibration Measurement A/S, FOSS Analytical A/S and Radiometer Medical ApS. Data were collected from

**Table 1**  
Data sources.

<i>Case firm</i>	<i>Data type (interview, workshop, etc.)</i>	<i>Position of respondent</i>	
Brüel & Kjør Sound & Vibration Measurement A/S	Interview, workshop	Group Quality Manager	
	Interview	Innovation Manager	
	Interview, workshop	Vice President of R & D	
	Interview	R & D Manager, Software Development	
	Interview, workshop	Global Solutions and Support Director	
	Interview, workshop	Vice President of Operations	
	Interview	Vice President of Production	
	Interview	Vice President of Strategic Marketing	
	Interview, workshop	Product Marketing Manager	
	Interview, workshop	Group Logistics Manager	
	Interview, workshop	Production Engineering Manager	
	Workshop	Business Development Manager (Calibration & Repair)	
	FOSS Analytical A/S	Interview	Market Manager, Aftersales
		Interview	Concept Developer
Interview		Senior Manager, Aftersales	
Interview		Head of Business Development	
Interview		Business Development, Project Manager	
Interview		Business Development	
Radiometer Medical ApS	Group interview	Service Innovation Team	
	Interview	Director of Customer Care	
	Interview	Global Product Manager	
	Interview	Market Intelligence Manager	
	Interview	General Manager, Nordic Sales	
	Interview	Senior Specialist, IT Solutions	
	Group interview	Service Marketing Team	

key informants, primarily through semi-structured interviews and workshops. Prior to data collection, extensive discussions were held with key gatekeepers, both to negotiate access and understand the organizational backgrounds.

With respect to Brüel & Kjær, 11 semi-structured interviews were conducted, including interviews with the vice presidents of R&D, strategic marketing, operations and production. Other respondents included the quality, marketing, logistics and innovation managers, as well as a business development manager. The interviews ranged in duration from just under one hour to 120 minutes. In addition, the research team facilitated a workshop, which included interviewees (see Table 1), to discuss the findings of the study and the strategic implications of the proposed model.

In FOSS and Radiometer, 7 and 6 semi-structured interviews were conducted with personnel, respectively. The sample included marketing and sales managers, business development managers, general and product managers, a solutions specialist, a director of customer care, and a concept developer. The length of the interviews ranged from between circa 50 to 100 minutes. In addition, focus group interviews were conducted with the teams responsible for developing services in both FOSS and Radiometer.

In total, 24 interviews were conducted across the three case organizations over a two year period. All interviews were transcribed verbatim and carefully reviewed by the research team. Where it was deemed necessary, specific points made in the interviews were clarified. In addition, a research assistant made extensive notes during all interviews conducted, which included observations and insights developed during each interview. These notes were checked by one of the authors, who were present at all interviews. Extensive reference was also made to archival sources, including published annual company reports, external documents and relevant marketing material. These sources were then used to corroborate the respondents' accounts. The researchers also made numerous visits to the organizations' corporate headquarters, viewed product showrooms, observed production operations where possible and partook in numerous informal conversations in the staff cafeteria with employees during visits.

### 3.2. Data analysis

Data analysis was conducted using each of the different sources mentioned above. Initially, following Eisenhardt (1989) and as each interview was conducted, within-case analysis was performed with each case organization. This allowed us to probe and incorporate emerging issues, reverting back to the literature in order to enhance our understanding. For each case organization, data from interviews, workshops, focus groups and archival sources was coded by one of the researchers using Nvivo software. Subsequently, another researcher then recoded a segment of the data as an independent check. This was followed by a case report on each of the case organizations, detailing important facts about the companies, which were extracted from the interviews, reports and websites.

Subsequently, a cross-case analysis of the three case organizations was performed. This allowed us to infer patterns in the data and develop the conceptual model presented in the findings. The model was then validated with the case organizations in the workshops.

### 3.3. Company backgrounds

Access was secured across the case organizations, being three large Danish manufacturers of specialist analytical equipment. All three companies operate in niche markets in which business customers are predominantly targeted. Each have a long history of product innovation and are renowned for superior quality and product excellence. Table 2 provides an overview of the case firms.

#### 3.3.1. Brüel & Kjær Sound & Vibration Measurement A/S

Our first case firm, Brüel & Kjær, is a leading player in providing advanced measurement equipment to a global market. It is known for providing what is described as the 'Rolls Royce' of equipment for carrying out measurement within its field. Offerings are not limited to manufactured equipment but also the provision of software and applications to conduct analysis. It has always provided customer support services for its equipment in terms of calibration and repair. In more recent times, the service offerings have been expanded to cover a broader range of services, such as service agreements and customized solutions. Brüel & Kjær is headquartered in Denmark and has expanded through the acquisition of business units into the United Kingdom and Australia.

Of the companies acquired, one had a very advanced service business for a market in which it operated. This business is now, within Brüel & Kjær, tasked with taking over a range of activities from its customers, which it subsequently offers as a subscription based on the outputs generated. The second acquisition works with large stationary equipment and has a well-developed unit of service engineers who visits customer sites and perform inspections and repairs. Finally, Brüel & Kjær conducts a range of training and installation services, as well as providing engineering services.

