Servitization: the theory and impact

Proceedings of the Spring Servitization Conference

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Research and Practice

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INTRODUCTION

Welcome! These are the proceedings from the fourth Spring Servitization Conference. The conference was launched in 2011 to respond to the growing interest in servitization, along with the limited opportunity with more mainstream conferences to accommodate this. The principal goal of the conference was, and continues to be, the creation of an intense debate around servitization that engages the broad range of disciplines contributing to this topic. To achieve this we maintain a single conference stream, with papers clustered into panel sessions around key themes. In this way each speaker has an opportunity to address the entire audience, stimulate discussion, and gain feedback on their work. This process is however demanding on the speakers, audience, and conference chairs – it's a tough call to deliver some forty papers in two days while maintaining high quality and value added interaction for all. To achieve this we have extended the more traditional conference model to embrace social media, interactive technologies, and structured debates around each paper.

To reward the speakers for their contributions there are four prizes awarded at the conference, these are:

- Best paper about Information Technology enablement of servitization
- Best paper bridging theory and practice on servitization
- Best industrial project describing a servitization transformation
- Best paper describing a novel business model in servitization

We still have much to learn both about servitization and the processes by which we bring our community together in this very dynamic area. We believe that the papers in these proceedings testify that we are making progress, but we believe that we have still only just started to realise our goals.

Tim Baines, David Harrison
May 2015

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PPRODUCT BIOGRAPHIES IN SERVITIZATION AND THE CIRCULAR ECONOMY

Luis Araujo and Martin Spring

ABSTRACT

Purpose: To examine the circulation of products in servitization and product-service systems from the perspective of product biographies, so as to develop insights into the novel institutional arrangements needed for servitization to succeed.

Design/methodology/approach: Synthesis of literature from servitization and economic sociology, combined with illustrative examples from secondary sources

Findings: Products in servitized systems, far from being the unproblematic and stable elements, are constantly being made and remade by processes of qualification and (re) classification. New systems of classification are required to enable more complex servitization to be achieved, and the Internet of Things provides both tools and additional challenges in this regard.

Originality/value: We extend our institutional perspective on products and services to consider the wider product-service system.

Key words: servitization, product biographies, qualification, classification, circular economy, internet of things

1. INTRODUCTION

Servitization has led to renewed and interesting questions about what services are and how they might be provided. But it also gives rise to a reconsideration of products. Under a conventional product-based model, (or what we have recently heard described as the 'Design, Deliver and Abandon' model...) capital equipment in B2B relationships becomes the property of the customer, and it is their responsibility (and right) to use it, maintain it, repair and modify it. This might entail the purchasing of spares and even technical assistance from the original manufacturer, but on a piecemeal, transaction-by-transaction basis. As we move across a continuum (e.g. Tukker, 2004) to more servitized offerings, more integrated maintenance and repair might become part of the relationship between the provider and the user. Further still, and the ownership of the asset may remain with the provider, and be made available to the user on a leased basis, or even operated by the provider so as to provide an outcome, on the basis of which the provider is paid. These various forms of servitization present challenges in designing, specifying and delivering the service elements, and in making them tradeable (Spring and Araujo, 2009). But how is the asset, the 'object', understood in all this? It exists; it is 'owned' by one economic actor or another. The principal interest in servitization has perhaps been the asset or product's role as a platform for services (Potts, 1988, Wise and Baumgartner, 1999); while these accounts certainly include maintenance and repairs, the emphasis has been more on the provision of these service elements rather than on what they do to the nature and identity of the asset or product. That is what we focus on here.

Furthermore, in doing so, we see servitized relationships in a wider context, as part of the emerging 'circular economy', in which rental/access (Lovelock and Gummesson, 2004), repair, remanufacturing and recycling become more prevalent. Early manifestations of servitization, or product-service systems, were rooted in these environmental concerns (Stahel and Reday, 1976/1981); in a sense, we are simply restoring that link. But we are doing so not particularly to re-animate the environmental motivation for servitization, but in order to explore the trajectory of assets or products in these wider systems, the better to develop our theoretical and practical arguments.

2. PRODUCT BIOGRAPHIES, QUALIFICATION AND CLASSIFICATION

Servitization and product-service systems, by definition, involve products. If we dwell at all on that rather basic statement, it is typically to contrast products with services, so as to understand what differences there are between the two, and why that might matter to their management. But there may be more to products than meets the eye. We suggest that, rather than being stable, unproblematic objects, around which the comparatively ephemeral and slippery services are conceived and delivered, products too are less stable than we might think. One way to put this is that products have biographies. Kopytoff (1986) argues that if economists see commodities as self-evident material things, circulating within economic systems by virtue of having use and exchange values, for anthropologists things have a material as well as a cultural dimension. They must be produced but also categorised, qualified as being a particular object. As a corollary, Kopytoff (1986: 90) suggests that we attend to the: "…eventful biography of a thing [which] becomes the story of the various singularisations of it, of classifications and reclassifications in an uncertain world of categories whose importance shifts with every minor change in context". The notion of product biography has been deployed extensively within social studies of foodstuff production and consumption. As Warde (2012) suggests, these biographies have been particularly good at capturing the changing biological and chemical properties of foodstuffs as they move down the production chain to supermarket shelves.

Callon et al (2002) take up the notion of product biographies to discuss their qualities and how they change over time. They make a helpful distinction between products and goods. Products' qualities are always open and liable to revision, as they degrade, are changed and are disembedded from one network and attached to another. On the other hand, goods are products – or indeed services (Araujo and Spring, 2006) – whose qualities have been temporarily stabilised for the purposes of exchange. So, a new car accumulates miles on the clock and routine wear and tear, as well as undergoing both routine and emergency repairs. These are parts of its biography. When the owner comes to sell it, it is necessary to stabilise it and change it into a good, by defining its mileage, taxation status, condition, maintenance history and so on, in order that prospective owners can compare it with other used cars for sale, and thereby value it. Similarly, transforming a house into a good involves more complicated qualification processes, drawing on experts such as surveyors, and drawing on external systems such as the Land Registry to vouchsafe the ownership of the house and associated land. (It is perhaps no coincidence that estate agents refer to a house for sale as a 'property'.)

There is an interesting contrast here between the car's enduring identity, conferred on it institutionally by, in particular, its registration number, its ever-changing material condition, and the occasional 'stabilisations', brought about by measurement of one form or another to make it tradeable. Likewise, the house remains No 2 Acacia Avenue, even though it is constantly changing in material form and can only be defined adequately for exchange by a sometimes Herculean (and expensive) effort of qualification. There is an old story about a caretaker and his favourite broom:

> 'The caretaker insists that he has had the same broom for the past twenty years; in fact, it's the best broom he's ever had, he says. He has only had to change the head three times and the handle twice!' (Smith, 2012: 176)

Is this the same broom? The identity of products is constructed through systems of qualification, classification and registration (Callon et al., 2002). However, it is also, for some actors, constructed through practices. The caretaker thinks the broom is always the same broom because it is entangled in his daily routine in exactly the same way every day: he puts it in the same locker when he goes home, and cleans the same floors with it. It might also be said that the broom is a broom because the caretaker classifies it as such. A more significant capital asset might be identified in an organisation's asset register, allowing it to be scheduled for routine maintenance, costed and valued

in, say, an ERP system. If, over the years, every part of it had been replaced, as with the broom, it would still be machine #1234. In this sense, products have biographies, but are qualified and classified to render them tradeable and manageable.

3. SERVITIZATION, THE NORMALIZATION OF 'REPAIR', AND THE CIRCULAR ECONOMY

Some forms of servitization see the product entangled in complicated inter-organizational relationships. This means that its biography, rather than being largely hidden within the boundaries of the firm that owns it, uses it, maintains it and disposes of it, is potentially written in a series of exchanges: owned by one firm, used by another, possibly maintained by a third. Many permutations are possible. As we extend the perspective to include the emerging 'circular economy', in which products are leased, shared, refurbished, dismantled for their parts to be re-used, recycled and so on, a much more dispersed and multifaceted picture of qualification emerges. We consider this now.

3.1 Qualification in Servitization

Servitization, as we have outlined, can take many forms. It is perhaps useful to characterise these in terms of the two main modes of service identified by Gadrey (Gadrey, 2000, Araujo and Spring, 2006). First is the 'request for intervention', whereby one economic actor A, acts to change the state of an object owned by another actor, B (which can include B's body, in the case of individual consumers), at the request of actor B. Examples might include the repair of a car belonging to B, or the cutting of B's hair. The second is 'access to a socio-technical capacity', whereby economic actor B pays economic actor A for 'the right to use, generally for a specified period' (Gadrey, 2000: 382) a combined technical and human capacity owned or controlled by A. Examples here include paying to use a mobile phone network. In servitization or PSS, these could be mapped broadly onto Tukker's (2004) product-oriented and use-oriented models, respectively. As we have emphasised before, the definition of a service in Gadrey's terms to make it tradeable, i.e. make it into a 'good', requires an effort of stabilisation and qualification.

In a request for intervention, there is a need, initially or in the early stages of a service interaction, to diagnose. Then there is prescription, then treatment (Harvey, 2011: 153). How trivial or complicated these are, and who does which part, varies from case to case. But in all cases, there is a need, more or less precisely, to qualify the product, stabilise it temporarily at this stage in its biography, in order to determine what intervention is necessary. Then, after the intervention, there is another qualification point. This might be trivial (a quick look in the mirror for a routine haircut customer) or very complicated (the re-commissioning of an overhauled machine tool). In an access-based model, the condition of the product needs to be stabilised at the start of the access period (the hotel room is cleaned and furnished with a full complement of linen) and checked at the end (the hire car is checked for new scratches and bumps).

3.2 Rethinking Repair

Graham and Thrift (2007), in their wide-ranging review of the role of repair and maintenance in advanced economies, argue that this activity should not be associated with exact restoration. Products or whole infrastructures can be repaired and upgraded to make them contemporary. They can be cannibalised for parts and their materials recycled so that parts of objects live on in different systems. Or, restoration can lead to complete rebuild which will allow something to live on in near pristine condition. Drawing attention to the general pre-occupation with original manufacture, Graham and Thrift suggest that repair and re-use are still unsung activities and could usefully take a more central role in our analysis:

> "...perhaps we have been looking in the wrong place. Perhaps we should have been looking at breakdown and failure as no longer atypical and therefore only worth addressing if they

> result in catastrophe and, instead, as breakdown and failure as the means by which societies learn and learn to re-produce." (Graham and Thrift, 2007: 5)

Various forms of repair, improvisation and systemic engagement with and between manufactured artefacts - cars, bridges, roads, buildings, computer networks and so forth – therefore constitute opportunities for learning, development and long-term value creation. In this sense, products can have colourful biographies.

3.3 The Circular Economy

Models based on non-ownership by the customer are extending into sectors other than capital goods. Severe and growing material scarcity, combined with the growing costs and environmental impact of energy consumption and waste disposal make the original manufacture of products less obviously desirable than it was even twenty years ago. Customers don't want the financial and environmental burden of ownership and, as with larger capital goods, moving ownership to the provider shifts incentives to promote good stewardship. Models based on temporary or shared ownership achieve many similar ends, adding up to a shift from a linear economy to a circular economy, i.e. from an economy based on the conversion of raw materials into products that end their lives as waste, to an economy where products are re-used, 're-purposed', repaired, remanufactured and recycled, rather than being used and discarded (Mulgan, 2013). This concept is nothing new, being set out by Walter Stahel over 35 years ago (Stahel and Reday, 1976/1981). However, recent impetus has been added by a number of think-tanks, including the Ellen MacArthur Foundation, focusing on the circular economy, and Collaborative Consumption (initially funded by NESTA). (See Figure 1; see also Spring (2013))

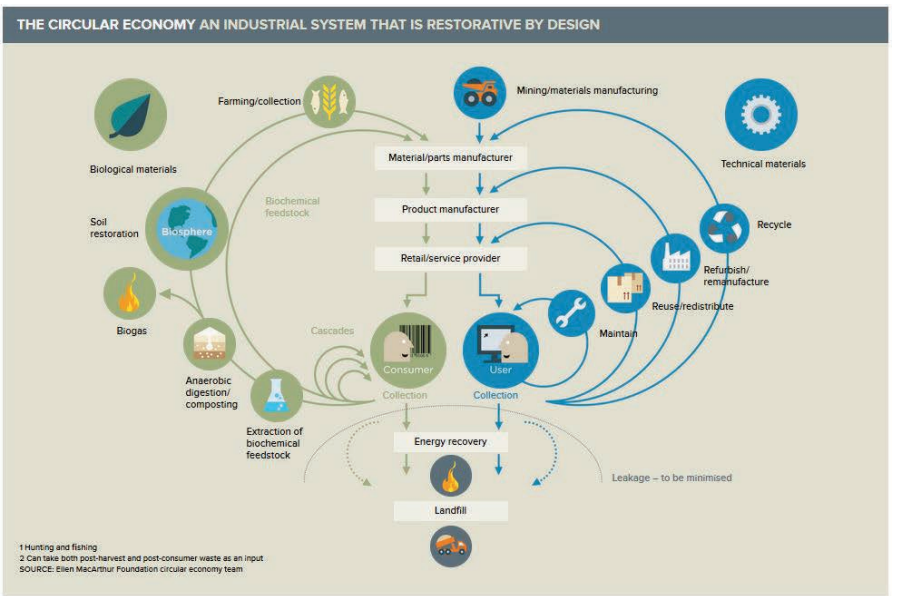

Figure 1: The circular economy (source, Ellen MacArthur Foundation)

Graham and Thift (2007) draw some implications of their analysis for repair, maintenance and recycling. First, many products are deliberately designed so that the possibilities of maintenance and repair are foreclosed or strictly controlled – i.e. they lack any kind of transparency so that they

cannot be easily repaired if they break down. This can apply to simple electrical plugs and power adapters, which are tightly sealed and warnings of "warranty void" if seals are broken, to increasingly modular computer systems, to many passenger cars which can only be worked on in a dealerships garage by mechanics using electronic diagnostic programs. So, once again, the institutional shaping of products in terms of property rights and liabilities comes into the picture. Of course, many products could be designed so that they are easily maintained, repaired and upgraded. Technological paradigms oriented towards the generation of accelerating waves of quick disposal could be reorganized around longer term and sustainable systems of service delivery designed from the outset to be easily and continually upgraded. But this presents new challenges of qualification.

For instance, as Insanic and Gadde (2014) describe in the case of IT equipment, the design of systems of service delivery around repair, recovery and disposal is complex, requires significant investment and the mobilisation of networks of different firms. Many product recovery options are available, each with its particular advantages and disadvantages depending on the features of the recovery object and the demand from potential users. In addition, the conditions in these complex arrangements feature considerable uncertainty, in terms of recovery volumes, timing, quality and composition. This uncertainty makes the coordination and control of product recovery problematic. Handling these issues requires substantial and continuous exchange of information among the firms involved. Insanic (2014) highlights the critical role of classification rules, in relation to how IT products can be dismantled and the pathways available to recovery, as way to coordinate distributed activities in product recovery networks.

Gregson et al. (2012) focus on the activities involved in the disposal of large ships. In this case, recycling activities need to be mindful of the problems of handling and managing wastes as much as activities designed to extract value from a disposed ship. In some cases, this is straightforward but in many others, it is not. In the case of breaking up large ships to extract materials such as metals and asbestos, there is considerable sorting work associated material recovery, which has a secondary market, and waste disposal, which has not. Again, classification is central to this task.

4. INTERNET OF THINGS

The Internet of Things refers to the anticipated shift in society and the economy driven by the rise of ubiquitous computing. The term is generally credited to a presentation by Kevin Ashton in 1999 who coined it to describe a general network of things linked together and communicating with each other as computers do today on the Internet. Consequently:

> "If we had computers that knew everything there was to know about things—using data they gathered without any help from us—we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best" (Ashton, 2009).

The Internet of Things opens up the possibility that every object that is manufactured can be tracked from cradle to grave – not just through the linear supply chain that takes it from manufacturer to end-user, but to every single user it comes into contact with, as well as the reverse chains that lead to dismantling, recycling and disposal. In a sense, the first tentative steps of the Internet of Things are already familiar to us – e.g. packages can be tracked through logistic circuits, time and location-stamped at the stroke of a few keyboard keys. For many of the products that move through supply chains, this information is only of interest to those organisations that are directly involved in manufacturing or transport (Speed, 2011). The Internet of Things promises to open up access to this information through public channels (e.g. using smartphone scanner apps). More importantly, in the Internet of Things, products will gather data about themselves and their surroundings ceaselessly:

> 'Unlike the old adage "a rolling stone gathers no moss," artifacts within the Internet of Things will gather moss. As they move from one place to the next, they will gather locative data; as people interact with them, they will gather social data; and even as they sit idly on a shelf, they may well be gathering data about the objects that are around them. This data will exist in virtual form even when the actual object has been broken, lost, or thrown away. Stored safely in the cloud and accessible for eternity, the object lives on as a ghost in the machine, waiting for a chance to be exorcised' (Speed, 2011: 19).

In other words, qualification and classification potentially become almost constant processes, rather than being brought about only occasionally.

Recently, Iansiti and Lakhani (2014) and Porter and Heppelman (2014) reflected on the impact the Internet of Things may have on firms, industries and business models. The common concern is how biographical data on products, especially capital goods, are going to be amassed, analysed and commercially exploited, and for whose benefit. Iansiti and Lakhani (2014) use the example of General Electric as illustrative of the trend towards new forms of value creation and capture. Whereas GE has long since shifted its emphasis from selling capital equipment to contract service agreements, covering the operational management of assets, the connectivity afforded by embedded sensors, microprocessors and software opens up new business opportunities. Connectivity allows GE to amass and analyse large amounts of data on its customer's operations and constantly think of new ways to improve performance. This required significant development of a unified set of software solutions, as well as new ways to design and sell offerings. Performance data on the customer's operation generates value through the 'optimisation' of its equipment set-up and maintenance. GE then capture value as a percentage of the customer's incremental performance improvements. Another possibility is outcome-based contracts where revenues are tied to promised performance improvements. These novel opportunities raise questions about how value is measured, the monetisation of performance improvements, as well as risk-sharing between GE and its clients.

For Porter and Heppelman (2014), data about a product's operating characteristics and history lead to a better understanding of how a product is actually used. These data have important implications for product design (potentially reducing the need for excessive product features or favouring products designed for ease of repair), marketing (by creating usage segments to be matched to customer types), and maintenance (by allowing service engineers to learn the nature of breakdowns before they visit the site). Porter and Heppelman (2014) also point to the substantial investments required to construct what they call a product cloud, comprising a product database as well as application platforms (e.g. allowing visualisation), analytics/rules engines (e.g. the algorithms involved in monitoring product operation) and smart product applications (e.g. software that monitors the autonomous operation of product functions). Developing these requires significant investment in technologies and infrastructure that are hardly widespread in the IT sectors, never mind in traditional manufacturing companies. If the solution is to rely on outside partners, many of the benefits as well as the risks that Iansiti and Lakhani (2014) allude to will have to be shared between the manufacturer, the customer and the intermediaries that construct product clouds. If the decision is to develop these skills internally, companies are faced with the prospect of how to reap returns from amassing large amounts of data and being able to construct business models in which data is monetised in a multiplicity of ways – including selling data to other providers or to other intermediaries.

5. CONCLUDING DISCUSSION AND IMPLICATIONS

The notion of product biographies throws into sharp relief the fact that the objects that we call 'products' in product-service systems are constantly changing, in their physical state and in their connectedness to networks of one form or another. And yet, in order to manage or exchange them,

it is necessary to stabilise, qualify and classify them, and to transform products into goods (Callon et al., 2002). If we extend our perspective beyond dyadic, servitized provider-user relationships into the wider product-service system, and in particular into the emerging 'circular economy', where repair, re-use, upgrading and dismantling are seen as the norm, the biographies of products and their constituent parts become much more complicated, making new and greater demands on our ability to stabilise and qualify them when necessary. While we have well-established institutions for defining, specifying and hence managing products in the forward flow of the conventional product supply-chain, in the various reverse loops of the circular economy, we face new challenges of qualification and classification: What is the state of a used personal computer? Given the data that may reside on its hard drive, what measures should be taken to remove the data to ensure security? How do we classify it and its constituent parts so that we can decide what to do with them if it is dismantled? How can we be sure that the metals we extract from it are of a particular purity? In some senses, help may be at hand. The technological developments covered by the shorthand term the Internet of Things means that products are able to generate data on their condition even as they progress through their biographies, meaning that we have fewer surprises and have less need for infrequent, major exercises in re-qualification. But this presents major challenges in terms of data collection and analysis, challenges that many IT-centred organisations cannot meet, let alone traditional manufacturing firms. Hence it seems that in servitization and in the implementation of the circular economy, analytics firms such as Google may be poised to step in, for better or for worse.

This approach has practical and policy implications. While product lifecycle management (PLM) software has been in use for twenty years or so, the evidence seems to be that it is used most fully for the product design and prototyping stages of the lifecycle, rather than subsequent delivery, installation, service and disposal stages (Lee et al., 2008). Servitizing product-based firms and providers of PLM software can identify and exploit entrepreneurial opportunities arising from the increasingly varied tapestry of transitions, connections and transactions that arise from products and the data associated with them throughout their biographies. The sheer amount of data arising from 'smart, connected products' in service also presents opportunities, as we have mentioned, for analytics firms who are able to collect, analyse and extract value from such data. Repair requires qualification, and qualification generates data.

Governments in both developed and developing economies are looking to the circular economy concept to enable sustainable growth (Foresight, 2013, Spring, 2013, Yuan et al., 2006). As we have shown, however, there is a great deal of work to do to establish the institutional mechanisms that will make the circular flow of products and their repair, remanufacturing and re-use as routine and straightforward as their production, distribution and use in linear supply chains. Developing rich understanding of products' biographies, and the ways in which products connect and disconnect to and from networks of actors and other products as they chart their course is a central part of that task.

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EXPLORING AND COMPARING THE SUSTAINABLE POTENTIAL OF ADVANCED SERVICES: INSIGHTS FROM TWO PRODUCT-SERVICE SYSTEMS CASES

Thayla T. Sousa-Zomer & Paulo A. Cauchick Miguel

ABSTRACT

Purpose: This paper aims to describe and compare sustainable aspects of two PSS cases with different product-service configuration and supported by distinct business practices, in order to provide empirical evidences of the mixed sustainable potential of different PSS solutions.

Design/methodology/approach: A qualitative analysis was performed concerning conceptual elements cited in the literature as important in each sustainability dimension. Furthermore, some propositions given by others relevant studies that explore companies' operations to support the delivery of advanced services were selected to conduct the study as well as to help to understand how different product-service arrangements and practices may affect the PSS sustainable performance.

Findings: The findings confirmed the literature discussions about the mixed sustainable potential of different PSS. The operational practices have also an important role in offering sustainable solutions. Some of the propositions investigated in the current research business context revealed that the relation between customers, service providers and other network actors are essential to support the offering and assure the sustainability. Moreover, quality control and information offered to customers may increase their trust in the PSS provider and can help to increase PSS acceptance. Sustainability performance measurement was also identified as an important issue that should be integrated with service performance measurement, in order to control the impacts during PSS life cycle.