Brüel & Kjær has close to 500 employees and an annual turnover of almost 125 million Euros. Its acquisitions in the United Kingdom and Australia were primarily motivated by an aspiration to achieve a full product range, covering all aspects of measurement and analysis within its field, as well as to acquire competitors with novel business models, operating within one of its target segments.

#### 3.3.2. FOSS Analytical A/S

Our second case firm, FOSS, is a leading player in the provision of analytical solutions in the routine testing of agricultural food and dairy products, both in laboratories and production. FOSS provides a comprehensive range of services designed to ensure reliability of instruments, including the remote monitoring of equipment and extensive training programs for customers.

It has established a service organization, which has included assigning the responsibility for service development to their business development function. Service agreements have been developed and are marketed and sold by the sales organization, where a separate unit for service sales has been established. Service engineers are employed locally by sales and service subsidiaries and central service hubs have been established in order to ensure the existence of customer-accessible facilities for repair and maintenance of equipment.

The company is headquartered in Denmark and has offices in 30 countries worldwide. It has over 1300 employees, over 300 of which are dedicated to providing services, including software, application and calibration specialists who can deliver on-site support. The company's annual turnover exceeds 260 million Euros.

#### 3.3.3. Radiometer Medical ApS

Our third case firm, Radiometer, is a leading provider of medical equipment used for performing analysis of blood samples of critically ill patients in hospitals. The equipment is used in hospital laboratories as well as for bedside testing in intensive care units. The company offers installation, training, and integration with hospital information systems, as well as advanced monitoring services.

Radiometer has developed service capabilities, which are organized by its local sales subsidiaries and from which service engineers are deployed on request. Furthermore, the company takes on a substantial role in ensuring that equipment is installed and that its proprietary software is integrated with hospital information systems. Training is of particular importance to hospital customers, in order to ensure that hospital and laboratory staff are capable of operating the equipment and compliant with relevant regulations and accreditation. Advanced services have been developed by the central organization in relation to

**Table 2**  
Company overviews.

Firm	Turn-over EUR	Staff	Product offerings	Service offerings	Countries with operations
Brüel & Kjør Sound & Vibration Measurement A/S	125 million	490	<ul style="list-style-type: none"> <li>– Transducers</li> <li>– Analyzer platform</li> <li>– Analysis Software</li> <li>– Measurement Frontends (hardware)</li> <li>– Hand-held Analyzers</li> <li>– Shakers and Excavators</li> </ul>	<ul style="list-style-type: none"> <li>– Installation</li> <li>– Training</li> <li>– Service &amp; Support Contracts</li> <li>– Software updates and revisions</li> <li>– Calibration</li> <li>– Maintenance</li> <li>– Repair</li> <li>– Spare Parts</li> <li>– System Modification</li> <li>– Rental</li> <li>– Standard Product Warranty</li> <li>– Environment Management</li> </ul>	<ul style="list-style-type: none"> <li>– England</li> <li>– Denmark</li> <li>– Australia</li> </ul>
FOSS Analytical A/S	269 Million	+1300	<ul style="list-style-type: none"> <li>– Various Substance Analyzers</li> <li>– Network Software</li> <li>– Analysis Software</li> </ul>	<ul style="list-style-type: none"> <li>– Customer Support Services</li> <li>– Training Courses</li> <li>– Preventive Maintenance Agreements</li> <li>– Remote monitoring</li> <li>– Pay-per-sample</li> </ul>	<ul style="list-style-type: none"> <li>– 30 countries</li> </ul>
Radiometer Medical ApS	+500 Million	+3300	<ul style="list-style-type: none"> <li>– Analyzers (hardware)</li> <li>– Analysis software</li> <li>– Equipment Connectivity</li> <li>– Software interface with Hospital and Laboratory Information Systems</li> <li>– Consumables</li> </ul>	<ul style="list-style-type: none"> <li>– Installation</li> <li>– Training</li> <li>– Documentation</li> <li>– Remote support</li> <li>– Remote monitoring</li> <li>– Customer care management</li> <li>– Service contracts</li> <li>– Pay-per-test agreements</li> </ul>	<ul style="list-style-type: none"> <li>– 130 countries</li> </ul>

efforts to ensure the connectivity of equipment and coherent marketing of service offerings. These developments are aligned with developments in equipment, software and organizational processes.

With more than 3300 employees worldwide, Radiometer provides premium healthcare equipment and solutions to hospitals, clinics and laboratories in over 130 countries. The company is headquartered in Denmark and has a turnover in excess of 500 million Euros.

**4. Findings: multiple trajectories for service-led growth**

In this section, we consider the case organizations by reference to the framework presented in Fig. 1, as set out in Section 2.3. In our analysis of the data, we found that each company is attempting to weigh the challenges and opportunities in seeking to move, simultaneously, in the different directions indicated by the arrows in Fig. 1—that is, towards serviceability, scalability and solutions. We consider below the evidence of these moves as well as the implications, or dilemmas, faced in the shifts.

*4.1. Product manufacturer*

All three case firms are best described as traditional manufacturers of highly sophisticated and advanced analytical equipment, which is highlighted in the bottom left quadrant of Fig. 1. Most revenues are derived from the sale of products which are primarily used to undertake R&D in laboratories, QA and for medical testing purposes. Customers access the equipment through purchase, whilst its application often requires the specialist knowledge of engineers.

For all three firms, the main capabilities lie in mobilizing technological and reputational assets, which have built-up over time as a result of the quality of their equipment, as well as their capacity for accurate and efficient measurement. This is reflected in the following comments:

*“We have very high spec products because that’s what they ask for - accurate. They want to have it calibrated so you can trust your measurements and that’s our old core market”* (Group Logistics Manager, Brüel & Kjør)

The specification and sophistication of equipment, coupled with reliability, has traditionally been the primary performance criteria. In all three firms, respondents acknowledged that while the traditional focus had been on the hardware side of the analytical equipment, there has been a more recent drive towards a stronger focus on software and services. This is illustrated in the following quote:

*“When I started [5 years prior to the interview] we looked very much at ‘this is a hardware box. Does it deliver the analytical measurements we believe?’ And that was it. We didn’t look at all at the sales channels or anything. It was just, here is a box, go sell. Whereas we become more all-inclusive in the way we work now”* (Head of Business Development, FOSS)

To ensure the effective functioning of equipment, calibration and installation services are typically provided as after-sales activities, tightly integrated with the product characteristics. Such support is considered a prerequisite to ensure the correct functioning of the products (cf. Szwejczewski et al., 2015).

Whilst Brüel & Kjør’s equipment has few moving parts, the equipment of both FOSS and Radiometer is more complicated, as the analysis of liquid content involves wear-parts and delicate processes. This complexity is illustrated in the following:

*“Analyzers are quite complicated because it’s – that’s a PC with some software, software can fail, but that’s really the easy part. And then there’s the whole chemistry department you can say, a lot of valves and tubing and we have to move around, like puncturing, micro-tainers blood, get the positions in the right places in front of faulting different sensors and need to get it out again and get it clean so the next patient result can go through without problems. There’s a lot that can go wrong”* (Senior Specialist, IT Solutions, Radiometer)

Although all three case firms are successful in their respective areas, our data suggests that within each company, there is a concern to turn towards services in order to grow revenues, while also seeking to ensure increased resilience. However, for each of the three firms, specific considerations exist which make the issue of assessing the risk of changing the business model very contemporaneous.

In Brüel & Kjær, there is an awareness that the firm has previously ventured too far from its center, with severe financial implications. Based on its core technology, Brüel & Kjær developed products for adjacent markets, bringing it in direct competition with some of the world's largest medical equipment providers. This turbulent period was described as an almost 'near death experience', and brought the company to the 'verge of bankruptcy'. The then family owners were required to sell the company, resulting in significant cutbacks and outsourcing. The historical past still looms large inside the organization and strategic decisions in moving towards services are conditioned by previous experiences. The issue of risk is therefore an important consideration for Brüel & Kjær. It has also been very careful not to force a customized solutions approach into the traditional business of producing measurement equipment. Rather, it has allowed the recent acquisition of a solution provider that incorporates its own measurement products (as well as competitor measurement equipment) to operate within its specific target market, while seeking to transfer experiences into the core business and seek applications with existing customers.

In FOSS, there is an appreciation of the need to integrate in-line equipment with the equipment of other providers in an environment which the firm does not control. Furthermore, there is an acute awareness of the difficulty in assessing the financial impact of moving towards pay per use contractual arrangements, where the supplier bears the cost of service provision, as is illustrated in the following:

*"I think that concern is more internally focused that if we do move into pay per analysis or something, it is more in terms of the cost of service. Because then that is on us also. So I do not think we are going to move radically over to the cost per sample or cost per analysis or one of these, whatever it might be before we are comfortable that the cost of service and the instruments is going to be minimum"* (Head of Business Development, FOSS)

To this end, the service development team undertakes risk analysis when developing offerings for different market segments.

In Radiometer, there is an awareness that the firm's razor-blade business model has always been, and remains, very successful. Although advanced services can supplement this product-focused business model and enable differentiation, there is a risk that such supplementation may undermine the profitability of consumables if customers focus exclusively on price per sample. Furthermore, the complexity of the healthcare systems in which its equipment is used suggests a clear risk in relation to the operation of equipment or operational responsibility. For the same reason, Radiometer is reluctant to offer consultancy services, although it is aware that this could be within the scope of its capabilities.

#### 4.2. Trajectory 1: Serviceability and the dilemma of closeness

Each case firm expressed a strategic intent to generate resilient revenue through advanced service offerings. The possibility of providing enhanced services is enabled through remote monitoring capabilities, offered as 'smart services'. Part of the challenge for each company is building services into their product offerings and convincing R&D customers to use the technology. This trajectory towards serviceability presents the dilemma of closeness, which requires customer insights to be obtained in order to develop complex service offerings, while customers are reluctant to provide the necessary access to information needed for developing such insights.