Originality/value: This may paper contribute with PSS empirical knowledge and to the understanding of how different product-service business models and operational practices may lead to achieve the sustainability.

Keywords: Advanced Services, Servitization, Sustainability, Sustainable Product-Service Systems.

1. INTRODUCTION

Product-Service Systems (PSS) is a special case of servitization (Baines et al. 2007) and have been widely discussed as a promising approach for moving the current unsustainable patterns of production and consumption towards a sustainable society (Ceschin 2013). As an integrated product and service offering that emphasises delivery of functionality instead of the product's sale, PSS offers the opportunity to decouple economic success from material consumption, allowing reducing the environmental impacts of economic activity (Baines et al. 2007).

Servitization is a growing area of research interest, but much is still to be learnt about its adoption in practice (Baines et al. 2012). PSS especially as a servitization case has become a popular subject for researchers engaged with sustainability (Tukker 2013) and the number of PSS publications has grown in the recent years (Beuren et al. 2013). However, despite all the knowledge regarding PSS sustainable potential, PSS solutions have not been widely implemented (Tukker 2013). One reason for this may be that sustainable PSS solutions challenge existing consumption and production patterns (Ceschin 2013). In fact, diverse PSS cases can be referred as advanced services, where products and services are integrated in a sophisticated offering with focus on capability delivered (Baines and Lightfoot 2014), that demand new practices different from those associated with conventional production process (Baines et al. 2012).

A complete picture of how companies operations should be configured to deliver advanced services is still an emerging research topic, and existing studies are mostly conceptual and, in general, empirical evidence is not provided (Baines and Lightfoot 2014). In addition, differences between PSS configuration exist, varying the sustainable potential of each case (Tukker and Tischner 2006). However, only a few studies in the literature provide a comparison between different PSS configurations and contribute to the understanding of how different PSS arrangements and associated business practices can increase environmental benefits (e.g. Tukker 2004). Thus, in order to provide empirical evidences of the mixed sustainable potential of different PSS solutions and how different PSS approaches and operational practices can contribute to sustainability, this paper aims to describe and to compare sustainable aspects of two PSS cases. The empirical investigation of the operational practices that support the offer is useful to increase the understanding of PSS sustainable potential and to contribute with its implementation in practice, since the diffusion of sustainable PSS is still limited (Ceschin 2014; Vezzoli et al. 2015). For manufacturers, this study provides insights of how the operations to deliver product-service solutions can be configured in order to support sustainable solutions.

The remainder of the article is structured as follows. After this introduction, the following section presents a brief literature review by covering PSS categorisation and sustainability issues. The third section starts with the description of the PSS solutions under investigation followed by the research design and procedures. The fourth section highlights the main findings of the present work. Finally, concluding remarks are drawn in addition to insights for future work.

2. PRODUCT-SERVICE SYSTEM CLASSIFICATION AND ITS SUSTAINABLE POTENTIAL

Different approaches in the literature build on a distinction between products and services, and demonstrate how a change in the balance between these can results in different levels of servitization (Baines and Lightfoot 2014) and environmental improvements (Tukker 2004; Tukker and Tischner 2006; Tukker 2013). An approach with focus on value proposition that distinguish between "base", "intermediate" and "advanced" services have been recently discussed (e.g. Baines et al. 2013; Baines and Lightfoot 2014). The base services focus on the product provision; intermediate services is based on exploitation of production competences to also maintain the condition of products and the advanced services have focus on the capability delivered through performance of the product (Baines et al. 2013; Baines and Lightfoot 2014).

Another frequently addressed approach for PSS classification proposed to distinguish between three main categories (Tukker 2004; Baines et al. 2007): (i) product-oriented, (ii) use-oriented, and (iii) result-oriented. In the product-oriented PSS, the product is offered in a traditional sale model, but also includes the sale of additional services (Baines et al. 2007). In the use-oriented and the result-oriented PSS, customer satisfaction is achieved by the functions provided by the products or the result of services rather than the product ownership (Chou et al. 2015).

Concerning the environmental benefits, it has been argued that different PSS shows a mixed potential (Tukker 2004). The product-oriented PSS is still centred in the sale of products, and limited improvements could be expected (Tukker 2013). Use-oriented and result-oriented PSS types can lead to great environmental benefits such as extending the product life cycle, changing consumption patterns, and reducing the total product and material use (Chou et al. 2015). Manufacturers and service providers are motivated to intensify services and optimise the product's operation to achieve sustainability (Hu et al. 2012).

Furthermore, the diffusion of sustainable PSS is highly dependent of its attractiveness, customer acceptance and satisfaction as well as the systems interactions and the collaboration between the actors in the value chain (Ceschin 2014). In addition to conceive sustainable solutions is also

important to understand the contextual conditions in which they are introduced and which strategies are more appropriated to each context (Ceschin 2013). In the transition toward product-service solutions, companies must carefully plan PSS implementation (Beuren et al. 2013). In this sense, the empirical investigations of PSS strategies can provide insights of how PSS solutions should be configured to provide environmental improvements. Next section describes the research methods adopted to analyse two PSS cases under study.

3. RESEARCH METHODS

This paper reports on the results of an explorative and qualitative study. Although quantitative research in PSS field is needed (Tukker 2013) qualitative research gives deep insights of the phenomenon under study by considering context-specific factors, complex patterns and causal relationships which are very important in PSS context (Velamuri et al. 2013). Hence, since empirical research comparing PSS business models and organisational practices is still limited, an explorative qualitative research approach was chosen. Furthermore, PSS environmental performance depends on a wide range of factors, such as the systems' design and the efficiency of networks and infrastructure (Mont 2004). These may lead to the following research questions: How and under which conditions different product-service configurations can contribute to achieve sustainability? What are the factors related to product-service configuration and organisational practices that may affect the sustainable performance of the PSS solutions when they are implemented? To answer these questions, the study at hand builds on existing theoretical contributions and draws upon empirical investigation. The following section describes the PSS solutions under study.

3.1. Water filter leasing and reverse osmosis system

The PSS models under study consists of a PSS based on a water filter leasing and a reverse osmosis water filter system that focus on the delivery of the result 'purified water'. They can provide a solution for overcoming a common problem in Brazil (the region where they are located) since the public water supply quality might be questionable, resulting in the consumption of bottled water.

The water filter leasing solution under study is offered by the Latin American leader company on the market of home appliances. It is a pioneering concept in the Brazilian market by being the only one that claims to have the complete control of the product life cycle. The company offers a small equipment (through a payment of a monthly leasing) and is responsible for product maintenance, repair and control. In the product end-of-life, the company performs the collection and recycling of the product. Long-term contractual agreements are established between customers (other companies or ordinary customers, i.e. persons) and the company. The manufacturer assumes the responsibility for recycling the packaging and the product by the end of its life.

The reverse osmosis filter system consists of a public water supply purification system through a reverse osmosis process. The purification equipment is installed in small commercial establishments and the product (i.e. the equipment), is connected to the public water supply to collect water from the local water network. To acquire water, customers go to the places where the equipment is installed bringing their own containers. The filtered water is provided in some pre-determined volumes, which the user chooses at the acquisition moment. The company (service provider) is responsible for the equipment installation and maintenance, which is designed for upgrading and refurbishment. A contractual agreement is established between the company and commercial establishments, and they share profits and responsibility for customer service.

Both solutions have common aspects of advanced services. The providers take the responsibility for ensuring the product availability and should assure the service performance. Contractual agreements are established between providers and customers (although in the case of reverse osmosis system the contract is established between the company and the commercial

establishments) and the payments are structured around product usage (pay-per-volume purified in the reverse osmosis system and pay-per-time usage in the water filter). To analyse the solutions, a combination of techniques was used (observations, technical information, and semi-structured interviews with some PSS actors). Data have then been synthesised in the light of the existing literature revealing some findings. Before hand, a literature review was performed addressing criteria that could be used to assess PSS sustainability aspects, outlined in the next section.

3.2. Analysis criteria

To define when a PSS consists of the sustainability requirements, it is necessary to define evaluation criteria regarding the three sustainability dimensions (environmental, economic, and social). Due to applicability limitations of existing tools to assess PSS sustainability (e.g. traditional LCA that is still not widely applied to 'non classical' life cycle strategies like PSS) as well the own study limitations (e.g., a lack of data from all PSS life cycle phases), a qualitative analysis was performed considering some elements in each sustainability dimension anchored in the literature. In the environmental dimension aspects such as energy consumption, waste generation and efficient use of transport (Hu et al. 2012), greenhouse gases emissions and efficient use of resources (Manzini and Vezzoli 2003) were selected. In the social dimension, the healthy and safety and customer acceptance aspects (Hu et al. 2012) were analysed. In the economic dimension the cost-benefit to stakeholders and added value (Hu et al. 2012) were analysed. Afterward, some structural and infrastructural propositions given by Baines et al. (2009) and Baines and Lightfoot (2014) to investigate the practices that support the delivery of the advanced services were chosen to conduct the study. This also helped to understand how different product-service arrangements and organisational practices may affect the PSS sustainable performance. Those are summarised in Table 1.

Propositions of Baines et al. (2009) and Baines and Lightfoot (2014)	Research questions for this study
Supplier relations	What are the supply chain relationships and how these relations may impact PSS sustainable performance?
Customer relations	What are the relations between customers and providers? How these may affect the PSS sustainable performance?
Quality control	What quality control is applied in each case? How it can impact PSS sustainable performance?
Planning and control	What planning and control systems are applied in the delivery of PSS? How they may affect PSS sustainable performance?
Performance measurement	What performance measurement is applied in the delivery of each PSS? How it considers the measurement of PSS sustainable performance?

Table 1: Propositions and respective research questions.

4. RESULTS AND DISCUSSION

In the water filter leasing PSS, the company produces the water filter and has monthly revenue structured around the product usage. The company offers four filter models to the market, which includes natural or chilled water, with different costs. In reverse osmosis water filter system, the company that installs the equipment is considered the service provider (the equipment is manufactured by another company abroad that is a business partner). The service provider establishes a contract with commercial establishments with frequent customer access such as supermarkets, bakeries, etc. The equipment is then installed in their own infrastructure.

Concerning environmental aspects, both studied PSS can contribute to minimise the environmental impacts of bottled water consumption. In both cases, the companies have interest to seek solutions with environmental benefits such as efficient, long-lasting, and recyclable products (Ceschin 2014). In the reverse osmosis filter system, the energy used is related to the operation of two hydraulic pumps that provide the pressure required for the filtering process. However, the used pumps do not

have high-energy consumption, since part of the required pressure for water filtration comes from the water supply network. In the water filter leasing the energy used is related to the operation of one hydraulic pump, an ultraviolet lamp used for the bacteria elimination, and for water cooling through thermoelectric system. Comparing both systems, the energy consumption in the use-oriented solution may be higher, as it involves the cooling system.

Regarding the greenhouse gases emissions, in the reverse osmosis system the company plans the routes to perform the equipment installation and maintenance in order to minimise the transport. The preventive maintenance is made weekly by the company, or when it is necessary a corrective maintenance. In the water filter leasing, the preventive maintenance is carried out every six months to replace the filter element or in cases where the customer requires a technical visit to solve a problem. As both studied PSS do not provide standard plastic bottles that generate many greenhouse gases during its production process, the emissions and transports performed are only related with to equipment installation and maintenance. As in the reverse osmosis system the maintenance is performed more often, the greenhouse emissions may be higher.

In the reverse osmosis system, filters are the only waste during the operational phase. Providing maintenance helps to extend equipment and components life, and at the end of a product's life the company performs repair and refurbishment of the equipment and its components (e.g. at the hydraulic pumps), minimising the waste. The equipment provider is especially encouraged of reducing the energy, material and water consumption in order to reduce costs. In the water filter leasing, the company recycles the product components, although the design of the products is not fully modular. In the operational phase, the wastes are associated with the filter elements and ultraviolet lamps. However, the replacement of the filters and lamps are performed less frequently than in the reverse osmosis system. With regard to the use of renewable resources and their efficient use, in the reverse osmosis system there is almost no water wasted. In the filtration process, the equipment has a water recycling system, since the volume captured from the water distribution network has impurities and the purified volume is lower than the volume captured. In the water filter PSS, the losses can be generated when the device is not used frequently. In this case, the customer must empty the reservoir with standing water, resulting in purified water disposal.

In the economic dimension, the reverse osmosis system allows gains to all stakeholders (e.g. for customers, the price of water is lower compared to the price of an equivalent mineral water volume). The commercial establishments have a 25% profit on monthly sales, with low operational costs. Furthermore, the PSS adds value to the commercial establishments, since more customers begin to shopping at the establishments where the equipment is located. Therefore, more commercial establishments began to be interested in PSS and the demand for equipment has grown in the last year. In the water filter leasing, the customer pays a fixed price (around US$ 25.00/month) for unlimited use. In addition, they also have to pay the energy costs to water-cooling (normal electricity bill). In this PSS, the company moved their position in the value-chain from being only a product manufacturer to providing customers with integrated solutions that can include product and services. This enabled the company to add value to their business.

In the social dimension, both solutions represent an opportunity for contexts with fewer economic possibilities, since they do not require payment for the full value of the product. Both solutions also provide good quality water to customers, which were confirmed by laboratory tests performed by the authors' university. Furthermore, both PSS minimise bottle usage, which is harmful for the health of customers and workers involved in the plastic resins processing. In relation to customer acceptance, in the reverse osmosis system, the demand for the equipment is continuously increasing, according to the interviews. In the water filter leasing, the company has supported the business for more than ten years, which provides an evidence of the solution success and customers'

acceptance. The following section presents some findings related with the operational practices adopted in each studied PSS.

4.1. Key findings

This section discusses three key findings related to the companies' operational practices that contribute to PSS sustainable performance: (i) suppliers and customers relations, (ii) quality and planning control and (iii) performance measurement. The development and delivery of sustainable PSS require a strong collaboration between the stakeholders (Vezzoli et al. 2015). In the reverse osmosis PSS, the service provider does not produce the equipment, it is imported from the US and the supplier transfers the knowledge to the company to perform the maintenance, repair and refurbishment. When some component fails, the company has the knowledge to repair, which reduces customer response time and ensures the provision of the service. In addition, when design improvements are needed, the supplier performs the necessary adjustments, and an exchange of technical knowledge is held between the supplier and the service provider. This has impact on the sustainable performance of PSS because when some internal unit fails, the filtration process and therefore the water quality are compromised. Furthermore, when some internal unit has a defect, it can lead to an increase of energy and water consumption.

The commercial establishments have a daily contact with customers, which allows monitoring their behaviour (informally) and identify current problems. In addition, when technical problems that might compromise the equipment performance and impact in energy and water consumption occur, they help to detect and reduce the generated impacts. Overall, the relationship between service providers and other actors may minimise the environmental impacts during the operational phase, as it is possible to have a better monitoring of customer behaviour and equipment technical performance as well as the faster diagnostic when a failure occurs. In the reverse osmosis system, the relation between commercial establishments and customer have allowed to company to perform a number of improvements in the equipment to meet the customers' needs. The customers' proximity also makes easy to provide information on adequate system use and to promote customers' orientation, reducing the generation of rebound effects due to excessive and incorrect use. In this sense, the offer is positively impacted by front-office staff (Baines et al. 2013), as well as the sustainability.

In the water filter leasing, the provider cannot predict customer behaviour because the equipment is installed in the customers' residence or business. Therefore, it is not possible to predict the rebound effects of excessive consumption or equipment incorrect use. Hence, the rebound effects resulting from excessive energy consumption can decrease the environmental benefits associated with the shared use. The relationship between provider and customer during the use phase is essential to monitor the customers' behaviour and how it affects the PSS sustainable performance. Indeed, the touch-points between customers and manufactures enable strong relationships (Baines and Lightfoot 2014). Furthermore, the possible customers' reactions due to the PSS implementation could be quantified and analysed in an evolutionary and dynamic view in LCA studies during the design phase. In short, the relationship between customers and providers is essential to achieve sustainability, because it allows customers' orientation and monitoring of the contextual dynamics of consumption and customer behaviour, avoiding and reducing the rebound effects.

Service quality via customer satisfaction has been widely used to measure service performance (Chou et al. 2015). The water quality control and the provision of information to customers may increase their trust in the PSS provider, helping to change their consumption behaviour associated with bottled water and to increase their acceptance and satisfaction. In addition, equipment quality control can reduce the operational costs and environmental impacts. In the reverse osmosis system, the merchants are the front-office actors on the service delivery and they also assume the risks,

therefore they are motivated to perform the quality control. In the water filter, the front-office employees are responsible for the quality control, and they have an important role in the customer relationship. In fact, employees are the channels to delivering product-service value and their commitment can drive customer satisfaction and influence service performance (Chou et al. 2015).

Concerning the practices of planning and control, in the reverse osmosis system the company carries out strict control of the equipment units and the maintenance process, in order to reduce the material disposal, waste generation and postponing the equipment components' life. To achieve effectiveness in service delivery, in the water filter leasing, the company developed a new business model to perform customer and maintenance services, in order to decrease management complexity and improve outcomes. Furthermore, product-service value and sustainability assessment are two essential criteria reflecting the performance of a sustainable PSS (Chou et al. 2015). Thus, in addition to adopt performance measures that reflect customers' outcomes a sustainability assessment that involves a combination of various indicators and allows evaluating the industrial impact on economy, environment and society should be adopted by the services providers. However, sustainability measures were not identified in the companies' systems.

5. CONCLUSIONS

This study explored the main sustainability aspects of two business models offering advanced services to supply a customers' need with a more sustainable alternative than the traditional products. The findings confirmed the literature discussions about the mixed sustainable potential of different solutions. Furthermore, the organisational practices associated with supplier and customers' relationships have an important role in conceiving sustainable PSS solutions. Through these relationships, the company can perform customers' orientation, monitoring their consumption behaviour and avoiding the rebound effects. The collaboration between stakeholders is essential for the offer delivering. As previously discussed in the literature, the front-office staff allows positive customer relationships. Service quality and control can also affect the PSS acceptance and customers trust in PSS providers, helping to change their consumption behaviour associated with traditional products. In addition, sustainability measures should be integrated into service performance measurement to help the companies to control their environmental impacts.

The study analysis is limited to two PSS solutions only, which may restrict the findings and their generalisation. Furthermore, quantitative studies should be performed in order to quantify the sustainable potential of each PSS category. Nevertheless, this study contributes to PSS empirical knowledge and provides insights of how companies should configure their operations to deliver sustainable advanced services. More empirical studies to investigate the sustainable potential of PSS solutions and how companies have structured their practices to support the sustainability are directions for future work.

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WEIGHT, SAFETY AND/OR SERVICES? AN AVIATION MANUFACTURER TACKLING CHALLENGES OF SERVITIZATION THROUGH DESIGN

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ABSTRACT
Purpose: Servitization literature elaborately discusses the challenges for manufacturers dealing with advanced services but lacks hands on insight on how to tackle these. This paper presents how the process took place in a large aviation manufacturer with the aid of design.
Design/methodology/approach: This paper describes a longitudinal case study that follows a single manufacturer in the aviation industry through action research.
Findings: A roadmap of the servitization process is discussed, providing insight and details of the actions taking place during the introduction of a service mindset. The paper argues for a design perspective to support manufacturers in servitization.
Originality/value: This paper brings in a new perspective on servitization: design, as well as documents a long-term effort of a manufacturer in servitization.

Key words: Servitization, challenges, manufacturer, aviation industry, roadmap, service-enabling system

1. INTRODUCTION
During the last decade, manufacturing industries such as the automotive and energy industry have been exploring opportunities to deliver advanced services (Baines and Lightfoot, 2013). These industries have provided much insight to advance the body of knowledge on servitization. From these experiences, various challenges to manufacturers transitioning towards services have been identified (Baines and Lightfoot, 2009; Oliva and Kallenberg, 2003; Nudurpati et al. 2013). The aviation industry is currently experiencing a similar move, looking for opportunities to differentiate based on services (Hall et al. 2013).

In the aircraft business landscape, specialized firms develop aircraft parts that are assembled by Original Equipment Manufacturers (OEM) (Ex. Boeing, Airbus, Embraer etc). To maintain a competitive advantage, manufacturers in the aviation industry have shifted from passive producers to active innovation research partners, sharing responsibilities and risks (Jones, 2012). This approach has fuelled technological advances over the years, delivering aircraft that are lighter, faster and safer than ever before. However, the passenger inflight experience has not changed radically in the past twenty years. In order to offer a personal brand experience and remain competitive, airlines are now shifting their focus to onboard experience and service satisfaction. Because of this change, the cabin design needs to provide a primary platform for any airline to express its own brand identity & services but must also adhere to the requirements of the OEM. This challenge requires cabin manufacturers to change their current product-dominant logic of engineering (reducing weight, new materials etc.) towards a service-dominant logic where the engineered products are regarded as service-enabling systems that support the service providers in their activities (Doganis, 2001; Kossman, 2006).

Zodiac Aerospace (made anonymous for reviewing purposes) is world leader in aerospace equipment and systems for commercial, regional and business aircraft, as well as helicopters and space applications. The company keeps to a traditional engineering, technological, industrial and management process, offering comprehensive and integrated cabin solutions. At this time, it is the only company in the aircraft cabin interiors industry to design and manufacture all the components

of an aircraft cabin, from cabin structures to seats, galleys, equipment, aircraft systems and aerosafety. This allows it to offer integral solutions to airlines and OEMs.

Zodiac Aerospace has recognized the responsibility and impact that manufactured products and equipment have on airlines' services processes. As a result of providing integral cabin solutions, Zodiac Aerospace aims to become a partner in redesigning service processes for airlines by re-envisioning products as service-enabling systems (Beelaerts van Blokland et al., 2012). In order to answer to the servitization and differentiation needs of airlines, Zodiac Aerospace (as a service enabler) wants to understand and support the service provider (airline) to serve their end customer as well as the onboard service team. However, in a traditional business arrangement, there is almost no direct link between the R&D departments of a manufacturer and the service provider (within the aviation industry the airline), nor between the supplier and the end-user (the passenger or cabin crew) (Hall et al., 2013).

This paper addresses how Zodiac Aerospace has tackled the organizational challenge of servitization towards developing service-enabling systems for airlines as well as what activities Zodiac Aerospace has undertaken in its transition. Furthermore, we discuss its impact on the organization and how design can support a manufacturing company dealing with servitization.

2. SERVITIZATION CHALLENGES

Existing servitization literature has recognized the complexity of servitization and focused on identifying and discussing the various challenges manufacturers encounter during the transition process towards delivering advanced services. Several authors have provided frameworks to classify the challenges, getting a grip on the transition process or structuring it (Lerch and Gotsch, 2013; Baines et al., 2013; Dix and Ganz, 2013). Currently, the identified challenges help manufacturers to know what to expect once they decide to look into servitization. However, these studies come from different streams of literature varying from engineering, marketing, environmental, management and design studies. Nudurupati et al. (2013) have made a valuable effort in mapping these different perspectives and bringing them together in one overview: a framework of eight challenges including "*Cultural transition, redefining the interface, product/service system design and supply network*", among others. This paper uses that framework as a starting point to map out what challenges Zodiac Aerospace encounters and how they address them. For the discussion of Zodiac Aerospace's challenges, one more challenge is added from Oliva and Kallenberg (2003): *building credibility for services*, both inside the organization and towards the external environment. In order to get internal support to continue with the chosen direction of servitization within Zodiac Aerospace, efforts were undertaken to showcase what value a service-orientation can bring to the organization, gain commitment, as well as show the external network that Zodiac Aerospace is a valuable and credible partner changing its capabilities towards supporting airlines in service differentiation.