For the three case firms as providers of analytical equipment, the provision of advanced services has the potential to create analytical integration capabilities. This would involve using analytical capabilities to increase the scope of measurement systems, in order to provide an overview and insight beyond the individual measure. In essence, this would require increasing the sophistication of the equipment to facilitate remote monitoring and analysis of the measurements. For

customers with a globally distributed application of the analytical equipment, this offers the potential to significantly increase the value of the measurement system:

*"... there's a huge stream/pool of data that need to be analyzed, and today, I mean, one big problem that they have is it's not always there that they can find it, sometimes they have to re-measure because they can't find the original measurements. Because it was stuck on somebody's PC and he left the company, or something like that. Management of data is a big subject these days"* (R&D Software Manager, Brüel & Kjær)

Realizing this potential implies drawing on the analytical capabilities of the provider, but also on developing the necessary infrastructure to capture and process data from equipment, including sensors and cloud-based software platforms.

However, this process has been found to not be so straightforward. The complexity in offering such advanced analytical services was accompanied by a reluctance on the part of customers to allow providers of equipment to access their proprietary data. Secrecy surrounding customers' R&D and QA functions presents a significant barrier to providing increased serviceability:

*"And handling those data is mathematics really. Some customers they won't allow us to pick up that data because they see it as integral part of their business, some of them allow us to actually get the data..."* (Senior Manager, After Sales, FOSS)

As such, there has been limited interest in allowing FOSS, as providers of analytical equipment, to gain insight into customers' operations. Brüel & Kjær faced a similar predicament. Consequently, part of the challenge in offering advanced analytical services is to create solutions which allow others (the customer) to develop analytical insights, while ensuring that the providers obtain only limited knowledge. Similarly, within the healthcare context, the ability to provide a solution which integrates sampling, testing and analysis with the hospital information system is of primary importance:

*"And all the information can then be keyed into the blood gas instrument and actually then go into the hospital information systems. And that's one of the things that the software is doing. Another thing the software is doing also, is that it helps the customer get an overview of the maintenance situation of the different analyzers"* (Global Product Manager, Radiometer)

Discussions in interviews and workshops indicated that advanced services could involve access to equipment based on alternative ownership, perhaps resembling fleet management solutions or pay per use arrangements, as reflected in the following comment:

*"...[the] approach of saying 'you don't need to buy anything, you just give us the monthly fee or resilient revenue and we ensure that the stuff is working, it's calibrated and it's up ... the uptime is okay and then we create the reports as you want'"* (Vice President of R&D, Brüel & Kjær)

A key challenge in this respect involves convincing customers to enter long-term service agreements, which entails developing the necessary capabilities amongst sales personnel. Selling advanced services is believed to require the re-training of sales personnel and a different means of incentivization, in an attempt to entice them to adopt a service mind-set. Brüel & Kjær is seeking to develop its service business by targeting specific strategic customers and co-developing advanced services. Here, the company draws on its analytical capabilities and its application engineers with experiences of offering engineering services to customers for particularly challenging measurement assignments. In both FOSS and Radiometer, service agreements are offered with differentiated service levels:

*"There are three different types [of service contracts], from – the*



*basic one is where you simply, you get the service call free of charge, so it's all – it's part of the contract. You pay for spare parts, you pay for driving, you pay for a number of things, but the remote support is actually part of the package. And then you go to the top level service contract, where the driving hours are included, spare parts are included, everything is included”* (General Manager, Nordic Sales, Radiometer)

For all three firms, advanced services entail providing software updates, which presents the challenge of communicating with the customer for what precisely they have paid, or are paying. It is typical for the companies to license application software that is continuously being developed and re-released on an annual basis. However, the duration and renewal of contracts was found to be a contentious issue:

*“...for this automatic renewal there are two religions also within Brüel & Kjær. Like ‘no, we cannot trap the customer in this way’ whereas you could say ‘why should he bother, I mean, he’s willing to have the ongoing support, why should he bother about making a new PO [purchase order] and getting that approved from everybody if he can just automatically continue’. I don’t think there are any other financial or ethical or technical issues in doing it, it’s just a matter of doing it”* (Vice President of R&D, Brüel & Kjær)

This was explained, in part, by software service contracts being of a shorter duration requiring renewal.

The dilemma here is thus one of the provider's closeness to customer operations. Developing and offering analytical services requires knowledge about a customer's use of equipment, as well as access to data about that use. However, in order to obtain the requisite closeness to the customer, the provider must, at the same time, ensure that it maintains a certain distance, so that it is not perceived as a threat to the customer. Rather than finding an appropriate level of proximity, it then becomes necessary to identify how exactly to maintain distance in certain ways, i.e. deliberately avoiding access to particular data.

#### 4.3. Trajectory 2: Scalability and the dilemma of technological simplification

Given the specialist nature of the equipment provided, the case firms expressed a strategic intent to expand their requisite markets by exploiting product capabilities. This is in line with the literature, which suggests that alternative parts of customers' value chains should be targeted in the process of commercializing solutions. We illustrate here how scalability entails a dilemma of technological simplification of product offerings.

For the case firms, this move towards targeting different parts of the value chains implied either using existing products and capabilities to develop a product market targeted at the production line of customers or, alternatively, using the equipment in their own service operations towards customers:

*“... most of our products ... until now have been sold to the R&D area. So the customer’s R&D departments, that means they have 2 – 3 equipment and when you are talking to R&D people also they can be without their instrument for a period, it is not normally a big challenge. We are trying now to expand also to selling to our customer’s production lines. So ... we also try to convince them that they could use our equipment or maybe a downscale variant of our equipment when they make production test. And we have managed to do that in some cases”* (Vice President of Operations, Brüel & Kjær)

The opportunity involved utilizing existing products and capabilities to target a new market which increasingly included online measurements of product qualities. However, a primary challenge when targeting production lines is that the requirements for the

equipment may change. The sophistication of equipment was described as taking on a less important role within production, whereas ensuring its consistent functioning was considered more critical to the smooth running of operations for the customer. Consequently, to achieve scalability in this sense, new requirements were placed on both the products and the services, which supplemented the equipment in these new contexts. This involved an ability to remotely monitor the performance of equipment but, importantly, also the capability to respond quickly and locally to any need for repair and calibration. For FOSS, this was considered less of a challenge as it possessed service engineers in the field, whereas within Brüel & Kjær, management were discussing whether and how to develop the capability to provide on-site support. It was recognized that service support in a production setting should be more urgent, unlike that to which those in a R&D setting were accustomed.

As a consequence, in Brüel & Kjær and FOSS, the seamless integration of analytical equipment into production lines in order to meet the requirements of customers was considered pivotal. A key strategic question relevant to expanding the market is how the characteristics between R&D and production differ and the resultant implications. For example, opportunities for moving into customers' production lines were described as being constrained by a lack of access to decision-makers at the right tier within the customer organizations. Additional questions relate to which customer segments to target, the degree of complexity of equipment for different contexts and differences in performance criteria upon which the organization is measured. Furthermore, changing the sophistication of the equipment has implications for the R&D efforts of the provider and the capabilities needed. This implies a shift in emphasis from exploration, where the research frontier and capability boundaries of the equipment are constantly pushed, to an emphasis on exploitation, where the focus is on achieving scalability and increasing the dependability of equipment in new contexts.

In the case of Radiometer, the healthcare context implied that scalability is of a different nature. Here, technological developments enabled the use of equipment for point of care testing, supplementing centralized testing in laboratories:

*“There are two main stations, either you are from a point of care or you are from the lab, and they’re completely different requirements. Because from the point of care, you are a caregiver, you are a nurse; your focus is the patient and the patient care. In the lab, your focus is the test and the analyzer and the technical part, and there are much higher expectations as to what the user can from a technical point of view than from the point of care.”* (Global Product Manager, Radiometer)

For the organizations, the scalability dilemma is how to ensure access to the buying center (or right tier) and, therefore, to the customer production lines and the simplification of measurement equipment. Simplification is necessary to achieve scale, but, at the same time, this also makes the equipment more standardized and therefore it may lose some of the distinctiveness that accounted for its quality in the first place. This then entails the risk of losing an element of distinctiveness, which allows the companies to be sufficiently interesting so as to be able to provide scalable solutions in the first place. This can imply, on the one hand, a need to develop competencies for creating less sophisticated equipment, while on the other, not losing the ability to make the most sophisticated equipment for other contexts. Thus, what may make analytical equipment providers attractive in the first place might, at the same time, make them more vulnerable when the equipment is applied in a new context. Consequently, it is not obvious whether providers should make their equipment less sophisticated, as this might be detrimental in the long run. Moreover, placing such equipment in a scalable context also involves risks such as failures and misuse.

#### 4.4. Trajectory 3: Solutions and the dilemma of organizational capabilities

A clear strategic intent to change the underlying business model towards solutions was expressed in each of the three companies. However, such a move is no small task, as customers may not easily engage in outsourcing their operations or moving to an outcome-based model. In each instance, solutions were described as meeting customer needs through the customization of offerings, which inevitably required integration into the customer's processes. This trajectory involves developing solution-based offerings, each requiring different organizational capabilities. In moving in such a direction, the dilemma is to what extent should new capabilities required for delivering solutions be allowed to influence, or be influenced by, the existing business and established capabilities.

Products form part of the solution offering which addresses the specific customer need. However, moving from being a product manufacturer into the solution quadrant, as shown in Fig. 1, means the role of the equipment changes and the customer becomes focused mainly on outcomes:

*“It’s really solution based, it’s nothing about hardware at all. ... The customer doesn’t care about the hardware, they care about the outcome”* (Group Quality Manager, Brüel & Kjær)

Providing solutions requires finding customers who are demanding them or, alternatively, convincing customers of the merits of outsourcing their operations. Each firm recognized that operating on the basis of a solutions business model necessitates the development of different capabilities and skill-sets, in order to ensure effective and efficient delivery (cf. Baines and Lightfoot, 2013). In the case of Brüel & Kjær, the parent company acquired a firm in another country, which provided solutions in a regulated environment:

*“So they are making the reports for the authorities, they are making complaints for neighbors, they are handling the whole thing, you could say, it is up at the highest level of the chain of services. So it’s very different what we are doing. Some of the strategy we have on [solution business], you could say, we would adopt in the two other business units if possible but we are far away there...”* (Vice President of Operations, Brüel & Kjær)