Unfortunately, existing literature provides little or no guidance on how to successfully tackle the discussed challenges. Baines et al. (2009) discusses the scarcity of previous studies "t*hat provide guidance, tools or techniques, that can be used by companies to servitize*", pointing out that "*Guidance in the literature on how to approach organisational strategy (for servitization) is largely limited to anecdotal evidence from case studies that suggest good practices and processes for implementation.*" (Baines et al., 2009, p. 562).
Nudurupati et al., (2013) add to the discussion that most of the existing servitization studies remain at a theoretical level, limiting the applicability of the findings.

Tongur and Angelis (2013) as well as Nudurupati et al. (2013) bring forward several studies from design research as new perspectives that can support servitization with more action-oriented approaches. Authors like Morelli (2006 and 2008) and Sangiorgi (2011) have already discussed how

design can be valuable for untangling the puzzles of servitization. They focus specifically on how to move from designing products towards designing product-service systems.

3. ACTION RESEARCH APPROACH

This paper reports on a longitudinal single case study using an action research approach following ZODIAC AEROSPACE in the actions they undertake on their journey towards servitization. The action research approach has been chosen due to the practical nature of the problem, enabling us to follow and support the manufacturer in their actions. Action research focuses on bringing about change (deliberate actions steered by research) and contributing to knowledge (by reflection on the actions undertaken and their according effects) (Reason and Bradbury, 2006). By this process of action and reflection, action research builds theory, in this study, used to identify the relevant steps involved in addressing the challenges of servitization (Wood-Harper, 1985; Coughlan and Coghlan, 2009). During the period of study (three years, from 2012-2015) the primary focus was on investigating how design can support manufacturers in the challenges of servitization and what the impact is in the long term.

The first two authors conducted this study. The first author (researcher from academia) initiated the study in collaboration with a local R&D manager. Within a year after the start, the second author started as a researcher embedded within the organization, having actual working tasks related to bringing in the crew perspective and transforming product development. The first author took on the role of an outsider facilitating the transition process as someone more neutral. The interplay between the internal change agent and the external facilitator enabled the researchers to reflect and plan ahead on a constant basis and to achieve more valid results than having only an internal change agent.

The close collaboration of Zodiac Aerospace with the university allowed: 1) To bring in knowledge from research on servitization, knowledge and expertise on service design as well as experience design. 2) An academic perspective providing evaluation and reflection on their activities, 3) To work with young designers that can provide quick results and hands on means and 4) The use of design tools and human-centred approaches, future oriented and creative.

4. FINDINGS

Table 1 describes how Zodiac Aerospace addressed the organizational challenges related to servitization as discussed in literature. It shows the sequence and manner in which design supported Zodiac Aerospace in servitization. The sequence of the transition process boils down to a roadmap where three separate phases can be distinguished: Introducing Service Mindset, setting a Structure for Servitization and delivering a Service Proposition.

The study started off close to the core activities of Zodiac Aerospace as a manufacturer: infusing the R&D activities with a service mindset by bringing in the airlines' values for differentiation (putting the passenger experience and crew service routines central to R&D). By doing so, a cultural transition was started, making it possible to tackle other servitization challenges with further actions. Slowly, through the diversity of activities taking place, servitization spread like a cloud of ink through the organization paving the way for the second phase: preparing the organizational structure to ultimately deliver service propositions (phase 3) and changing the company's business model and revenue streams as well as positioning in the supply chain.

At the moment of writing, we have seen evidence of a cultural transition, engineers are starting to feel comfortable in involving passengers and crewmembers and are able to use design tools to design product-service systems. Phase 2 is currently being planned to take place in the coming year.

The next section discusses the activities in phase 1 in more detail. We describe the purpose of every action, and the impact on servitization within Zodiac Aerospace.

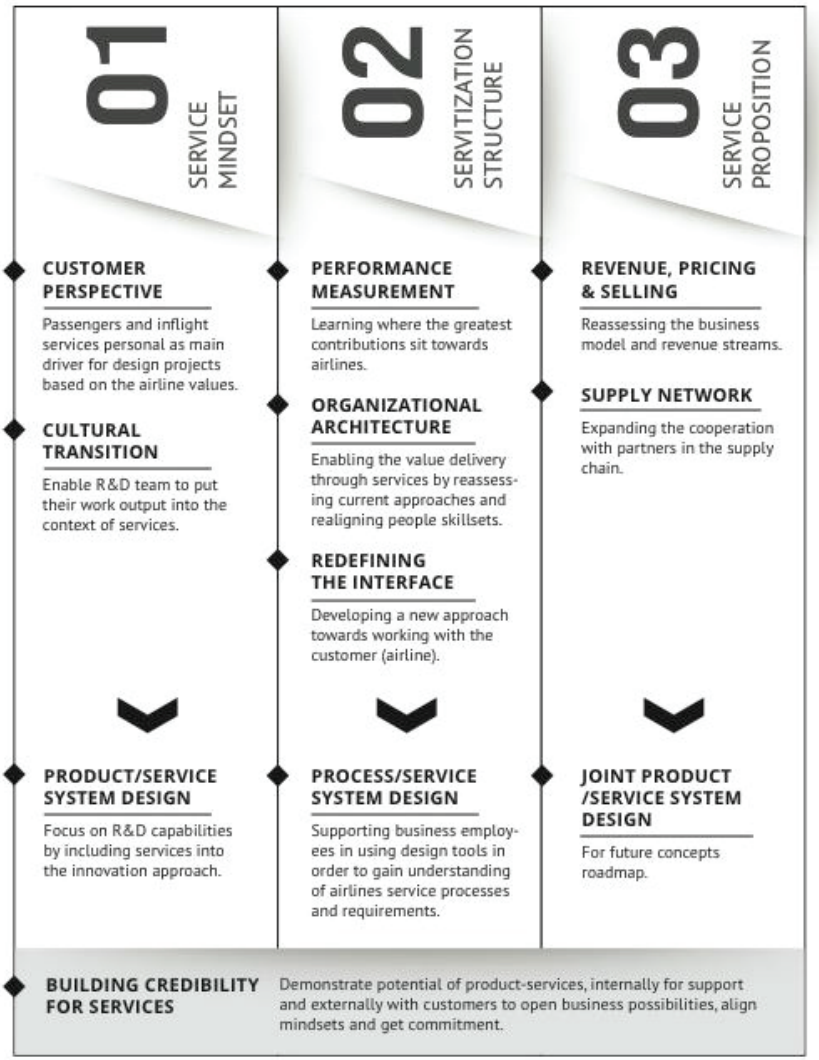

Table 1: Roadmap of servitization of Zodiac Aerospace, in which sequence the various servitization challenges were addressed and with which focus.

5. INTRODUCING A SERVICE MINDSET

The first phase in the servitization roadmap for Zodiac Aerospace focused on introducing a service mindset within the organization. The primary starting point was within the R&D department,

supporting engineers to take the changes within airlines into account especially with regard to differentiation.

5.1 Customer perspective

Viewing Zodiac Aerospace products through the customers' eyes provides valuable information on how to support service challenges via product systems. In order to bring the customer perspective into R&D projects, Zodiac Aerospace used distinct design efforts such as: (a) building an "Experience Lab", (b) strengthening "Collaboration with Academia" and (c) contracting a former inflight services team member as an internal "Service innovation consultant".

(a) Experience Lab: In contrast with traditional R&D that focuses on meeting airworthiness regulations (reducing weight and increasing safety), the Experience Lab permits early prototyping of the on-board customer experience by putting design concepts (product-service systems) in their context of use. This enables the R&D team to understand the impact of their concepts within service routines. The Experience Lab is at a fixed location and is built as a fully equipped mock up of a commercial aircraft.
(b) Collaboration with Academia: Zodiac Aerospace has partnered with the design faculty from Delft University of Technology, collaborating in diverse research projects and sponsoring Design Master courses. For example, for three consecutive years, students work on assignments provided by Zodiac Aerospace. As part of the assignments the young designers include values and perspectives of various stakeholders into their concepts pertaining to new kinds of technologies and new on-board service processes.
(c) Service Innovation Consultant: By employing one of the primary representatives of their customers, Zodiac Aerospace is able to quickly gain feedback and actively bring the customer perspective into the R&D initiatives.

5.2 Cultural transition

The current product-oriented guidelines for product innovation, concerns and customer relations are reshaped by pushing cultural change towards a service-oriented mindset. Traditionally, the aviation industry has its foundations in military services, where safety and reliability are the main anchors for NPD. Zodiac Aerospace is partnering with a local design faculty with the purpose of exposing their R&D team to a new set of service design skills. This approach allows the leap out of the traditional development ways, and initiates an internal shift of mindset leading to organizational motivation for change. This is achieved by putting the NPD team to work with young service designers on product-service concept ideas that break loose from current practices without compromising safety and reliability.

5.3 Product/Service System design

Most of the time, the NPD team focuses on the design of physical products. Less priority is conferred to the service systems to which they belong. In order to offer advanced service solutions, design concepts should take into account from an early stage the interactions between products-services-processes and users (both crew and passengers). Zodiac Aerospace is exploring a suitable methodology to provide the NPD team with the best design methods and tools for service-system requirements.

5.4 Building Credibility for services

The industry is used to the traditional role of the supplier as a product manufacturer. In this role, Zodiac Aerospace is not expected to own expertise in services. The challenge becomes to re-position their business capabilities in the marketplace. For this purpose, building credibility with the client (and internally with diverse business units) is critical for the organization to break the resistance of airlines to accept the supplier as an "advanced service provider" and "customer experience enabler". Design is giving a critical support here by demonstrating the potential of Zodiac Aerospace as a

"customer experience enabler", by generating visions (design concepts) of the enabled in-flight services and the consequent differentiating customer experience. This is already generating a new attitude from the airlines.

Design approaches adopted by Zodiac Aerospace to build credibility include activities such as (a) Roleplaying for internal purposes showing to Zodiac Aerospace employees how their concepts are used in service routines, (b) Industry Awards obtained through design concepts give a ripple effect of credibility throughout the company and towards the network, (c) Airline Co-creation in developing new propositions and concepts and (d) Marketing Initiatives using future visions developed by designers.

6. LESSONS LEARNED

Within Zodiac Aerospace servitization took place in three different ways in order to move from certifying demanded products towards focusing on underlying problems and make bigger leaps in innovation with the customer in mind. First servitization was a learning process to gain capabilities to focus on the customer perspective, and develop service-oriented propositions, not only for R&D but also in other departments such as sales. Second, it was also a 'political' process where both internally and externally relations were redefined, or established. Zodiac Aerospace visually mapped its current and desired internal and external actors, relationships as well as the value streams to get a grip on this process. Third, servitization leveraged a strategic process where KPI's of departments were redefined as well as long-term roadmaps and future scenario's were developed not only for the entire company but also the different business units.

Figure 1 provides an overview of the general lessons learned by Zodiac Aerospace. It discusses the needs Zodiac Aerospace encountered and which activities were undertaken to address the needs. Zodiac Aerospace worked with simultaneous processes of developing service concepts next to "keeping the shop open" and delivering for current customer demands. These two interests collided on different occasions, specifically when assigning staff to projects, giving priority to projects and dedicating funds. In the past three years with Zodiac Aerospace we identified three key-moments that were important for the success of servitization. They can be regarded as tipping points, which enabled to leverage the opportunities for servitization. These moments were: 1. When Zodiac Aerospace moved from a bottom up to top down approach in addressing services, as servitization was recognized as a possible strategy by upper management (by doing so more resources could be dedicated), 2. When the activities moved from R&D to elsewhere in the organization (other silo's, and countries) and 3. When Zodiac Aerospace decided to go public (towards their clients but also on industry meetings) with their efforts to deliver service-enabling systems.

7. CONCLUSIONS AND IMPLICATIONS

This paper presents a first exploration of all activities undertaken within Zodiac Aerospace in the past three years. By linking the activities to the existing body of knowledge on servitization, our understanding of the transition process in practice is extended, at the same time providing more structure for the next steps planned by Zodiac Aerospace. This paper documents the first phase of the servitization roadmap, as the second phase is currently taking place, more publications will follow documenting the following actions within Zodiac Aerospace. The case of Zodiac Aerospace shows how a manufacturing organization can pace its servitization efforts and which challenges are worthwhile addressing first since they have a domino effect in the organization (in the case of Zodiac Aerospace, the most primary ones were: bringing in the customer perspective and building credibility for services).

DOMAIN	NEEDS	ZA APPROACH
1. REFERENCE & GUIDANCE	■ To contextualize To learn about (servitization) To understand complexity To benchmark To get guidance To avoid known mistakes To repeat succesful practices	■ Get information and guidance about servitization. ■ Learn from previous experiences and good practices of others. ■ Seek external support/expert to give guidance. ■ Hire crew to provide user perspective
2. CRITICAL SELF DIAGNOSIS	■ To map / visualize current scenario To self-analyse / evaluate To locate (see where is ZAGE in the process) To decide To learn of mistakes	■ Build in time for reflection and discussion ■ Initiate, enable and manage the learning process.
3. PLANNING & STRATEGY DEVELOPMENT	■ To map / visualize future scenarios To set goals (where does ZAGE want to be) To plan - go into action To find solutions / directions To decide	■ Visualize future scenarios as goals (for both clients as ZAGE) and the process to get there. ■ Identify tipping points for scaling up - from R&D to elsewhere - from bottom up to top down - to other silo's and countries - to go public - to use servitization strategically ■ Visualize and plan the flow of value in a new ecosystem.
4. FACILITATE & CONVINCE	■ To convince To align mindsets To get commitment	■ Build credibility by quantifying potential of services ■ Experience Lab as boundary object / envision goals / have physical space for collaboration / bring in customer perspective

Figure 1: Lessons learned from Zodiac Aerospace: How did they address their needs?

At the moment Zodiac Aerospace is experiencing a tipping point in their journey. Where the first phase was organized to infuse the organization with a service mindset using a bottom up approach, the next phase requires a clearly outlined strategy from top down in order to support Zodiac Aerospace to restructure the internal organization for servitization. Upper management has at this point recognized the potential value of servitization as a strategy but is still defining its approach structure. This will be one of the primary steps to be taken next. The discussed roadmap enables these next steps as it provides insight into what to expect and what kind of measures to be taken. We identify this tipping point also as an important topic for further investigation in future research as well as an important moment during servitization that needs to be recognized and addressed.

With regard to the potential of design to support servitization, the following elements are identified as prime targets for future research: The action-oriented or hands-on approach that design brings, with intermediate tangible results that can be easily communicated with stakeholders, the ability to

deal with complex matters through visual representations (acting as boundary objects), and the experience-centered perspective focusing on bringing the values of various stakeholders together in designing new product-service systems.

In the process of experiencing organizational transformation Zodiac Aerospace has acknowledged the support of academic knowledge through diagnosis, reflection, evaluation, and structure provided by theoretical advancements. Furthermore, having academic researchers on board supported the credibility and rigour of servitization through different management layers in the organization.

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SOCIAL AND COLLABORATIVE SERVICES FOR ORGANIZATIONS: BACK TO REQUIREMENTS

Mayla Alimam, Emmanuel Bertin & Noel Crespi

ABSTRACT
Social and collaborative services have widely spread within the enterprises as they play a part in improving productivity and business outcomes. However, the deployment of these services fluctuates between success and failure. This paper intends to assess their deployment and how they can contribute to value creation in different industries. We investigate the relationship between the services' functionalities and the organizational requirement of these services represented by the coordination. We also consider the organizational transformation driven by servitization and emphasize its impact on the act of coordination. We highlight the tight correlation between the functionalities and the requirement in organic forms which suggests a successful deployment in such enterprises. We nonetheless find that, when the servitization is a strategic intent in organizations with mechanistic characteristics, deploying social and collaborative services can contribute to achieving this aim.

Key words: social and collaborative services, mechanistic form, organic form, organizational evolution, servitization, coordination

1. INTRODUCTION

IT services within the enterprises are enabling technologies applied to facilitate the execution of the enterprise's business activities and hence, increase their performance and improve their productivity. Traditionally, these services have been the Information Systems (IS), being delivered in different models such as intranet, Enterprise Resource Planning (ERP) and Electronic Data Interchange (EDI). A continuous evolution of these services is yet observed and new products labelled as "social" or "web 2.0" have appeared and swept through the popular culture to reach the industries. From Computer Supported Collaborative Work tools to Enterprise 2.0 to Enterprise Social software, these social and collaborative services are increasingly being considered in organizations' strategic IT roadmaps. They are attracting enterprises' top management as they contribute to value creation. Based on a survey covering 4,200 companies around the world, the McKinsey Global Institute outlines that 70% of these companies are deploying social and collaborative services (Chui et al. 2012). However, this deployment is not been adequately successful. Only 3% of the companies are declared as fully benefiting of these services.

Researches addressing social and collaborative services in the enterprises are still at an early age. They often focus on their deployment while defining guidelines and outlining factors that promote their adoption (McAfee 2013, Buregio et al. 2015, Yang et al. 2013, Komarov et al. 2014). Even though some studies characterize the social and collaborative services, they fall within the scope of business activities (Williams and Schubert 2011, Kuettner et al. 2013). They assess their impact on enterprises by examining their context of use, which supports different types of activities. A complementary focus is however necessary to take account of the actual organizational needs for such services, along with the organizational transformation trend. Indeed, today's companies are evolving (Daft 2012), and market analysis is highlighting the current servitization process especially in technology driven industries (Marks et al. 2011). As different types of enterprises involve different ways of working, deploying social and collaboration services will, in its turn, differ in accordance with enterprise types.

This paper investigates the relationship between the nature of social and collaborative services and the organizations' characteristics for the purpose of assessing the deployment of these services in different organizations. Our methodology consists of the following: on the one hand, by looking into how these services have evolved over the years, we identify several distinctive functionalities that make them uniquely powerful and urge to their adoption in the enterprises. On the other hand, we examine the basic requirements of such services in organizations in order to identify the key organizational need that requires to be aligned with these services. In addition, we consider the evolution of the organizational forms and how organizations are migrating from traditional, mechanistic and product-centric business towards more organic forms such as service-oriented enterprises and ecosystems. We emphasize the impact of this organizational transformation on their requirement. Finally, we examine the correlation between the services' functionalities and the organizational requirement in different forms. The rest of the paper is structured as follows: Part 2 explores the functionalities of social and collaborative services. Part 3 examines the basic requirements of such services in the organizations. Part 4 describes the relationship between the services and the organizations. Part 5 gives the conclusions.

2. EXPLORING SOCIAL AND COLLABORATIVE SERVICES

A large variety of terms have been coined until present to describe the social and collaborative services in the organizations. Some of them were equivalents to others representing shared concepts. Some others introduced new capabilities with their emergence. We trace the evolution of these services over the years while deriving the main functionalities that they are offering.

2.1 Evolution of Social and Collaborative Services

Social and collaborative services can be either tools comprising one or several applications, potentially integrated within the enterprise's system in use (e.g. integrated instant messaging and email services as an independent application or an accessible service through the employee's portal), or otherwise, full-feature platforms that accumulate several services in one single place (e.g. an enterprise social network).

The 1980s and 1990s witnessed a conflicting use of terminology including *Groupware*, *Group Support Systems* (CSS, previously group decision support systems) and *Computer Supported Collaborative/Cooperative Work* (CSCW) to describe the study of technology and coordination of groups with multi-disciplinary perspectives. CSCW was the term held by the academic community for an annual CSCW conference since 1986 whereas groupware continued to appear in both CSS and CSCW literatures (Allen 2004).

The term *Social Software* substituted Groupware (Shirky 2003) and got into more common usage in the 2000s (Grudin 1994). However, its popularity is probably related to the convergence of technological, cultural and societal factors that has brought the desire and the ability for people to use technology to communicate, connect and collaborate (Cook 2008) with the aim of developing new social connections and earning reputation in communities (Farnham et al. 2004).

The emergence of Web 2.0 in 2004 and the similarities of its concepts with the social software led to the introduction of *Enterprise 2.0* (E2.0) which was defined as "the use of emergent social software platforms within companies, or between companies and their partners or customers" (McAfee 2006). This latter, entitled *Enterprise Social Network (ESN)* or *Enterprise Social System (ESS)*, penetrated the enterprises as online social networks for employees' professional exchange (Mathiesen and Fielt 2013).

2.2 Main Functionalities of Current Services

Through the evolution presented in the above section, we observe different standpoints regarding the functionalities of social and collaborative services. We agglomerate features that have been outlined in previous seminal researches into a single list representing the main functionalities of current services.

From the perspective of CSCW, Grudin and Poltrock (Grudin and Poltrock 2013) introduce a framework categorizing the features they observed in developed CSCW technologies. They identify three variables describing the technologies' behaviour and evaluate each of the variables according to temporal determinants, i.e. whether being practiced on real time basis or asynchronously. Their proposed behaviour categories are: communication (e.g. emails), information sharing (e.g. document management systems) and collaborative coordination (e.g. group calendars and social networks).

From the perspective of E2.0, the technologies are built into platforms linking together collaborators by new ways of communicating. The communication processes are performed either through channels, i.e. person to person / persons, or following a publish/subscribe pattern (Eugster et al. 2003) over communities on a larger public scale. Since he has coined the term E2.0, Andrew McAfee is continuously emphasizing, in his work, the practice of knowledge management and information exchange that is ensured by these forms of communication processes (McAfee 2006, McAfee 2013). Moreover, current services such as ESSs, surpass their predecessors by enabling a social interaction between the users while controlling their rights and distributing the access, e.g. controlling the ability to create, modify or access a content through the service (Chui et al. 2012).

Bringing together all the mentioned functionalities delivers the following list: communication, supporting knowledge management which includes information sharing and organizing, collaborative coordination, supporting teams represented by the social interaction between group or community members, supporting social behaviours and providing the ability to build a social network of strong and weak ties, supporting different levels of access and controlling rights. This list is summarized in Table 1.

Functionalities of Services
Communication
Knowledge management
Collaborative coordination
Team support
Social behaviour
Controlled access and rights

Table 1: Main functionalities of social and collaborative services

3. ORGANIZATIONAL REQUIREMENTS FOR DEPLOYING SOCIAL AND COLLABORATIVE SERVICES

The various functionalities we introduced above are related differently to the organizations according to the organizational form of each enterprise.