Learning opportunities through the acquisition, in both transferring and implementing the model to the traditional business, were considered valuable but not without challenge, with some questioning the feasibility of making those transitions. In the case of FOSS, the firm is in the very early stages of attempting to develop a solution offering but is not experiencing the anticipated customer demand, with some questioning whether it is actually a financially viable model to move towards. Within the healthcare context, Radiometer's customers similarly face the challenge of satisfying audit requirements. As explained by the Director of Customer Care, this presents an opportunity for Radiometer to offer solutions for point of care testing, reassuring hospitals that equipment will comply:

*“I think in point of care the big change is IT. IT is the big push in services that are – that we are able to offer through software, middleware software, connectivity, but also “What burden can you take away from me?” I think our top services are compliance based services”* (Director of Customer Care, Radiometer)

In all three firms, the need to develop relational capabilities is considered to be a prerequisite to providing solutions. In the case of Brüel & Kjær, the different business models being operated were described as follows:

*“...we focus on the relationship to the customer and the partnership, that’s very much growing the business together. And the other one is more one-off... where the value is more traditional like*

*good quality and high performance. ... The other one is more getting embedded in the customer’s work flows and stepping up the value chain; also being more developmental on each other; and making it more difficult for the customers to step out”* (Vice President of Strategic Marketing, Brüel & Kjær)

The need to become immersed in customer processes is clearly evident, though the extent to which the customer is willing to allow this varies depending, again, on the context and access to decision-makers. The dilemma here centers on investing in and developing the necessary organizational capabilities for changing the business model. In the case of Brüel & Kjær, this was clearly evident with the acquisition of a competitor to acquire the capabilities and know-how to provide solutions. The issue, however, in obtaining capabilities through acquisition is how, and to what extent, to integrate those capabilities into the traditional business model. Within Radiometer exists a very successful razor-blade business model and which respondents did not inadvertently wish to destroy (or risk) by providing outcome-based offerings.

Furthermore, there is the issue of integration and interference in customer processes, in which these firms have not previously engaged. Integration means different things in different contexts, so whilst servitization is about integrating products and services, it is by no means clear what integration will look like with a specific customer, beyond the need to adopt a relational approach.

The three dilemmas identified through our interactions with the case companies and more fully detailed above have implications for product sophistication and simplification, depending on the relevant context. The challenge, then, is how organizations manage and respond to these dilemmas.

## 5. Discussion

This study illustrates the dilemmas faced by each of the three case firms in attempting to transition towards services on multiple fronts. Using the framework presented, we have attempted to provide rich insights into the process in which these organizations are engaged. More specifically, we have identified, using an iterative approach, that the case firms are moving in multiple directions simultaneously, each presenting different opportunities and challenges. Management is shown to be simultaneously grappling with multiple positions and the associated complexities. The implications of this transitions, and the identified dilemmas, are elaborated further below.

### 5.1. Towards serviceability and scalability

In providing advanced, reliable equipment, the case companies have each, over time, developed considerable reputational capital. Accordingly, and not unsurprisingly, the firms are developing capabilities to provide advanced services to customers in respect of their equipment. This vertical movement (Trajectory 1), as illustrated in Fig. 1, from being a product manufacturer towards greater *serviceability* primarily involves extending analytical capabilities to monitor and analyze measurement in distributed environments for customers. Rather than providing individual measures, it is about *‘moving beyond’* to provide a suite of measurements. In part, this is being delivered through the online capabilities of the firms.

The level of technological sophistication is an important consideration. In this regard, the advanced services are essentially intended to increase the analytical capabilities of the equipment. Within the context of R & D, it can be difficult to fully specify future applications of analytical equipment. Consequently, the potential capabilities of that equipment are typically an important factor for customers in their purchasing decisions, which is, in part, related to the sophistication of the equipment. Traditionally, the use of equipment is performed within the customer organization, with the case firms having only limited access to information about the use and resulting data from the

application of that equipment. Although the technologically sophisticated equipment provided by each of the companies is sought after by customers, those same customers may not wish for the provider to be too close to the actual usage, which, in turn, means limited knowledge of the application of the equipment is acquired and, as a result, the possibility of providing advanced services is limited. Such findings then challenge simple exhortations that new revenue streams may be created easily through big data, connectivity and servitization (Opresnik and Taisch, 2015).

As noted in Section 4, the study further highlights the significant challenges confronting the case firms in attempting to expand their markets by operating in different contexts. Here, the dilemma is shown to be one of moving from the R & D laboratory context into customers' production lines, in order to make offerings more *scalable* (cf. Kowalkowski et al., 2015). This in itself presents challenges in that customers are not interested in the product *per se* but, instead, the ability to provide dependable results, thereby ensuring trustworthy measurements on a continuous basis, without interruption. Thus, whilst the essential product features of providing measurements within their respective fields are found to be similar, the performance criteria upon which the case companies are evaluated vastly differs. The key here is dependability of results, and, in the case of a breakdown of equipment, urgent engineering support services to remedy the situation. This shifts the emphasis in the production context from the sophistication of equipment to one of simplicity and dependability in use. This is very different from the traditional R & D context and necessitates a different set of capabilities.

### 5.2. The role of integration for solutions and inherent complexities

Whilst the literature on service-led growth rightly emphasizes the value of providing integrated solutions, less attention has been paid as to how integration can take on various roles. In order to understand, therefore, how companies attempt to transition towards solution-based business models, it is necessary to unpack the role of integration.

The cases presented serve to illustrate that integration can take on different forms depending on the context in which the solution is provided. In extending the market by moving beyond the R & D lab, it is suggested that the role of the product changes, with the result that the hardware side of the solution loses its primacy. This is illustrated in the case of Brüel & Kjør, which acquired a business operating under an alternative business model within the same niche market. Essentially, the acquired business had developed a solution offering through which it could provide a complete setup of hardware, as well as undertake the actual operation of the equipment (cf. Johnstone et al., 2014). This included performing measurements and analysis on behalf of its customers. In Brüel & Kjør, there is an aspiration to replicate this business model in other parts of its business. Efforts have been made in partnership with key customers to develop advanced services within the R & D context. However, whilst transforming such advanced services into solution-based business models presents opportunities, there is a realization within Brüel & Kjør that this transition will be of a different nature and far from straightforward. Firstly, the sophistication of the equipment remains central, which, for software and advanced analytical services, implies a vastly different complexity of measurements and data handling. Secondly, concerns surrounding confidentiality and secrecy amongst some customers suggest a different nature of integration between the product in use and the data handling for advanced analytical services.

Thus, for niche providers of advanced analytical equipment, there is the potential to offer solutions which draw upon their deep technical insights and capabilities for analytical integration. In realizing such opportunities, however, manufacturers are faced with different possible paths, implying different strategic logics. Whilst attempting to pursue these different logics concurrently, depending on opportunities arising with various customers, is arguably a sensible approach, it also opens

up a number of strategic concerns with respect to a lack of detailed understanding of the primary motives of the target customer. Consequently, this will entail greater risks when attempting to develop solutions. The different strategic paths outlined—simplification and sophistication of equipment—towards solutions imply different roles for products and services and different integration logics. Pursuing both without eroding capabilities and reputational capital within a niche market is not without challenges. The two strategies require different capabilities and skill-sets, where synergies may be difficult to achieve.

Importantly, the findings serve to illustrate the inherent challenges of, on the one hand, attempting to develop exploratory technologies for specialized use in one context, whilst, on the other, exploiting them for maximum gain in other contexts (O'Reilly and Tushman, 2008). Moreover, the ability to reconfigure operating routines from one context to another has been shown to be far from straightforward, contrary to what some literature would suggest (Teece et al., 1997).

## 6. Conclusions

In this paper, we show that there are multiple paths towards service-led growth. In so doing, we highlight important dilemmas, which emerge when seeking simultaneously manage *multiple positions*, whilst we also identify implications for the type of *capabilities* required.

### 6.1. Contributions

Our research makes a number of key contributions. Our first contribution is to show that while the service-led growth literature typically discusses the extension of the product by adding (or bundling) services, for providers of analytical equipment, service-led growth can mean vastly different things in different contexts. For instance, when seeking to move in the direction of advanced services in the context of R & D functions, product functionality and technological sophistication remains central and services are essentially about *extending* analytical capabilities. This resonates with the broader service-led growth literature in its suggestion that companies should attempt to move in this direction (Baines and Lightfoot, 2014). However, it is our contention that, in other contexts, service-led growth may involve reducing the importance of the product by creating a service delivery system that enables a provider to achieve the performance required when targeting a different part of the customers' value chain (cf. Baines et al., 2009b; Matthyssens and Vandenbempt, 2008; Elfving et al., 2015).

Our second contribution is to show that these markedly different contexts relate to the notion of 'becoming an industrializer' (Kowalkowski et al., 2015), to the extent that providers of analytical equipment successfully commercialize ventures in either direction (towards serviceability and scalability) by enabling these to be targeted at a broader segment of customers (see Fig. 1). However, the nature of the two contexts would suggest that achieving industrialization involves significantly different strategic considerations. In the case of the move towards serviceability, the role of the product in advanced services and solutions remains central, with significant complexity arising from accommodating heterogeneous customer needs and analytical sophistication, such as that found in R & D functions. Consequently, achieving a standardized package which is industrializable suggests a need for greater investment in developing a scalable platform (Davies et al., 2006). In the case of moving towards scalability, the role of product sophistication is reduced and replaced by a need for dependability. This involves building capabilities for ensuring that the equipment is functioning according to its specification on a continuous basis, including the ability to perform remote monitoring and servicing of equipment when needed. Whilst developing such capabilities is argued to require significant investment (cf. Teece, 2007), it is important to note that they are different in nature and this raises important

questions of how equipment providers with the necessary capabilities in their niche industry strategize to succeed in the marketplace.