3.1 Evolution in Organizations: Towards Servitization

Standing as a mean to accomplish the organization's overall goals, organization's forms are indeed not all similar. They vary in accordance with the organization's management and strategy. In fact, they balance between two edges: the mechanistic edge and the organic edge (Burns and Stalker 1972, Daft 2012). On the one hand, the mechanistic model represents the rigidity and the verticality

of strictly formalized business processes, as for instance in Fordist or bureaucratic organizations. On the other hand, the organic model represents the fluidity and the horizontality (Ylinen et al. 2014). The latter model is increasingly becoming a goal for companies searching to face sustainable challenges such as the organization's growing size and the competitive changeable environment outside its boundaries (Daft 2012). The transformation between the two edges is led in manufacturing firms by servitization, driving the company towards service provision (Vendrell-Herrero et al. 2014). It engenders new ways of working that require being investigated and equipped with the appropriate IT services (Baines and Howard 2013). In both models, the major driver for social and collaborative services consists in supporting and enhancing the coordination.

3.2 Coordination: the Key Requirement in Organizations

Coordination is described in the literature as the linkage between parts of an organization (Van de Ven et al. 1976). It represents the core of collaborative work and the driver for achieving the organizations' activities and processes (Okhuysen 2009). Consequently, equipping this key requirement with powerful IT services such as the social and collaborative services may ensure a better accomplishment of the interdependent tasks. Nevertheless, the form of this coordination diverges considerably in organizations. In fact, it is tightly related to the dominant organizational structure.

Mechanistic organizations imply a high formalization and respect of standard procedure. In a pre-defined manner, information flows vertically up the organization's hierarchy and business processes get broken down into strict tasks (Daft 2012).

Moving towards organic forms such as service-oriented companies and ecosystems, coordination's complexity strongly rises. Employee empowerment (Jiang et al. 2011) and the new ways of working occurring in these forms cause the information to flow cross-departmentally and in all directions. This results in a large amount of information to be handled and might therefore get challenged by an information overcharge.

4. RELATIONSHIP BETWEEN THE SOCIAL AND COLLABORATIVE SERVICES AND THE ORGANIZATIONS

Having identified the coordination practices in an organization as its key requirement for deploying social and collaborative services, we illustrate in this section the relationship between this requirement on the one hand, and the services represented by their main functionalities on the other hand. Figure 1 demonstrates this relationship. As shown in the figure, the organizational evolution is illustrated on a continuum ranging from the mechanistic to the organic edge. The servitization process represents the evolution axis towards organicity.

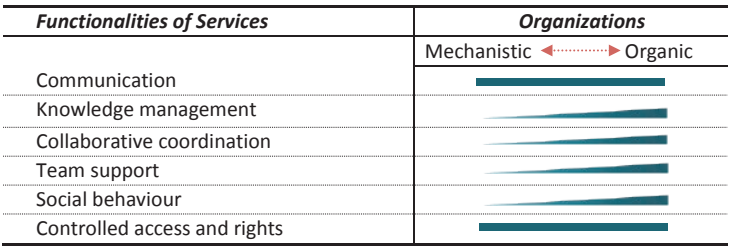

Figure 1: The relationship between the functionalities of social and collaborative services and the organizational key requirement

In fact, the organizational need for each of the services' functionality is directly linked to the coordination practices in a particular company. Thus, as the coordination's complexity levels for the two extreme models are divergent, the need of functionalities might change. This latter is illustrated in the Figure 1 for each functionality. For instance, communication is highly important in both mechanistic and organic models since information flow, whether vertical or horizontal, circulate through communication. On the other hand, the need for team support is less important in mechanistic models than in organic ones. This is because of the horizontal cross-departmentally coordination that is highly required in organic forms.

However, organizations are a hybridization of characteristics of each of the two edges only with different degrees. They therefore have different degrees of needs depending on their position on the continuum. Our findings suggest a high correlation between the services' functionalities and the organizations on the organic edge. We relate this to their close fit to the way of working in enterprises with higher organic characteristics such as service-oriented companies. Our findings also suggest a significant decline of correlation in organizations with more mechanistic characteristic.

These findings underline the relationship between the services and different types of companies. They suggest that deploying these services in organic companies leads to a successful adoption and assists, on the other hand, the transformation processes in evolving ones. Giving as an example the Zero email program announced by Atos in 2011[1]. Gartner's research note described that program as "a big change effort" supporting established ways of working and behaviors (Bradley and Searle 2014).

Nevertheless, challenges might arise to influence this success. Such challenges are the organization's size, user acceptance of these services, the technology already being in use and its overload effect.

5. CONCLUSION

Describing the relationship between the social and collaborative services and different forms of organization legitimizes the lack of their deployment's success in some companies. We highlight the tight correlation between the services and organicity driven by servitization. Despite some remaining challenges, the adoption of these services in an organic company should not fail. It shall lead the company to a better productivity and contribute to its value creation.

Nonetheless, we find that deploying such services in an organization with mechanistic characteristics assists the company along its journey towards servitization. It tackles some of the barriers that are challenging the servitization process as for instance, the organization's architecture and capabilities (Nudurupati et al. 2013).

To carry out this work, we suggest performing a complete requirement analysis comprising a detailed study of coordination practices in distinctive organizations. Surveys about the services implication as well as stakeholder interviews can serve as a feedback to support this academic research in order to validate the proposed requirement list. Furthermore, an analysis of the features of different types of services is to be carried out to identify the specifications list that will allow prototyping future services.

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SERVITIZATION THROUGH HUMAN-DATA INTERACTION: A BEHAVIOURAL APPROACH

Ganna Pogrebna

ABSTRACT

Purpose: This paper proposes a new approach to servitization and business models by understanding behavioural aspects of human interactions with technology, specifically, with "smart" devices, connected devices, autonomous systems, and internet of things (IoT) through understanding and interacting with data which these devices and systems generate.

Design/methodology/approach: Proposed approach, Behavioural Human Data Interaction Hypothesis (Behavioural HDI Hypothesis), which differs from existing literature, leverages on research in behavioural science, data-driven business models, multi-sided markets, and Human-Data Interaction (HDI).

Findings: Behavioural HDI Hypothesis can offer a new approach to future markets for data because it helps to (a) predict consumer choice of product and services; (b) suggest new and improved interaction mechanisms between consumers and their self-generated data; and (c) propose a new approach for building and evaluating business models.

Originality/value: To date, very little has been known about whether and how consumers and households accumulate, review and use self-generated data about consumption decisions and how this affects market relationships between consumers and providers of goods and services. This paper shows how Behavioural HDI Hypothesis can make markets for data more efficient through better personalisation and servitization. It also has implications for data collection visibility, data ownership and structure, platform trade-off, security and other ICT-related challenges which negatively affect current business models in the digital economy.

Key words: servitization, data as a service, Human-Data Interaction (HDI), new business models

1. INTRODUCTION

The development of information and communication technology (ICT) in the modern economy has created opportunities for businesses to provide customised products, services and experiences to their customers. This customisation became possible due to large volumes of (personal) data which customers generate on a day-to-day basis and which businesses collect, store and analyse. For many businesses, the future relies on their ability to process the data in order to accurately predict consumer preferences and create personalised products, services and experiences in the most cost-effective way.

Yet, at the moment, data-driven business models through personalisation are still in their infancy as even companies with access to large amounts of data struggle to create reliable forecasts of future customer wants and needs to quickly react to changes in market trends. One of the most notable examples of forecasting inefficiency are so-called *recommendation systems* (available via major retailers) which are supposed to make suggestions about *what a customer might like to purchase in the future*, but which are in fact rarely used. Furthermore, we also do not see a development of effective markets for data where consumers of goods and services (henceforth, users) would trade their self-generated data with producers of goods and services (henceforth, providers) which inhibits an effective use of data as a service.

This paper first considers reasons for the current data market inefficiencies and then develops a model of market for data where users and providers interact to develop new business models utilising different types of data as well as different ways in which this data is perceived by the users. The proposed model – *Behavioural Human-Data Interaction Hypothesis* – is based on Data-Driven

Business Models approach which explains how business models can be developed using data (e.g., Hartmann et al. 2014); an open multi-sided markets approach which offers an account of how new markets with multiple players can be created in the digital economy (Ng 2014); as well as research in Human-Data Interactions (HDI) research which explains how users interact with data (Mortier et al. 2014). This new *Behavioural HDI Hypothesis* is also rooted in behavioural science literature and has significant implications for new business models in the digital economy as well as offering important solutions for the currently existing ICT-related servitization problems such as data collection visibility, data ownership and structure, platform trade-offs, and security.

2. MARKETS FOR DATA: PRESENT AND FUTURE

2.1 Current Market for Data: Value and Worth

Let us first consider the current market for data. In this market, users supply data and providers demand data as described on Figure 1 below. For the purposes of this paper we will concentrate on user self-generated data which may include personal data (data reflecting behaviour of an individual user) or social data (the data for the whole household, etc.). Providers demand the data and are willing to pay the demand price P_D for the data (this is how much the data is worth to providers). This price is relatively high as it allows providers to offer *better* (more personalised) goods and services to users and increase providers' profitability via better understanding user demand for goods and services as well as via increasing user value. We define providers broadly – this could be companies which trade data, data analysts, app developers and providers of goods/services.

Users are willing to offer data at a supply price P_S which is perceived by them as very low. On Figure 1 we choose a price level close to 0 in order to describe the level of P_S (this is how much the data is worth to users). In practice, this price is not expressed in monetary terms, i.e., users do not directly receive any money from the providers. Instead, it reflects the "cost" of data to users in terms of, e.g., loss of privacy, etc.

Abstracting from different types of data as well as from different ways in which the data is perceived by users and providers, the level of P_D and P_S (shown using the vertical axis) remains stable irrespective of the quality of the *data as a service* (shown using the horizontal axis). The *data as a service* variable depicts how effectively available data can be converted into meaningful business models (provision mechanisms). In other words, it reflects the value of the data for providers and users on the market.

Figure 1 Current Model of Market for Data

We assume that the value of data is the same for providers and users for the following reason. If providers receive valuable data about user behaviour, they will be able to provide better (more personalised) goods and services to the users. Therefore, data of higher quality which produces better predictions of behaviour and lead to an increase in user wellbeing and provider profitability should be valued higher by both sides of the market (users and providers). In practice, there is, of course, a lot of uncertainty as to the value of the data (see, e.g. Ng et al. 2015). Yet, this question requires a separate investigation and for the purposes of this paper we do not consider uncertainty about the data.

Figure 1 shows that the current market is inefficient: since the disparity between the supply and demand price for data is very large, the data is not traded. In principle, providers are willing to pay P_D to obtain the data, but users are offering the data at a very low price P_S which means that providers can either (a) obtain the data themselves at a very low (or even zero) price in which case they receive a profit margin of $P_D - P_S > 0$ (e.g., Google, Facebook, etc.); or (b) purchase the data from other providers (intermediaries) at P_D in which case intermediaries receive a profit margin $P_D - P_S > 0$. Note that the obtained/purchased data can be of low or high quality as captured by the *data as a service* variable and the demand/supply price does not depend on it.

2.2 Future Markets for Data Ignoring Behavioural HDI

In recent years, various issues were raised with regard to supply price for data. Specifically, the development of new technologies (e.g., Eckl and MacWilliams 2009) resulting in concerns about data ownership (e.g., Evans 2011), data privacy (Itani et al. 2009), as well as the inequality between users and providers in terms of profit distribution from data usage. Under these circumstances, user perceptions of data markets have changed giving rise to scepticism about the potential of trading data with providers. This sceptical view which ignores the fact that people interact with different types of data in a different way is depicted on Figure 2.

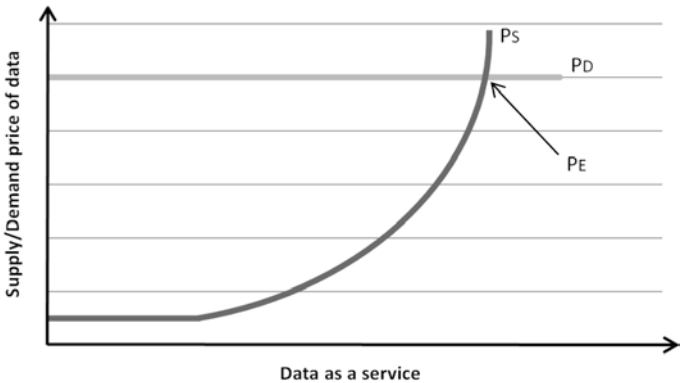

Figure 2 Future Model of Market for Data without Behavioural HDI

According to this view, providers in the future will still be willing to purchase data at a demand price P_D. At the same time, the supply price P_S for users will range from very low for less valuable data to high for more valuable data. Therefore, users will only trade the data with providers at an equilibrium price P_E at the intersection of supply and demand price functions on Figure 2. Effectively, this means that in order to trade, users would need to provide data of high quality, exert a significant amount of effort to accumulate the data, and engage with providers. This creates serious objections to direct user-provider markets for data since the potential logistical costs of users engaging with providers is very high and very few users would be able to engage with trading data.

However, applying such a model of market relationships would not be correct because it does not capture the complex human-data interactions within the digital economy.

3. BEHAVIOURAL HDI HYPOTHESIS AND ITS IMPACT ON BUSINESS MODELS

3.1 Behavioural HDI Hypothesis

The market structures presented in sections 2.1 and 2.2 do not take into account that different types of data which may be perceived by users differently. Yet, by applying Behavioural HDI Hypothesis we can show how different types of data (with different value to users and providers) can be successfully traded on the market for data. Behavioural HDI Hypothesis distinguishes between traditional data, invasive data, and inventive data (see Figure 3).

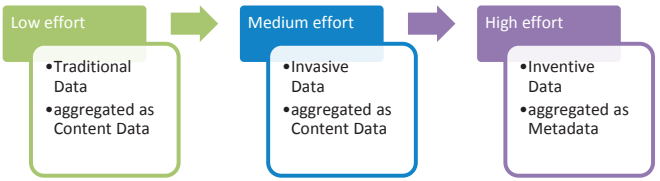

Figure 3 Data Types according to Behavioural HDI Hypothesis

The data types presented on Figure 3 differ by the amount of effort which a user needs to exert in order to engage with each type from low effort (traditional data) to high effort (inventive data). Due to the fact that users need to exert a different amount of effort to engage with each type of data, they will perceive the 3 types of data differently.

Traditional data involves minimum/low user effort because it is accumulated by technology which exists in the households of the majority of users. The data generated by this technology is reviewed by users on a regular basis and all users can easily assess this data (e.g., data from electricity meters, water meters and other "traditional" devices).

Invasive data involves medium user effort because it is accumulated by technology which is accessible and yet non-"standard". For example, data from mobile applications (apps), smart home sensors, etc. requires for the user to install the apps or devises and learn how to read and understand self-generated data obtained through this technology. This type of data is called "invasive" because this data often influences human behaviour (e.g., fitness apps may make an individual exercise more).

Inventive data involves maximum/high user effort because it requires for the user to add relevant content to existing data accumulated through Internet-of-Things (IoT). Particularly, inventive data may require for the user to add context to the data collected through other devices. In other words, inventive data does not only tell an individual that electricity was used but also stores important information about who used it, when and which device was turned on. This type of data is called "inventive" because it requires the user to innovate or co-create together with providers in order to receive the best-quality informative data.

While traditional and invasive data is used, aggregated and analysed by providers as Content Data (data which provides information about action events but gives no context about these events such as, e.g., Big Data or Connected Data), inventive data is accumulated as Metadata (data which provides information about events in conjunction with their contexts).

3.2 Perceived Market for Data with Behavioural HDI Hypothesis

Since different types of data under Behavioural HDI Hypothesis are not perceived by users in the same way, we can modify Figure 2 to introduce different types of data and show how future markets for data may be affected by these different perceptions.

Previous research (e.g., Parry et al. 2015; Ng et al. 2015) shows that context-dependent data provides important benefits for customisation, personalisation, and creating new business models. Therefore, it is likely that the quality of data as a service will increase from traditional to invasive data and then from invasive to inventive data. Users would demand a higher and higher price P_S as they go from traditional to invasive and from invasive to inventive data because, according to Behavioural HDI, they have to exert more and more effort to obtain the data. At the same time, since under Behavioural HDI, users will not perceive traditional, invasive and inventive data in the same way, rational providers will anticipate this change in user preferences for data which will result in changes to demand function for data. Specifically, the demand function for data will follow a pattern, at first increasing and then stationary. Traditional data will become less valued by providers and the demand price will be flat on the region covering traditional data. However, for invasive and, especially, inventive data the demand price will be increasing intersecting with P_S on an interval covering a large portion of inventive data and forming an interval of equilibrium prices P_E. Such shape of P_D function even allows for a small portion of invasive data to be traded if this data is of relatively high quality (see Figure 4).

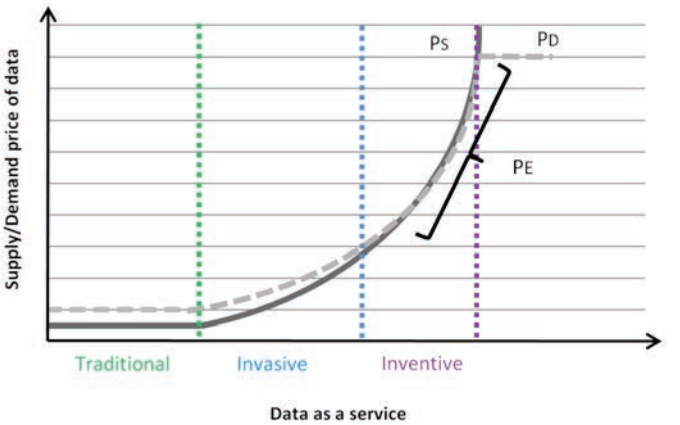

Figure 4 Future Model of Market for Data with Behavioural HDI

Overall, under Behavioural HDI, different user perceptions of traditional, invasive, and inventive data will result in large portions of data being traded on the data market which will be beneficial for both users and providers. After reaching its maximum, P_D will be flat due to the fact that providers have budget constraints and beyond a certain point even extremely valuable inventive data will become too costly for providers.

Behavioural HDI provides a system of market relationships through which providers can better fulfil users' wants and needs by better understanding their preferences and offering better (more personalised) services. It also suggests new and improved interaction mechanisms between users

and providers as they have an opportunity to directly trade data on the market. It also may offer new approaches for building and evaluating business models. Specifically, business models can be evaluated based on the user effort level necessary to engage with providers, the actual price at which the data is traded (top of bottom of the P_E interval), etc.

4. IMPLICATIONS OF BEHAVIOURAL HDI

The proposed approach has several important implications not only for new business models but also for research and practice of data collection visibility, data ownership structure, platform trade-offs and security of data.

Current ICT systems often collect data in ways which are subtle to users: many people do not realise that their supermarket or coffee shop club cards, smartphones or social media webpages constantly collect and accumulate their personal data. Even though providers seem to believe that users prefer subtle data collection to visible (judging, for example, from the caution around the deployment of Google Glass), it is not clear whether users actually prefer devices which collect their personal data in a subtle way to those which do it in a visible way. It is also not clear whether users are more concerned about the visibility of data collection or about the possibility that a device maybe collecting information which is unknown to the user. Behavioural HDI allows us to study these issues systematically by eliciting user preferences over different types of data.

Since the supply of data is dependent on the technology, the ownership of the data often remains with the technology owner. For example, Internet search data trends are owned by large corporations (e.g., Google) or supermarket data owned by large supermarkets (e.g., Tesco) and it is often difficult or even impossible for individual users to obtain their self-generated data. Furthermore, the data collection mechanism, structure, representation, storage and, therefore, the potential applicability of the data is dependent on the technology, i.e., the nature of how the data is collected affects how it could be used. Since such data often has a vertical structure, it is primarily beneficial to companies and not to individual users. However, it is not clear whether users would be interested in having access to their own data (should they be able to view their data in a different way through novel visualisation mechanisms) or prefer to outsource data management and analysis to a third party which would then present it in a meaningful way and communicate it to each user as a set summary statistics or recommendations. Understanding these individual preferences is very important and Behavioural HDI can provide novel data ownership solutions through increased user participation in data markets.

All providers have platforms for their IoT devices such as “smart” sensors within the home, apps, and wearable devices. Increasingly, platforms emerge which offer reporting services across many of the same provider’s products. This causes “*vendor lock-ins*”. Consider an individual who owns a technology produced by a certain provider (provider A). When a user is next presented with a choice between two new technologies, of which one is made by provider A and another by a new provider (provider B), the “convenient” decision for the user is to opt for technology from provider A because it allows this user to stay with the current platform instead of using two different platforms or switching to a new platform. As a result, users may not always choose the best or cheapest technology or device weighing their decision more on their existing products and on how an additional technology benefits the overall platform than how it performs on its own. Behavioural HDI allows users to differentiate between data types and provider propositions on the market which can give users more information about how to make most effective decisions.

Privacy, confidentiality, and trust issues of data, especially invasive and inventive data, can impact individual behaviour. While Behavioural HDI does not aim to influence the area of privacy directly, data protection mechanisms are significantly more manageable if the data is partitioned into different types. Inventive data is collected and shared by the users under their own control and,

therefore, private information is unlikely to be shared again user's will (e.g., Ng 2014). At the same time, traditional and invasive data, especially when combined through linking and re-matching data from different sources, may pose challenges for privacy. Behavioural HDI may offer a systematic approach to policy regulation of traditional and invasive data by identifying data types and market relationships with high risk of privacy infringement.

Behavioural HDI is useful for business practice. The understanding of the types of data as well as different ways in which these data are perceived by consumers can allow businesses to (a) decrease uncertainty about the value of the consumer-generated data; (b) simplify consumer-business interactions; and (c) motivate consumers to collect and supply high-quality data to businesses. By incorporating Behavioural HDI into their business models, companies can create systems which would allow them to quickly aggregate and use data to accurately anticipate consumer demand and produce customised products and services. Behavioural HDI can change *recommendation systems* (available via major retailers) to *co-creation systems* where instead of making recommendations to consumers, companies can collect data on features of products which consumers may need or want in the future and cater to consumer needs making full use of data as a service.

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Technologies and data – part I

THREE DIMENSIONAL PRINTING TECHNOLOGY SUPPORTING DEFENCE SERVICE SYSTEMS

John P.T. Mo, Karim Ghaoui

ABSTRACT

Purpose: Equipment utilised in a defence system may be geographically dispersed and any associated spares that may be required to support mission systems may not be immediately delivered to an operating defence site or customer. Current day defence program budgets, particularly support system budgets, cannot be achieved due to associated supply chain constraints.

Design/methodology/approach: This research the commercially available 3D printing technology into the support system architectures of defence programs.

Findings: The viability of 3D printing supporting defence system has been evaluated under three components, i.e. the qualitative assessment, contractual and IP constraints, and optimization of quantitative model.

Originality/value: This research proposes an alternative support solution within time and cost boundaries that allow for reductions in defence program budgets as well as improvements in program performance.

Key words: 3D printing, defence service system, contractual constraints, qualitative analysis, quantitative analysis

1. INTRODUCTION

Three dimensional (3D) printing or sometimes called additive manufacturing works by constructing layers and adding material to sections of the part. The process allows for the fabrication of new, weight optimized parts so that systems like aircraft can significantly cut fuel consumption. However, it also opens the door to making counterfeit parts for commercial or defence operations, designed for sabotage (Berman, 2012).

3D printing is shifting from a pure rapid prototyping technology to serious production readiness. It does not require sophisticated tooling or manufacturing machines and is therefore opening up new market opportunities for machines' suppliers and support service providers to supply parts at short notice. It has been estimated that the market for systems, service and materials for 3D printing will be EUR 1.7 billion in 2012 and is expected to quadruple over the next 10 years (Roland Berger Consultants, 2013). Furthermore, in 2010, 3D printing machines were generally ranging in price from $20,000. In 2013, the price dropped to less than $1,000, making the technology increasingly commercially attractive.

Inadequate spare part stocks, or item obsolescence, can lead to unavailability of systems and loss of revenue if subsystems or items fail and cannot be replaced. 3D printing technologies have the potential to replace damaged or broken components but application in defence sustainment programs is still limited due to commercial and contractual constraints within defence agreements, supplier data, and contracting issues associated with the 3D printing of third party manufactured items (Bak, 2003). However, there is a lack of systematic study of these constraints.

Many companies have tried the technology but they are unable to use 3D printed parts in their service contracts due to numerous restrictions. Hence, the progress of introducing this technique to supporting defence service systems is slow. This paper fills the knowledge gap by developing a systematic approach to evaluate different support scenarios with 3D printed part supplies.

2. LITERATURE REVIEW

3D printing is a manufacturing process that allows the creation of complex or illogical shapes using readily available software packages (Lipson & Kurman, 2013). These shapes are allowed to materialize using a 3D printer, where moulding or machining techniques are incapable of producing similar outcomes. Irrespective of the actual physical manufacturing process, the 3D Printing process is carried out in two stages:

1. The direct transfer of data from software to printed structures; and
2. The repeated repositioning of the printed head in all three directions in space such that an object is printed layer by layer.

Wittbrodt (2013) evaluated the economic aspects of 3D printing for 20 products. The parameters measured include printing costs, high and low retail costs, and the percent change in the high and low cases. The results demonstrated substantial cost savings for distributed manufacturing over purchasing from online retailers. The total operating cost for printing the 20 selected products was approximately USD $20 including energy and feedstock costs. However, Wittbrodt's study did not take into account detailed financial variables such as energy cost escalation rates, inflation, discount factors, loan rates/capital costs, or opportunity costs.

One of the primary concerns with the viability of wide-scale use of 3D printers is quality. Islam et al (2013) studied the dimensional accuracy of 3D printed components and notable consistent deviations causing inherent size errors associated with the 3D printing process. Technically, at this point in time, compliance with measurable quality standards remains unspecified. There are few current studies or texts that address the quality of 3D printed parts. According to Jenkins (2006), with appropriate levels of expertise, 3D printing technology can integrate digital and physical production. Ratto & Ree (2012) acknowledged that these changes represented a shift in cultural conceptions of property, seeing the 'mash–up' culture of the Web as creating new kinds of value. However, most also understood how current owners of IP might see desktop fabrication as a threat. Individuals were unsure how fabricated objects might participate in current IP regimes. Campbell et at (2011) further predicted that 3D printing could be applied to bio-printing of human organs, weapons and shift of production from capitalist to less developed countries where control of IP is a problem.

BAE Systems Australia has completed a three-month trial at Edinburgh Parks to produce 3D printed plastic parts (Sysourphat, 2013). The trial aimed to raise awareness of 3D printing for customer solution development and delivery, and to test how 3D printing could complement BAE Systems' service offering. The trial outcomes included the following:

- Around 300 parts were manufactured for various business units.
- Parts up to 20 cm in size were manufactured for jigs, visualisation and product applications.
- The trial proved 3D printing was a fast process, cost competitive for small production runs and could deal with complex, integrated mechanical designs.
- BAE Systems' Australian business considered using 3D printing to expand the organisation's advanced manufacturing capabilities to support defence systems.

Literature review and the trail by BAE Systems Australia show that to study the viability of 3D printing in defence applications, three inter-related analyses should be considered:

1. A qualitative assessment of the feasibility of introducing this technology to the service environment,
2. A study scoping contractual constraints and intellectual property (IP) agreements, and
3. An analysis and optimisation model which closes the loop with a quantitative assessment.

The purpose of this paper is to explore the systematic methods of analysing the support system with respect to application of 3D printing technologies.

3. ASSESSMENT OF THE SUPPORT SYSTEM

A services and support contract includes incentives and penalties against agreed service levels. Hence, the service contract requires a thorough understanding of how the engineering system works and how the supporting systems around the asset should operate to achieve the desirable performance (Baines et al, 2007). The shift in business environment and model has driven the research need for new methods and processes to design service solutions for complex systems, for example, applying 3D printing for achieving successful service delivery on time on budget. The objective is to "get the best value for money" on supporting asset capabilities for the asset owner.

3.1 Qualitative Assessment

An efficient support organisation is able to restore a failing technical system to the normal state as fast as possible. In designing support solutions, due to the interacting relationships between the customer and the service provider, the characteristics of both service elements and hard system components must be integrated into the service system with a critical reasoning process that aims to produce a solution design in unison with all parties involved in the performance based contract (Mo, 2011).

For efficient operations service personnel need easy access to spare parts. A special warehouse called a depot is used to store both repairable and discardable (i.e. non-repairable). The stock level is determined by the normal inventory practices such as economic order quantity. Apart from minor repairs done at the depot, most broken items are sent to a workshop for repair. The time it takes for an item to be repaired is called turn-around-time (TAT). However, TAT depends on the manufacturers' work priority and is not reliable, especially when the part is required urgently and it is out of stock due to many reasons, e.g. end of supply cycle, high consumption in special operations.

The concept of 3D printing is to make the spare parts on demand. Insinna (2014) reported that sailors operated a 3D printer on board a ship. The 3D printers have to withstand the harsh maritime environment and be subjected to the pitch, the roll, the yaw of a ship. With these added forces, there are factors to consider such as tolerances, and how the printer itself reacts to those other forces. These challenges are slowly overcome by advancement of technology (Thompson et al, 2009). Hence, a qualitative assessment on the feasibility of 3D printing on demand is required.

3.2 Contractual and IP Constraints

Apart from the operating constraints, many other constraints can affect the viability of 3D printing to be used in the defence environment. These contracts and regulatory requirements should be reviewed prior to the application of 3D printing technology.

- **Certification** – an issue associated with the 3-D printing of components within an engineering system. For example, NASA has identified that all environmental and qualification tests of 3-D printed parts required for flight and safety certification were conducted at Marshall in several client facilities (Anderson, 2014).
- **Safety Risks** - 3D printers can be relatively complex. There is growing concern with not-so-obvious ones, such as airborne emissions and indoor air quality. Further study is needed before standards can be put in place, but some printers have been shown to emit significant amounts of ultrafine particles (UFP) (Stephens et al, 2013).
- **Obsolescence** - The key advantage associated with managing equipment obsolescence, barring any IP agreements, is that once a spare part is required once obsolete this part can be scanned, even if broken (Maxwell, 2012),. The broken elements may be reconnected on

the digital file, a new spare may simply be printed.

- **Defence (Contractual) Constraints** – Product manufacturers, particularly in defence specific manufacturing, generally patent their products such that the technology employed may not be replicated or reverse engineered and introduced into different products (Walker K., 2014).

3.3 Cost analysis and optimization

There are many costs related to support of the technical system, for example costs for maintenance personnel, discardable items, repair costs, facilities, maintenance tools and equipment. Other cost parameters are acquisition/development costs, operating costs and phase-out costs. Together with these life support costs (LSC), these cost parameters account for the Life-Cycle Cost (LCC) of the system. When designing the support organisation these support costs should be minimized but they are influenced by the operational availability (A) of a technical system. When the system is down, due to some sort of failure, the owner can't sell their services. The operational availability, A, of a technical system is given as:

$$A = MTBF/(MTBF + MDT) \quad (1)$$

where MTBF is the mean time between failures and MDT is the mean downtime. Downtime refers to the time the system is unavailable and fails to provide its primary function. Equation (1) indicates that there are two parameters affecting the availability of a system. The most effective way to ensure a high availability is obviously to have long MTBF and low MDT. A problem is that improvements on MTBF and MDT are expensive. MTBF can mainly be affected by investing in more reliable, often more expensive items (if there are any). A support organisation can also increase MTBF of the system by doing more frequent inspections of item condition and/or introduce shorter service intervals. However, this tactic is expensive and it increases MDT. Compared to MTBF there are more ways in which a support organisation can affect MDT:

a. Faster transportations of staff and items
b. Stock optimisation
c. Shortening of lead times

The feasibility of using 3D technology is also governed by quantitative assessment in terms of financial viability and availability. Since each application is different, the quantitative assessment must be carried out for individual support systems. The problem is that there are many possible combinations of parameters affecting MDT.

4. QUANTITATIVE RESULTS

We use a real support solution with 10 defence systems as a case to illustrate the assessment process. These defence systems are selected because they have no contractual and IP constraints, and that the 3D printing facilities are well equipped in the satellite store locations.

The storage concept is to have a central store for spares, mainly Line Replaceable Units (LRUs). Five of the systems are located at sites fairly close to the central store. The average transportation time from the central store is 1 day and to the store 2 days. The 5 systems with the longest distance to the central store are given a common Regional Store. Other system parameters were adapted from actual data. Since there are thousands of spare parts on a system, the effect of changes in supply of parts to the availability of the defence system is complex. We used a software OPUS10 to analyse and find an optimal storage policy for spare parts, including stock sizes and reordering points.

4.1 Original scenario – no 3D printing

The organizational plot (Figure 1) shows that parts are stored at central store and distributed to the required service.

Figure 2 shows the C/E diagram. The point (Point 30) selected on the Cost/Effectiveness, Availability versus Cost curve fulfils the criteria to achieve the best possible availability for the return on investment. The graph indicates that to achieve an availability of 94.92%, a Life Support Cost (LSC) of spares investment of AUD $1,350,499 is required.

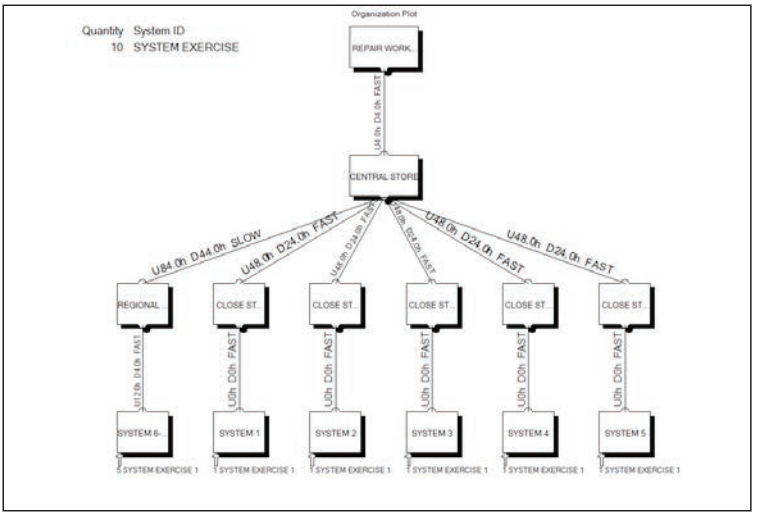

Figure 1: Organisational Plot

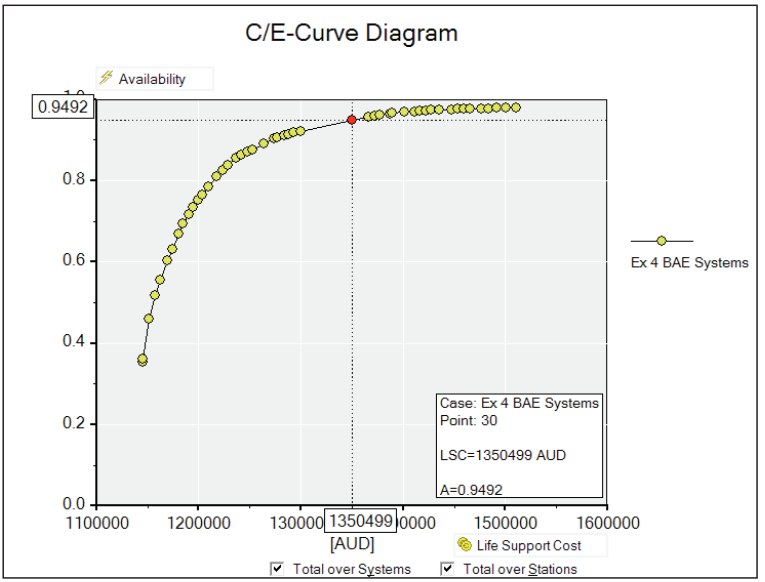

Figure 2: Original Scenario Cost/Effectiveness Curve Diagram Result

4.2 Modified scenario 1

The 3D printable items within System 6-10 may also be printed within proximity of the operating site, a new DEPOT station identifier under the description of 'CLOSE STORE X' is established. Figure 3 shows the organisational plot for scenario 1 where systems 6 to 10 are served by 3D printed parts.

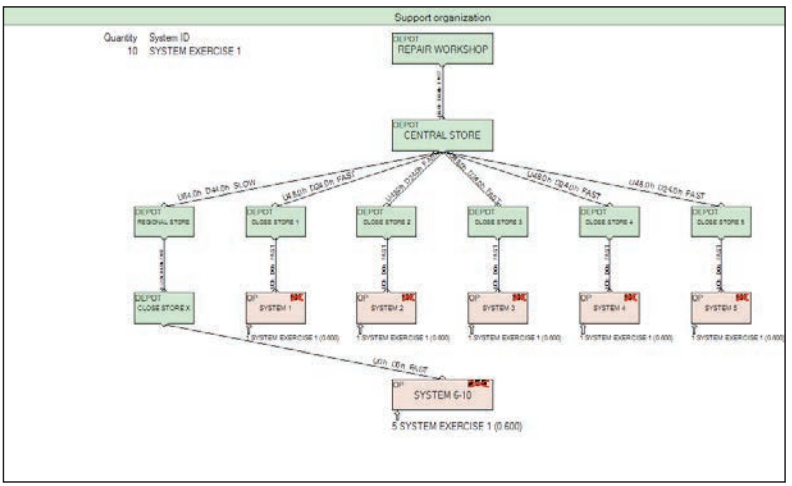

Figure 3: Support Organisation Modified Scenario 1

The scenario suggests that all consumables or items listed to be re-ordered rather than repaired are capable of being 3D printed. Hence the revised model is based on the assumption that the original

Lead Time of 336 hours is now reduced to 8 hours, which is the time required for the consumable parts TBU08, and TBU18 to TBU21 to be printed and ready for replacement. Also note that the Ordering setup cost 'ORDSC' field has been reduced from AUD 400 to AUD 50 to reflect the reduction in administrative set up costs. Figure 4 shows the C/E curve for scenario 1.

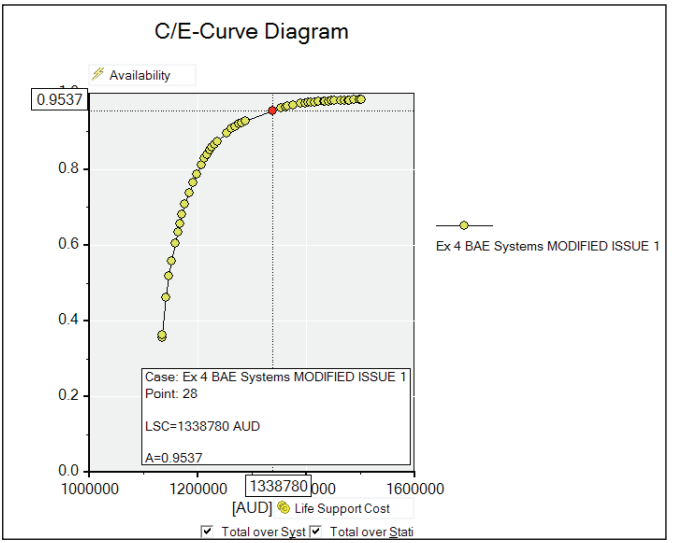

Figure 4: Scenario 1 Cost/Effectiveness Curve Diagram Result

The optimum point to select as demonstrated in Figure 4 is point (Point 28). The selected point on the Cost/Effectiveness, Availability versus Cost curve fulfils the criteria to achieve the best possible availability for the return on investment. The graph indicates that to achieve an availability of 95.37%, a Life Support Cost (LSC) of spares investment of AUD $1,338,780 is required.

4.3 Modified scenario 2 – more printable items

In Scenario 2, the assumption is made such that 5 repairable items are also 3D printable and the time required to return to service is 8 hours rather 730 hours. The C/E curve is shown in Figure 5.

The point (Point 31) selected on the Cost/Effectiveness, Availability versus Cost curve fulfils the criteria to achieve the best possible availability for the return on investment. The graph indicates that to achieve an availability of 95.84%, a Life Support Cost (LSC) of spares investment of AUD $1,262,158 is required.

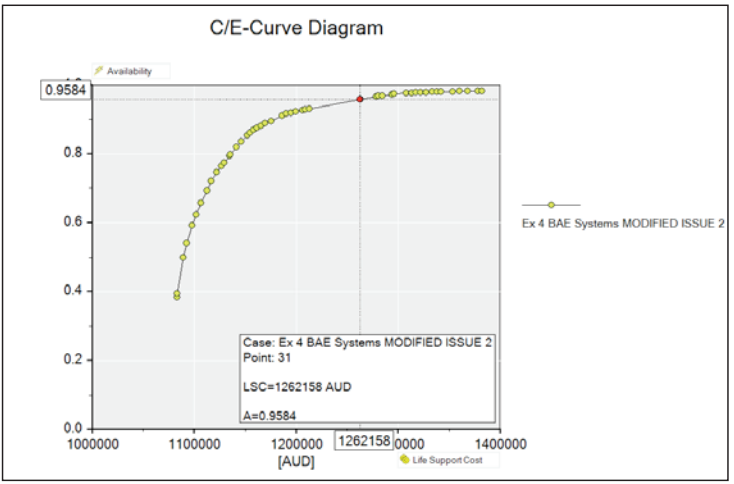

Figure 5 - Scenario 2 Cost/Effectiveness Curve Diagram Result

4.4 Evaluation of Qualitative Results

A comparison of the system reliability changes indicates that the measured parameters remained unchanged. This is an expected outcome as the reliability accounts for every line item in the system and the quantity of items and the expected failure rates remained unchanged. Therefore the Mean Time Between Failure (MTBF) of the system, which is an inherent property of each component and is summed throughout the system, as well as the inherent availability which only additionally accounts for time to repair, remain unchanged regardless of the support organizational strategy used.

The spares recommendations demonstrate the reduction in the spares stock size. The trend indicates further reduction in spares stock sizes and hence organizational costs once the 3D printing capability is further imbedded into the support organization. These costs include, maintenance, transport and holding costs. The modelling results indicate that the mean downtime of the systems decreases, and the system availability increases.

The number “not operationally ready” (NOR) indicates the quantity of unavailable systems. This is calculated directly from knowing the number of systems deployed per system position, per system or per station, or in total (NS), as a product with the inverse of system operational availability, NOR = NS x (1-A) . The 3-D printed models assume that required spares are printed on demands. Therefore, it is an expected result that the 3-D printed scenarios have a quantity of items not operationally ready that exceeds the traditional sparing organization.

Note that there are no cost savings in the Modified Scenario 1 of the 3-D printer applications. This is due to the fact that only discardable items were highlighted as 3-D printable items in the Modified Scenario 1. The maintenance policy with discard items is to repair by removal and replacement and by the reordering of required items. Corrective maintenance costs are affected in Modified Scenario 2 where LRUs which are repairable are modelled in a 3-D printing support organization scenario.

The Risk of Item Shortage increases with the introduction of increased 3-D printing into the support organization. Mathematically, this is correct as the model accounts for the fact that there are no spares in stock for a 3-D printable item, increasing the risk of not readily replacing a broken component.

5. CONCLUSION

This paper has reviewed the literature and the outcome of the trail by BAE Systems Australia. The initial review shows that to assess 3D printing in defence applications, three inter-related analyses should be considered. This paper explored these methods of analysing the support system with respect to application of 3D printing technologies.

First, the qualitative assessment takes into account the practicality of using 3D printing technology, including the application conditions, accuracy and time frame. The qualitative assessment ensures feasibility of introducing this technology to the service environment. Second, the service contract and IP arrangement must be resolved prior to the production of 3D printed parts. This problem is particularly tricky when the system to be supported is not designed and manufactured by the servicing contractor.

The research has used a real support solution with 10 defence systems which fulfils the above conditions. The effect of 3D printing has been analysed not only on the costs but also the support system structure and out of system constraints. The support system structure refers to variations in the extent of applying 3D parts in the systems. Three scenarios are studied in which the key performance including system reliability, item consumption costs, spare holdings, downtimes, transport costs, corrective maintenance costs are different. The result shows that a holistic solution that covers the system, both within and outside the support solution, can only be achieved when adequate corporate processes are established. The practical implication of these processes and their development will need further research.

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THE IMPACT OF DIGITAL TECHNOLOGIES AND ECOSYSTEMS ON THE SERVITIZAZION OF OMPANIES: A PRELIMINARY ANALYSIS

Marco Ardolino, Nicola Saccani & Marco Perona

ABSTRACT
Purpose: This paper describes an ongoing research program and presents the preliminary results of a literature review aimed at defining the enabling role of digital technologies, business ecosystems and platforms in the servitization process through the provision of customer-centric solutions.
Design/methodology/approach: Literature review
Findings: The description of each block forming the research framework that grounds the research program is provided. Moreover some example of the enabling role of digital technologies and business platforms is presented in the paper.
Originality/value: The concept of customer-centric solution is introduced in this paper as a model that could be potentially enabled by the exploitation of digital technologies and through a business platform to which several actors contribute, forming a business ecosystem.

Keywords: Servitization; Customer-centric solutions; Digital technologies; Business ecosystems, Business platforms

1. INTRODUCTION

In recent years the competition among manufacturers has become tighter due to phenomena such as globalization and the increasing request for more customized offers by customers. Moreover, achieving a great customer experience has become an essential element to enhance customer satisfaction and increase revenues. Due to these trends, several companies moved from the production and sale of products or systems, to the provision of *customer-centric solutions* through a process named *servitization* (Vandermerwe and Rada, 1989; Davies et al. 2004; Tuli et al. 2007; Storbacka, 2011).

The literature has highlighted different enablers of the servitization process: one of the most important is technology and, in particular, ICT (Kowalkowski, Kindström and Gebauer, 2013). The diffusion of digitization and the enhancement of digital technologies like the mobile Internet, the Internet of Things (IoT) and cloud computing have the potentialities to support this transformation. Notable case studies show these trends; Apple has become the largest worldwide music seller after the creation of the iTunes® store, while Rolls Royce has pervasively adopted sensors able to monitor 24/7 the airplane engine status in the TotalCare® program. In this case the technology plays an essential role in increasing customer value, providing "smarter" services, improving service planning and delivery efficiency and enabling deeper customer relationships (Penttinen and Palmer, 2007).