Our third contribution is related to the above and is in the finding that integration can mean very different things in different contexts. We extend the notion of industrialization proposed by Kowalkowski et al. (2015) by suggesting that elements of standardization are fundamentally different in the two contexts described above. This is important, since achieving industrialization is about enabling standardization of the elements of solutions which can be packaged and commercialized in new market segments, which then may be used repeatedly (Davies et al., 2006). However, given that the elements of integration vary between the two contexts, the objects of standardization are likewise different and necessarily involve divergent implications. In the first context (i.e. serviceability), integration is about ensuring that measurements taken in one space can be accessed, analyzed and aggregated in another time and space. In the other context (i.e. scalability), integration involves synchronizing with the customers' processes to ensure that the operation runs smoothly and is uninterrupted and dependable. In other words, this means ensuring that the resources necessary for service delivery, such as performing calibration or repair on-site, are available at the right time and place, as and when needed. Thus, integration means different things in these markedly different contexts, which has implications for how organizations attempt to achieve industrialization. To date, studies do not distinguish between what integration can mean in different contexts when attempting to 'industrialize' service offerings.

The above contributions have a cumulative effect, in that they discuss the dilemmas and inherent complexities involved in developing service-led growth strategies. This paper then provides a more nuanced understanding of the paths towards implementing a servitization strategy and the predicaments managers encounter in seeking to integrate products and services.

## 6.2. Managerial implications

In all three companies, there was a very apparent awareness of the importance of developing business models that rely less on hardware for its key value propositions. Increasingly, each of the three companies has seen a shift to first software and, more recently, service-based business models. Although this transition is acknowledged and addressed, it raises important managerial challenges, particularly in light of the fact that the relationship between the equipment or product and services is altered and complex (cf. Cusumano et al., 2015). However, this change in relationship is not simply a matter of services replacing equipment—it is much more intricate. In some segments of the markets served by the three firms, the ability to offer the most advanced equipment will still win the offering company the order, whereas in others, performance criteria are changing. This means that in some respects, the requirements for equipment sophistication are reduced, with substantial implications for business models and organizational capabilities. The three cases illustrate some of the complexities faced by the firms in managing the transition and may offer managerial guidance as to the key dilemmas and concerns which need to be addressed.

Consequently, for providers of analytical equipment attempting to pursue service-led growth, this study highlights important managerial implications. The three case firms were shown to be grappling with how to commercialize advanced services and solutions. In the case Brüel & Kjør, these had initially been developed in cooperation with a strategic customer and thus involved a significant degree of customization. In order to industrialize such solutions, however, firms need to develop standardized elements which can be effectively repackaged to target customers in various market segments.

Whilst the case firms each have a history of developing industry-leading technology platforms within their respective niches, the replication of solutions business models presents significant challenges. As noted in the case of Brüel & Kjør, the acquired business unit has, to an extent, been able to successfully implement this transition. In this instance, the business model has effectively been commercialized within the entire market segment. However, this market segment has particular characteristics, such as the regulatory environment in which it operates, that makes it difficult for the provider to mirror this business model in other market segments. While such acquisitions may provide inspiration for developing new business models, providers need to be attentive to the contextual nature of their existing business and the challenges involved in attempting to transition to services and solutions.

Consequently, managers need to think carefully when venturing outside their existing markets in seeking to explore and exploit their expertise in analytical equipment. Thus, managers are confronted with a dual challenge when venturing into new arenas. On the one hand, they need to develop their competencies in identifying arenas within which they are able to exploit existing capabilities. On the other hand, in venturing into arenas in which vastly different capabilities are needed, they need to realize complementarities between these new and existing capabilities (Visnjic et al., 2016). Finally, an important consideration for managers relates to the move from a niche marketplace and the necessary careful consideration of the competitive environment of new arenas and their implications for existing business models.

## 6.3. Limitations and further research

This study is of course not without limitations. We focus only on analytical equipment providers operating in niche markets, thus limiting the wider applicability of the findings. However, the cases presented provide rich insights, allowing for other researchers to compare these findings to other contexts. They may wish to consider whether the presented dilemmas appear in other contexts and if so, the resulting implications, as well as the prospect of further dilemmas arising. Thus, we argue, the findings presented in this paper are analytically generalizable (Eisenhardt, 1989). Future studies could build upon this study by examining other markets and contexts. Moreover, other studies may examine the roles external actors (that is, suppliers and customers) play in service-led growth.

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## Appendix: Sample Research Template

### Organizational and personal history.

- Can you tell us about your background and how you came to work in your current role?
- Can you describe the organizational structure? Has this changed in recent times?

### Strategic overview-

- How would you describe the development of the global market in your industry in the last 10 years?
- What challenges have the company experienced in adapting in new markets?
- What are the strategic priorities for your company?
- How would you describe your business model(s)?
- Can you describe the markets in which you operate? What changes have you seen over time?
- Have you made any acquisitions in recent times and please explain the rationale for doing so?

### The company as a product-service provider

- What products does your company provide? Please describe the different contexts in which your products are used? What is it that is unique about the analytical equipment you provide?
- What services does your company provide? How do you categorize services?
- Could you describe the design process for services?
- What do you understand by customer solutions?
- How do you integrate products and services to provide customer solutions? What new capabilities do you require to provide solutions?

### Product and service architecture considerations

- What are the primary objectives in the design of new products and services?
- How would you describe the architecture of your main product(s)?

### Customers

- How would you describe the relationship with your customers? How do you get close to customers?
- What risks are associated with the provision of services to customer?
- How does providing services affect your relationship with customers?

### Others

- Is there anything we have overlooked?

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