These developments are also paralleled (and often enabled) by the development of ecosystems of actors collaborating in the creation and delivery of an integrated solution through the exploitation of a platform (Cusumano, 2010b; Gawer and Cusumano, 2014). The adoption of a platforms supported by a business ecosystem gives two important advantages, namely: 1) the possibility to exploit different competences and capabilities in order to enrich the features of the solution provided to the customer; 2) the opportunity for the customer to take advantage of the typical modularisation characteristics of the platform which increases the customizability of the solution.

This paper describes an on going research program and presents the preliminary results of a literature review aimed at defining the enabling role of digital technologies, business ecosystems and platforms in the provision of customer-centric solutions by companies (not only manufacturing

ones). The objective of this paper, in particular, is to present the research framework developed for this study (see Section 3).

The paper structure is the following. The next section provides a background of the research program with the analysis of main enablers and obstacles linked with the servitization process, focusing in particular on the role of ICT. Section 3 deals with the analysis of each block that forms the research framework, namely: customer centric solution, platform, business ecosystem and digital technologies. Finally, in section 4, conclusions and future steps of the research program are presented.

2. SERVITIZATION DRIVERS, ENABLERS AND THE ROLE OF ICT

Concerning the drivers for moving from products to solutions, the literature agrees that companies aim at achieving benefits along three directions: financial, strategic and marketing (Gebauer, Fleisch and Friedli, 2005). In particular they found the important role of leadership, vision, and marketing on the effectiveness of servitization strategies. According to Paiola et al. (2013), also integration and service capabilities are key enablers to provide customer-specific solutions that may be developed internally, externally or in a mixed way. As the relationships with customers are crucial in the provision of integrated solutions, another important enabler for servitization is focusing on the personnel training to increase frontline employees' ability to successfully interact with customers (Neu and Brown, 2005). Since the servitization process may entail innovative business models characterized by non-traditional revenue streams (e.g. leasing, renting, pay-per-use, pay-per-x, etc.), adequate financial resources are essential in order to assume the operating risk of the product.

In parallel with organisational and financial aspects, technology could be a fundamental enabler for the provision of advanced services. Studies in the literature, in fact, underline the importance of adopting appropriate ICTs (Information and Communication Technologies) in order to provide customers with integrated solutions made of combination of products and services. Kryvinska et al. (2014) state the enabling role of technology highlighting two different ways in which ICT could enhance and support servitization, namely: "product deliverer" and "service deliverer". *Product deliverer* means that technology is the object of the offer (e.g. music provided through MP3 files instead of traditional CDs) while *service deliverer* concerns a service, which is delivered thanks to a digital channel (e,g, condition monitoring services directly provided by the supplier). With respect to the importance of technology in condition monitoring, Oliva and Kallenberg (2003) stress the importance of IT skill as a crucial element to provide remote services on the installed base. However, ICT not only enables servitization allowing the provision of effective diagnostics services on the product, but it also reduces costs, improves internal efficiency and increases the service business orientation of the company (Kowalkowsi, Kindström and Gebauer, 2013). Moreover, the improvements of ICTs (in particular digital ones) have pushed towards the diffusion of "mobile services" exploiting the expansion of WiFi networks and the diffusion of mobile Internet. Companies such as Apple, Google, Microsoft, Samsung and many others are taking advantage of these trends offering integration between hardware and software (including media content) and creating an attractive value proposition for hardware manufacturers, developers, content providers and end users (Gawer and Cusumano, 2014a). A second important trend that is effecting the development of mobile services concerns the development the so-called *smart cities,* characterized by smart services provided directly to citizens. The enhancement of digital technologies and the diffusion of web 2.0 have also supported the development of the so-called *sharing economy* with services such as car-sharing, car pooling, bike sharing, home-sharing and many others. Finally web 2.0 makes companies able to incorporate and interact with customers in any phase of the value creation process exploiting tools such as forums, blog and wiki. However, how these digital technologies act at a strategic, organisational and operational level in the servitization process of a company is a topic that deserves further investigation.

3. RESEARCH FRAMEWORK

The first objective of the study presented in this paper is to investigate the relationships between the increasing diffusion of customer-centric solutions and the role of disrupting digital technologies introduced in recent years. Moreover, as some notable case studies highlighted the importance of platforms and business ecosystems to create and deliver offers, a second objective is to understand the role of platforms in the development of integrated product-service systems and the involvement of different actors in order to acquire the appropriate capabilities through business ecosystems.
The research framework is depicted in Figure 1. The following subsections describe the different entities in the framework, based on a preliminary literature review.

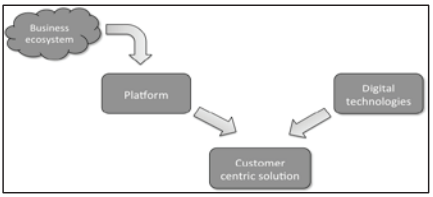

Fig. 1 Research framework

3.1 Customer-centric solutions

Davies et al. (2004) define solutions as ''innovative combinations of products and services leading to high-value unified responses to customers' needs''. Even though several definitions have been developed concerning solutions, all of them state that they are combinations of products and services. Nevertheless, in recent years the concepts of products and services have been transforming. As an example, Sampson and Froehle (2006) developed a new service theory stating that standard activities concerning businesses such as garbage collection or retail banking, even though they are intangible and do not manufacture anything, could not be considered services since there is no co-creation of value with the customer. Therefore, in our opinion, in the solution concept, it is not so relevant to distinguish the product component from the service one, because what really matters is the focus on the customer needs met by the solution. Thus, a solution is characterized by a combination of elements that may be material and/or immaterial, despite being called services or products. Moreover the importance for the customer does not stand in the combination of goods and services itself, but rather in the continuous relationships and support by the supplier and the possibility of customizing the solution during its "lifecycle" (Storbacka, 2011). Therefore, this implies that companies need to focus on designing the best solution for meeting customers' needs, and change the nature of the offer from product-oriented to customer-oriented.
Following this line of thought and based on the literature about the provision of integrated solutions, we have developed a definition of *customer-centric solution* for the purpose of this research program, namely: *a customized and integrated combination of material and/or immaterial components aimed at meeting customers' needs and providing an improved customer experience.*
A more detailed description of some crucial elements of the definition follows:

- … *customized* - The customer experiences high (at least perceived) customization in the offer. The customer may be involved in the development/enhancement of the offer through data and information he explicitly/implicitly sends to supplier. Greater customization does not imply necessarily higher costs for the supplier/seller if the solution structure is characterized by high modularity;
- … *integrated combination of material and/or immaterial components* – The solution is generally characterized by the presence of both material and immaterial components. However the focus is not on the nature of the single components, but on the value provided

to the customer, and on the enhancement of the efficiency and effectiveness in customers' operations (or consumers activities in B2C contexts) thanks to the adoption/usage of the solution;

- … *aimed at meeting customers' needs and providing an improved customer experience* – The relationship should embrace the whole "solution lifecycle". In this way it is possible to meet implicit and latent customers' needs, continuously improving the solution with the information and feedback implicitly or explicitly received by the customer. All this will lead to achieving a superior customer experience.

3.2 Business platform

In recent years, several companies operating in ICT sectors such as Qualcomm, Cisco, Intel and more recently Apple and Google have used the concept of platform. Furthermore, the diffusion of smartphones has opened an intense battle between mobile platform providers (Cusumano, 2014). Even though this concept is almost always associated to ICTs and IT industries, the adoption of platforms has its origins in the manufacturing sector (e.g. automotive) in order to exploit modularization and allow easy modification of the product through the addition, removal, or substitution of features (Sawhney, 1998). The platform concept is related to different fields of research, such as: business ecosystems, interfirm networks, technology platforms, network visualization and mobile telecom industry. These fields have in common two specific aspects, namely: 1) technology exploitation; 2) the participation and collaboration of several actors who contribute to the platform.

The first point is exemplified by personal computers, video game consoles and, more recently, smartphones and tablets which have become platform-based technologies whose functionalities can be extended by external applications that are procured by the customers (Ceccagnoli and Forman, 2012). According to the second point, it is possible to distinguish two different kinds of platform (Cusumano, 2010; Gawer and Cusumano, 2014), namely: internal (or product) platform and external (or industry) platform. The internal platform concerns the development of a common structure by a single company that leads to a wide range of products thanks to the combination of several modules. On the other hand, an external platform is similar to the previous one but it is based on the collaboration with external firms that can develop their own complementary products, technologies, or services to contribute to the platform. In this paper we refer to the latter type of platform, that is the one which involve the contribution by external actors (called "complementors") forming a "business ecosystem" (cfr. Section 3.3). In this case the offer provided by the complementors is fundamental to create value for the customer; the platform by itself would be irrelevant without the complementary products and/or services. Concerning the development of customer-centric solutions, the platform can be a very relevant element, since it could be the optimal vehicle to achieve customization and integration enhancing modularization features.

According to the literature analysed on platforms and the relationships with the provision of customer-centric solutions, we refer to the concept of platform as: *the material/immaterial container, characterized by high modularity, on which several complementors contribute and through which is possible to provide customers with customer-centric solutions*.

3.3 Business ecosystems

Strictly connected to the concept of platform presented in the previous section, there is the concept of "business ecosystems". Even though the business ecosystem concept is quite diffused in the literature, there is not a unanimous definition. The notion was introduced by Moore (1993) referring to a group of companies that evolve capabilities around innovation. Adner and Kapoor (2010) state that ecosystems can potentially involve all typologies of actors such as OEMs, SMEs, Universities, research centres, individual professionals, employees, citizens and consumers. Therefore, the diffusion of ecosystems in some industry sectors has led to a new context in which the innovation is not handled by a single actor but by the contributions of several actors. Even though the ecosystem involves the presence and relationships among several actors, there is no neither capital nor joint

effort in a specific project or business area since the collaboration is based on general agreements. Moreover actors are sometimes characterized by resource asymmetries and unilateral dependence, thus the complementors (companies in the ecosystem which contribute to the platform) depend on a leading firm, generally named the "platform leader" or "platform provider" (Gawer and Cusumano, 2014). Therefore complementors depend on the resources and visibility offered by the platform leader while, on the other hand, the platform leader also depends on its network of complementors because they give value to the platform.

Concerning the research program presented in this paper, service-oriented value innovation often requires several and peculiar competencies to provide a complete solution able to meet customers' needs. Since the business ecosystem is an organization model extremely flexible and able to attract resources of all sorts, it seems to be the appropriate paradigm in order to face the challenges of servitization. Moreover, thanks to the collaboration of several actors, which cover several competences and could share different capabilities, it seems to be a suitable way to provide customers with integrated solutions able to meet all explicit and implicit customers' needs.

In recent years business ecosystems have been largely adopted (or emerged) in the IT sector. Once again the case of the diffusion of smartphones and tablets is a good example to show the links between ecosystems and technology since it led to the creation of an ecosystem of developers of mobile apps. However technology is not only the "object" to which the ecosystem contributes, but it may be also the enabler of the ecosystem itself. A typical case related to this issue is the diffusion of communities on the Internet made of several users, which give their ratings or feedback about something. The mobile application Tripadvisor® is a typical example of this phenomenon since it gathers millions of users who give feedbacks and ratings concerning their experience about hotels and restaurants. This is a particular case since the user is both "part" of the ecosystem (as he provides feedback) and the customer (as he checks the ratings and feedbacks of the structures when he has to choose one of them).

Based on the literature about ecosystems and the relationships with the provision of customer-centric solutions, we refer to the concept of ecosystem as a *group of actors, which contribute to the development of a particular platform. Even if they keep their independence, the actors that form the ecosystems exploit the platform leader visibility (or the platform itself if it is an open platform) and provide all the elements that are needed to enrich the customer centric solution*.

3.4 Digital technologies

In recent years the exploitation of ICT and digitization in manufacturing are having a disrupting impact on several companies as much as happened in other industries, such as telecoms, photography, music and publishing (The economist, 2012). The introduction of digital technologies is affecting both large companies and SMEs, enabled by the fact that digital infrastructures and devices are more affordable nowadays. The adoption of digital technologies can potentially impact several business areas of the company and improve the efficiency and the effectiveness of many processes within the firm. As an example, significant improvements could be achieved in supply chain management since, for example, negative implications of the bullwhip effect may be mitigated by smart ICT applications (Belvedere, Grando and Bielli, 2011). Moreover the adoption of new technologies like additive manufacturing may potentially affect spare parts supply chain increasing the decentralization of production with relevant improvements in total operating cost and downtime cost for customers (Khajavi, Partanen and Holmstrom, 2014). Thus, techniques concerning additive manufacturing have started to be used not only for prototyping, but also for direct production and this phenomenon is affecting different industry sectors such as: aerospace, medical, automotive, consumer products, architecture, and electronics (Vicari, 2014). Exploitation of digital technologies has also improved the efficiency and the effectiveness of service operations such as the collection and processing of real-time information about the condition and utilization of the installed

base for delivering remote monitoring services (Kowalkowsi, Kindstrom and Gebauer, 2013). In this case ICT has the power to cover all the operations needed to deliver these kinds of services, namely: capture data from sensors located on critical components of the product, transmit data gathered from the product or fault codes to the manufacturer, store data, analyse data in order to transform them in useful information about the product and arrange the necessary response functions and actions required on the basis of the information collected such as repair, inform customer or arrange maintenance (Lightfoot, Baines and Smart, 2012). These kinds of services that are enabled by intelligence embedded in the product are generally defined *smart services* (Almendinger and Lombreglia, 2005).

Concerning the research program presented in this paper, we will consider specific digital technologies that are related to the Internet such as: the mobile Internet, the Internet of Things and the cloud computing. They are hereafter briefly described:

- *Mobile Internet* – mobile Internet could be defined as the combination of mobile computing devices, high-speed wireless connectivity and mobile applications (McKinsey, 2013). Smartphones and tablets are the main devices used to access the mobile Internet and they are packed with sensors, like accelerometers and GPS. The diffusion of mobile Internet has also been possible thanks to the enhancement of mobile wireless connections that has allowed reaching very high speed rate on the Internet. Finally, the diffusion of a plethora of mobile applications for smartphones and tablets has been crucial to the potential impact of mobile Internet use, multiplying its capabilities.
- *Internet of things* - The term Internet-of-Things (IoT) is used as an umbrella keyword for covering various aspects related to the extension of the Internet into physical objects (Miorandi et al. 2012). Therefore IoT refers to the global network interconnecting physical objects (named *smart objects*) adopted in several contexts such as: machinery, shipments, infrastructure, and devices. An object could be defined "smart" when it has communication functionalities and possesses at least some basic computing capabilities. Important enabler of the IoT has been the enhancement of sensors and actuators related with several kinds of products and the exploitation of new wereable technologies;
- *Cloud computing* - Cloud computing refers to the delivery of computing as a service rather than a product and allows to run software, applications and services through networks or the Internet. Indeed companies potentially reduce the need for storage and processing power on local computers and devices. Great potentialities for cloud computing have been seen in media companies which have started to experience the provision of cloud-based services instead of selling products. For example in media and entertainment industry, provider of on-demand Internet streaming media placed "in the cloud" has replaced DVD video stores.

4. CONCLUSIONS AND FUTURE STEPS

The main goal of the research program presented in this paper is to understand and describe the enabling role of digital technologies (in particular internet-based ones), business platforms and ecosystems in the provision of customer-centric solutions. Two research questions will be scrutinized (although they are preliminary and will be refined during the study):

- RQ1: How digital technologies enable the provision of Customer Centric Solutions?
- RQ2: How business ecosystems and platforms amplify the benefits deriving from servitization through the provision of Customer Centric Solutions?

The preliminary results of the literature review have highlighted a gap of studies concerning the relationships among the three elements (servitization, digital technologies and business platforms). Therefore, this research is expected to contribute to the servitization theory by shedding light on the mechanisms through which digital technologies and platforms enable customer centric servitization.

The preliminary analysis of the literature allowed building a definition of customer-centric solutions, business platforms and ecosystems that can be used for investigation in the servitization field, and therefore constitute the first contribution of this research. Additionally, studying successful business cases, the research aims at understanding how companies can succeed in the servitization journey through the exploitation of digital technologies and business ecosystems and platforms. Therefore, this study has a potential impact on practice, too, since it can support practitioners in understanding the key elements to be considered when implementing a digitally-enabled servitization strategy, and to act accordingly. The research will follows three different main phases, namely: literature review, literature case studies and empirical case studies.

In the literature review, an in-depth analysis of the research streams related to the blocks presented in the framework will be carried out. The goal of this phase is that of gaining knowledge of the main key factors that characterize all the blocks. Preliminary results have been introduced in this paper.

The following step foresees the analysis, drawing from secondary sources, of relevant business case studies of companies having moved to the provision of customer centric solutions with the help of digital technologies or/and platform and business ecosystem implementation. It will be necessary to collect data and information focusing on industry sector reports, company annual reports, press release and specific websites.

Finally, the empirical research phase will consist of field case studies . This phase will be preceded by the development of an appropriate research protocol.

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THE ROLE OF INSTALLED BASE INFORMATION IN SERVITIZATION: A KNOWLEDGE MANAGEMENT VIEW

Andrea Alghisi, Nicola Saccani & Marco Perona

ABSTRACT

Purpose: In the last decades, growing competitive pressures and increased customer expectations have pushed western manufacturers to extend their offerings through the provision of value-adding services. This paper aims to develop a theoretical framework for the identification and development of installed base information management practices for the successful deployment of a servitization strategy.

Design/methodology/approach: The research is based on a two-step literature review. The first one focuses on the knowledge management (KM) theory, and was aimed at defining a general framework about knowledge management. The second step consisted in applying the resulting framework to a set of papers focused on servitization and installed base information issues.

Findings: Results identify the conceptual relevance and guidelines for knowledge management (KM) as a lever supporting the servitization process of manufacturers.

Originality/value: This work identifies relationships between KM practices (both organizational and technological) and key aspects of the servitization strategies and processes. Moreover it contributes to practice by supporting companies to configure the KM practices and KM systems that better suit their servitization strategies.

Key words: Servitization; Installed Base; Knowledge Management; Literature review.

1. INTRODUCTION

In recent years, due to increasing competitive pressures, evolving customer needs and demand stagnation, the servitization of manufacturers, defined as the process of creating value by adding services to products (Baines et al. 2009) has become a topic of great interest amid Operations Management scholars. Such transition from products to services that underlies the concept of service orientation described by Oliva & Kallenberg (2003) has been also labelled as Industrial Product-Service System (Meier et al. 2010) and service infusion (Brax 2005; Gebauer et al. 2008; Holmström et al. 2010). Companies undergoing this transition move towards the provision of Product-Service Systems (PSS), i.e. integrated product and service offerings that deliver value in use (Baines et al. 2009; Tukker 2004). However, evidence from research and business practice suggest that the transition toward the provision of the so called Product-Service Systems implies challenges that could neutralize the opportunities given by service offerings (Martinez et al. 2010; Alghisi & Saccani 2015). This paper presents the preliminary results of a study that aims to increase the understanding of the relationship between manufacturers' servitization strategy and the implementation of Knowledge Management practices such as collection, analysis and utilization of data generated from the use and support of industrial equipment (the so-called *installed base information management*). Despite multiple evidence presented in literature and practitioners' growing interest in the management of information generated during products' lifecycle (Neely 2009; Ng & Nudurupati 2010; Greenough & Grubic 2010; Ulaga & Reinartz 2011), what emerged from a preliminary study of the literature is the lack of a comprehensive treatment of the installed base information management topic (Ala-Risku 2009). More specifically, the scientific community has not developed yet an interpretative theory of the role and impact of installed base information management practices in the servitization of manufacturing. The present research aims to fill this knowledge gap by adopting a holistic perspective on the topic of installed base information

management, investigating the role of installed base information for the provision of PSS through the lens of Knowledge Management theory.

2. RESEARCH DESIGN

In order to answer to the research question reported in section 1, a two-steps literature review has been set.

2.1 Development of a Knowledge Management interpretative framework

			Alavi and Leidner, 1999	Alavi and Leidner, 2001	Armistead and Meakins, 2002	Earl, 2001	Hahn and Subramani, 2000	Holsapple and Joshi, 2002	Mehregan et al., 2012	Lee, 2000	Maier, 2001	Nunamaker, 2001
KNOWLEDGE	HIERARCHY			*			**					**
	TACIT/EXPLICIT			**	*		**	*				
	COLLECTIVE/INDIVIDUAL			*	*		**					
	OBJECT		**			**					*	
	TYPOLOGIES			**				*				**
KNOWLEDGE MANAGEMENT	FEATURES	Free/ restricted access to information			**	**						
		Formal procedures/ informal network					**			**	**	
		Approach		**				**		**		
		Processes			**	**						
	CRITICAL SUCCESS FACTORS	Enabling learning			**	*				**		
		Organization	**					**	*	**	*	
		People skills						*		**		
		Enabling communication/sharing	**		**	*			**	**	**	
		Measurement			**	**			**			
		Alignment with strategy						*	**		**	
		Intellectual property	**			**					*	
		Financial resources						**				
		Environment						**				
KNOWLEDGE MANAGEMENT SYSTEMS	FEATURES	Size					**					
		Aims		**								**
		Data management	**									
		Interoperability	**									
	FUNCTIONS	Communication		*	*	**	**		*		*	*
		Document management							*		**	*
		Coordination										**
		Navigation	**	*		*	*				*	
		Database management	**	*		*	**		*			
		Search	**				**				*	*
		Knowledge flow		**							*	*
		Knowledge mapping	**	*	*	**	**				**	

Table 1: Framework dimension and relative citations (original contribution of the authors are labelled with *, citations of previous works are labelled with **)

In the first step, influential papers associated with knowledge management (KM) have been identified through a bibliographic research carried out in several search engines, such as Google Scholar, Science Direct, Scopus, and Web of Science. The search provided a final list of eleven papers, of which eight journal articles and three conference proceedings focusing on the development and study of the KM theory. Years of publication range from 1999 to 2013. These papers were analysed to identify the characteristics that, in the authors' opinion, define a knowledge taxonomy, successful KM practices and knowledge management systems (KMS). These features have been transcribed into summary tables using the exact author's words, in order to prevent misinterpretation. The tables show the bibliographic references, to maintain a connection to the source article. The classification structure evolved during the literature review: some categories were split into further and more detailed ones, while other features were merged in more comprehensive and general ones. This has led to a creation of a research framework grounded on theory aimed to analyse the servitization literature through the lens of knowledge management. Table 1 provides a connection between papers used to develop the framework and each framework dimension. The main features of the framework are described in Alghisi & Saccani (2014).

2.2 A framework for servitization practices

Starting from the servitization literature that has been discussed in the Introduction, a framework to describe the main levels of the practices that characterize a servitizing firms has been built during this research. The framework is composed of 5 main constructs: i.) Strategy, ii.) Business model, iii.) Operations, iv.) Services, v.) Performances. Each construct, except for Strategy, is then described by a set of variables (reported in the first row of Table 2). This framework is functional to evaluate at which hierarchical level (Strategy, Business Model, Operations), on which specific service (Services) and on which specific performance (Performances) the Knowledge Management practices actually have an impact. Concerning the definitions of framework constituent constructs, the distinction between strategy and business model may be hereafter described in order to support the understanding of the results discussed in the present chapter. According to (Burkhart et al. 2011), strategy describes how a company can perform better than its competitors, while business models are illustrating how different facets (e.g. revenue stream, cost structure, partnerships, customer relationships, value proposition, key resources/activities, etc.) of the business are fitting together. Furthermore, business models are seen as the link between a strategy and corresponding business processes (i.e. "operations" in the present work). Variables included in the Operations and Performances constructs, have been inspired by Slack et al. (2009) while variables of the Services construct are derived from previous work on the topic such as Neely (2009).

2.3 Literature review to identify Knowledge Management practices supporting servitization

Concerning the literature review, a structured keyword search was performed in the Scopus® database in May 2012 using 225 queries obtained from the combination of two sets of keywords related to the topic under investigation. These keywords emerged from a preliminary literature analysis of thirty seminal papers that explicitly mentioned the phenomena of installed base information within servitization context. The first set includes keywords related with the context of the study (e.g. Servitization, Product-service system, etc.) and with practices directly influenced by the management of information collected from the installed base, while the second set includes keywords related with the issue of installed base as well as the generation, collection, storage of data and information, both from a technical and technological point of view (e.g. PLM, PDM, RFID), economic (i.e. value of information) and management (e.g. information management, asset management, etc.). 18,399 papers resulted from the multiple queries and led to the creation of a first database ("Papers database"). Meanwhile, in order to guarantee the quality of the literature review, a selection of journal has been made within the Journal Citation Report of the ISI Web of Knowledge® (Reuters). In particular, journals from nine specific research areas were extracted: Computer Science, Telecommunications, Robotics, Operation Research, Management, Health care & Services, Engineering, Business, Automation. Finally, only journals that had an Impact Factor have been selected resulting in 1,689 journals which eventually led to the creation of second database ("Journals database"). The final step of the literature selection has been to join the two above mentioned databases using the relation constructed on the "ISSN" database field. By doing so only the papers with a valid ISSN that was matching one of the ISSN of the journals included in the "Journals database" was eventually selected and considered for the further steps of the literature review. In particular, applying these criteria the papers went down from 18,399 to 1,236. After the selection process and an abstract content based analysis the 1,236 papers have been sized down to 98. According to Seuring & Gold (2012) a mixed inductive-deductive approach that combines the strength of theoretical grounding with general openness towards unexpected findings has been adopted: a preliminary analytic frame of categories and dimensions was established on the basis of existing theory emerged from the analysis of thirty seminal papers, while single categories have been inductively refined during the coding process. An additional literature search was then performed in Google Scholar® to update the "Papers database" constituted by the 98 papers selected. There, we searched papers that cite the most significant papers emerged in the first literature review (cross references), as well as papers that explicitly address both the topic of

knowledge management and the topic of servitization (or similar concepts), or more broadly the capabilities needed in a servitization context. At the end of this research 89 papers published between 1997 and 2014 were collected and stored in the "Papers database". At this point, on the 187 papers contained the "Papers database" has been conducted an evaluation of the abstract aiming to point out whether the paper was addressing at least one of the Knowledge Management interpretative framework variables. These criteria, compared with those adopted in the abstract content based analysis previously performed on the 1,236 papers, are more restrictive: while all the 187 papers met the first set of criteria, only some of them met also the second set of criteria based on the Knowledge Management interpretative framework. As a result, through this further analysis, 140 papers have been discarded. Therefore, the in-depth textual analysis have been performed on 47 papers which came out of the above descripted literature review process.

3. FINDINGS

By combining the two frameworks described so far to analyse papers that came out from the literature review described in section 2.3, a comprehensive framework to find and assess the impact of Knowledge Management practices on servitization has been built (Table 2). All the relevant contributions that highlight potential relationships among two or more variables of the framework were in a first step transcribed within the framework using a coding technique. The second step has been the elaboration and the standardization of each contribution. In case either variables of the Knowledge Management interpretative framework or variables of the servitization practices framework where not explicitly addressed by the analysed papers, a deductive approach was adopted. In Table 2, for each intersection the numbers of validated contributions from the literature are displayed. This final framework can be read both horizontally and vertically. A horizontal reading is useful to understand which are the Knowledge Management related aspects that are discussed in the literature when dealing with servitization. A vertical reading, vice versa, can give hints on which are the servitization practices more impacted, according to literature, by Knowledge Management practices. It comes out that among Knowledge variables, Information is the most discussed aspect in literature with 144 contributions, followed by Data and Knowledge (36 and 35 contributions respectively). It has to be said that at least some of the contributions which have been classified as addressing the Information variable may actually refer to data related aspects. However, in this literature review contributions have been classified according to the exact words used. In aggregated terms, it emerges that within the hierarchy of knowledge, Information is the level that so far has been seen as the most important one for servitizing firms. This is coherent with the current evolution of ICTs and technologies that are now providing large volume of data and tools to extract information, but it is not yet completely clear how to generate knowledge out of them. On the other side, a large number of Knowledge variables are not either explicitly or implicitly addressed in the literature as enablers of servitization. Looking at the list, however, most probably this is due to a lack of holistic research on Knowledge Management in servitizing context rather than real lack of impacts. Among Knowledge Management variables, the most discussed is the knowledge creation process with 40 contributions, followed by Formal procedures/informal network and Access to information (with 17 and 12 contributions respectively). As well as in Knowledge dimension, also in Knowledge Management some relevant variables have not been addressed yet. As stated before, this seems to be due to a lack of investigation rather than a lack of impact of these variables on actual servitization practices. Finally, analysing variables related to the dimension "Knowledge Management System", the most discussed one is Functions, which is related to all the generic functionalities (not linked with specific functionalities investigated through other variables such as Navigation, Search, Knowledge flow, etc.) with which KMS can support firms in the Knowledge Management. In contrast to what happens for Knowledge and Knowledge Management related variables, almost all the variables of Knowledge Management System have been suggested, at least by one paper, to have an impact on servitization practices.

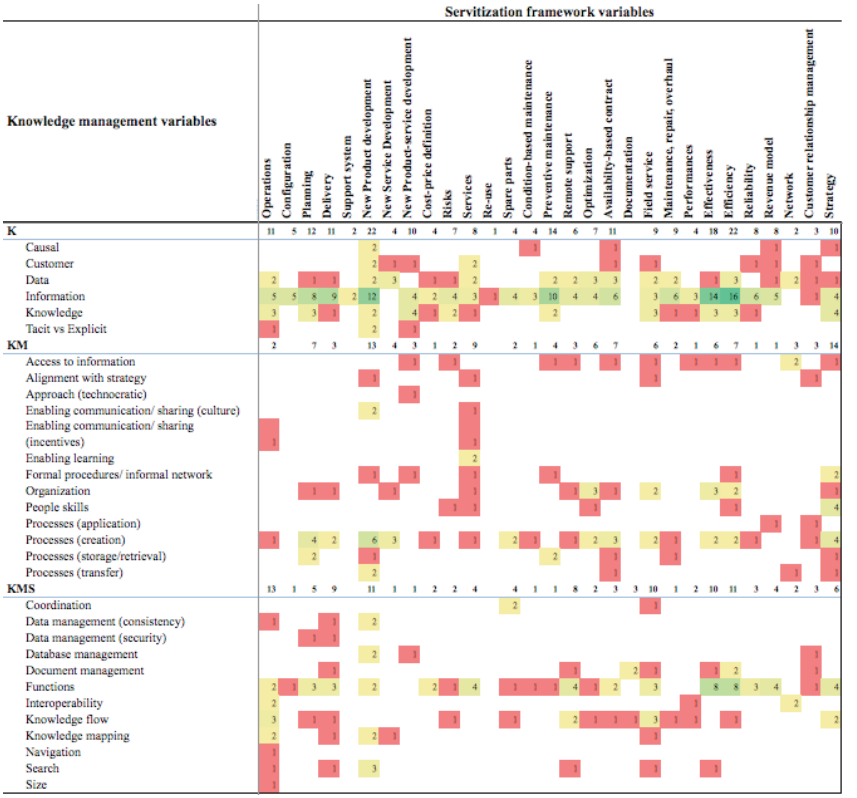

Table 2: The detailed framework to analyse the relationship among the KM variables and the variables of the servitization framework, populated with the findings that address each crossing

Reading Table 2 in the vertical sense, it emerges a quite homogeneous distribution of impacts across the variables of the servitization practices framework. The most addressed variable, with 56 contributions, is the Effectiveness, followed by New Product Development and Efficiency with 50 and 48 contributions respectively. This means that in a large number of contributions, an increase in the effectiveness and efficiency of either operations, services, business model or strategy is linked to a specific Knowledge Management framework variable. Hence, according to literature, New Product Development is among the Operations variables the most impacted one by Knowledge Management practices. It is followed by Planning operations (35 contributions), Field service (34 contributions) and Strategy (30 contributions). Vice versa, the variables with fewer contributions are Re-use (5) which is a service not yet widely diffused and Network (10) which is an element of the Business Model of a firms which actually affects Knowledge Management practices rather than being affected. Concerning the Knowledge dimension of the framework, the extant literature mainly explores the impact of different types of data, information and knowledge on servitization of manufacturing. In particular, as highlighted in Table 2, data and information on products usage, maintenance, deterioration collected both from sensors and operators could be beneficial for servitizing firms. Service operations can be streamlined and product design could be improved (Abramovici & Lindner 2011; Holmström et al. 2010; Johnson & Mena 2008; Lightfoot et al. 2012). In order to support the strategic development, customer knowledge has to be created and improved

by collecting data and information both on the customer and on its operations (Meier et al. 2010; Laine et al. 2010). Moreover, an increasing effort should be made by servitizing firms in order to explicit in-service knowledge that it still largely implicit. This shift can be achieved both through the implementation of ICT tools and the creation of taxonomies (Wang et al. 2011; Kowalkowski 2008; Baxter et al. 2009; Goh & McMahon 2009). Concerning the Knowledge Management dimension, Table 2 has shown that extant literature has so far mainly studied aspects related with organizational issues and on the process through which knowledge can be extracted out of raw data. In particular, servitizing firms should develop specific strategies to drive the collection and use of data on and from the installed base (Goh & McMahon 2009). This kind of strategy on the use of information can then be supported by incentives, commitment of management team, and the development of a sharing culture within the company through the introduction of inter-functional teams (Jagtap & Johnson 2011; Goh & McMahon 2009). Moreover, new set of skills have to be acquired in order to create actionable knowledge and make sense of the increasing amount of data that are made available by spreading sensors and evolution of ICTs (Agnihothri et al. 2002; Kowalkowski 2008). Condition monitoring expertise allows increasing the overall effectiveness and efficiency of service operations, data scientist capable to handle statistical techniques and develop business intelligence tool and machine learning applications will improve the new products and help to develop predictive maintenance strategies (Yang et al. 2007; Laine et al. 2010; Lightfoot et al. 2011). Finally, concerning Knowledge Management System scholars are stressing the role of condition monitoring technologies and ICTs that enable real time data collection, transfer and analysis (Meier et al. 2010; Kowalkowski et al. 2013; Lightfoot et al. 2012). Moreover, in order to effectively manage data, information and knowledge along the product life-cycle, development of common data-model should be a priority of servitizing firms and their networks (Aho & Uden 2014). Ontologies to formalize and explicit tacit knowledge could boost effectiveness and efficiency of service operations supporting technicians with context-specific functionalities (Zhu et al. 2012). Finally, development of intelligent products with powerful functions in terms of data collection and transfer as well as self-reasoning capability is maybe the strongest enabler of servitization strategies (Allmendinger & Lombreglia 2005).

4. CONCLUSION

The present research shows that servitizing firms should carefully configure their Knowledge Management practices in order to successfully develop their service offerings and to achieve the expected benefits. Data and information extracted from the installed base are important resources that can inform and support decision making at different levels (strategy design, business model configuration, operations choices) as well as improve performances of present and future product-service solutions. The contribution of the present research is twofold. It contributes to the theory having developed a framework grounded in the Knowledge Management theory that has been used to systematize the literature concerning one of the enablers of servitization. Thus, the comprehensive framework that emerged from this analysis identifies a set of practices in terms of Knowledge (typologies of data, information and knowledge), Knowledge Management (processes and organizational arrangements) and Knowledge Management System (software and hardware specs) that positively impact on servitization. Even though the framework has kept an holistic view, it was able to identify how every single Knowledge Management practice impacts on each service-related aspect such as the different phases of service-related operations (configuration, planning, delivery), both to new product and service development processes, the improvement in efficiency and effectiveness of specific services as well as configuration elements of the business model (partnerships, revenue model, customer relationships management). The research contributes as well to the practice by providing to companies a useful tool to identify the set of practices that better support their servitization strategy. The developed tool support companies in the identification of KM practices that better suit with their operations, service portfolio and

performance improvement objectives. Future researches should aim to explain the relationships herein highlighted, using case studies, and even testing them with explanatory survey.

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DIGITAL RESOURCES AND THEIR ROLE IN ADVANCED SERVICE PROVISION: A VRIN ANALYSIS

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ABSTRACT
Purpose: We examine the role of digital resources in the context of advanced service provision to determine their strategic potential.
Approach: We conduct a theoretical review of the literature to identify digital resources which we subsequently analyse with regards to their value, rarity, inimitability and non-substitutability (VRIN).
Findings: Our analysis shows that the strategic value of the digital resources is unlocked through their complementarity.
Value: The research has implications for the management of advanced services and contributes towards the grounding of servitization research in the wider economic and management theory.

Key words: Servitization, advanced services, resource-based view, resource value, complementarity, digital resource

1. INTRODUCTION

Information technology (IT) plays an essential part in *servitization* – a recent trend that implies the provision of advanced product-based services and solutions that replaces a traditional product offering. Prominent examples such as Rolls Royce's 'power by the hour' (Neely 2008) or Alstom's provision of train-life services (Baines et al. 2011) highlight IT resources as important enablers for delivering outcome-focused product-based services. Two important developments on the technical and business fronts require a focused analysis of the IT resource that goes beyond the individual examples.

First, new technological developments in the domain termed 'Internet of Things' and products digitalisation (Bharadwaj et al. 2013) have direct implications for understanding of the central role of IT resources in the advanced services context. As sensing and transmission technology becomes increasingly more available and affordable, substantial opportunities open up for manufacturers to further increase the digitalization of their products and reap the potential strategic advantages that digitization offers. Second, reflecting on the technological advancements there is an emerging understanding in the business and management literature that the IT resource can be more than an enabler of a strategic process but instead can itself be a source for sustainable competitive advantage (Wade & Hulland 2004). Hence, in the context of advanced services it is critical to understand to which extent the IT resource could be a source of long-term strategic differentiation – a realisation that would have substantial managerial implications.

The present study draws on the resource-based-view (RBV) of the firm and insights on digitalization to examine the role of digital (i.e., IT-based) resources in the provision of advanced services. The RBV theory argues that only resources that are Valuable, Rare, Inimitable and Non-substitutable (VRIN) have the potential to create sustainable competitive advantage (Barney 1996). Based on these criteria we examine the digital resources that form part of the advanced service provision and determine their strategic potential. We first conduct a theoretical review (Paré et al. 2014) of the extent literature to identify the range of core digital resources and subsequently apply a VRIN analysis to identify their strategic potential. Our analysis shows that a number of digital resources identified are rare, inimitable and non-substitutable, but are not necessarily valuable. In particular the value of product-service data and interpretive capability is only unlocked through the *complementarity* of these resources. The analysis further shows that the product-service data and the sensor & transmission device offer significant protection from competition.

2. THEORETICAL BACKGROUND: SERVITIZATION, IT AND THE RESOURCE BASED VIEW

The notion of *servitization* describes a business model transformation where a manufacturer increasingly offers services integrated with their product (Baines & Lightfoot 2013). The provision of advanced services represent a special case of servitization where the manufacturer provides the customer with a capability instead of a product. In the frequently used example of the 'power-by-the-hour' service provision Rolls Royce provides a propulsion capability to airlines instead of selling its engines in a traditional way (Neely 2008). The airline is charged on the basis of the propulsion value that has been provided ('value in use') and Rolls Royce retains the ownership of the engines, remains responsible for their upkeep and ultimately the availability of the propulsion capability. Offering such advanced services provides the manufacturer with resilient revenue streams, opens up new revenue streams and long-term business relationships (Baines & Lightfoot 2013). Advanced services that manufacturers offer rely to a great extend on IT which is embedded in physical products. Such embedded IT constitute what we termed 'digital resource', and in order to unpack the role of such digital resource we turn to the Resource Based View (RBV).

The RBV as an economic theory argues that a firm's competitive advantage lies within the use of its strategic resources (Barney 1991). RBV theory puts a focus on the individual resource and the systematic evaluation of its 'strategic potential' for creating a sustainable competitive advantage. The strategic potential of a resource is identified along four attributes: the resource value, rarity, imperfect imitability, and non-substitutability (Nevo & Wade 2011). The four VRIN attributes together describe a necessary but not sufficient condition for a candidate resource to constitute a source for sustainable competitive advantage (Barney 1991).

Applying the RBV to the IT context requires a careful consideration of the range of IT-related resources. Wade and Hulland (2004) differentiate between *IT assets* (i.e., hardware, software applications, data repositories) and *IT capabilities* (i.e., repeatable patterns of actions in the use of assets incl. technical IT skills, IT management skills, Business-IT relationships) (Piccoli & Ives 2005). Research has often rejected the strategic potential of software or hardware infrastructure as they are generally widely available or imitable (e.g., Bharadwaj, 2000; Carr, 2003). The data resource is less frequently examined in RBV studies although its strategic potential is recognised (Piccoli & Ives 2005). IT capabilities such as IT planning, development, operations (Ravichandran & Lertwongsatien 2005) or information exchange capability (Barua et al. 2004) are more frequently identified as 'strategic resources'. Seddon (2014) also identifies Business Analytics as a strategic IT capability that provides the focal firm with a competitive advantage. In addition to a focus on individual resources recent developments in RBV theory have emphasised the value of resource combinations suggesting that resources that by themselves would not meet the VRIN-criteria in combination can create a 'defensible strategic position' (Bingham & Eisenhardt 2008). This focus on resource complementarity has been further advanced in studies exploring 'IT enabled resource' (Nevo & Wade 2010) or 'IT embeddedness' (Kohli & Grover 2008) where the synergistic combination of IT resources and organisational capabilities are identified as source of competitive advantage.

3. DIGITAL RESOURCES IN THE PROVISION OF ADVANCED SERVICES

The present study uses the term 'digital resource' to extend the way the 'IT resource' is defined in the Information Systems (IS) literature. Digitalization describes the process of incorporating digital capabilities (i.e. sensors or connectivity) into objects that are primarily physical (Fichman et al. 2014). Hence, an embedded digital component significantly amplifies the capabilities and value of the physical product and enables value creation outside the physical product itself (Porter & Heppelmann 2014), leading the product to be considered as a digital resource. Applying this notion of digital resource to the servitization context we define *digital resource* as a combination of digital assets and capabilities that play a role in the provision of product-based services.

To understand the diverse digital assets and capabilities that play a role in the provision of advanced services in the manufacturing sector we have carried out a theoretical review of the extent literature (Paré et al. 2014). A *theoretical review* seeks to "tackle an emerging issue that would benefit from the development of new theoretical foundations" (Paré et al. 2014 p.6). Such a review goes beyond assembling and describing past work but seeks to develop new conceptualisations. For the present study we have purposefully selected descriptions of advanced service provision in manufacturing and have examined the digital resources used and their particular roles and contributions. Our objective was to analyse the digital assets and capabilities that form part of the advanced service provision in order to subsequently analyse their strategic potential.

3.1 Digital Assets

Based on the review of the advanced services literature we have identified three distinct digital assets: Sensor & transmission device, analytic software and product-service data. **Sensor devices** detect, measure and digitally record data on the status and use of the product. **Transmission devices** transfer the sensor data from the product to the central data repository. The range of sensors and nature of transmission device are dependent on the nature of the product and its use. As an example, Baines et al (2011) describes how a rail systems manufacturer (Alstom) provides train systems to a transport provider (Virgin Trains) in form of advanced services. A large array of sensors and transmission devices on board of the trains continuously capture and transmit details such as propulsion, tilt, high tension, braking, air and aggregated error-codes via cellular networks to the manufacturer's control centre. The incoming '**product-service data'** accumulates over time creating a rich digital representation of the installed product base (Reim et al. 2014). Jagtap and Johnson (2011) describe how an engine manufacturer who provides advanced services in the aero engine industry has accumulated vast amounts of product-service data detailing the life of individual machine component, its deterioration and life cycle cost. Software and **analytic software** in particular is highlighted in several servitization descriptions. Manufacturers with more advanced service portfolios rely on more sophisticated software packages to process their data (Alghisi et al. 2013). As an example Vanzulli et al (2014) outline the decision surrounding the adoption of cloud-computing software at Hitachi highlighting the benefits of reduced initial investment and the shortening of implementation time.

3.2 Digital capabilities

We distinguish two distinct digital capabilities: interpretive capability and relational capability. The first, 'interpretive capability' draws on Daft and Weick's (1984) notion of interpretation as "the process through which information is given meaning" (p.286). In the present context 'interpretive capability' captures the confluence of the *technical ability* for analyzing the product-service data, and the *domain knowledge* to convert the analytical insights into actionable insights. Several accounts focus on the service provider's ability to utilize the 'product-service data' and its insights to effectively support business operations (**interpretive capability for operational purposes)**. Operational benefits include the facilitation of *remote diagnostics* by providing insights into possible root-causes for systems failures, or required parts and expertise required for repair (Grubic 2014). MAN Trucks is able to analyze the product-service data to identify fuel-consumption and inefficient driver behaviours (Lightfoot et al. 2011). Product-Service data is also utilized to efficiently carry out *predictive maintenance* operations (Grubic 2014) and to create efficiency in the administrative aspect of the service provision by efficiently determining service charges (Brashear Alejandro et al. 2013) and controlling the conditions of product use.

Further accounts describe a service provider's ability to utilize the product-service data to develop its service provision (**Interpretive capability for business development**). The ability to correctly interpret product-service data provides opportunities to identify service usage patterns, inefficiencies in product use or unmet service needs (Reim et al. 2014). An in-depth understanding of

the customer-base, the product and the market are critical to appropriately judge the patterns and insights that can be derived from the product-service data. The interpretive capability is also used to offer added value to existing service relationships by providing advice on asset efficiency (Ulaga & Reinartz 2011) or additional process analysis (Brashear Alejandro et al. 2013). These offers are conditional on the service providers ability to utilize the accumulated product-service data in combination with its further customers insights and product understanding.

Other accounts in the servitization literature focus on a service provider's ability to use product-service data in combination with a detailed product understanding to draw conclusions about the product behaviour and production development **(interpretive capability for product understanding)**. Baines (2013) describes how the visibility of asset operating characteristics together with the design and technical capabilities is key to improved equipment design, enhanced asset performance and availability. Product-service data is said to radically increase the speed of product innovation (Reim et al. 2014) and might even be interpreted as a R&D investment (Grubic 2014). Ulaga & Reinartz (2011) describe how an aircraft engine manufacturer saw the interpretive capability as so important that they would, at times, take unprofitable contracts in order to enrich their product-service data, advance their predictive model and increase their failure rate predictions.

The second, '**relational capability'** draws on Lorenzoni & Lipparini's (1999) definition: "the capability to interact with other companies" (p.317). A digitally enhanced product-centered service constitutes a change in the provider-user relationship where the product remains in regular communication with the service provider requiring a high level of trust and careful explanation of the underlying data protection and use agreements (i.e., **product-service communication**). Westergren (2011) describes a case of a remote monitoring service provider who failed to properly articulate the value proposition and hereby threatened the product adoption. An organisation's ability to anticipate concerns regarding the digital capabilities of products and its ability to address these concerns are critical for integrating the digitized products into service offerings. The literature also points towards a service provider's ability to craft mutually beneficial forms of data use as an important relational capability (i.e., **data sharing strategy**). Organisations skilfully share product-service data with service users to directly communicate the created service value or payback simulation tools (Ulaga & Reinartz 2011). Real-time utilization data of Toyota Trucks is shared with the service user to allow customers to increase safety and productivity improvement.

Our review of the digital resource that form part of the advanced service provision has revealed a number of critical assets and capabilities. Although we present these here as independent resources we recognise that they are highly interdependent in practice. For example, an enhanced understanding of failure rates and patterns (product understanding) enhances a service provider's predictive maintenance function (operations) or its ability to develop competitive contracts due to an enhanced product risk understanding (business development) (Ulaga & Reinartz 2011).

4. ANALYZING THE STRATEGIC ROLE OF THE IT RESOURCES

We now examine the digital resources identified above with regards to their value creation, rarity, inimitability and non-substitutability. The analysis also examines the complementarity among those digital resource (Bingham & Eisenhardt 2008) to shed light on their synergistic relationships.

4.1 Value creation from digital resources

The *value creation* describes a resource's "ability to support strategies intended to capitalize on market opportunities or fend off threats" (Nevo & Wade 2010, p.164). In detail, this includes (i) the extent to which it reduces a firm's cost base, or (i) the extent to which it provides a source of differentiation (Bingham & Eisenhardt 2008). First, the combination of product-service data together with the interpretive capability create diverse opportunities for **cost-reduction** in advanced services

provision. Remote diagnostics and predictive maintenance reduce the number of expensive unscheduled field visits and help to ensure service availability in a more cost-efficient format. The ability to observe product behaviour provides a cost-efficient way to ensure that the contractually agreed terms are met. Utilizing product-service data to improve product design can further reduce expensive repair-visits. Utilizing the data to increase the accuracy of failure rate predictions provides opportunities for being more competitive in service pricing. Second, the combination of product-service data and interpretive capability provides opportunities for **differentiation** as it allows the service provider to identify unmet user needs, target service offers or provide additional services as point of differentiation. The service providers ability to identify early market shifts or develop separate business propositions help to create new opportunities. The opportunities for cost-reduction and differentiation are based on the *complementarity* of product-service data and interpretive capability. An organisation's interpretive capability (analytical ability and domain knowledge) or product-service data alone does not create a comparable value proposition. The other resources are supplementary in their ability to create value: they are essential in the creation of the data resource (i.e. sensor & transmission device, relational capability) or are critical enablers of interpretation (i.e. analytic software, software integration).

4.1 Rarity of digital resources

The *rarity* of a resource is determined by its relative unavailability to current and potential rivals (Nevo & Wade 2010). Assessing the rarity of **sensor & transmission devices** requires a differentiation between their consideration as technical artefact or as distributed data source. As technical artefacts sensor & transmission devices are widely available (thus offer little strategic potential). As distributed data source 'rarity' refers to their distribution range, which is tied to the installed base. In the context of advanced services a high market share creates the rarity of the distributed sensor & transmission devices. Assessing the rarity of **product-use data** requires a differentiation between the data on individual service-provider–user dyads and the data that captures the wide range of service-provisions. The data of individual dyads may be shared with the individual user, however, the wider range of product-service data that captures different service contracts will not be available outside the service provider (unless a third-party technology provider is involved) and would be considered as rare. Assessing the rarity of **interpretive capability** also requires a differentiated consideration as it captures both the analytical ability and domain knowledge. The analytical capability, although highly sought after, is available in the market. However, the domain knowledge and contextual insights about the product, the customer, and the market is generally more specific, scattered within the service provider and would likely be considered as rare. The available case descriptions are not sufficiently detailed to assess to which extent the **relational capabilities** could be considered as rare. **Analytic software** is widely available.

4.3 Inimitability of digital resources

The *inimitability* of a resource is determined by the costs and difficulties that are associated with its duplication (Nevo & Wade 2010). Barriers to resource duplication include ownership rights, path dependencies, time compression diseconomies or causal ambiguity (Bingham 2008). The inimitability of the **product-service data** is defined by the effort involved in its duplication. In most cases the product-service data will capture product health and utilization records covering an extensive range of sensors over a larger period of time therefore path dependencies and time-compression diseconomies create significant barriers to imitation. A wide distribution of sensors and long time utilization periods are required to create a rich data resource, which is a barrier to its imitability as a competitor would face significant cost and time delays before obtaining a comparable data resource. To the same extent, a focal company's well developed **interpretive capability** is difficult to imitate as it has been honed over years by trialling and refining predictive algorithms which is preconditioned by the availability of meaningful product-service data. The **sensor & transmission devices** as distributed data source are protected by path dependencies due to its link to the installed product

base which is difficult to imitate. Further, long replacement cycles in some of the products negatively impact on the time-frame for sensor-distribution even in case of a large installed base. The other resources (software, relational capability) do not provide significant barriers to imitations as they are not protected from ownership rights, path dependencies and time-diseconomies.

4.4. Non-substitutability of digital resources

The *non-substitutability* of a resource refers to the nonexistence of strategically equivalent resource (Nevo & Wade 2010). Hence, a focal resource that would offer the same functionality as other resources would be 'substitutable' (Barney 1991). An assessment of the substitutability of the digital resources can only consider the technology and business practices currently in place. Future developments and innovations may create resource substitutes (as outlined in the discussion). Based on the current market insights the **distributed sensor & transmission resource** is essential for capturing raw data at the point of product-performance and use. While in some instances the service user's system could create some of the **product-use data** (e.g. manufacturing information systems) the same level of detail on the individual product health and usage will be provided. The analytical process can certainly be supported by dedicated applications, however, the domain knowledge, which is an essential part of the **interpretive capability** will unlikely be substitutable. The other digital resources are subjected to substitution threats: cloud-based software services (e.g. Salesforce.com) are already substituting individual **software** installations and the increasing acceptance of digitized products is a likely substitute some of the **relational capabilities**.

5. DISCUSSION & CONCLUSION

The present study has set out to examine the role of digital resources in the context of advanced service provision and identify their strategic potential. Our analysis shows that none of the digital resources on their own meet all VRIN criteria (see table 1). Hence, as individual resources they have a very limited potential to create a sustainable competitive advantage for the focal firm. However, the combination of product-service data and interpretive capability meets the VRIN criteria and hereby has the potential to be a source of sustainable competitive advantage for the service provider. Indeed, a resource combination creates a sustainable competitive advantage if it reinforces the competitive advantage over time (Piccoli & Ives 2005): By creating cost-efficiencies and opportunities for differentiation the combination of rich product-service data and superior interpretive capability can stimulate growth in market share which would further enrich the product-service data, provide for additional insights and further strengthens the strategic value of these digital resource.

	Value creation	**Rarity**	**Inimitability**	**Non-substitutability**
Distributed sensor & transmission devices	low	High	high	high
Analytic software	low	Low	low	low
Product-Service Data	High (in combination)	High	high	high
Interpretive capability	Low (as individual)	Medium	high	high
Relational capability	low	Low	low	low

Table 1. A VRIN analysis of digital resources in advanced services

Our analysis and findings lead to a range of theoretical and managerial implications. The identification of digital resources as source for competitive advantage emphasises the need to explicitly consider the digital domain in future research on servitization and advanced service provision. The *information systems* discipline offers a range of insights that help understand the intrinsic properties of digital assets and capabilities and its management. The study also offers implications for RBV theory which traditionally considers 'ownership' of resources as a critical

precondition for creation of competitive advantage (Barney 1991). Our research points to data as potentially shared resource with significant strategic potential. Hence, current RBV theory-development that explores the strategic role of shared resources (Lavie 2006) should take note of the servitization context as a domain with significant potential for shared resource use.

Our research creates a series of direct managerial implications but also points to future managerial challenges. Our VRIN analysis identifies the *potential* for competitive advantage but the *realization* of this competitive advantage is dependent on the effective development and strategic exploitation of the digital resources. In particular the complementarity between product-service data and interpretative capability requires a systematic and coordinated approach to resource development. Our research also points to the information and analytical advantage that can develop as part of the digital resource exploitation although at this point the information advantage is rarely included in the economic rational for servitization (Baines & Lightfoot 2013). Managers should consider the increasing value that can be derived from developing these digital resources and the spill-over effect for traditional product sales channels in the assessment of their servitization decision. The identification of strategic resource should also encourage managers to focus on protecting the resource base from losing its competitive potential. The sharing of data might on the one hand allow to increase the value that can be derived from it, but on the other hand may reduce the rarity of the data resource which could undermine its strategic potential.

The resource-based view and the VRIN analysis in particular has offered a viable framework for a systematic analysis of the digital resource. While the framework itself has limitations our use of secondary data and the intrinsic challenge of categorizing and assessing the attributes should be acknowledged as additional limitations. Nevertheless, our work and the insights that we have created point to the digital resource as a critical factor in the further trajectory of servitzation practice and research.

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Technologies and data – part II

HOW DIGITALIZATION CAN ACCELARATE THE TRANSFORMATION FROM MANUFACTURER TO SERVICE PROVIDER

Christian Lerch & Matthias Gotsch

ABSTRACT

Purpose: This article intends to contribute to the discussion about the increasing digitalization of manufacturing industries. In more detail, it tries to specify the influence of the digital revolution on the transformation of manufacturers into service providers and hence, on the servitization process in industries in general. The aim is to deliver first findings about the drivers of and barriers to digitalization with respect to industrial service offers.

Design/methodology/approach: The study uses existing theoretical concepts about the transformation of manufacturers as well as a concept about the influences of digitalization on this transformation. By means of a cross literature analysis, this article derives overall drivers of and barriers to the increasing digitalization of industrial service offers.

Findings: We identified eight factors which influence the digitalization of service offers in terms of triggering or hindering this process. These factors are embedded into existing theoretical concepts to construct a new framework considering digitalization in the servitization trend.

Originality/value: This article delivers a first conceptual approach to clarifying the role of digitalization in the context of servitization and gives insights into the drivers and barriers concerning the propensity of manufacturers for using digitalized service offers.

Key words: Product-related services; industrial services; service typology; digitalization; product-service system; digital product-service system

1. INTRODUCTION

In recent years, the term servitization has been used to describe the increased service orientation in industry (see Baines et al. 2009; Lay 2014). Product manufacturers no longer just sell their products, but have also begun to offer services tailored to the product (see Baines et al. 2009; Wise/Baumgartner 1999; Vandermerwe/Rada 1988). These range from traditional product-related services, such as maintenance, repair and training to advanced customer-oriented services or product-service systems (see Lay 2014; Oliva/Kalleberg 2003; Mathieu 2001).

Of a result of this trend in industry, it is assumed that product manufacturers move on a transformation path from manufacturer to solution provider (see Gebauer et al 2005; Gebauer 2004). This transition path has been analyzed in the literature in various articles and is described as taking place in different stages, each with different potentials for competition (see Matthyssens/Vandenbempt 2010; Gebauer et al. 2008; Matthyssens/Vandenbempt 2008; Penttinen/Palmer 2007; Oliva/Kallenberg 2003; More 2001). At the end of the path, manufacturers offer innovative product-service systems, such as availability guarantees or BOT-models, which increase customer value on the one hand and create a competitive advantage for the provider on the other (see Brady et al. 2005; Boyt/Harvey 1997).

Beyond this trend of servitization, manufacturers have also begun to equip their products and machines with intelligent digital systems so that they can operate independently and communicate with other machines in production. This development is referred to as “Industry 4.0” in Germany, and includes the digitalization of traditional industries (see Spath et al. 2013; Bauer et al. 2014). As a logical consequence of this trend, an increasing number of manufacturers are beginning to use digital systems for their service offers, too (see Münster/Meiren 2011).

Due to the extensive possibilities offered by digitalization, these questions arise: How far do digital systems influence the transformation from producer to solution provider and what drivers and barriers are hidden behind this process? To answer these questions, we conduct a literature review focusing on articles dealing with digitalization and the transformation of manufacturers. By analyzing the most relevant articles, we derive the drivers and barriers described in the different studies. Finally, we discuss the findings by reflecting the existing theoretical concepts, deliver implications for strategic management and give an outlook on future research.

2. DIGITALIZATION AND ITS INFLUENCE ON THE TRANSFORMATION OF MANUFACTURING FIRMS

So far, there are very few analyses in the literature of the influence of the digital revolution on the transformation of manufacturers into service providers. Lerch and Gotsch (2014) deliver a first concept, which considers existing transformation models and analyzes the role of digitalization during this transition process. In this study, the authors assume that there is a positive relationship between the degree of digitalization and the level of servitization of manufacturers. Based on the analysis of three case studies, they argue that a higher service orientation with more complex services leads to a greater need for digital solutions. On the other hand, using ICT systems opens up new potentials for providing innovative services (see Lerch/Gotsch 2014).

Taking the theoretical concept of transformation into account and due to the implied interactive effect, they reason that manufacturers progress along a dominant transition path, influenced by both digitalization and servitization. Due to the individual characteristics and activities of manufacturers, they further conclude that there exist various patterns along the transition path. These patterns are stable equilibriums as long as the companies do not enhance their service offers. Indeed, these equilibriums become unstable as soon as the company innovates and the manufacturer is driven back to the dominant path until a new equilibrium occurs.

Based on an in-depth analysis of three case studies, the authors develop four generic stages of the dominant path, which are also found in literature. Depending on the individual characteristics and activities of manufacturers, these generic stages differ from each other, are expressed in different ways and are located closer to or farther from the dominant path. The authors suggest the following four stages (see Figure 1):

I. Manufacturer: The first stage is characterized by manufacturers providing obligatory product-related services such as installation or maintenance and repair and using standard ICT solutions for their services like digital text files, e-mail, video-calls, etc. This stage sees ICT solutions being used for daily work, with almost no significant impacts on how service offers perform in competition.
II. IT-based services: Companies at stage II use ICT solutions to improve their existing service offers; this is also known as the concept of teleservices. As a result, companies are able to provide services faster, with less resource input and/or higher quality.
III. Pure digital services: Manufacturers at stage III offer services that are enabled by ICT systems. Examples of such services include software-based simulations, virtual or augmented reality applications or digital technical analysis. These services extend the service offers of manufacturers and enhance the performance of the product or the service significantly.
IV. Digitalized product service systems: Manufacturers at this stage not only provide complex product service systems to their customers, but use ICT solutions as a new component in the product-service bundle, too. The aim of this digital infrastructure is to create intelligent, independent operating systems which are able to deliver the highest availability, optimal operating conditions and strongly reduced resource inputs at the same time.

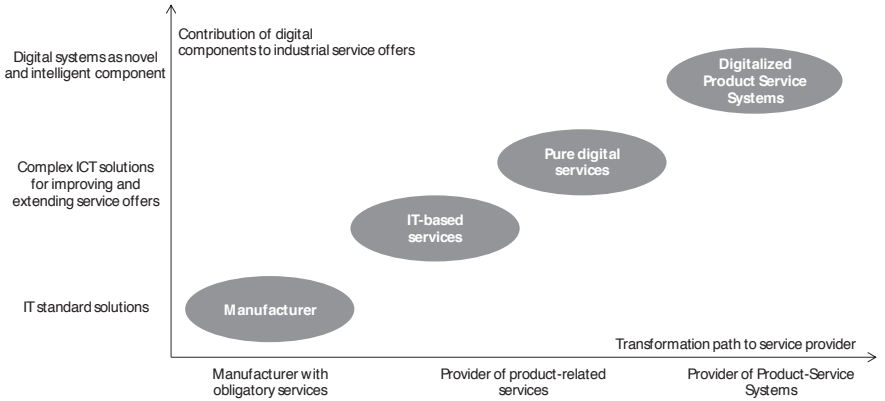

Figure 1: Transformation framework of manufacturers under the influence of servitization and digitalization (source: Lerch/Gotsch 2014)

Using this theoretical concept, we now want to identify the drivers of and barriers to this hybrid transition. We review the literature focusing on articles which describe the relationships between the characteristics and the activities of manufacturers and their propensity to use ICT systems for providing services. We subsequently identify a first set of drivers and barriers by a cross analysis of the relevant articles.

3. DRIVERS OF AND BARRIERS TO DIGITALIZATION

Because digital services can be offered and provided independent of location and consumer, traditional IHIP-criteria are no longer valid for digital service creation (see Holtbrügge et al. 2007). Additionally, new capabilities arise due to the increasing digitalization of services. Opportunities open up concerning process simplification, process acceleration or process optimization as well as new forms of customer integration (see Schuh/Fabry 2014). Therefore, it seems important to study in detail the drivers and barriers of service digitalization by means of a cross literature analysis. The analysis consists of two different approaches. On the one hand, new connections and combinations between classical servitization literature and digitalization literature are created. On the other hand, recently published literature dealing with digitalized industrial services is scanned, analyzed and interpreted under the aspect of digitalization.

Based on the literature analysis, we identified eight main drivers of the digitalization of industrial services, which will be introduced in the following: First, the *complexity of services* offered by the manufacturer seems to influence the degree of digitalization. The more advanced and ambitious the services, the more support by smart ICT solutions is needed for manufacturers to offer them to the customers (see Lerch/Gotsch 2014; Gebauer et al. 2011).

Second, the *technical infrastructure*. Highly available and real-time communication networks are essential for service digitalization. The networks must have high data transfer rates and must be able to process large amounts of data. Without a stabile and reliable network, digital services cannot be offered economically. Only broadband networks allow all the advantages of digital solutions to be used for the digitalization of industrial services (see Bauer et al. 2014; Westkämper et al. 2013).

Third, the *integration of upstream and downstream value chain partners* also has to be considered. Particularly for manufacturing companies, it is essential to work cooperatively with technology partners or suppliers in order to continuously improve products. At the same time, it is increasingly

important to deepen the relationship with customers, because the demand for customized products and services is rising. The growing need to integrate customers and suppliers into production processes can be managed more efficiently through the use of digital services (see Buschak 2013; Gebauer et al. 2011).

Fourth, the *share of exports* seems to be another driver of service digitalization. Especially companies with a high degree of export sales benefit from new digital opportunities, because digital and remote-controlled services open up the chance to offer downstream activities independent of location and consumer, e.g. remote maintenance or remote repair services. High-quality products that are also equipped with spatially independent services are supposed to encourage foreign customers to make a purchase decision (see Holtbrügge et al. 2007).

Obviously, the services of manufacturers always have to be considered in terms of their connection to the core product. Therefore, it is not surprising that the degree of *digitalization of the core product* influences the degree of digitalization of the accompanying services. Digitalization makes it technically feasible to equip all the products and machines with an IP so that these components can communicate and interact in a network. In order to integrate services into this network and increase the added value, the services have to be digitalized in the same way as the physical components (see Hoffmann 2014; Bauer et al. 2014).

The *complexity of the core product* also has to be considered. Generally speaking, the more complex the product, the more useful the services, especially for the customer. Therefore, there seems to be a connection between product complexity and the offer of product-accompanying services. Customers who purchase a technically complex product with digital components need consulting and training services, which should preferably be provided in a digital way (see Dachs et al. 2013; Rainfurth 2003; Wassmus 2014).

The *batch size* also seems to influence service digitalization, due to the fact that companies offering one piece production have close customer contacts and products with a higher degree of individualization, which require more services. Complex machines and diverse systems require a huge range of accompanying digital services (see Borgmeier 2002; Rainfurth 2003, Seegy 2009).

Last, but not least, *company size* affects service digitalization. Large enterprises are more likely to have the resources and competence to apply digital components. Many SMEs do not have their own IT service division and are not able to provide individual digital solutions (see Reichwald et al. 2009; Rainfurth 2003). Therefore, we suggest company size as the final digitalization driver. To sum up, the eight main drivers of the digitalization of industrial services are:

- Complexity of offered services
- Technical infrastructure
- Integration of upstream and downstream value chain partners
- Share of exports
- Digitalization of core product
- Complexity of core product
- Batch size
- Company size

Simultaneously, the major barrier to the digitalization of services seems to be the lack of qualified employees in manufacturing companies. The employees providing the services need a continuously rising technical qualification profile with knowledge of engineering, mechatronics and IT. Digitalization significantly increases the complexity, abstraction and problem solving requirements

for all employees. Special training and further professional development courses have to be offered to overcome this barrier and prepare staff to offer digital services (see Kagermann 2014).

4. DISCUSSION AND IMPLICATIONS FOR STRATEGIC MANAGEMENT

Based on literature analysis we assumed that there is a positive relationship between the degree of digitalization and the level of servitization of manufacturers. Taking the theoretical concept of transformation into account we proposed that manufacturers progress along a dominant transition path, influenced by both digitalization and servitization. We regarded a transformation framework of manufacturers under the influence of servitization and digitalization with four generic stages of the dominant path, labelling these stages I) manufacturer, II) IT-based services, III) pure digital services, and IV) digitalized product service systems.

By conducting a literature review focusing on articles dealing with digitalization and the transformation of manufacturers and analyzing the most relevant articles, we derived the drivers and barriers which influence the digitalization of service offers in terms of triggering or hindering this process. Summarizing, we identified eight factors which fit to existing theoretical concepts and can be embedded in the transformation framework considering the digitalization and the servitization trend. These identified drivers can be clustered into five main groups:

1. Corporate characteristics (e.g. company size)
2. Profile of service offer (e.g. complexity of offered services)
3. Characteristics of the core product (e.g. digitalization of core product, complexity of core product, batch size)
4. Location (e.g. technical Infrastructure)
5. Business and market activities (e.g. integration of upstream and downstream value chain partners, share of exports)

Because most of these drivers are depending on default characteristics (e.g. corporate characteristics or characteristics of the core product) or even external instances (e.g. technical infrastructure), we assume that there is a boundary of digitalization for each individual company. Consequently, strategic management only can exploit the existing digitalization potential, but not actively increase their individual boundary of digitalization.

Furthermore, another main implication for strategic management, which can be derived from our findings, is that the person in charge always should be aware of the company state regarding the current positioning in the transformation framework. According to this positioning, in each case other measures are appropriate in order to continue the journey from manufacturer to service provider successfully.

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THE INFORMATION GATHERING AND UNDERSTANDING IN SERVITIZATION ORGANIZATION

Eugen Molnár, Rastislav Molnár & Michal Greguš

ABSTRACT
The Business today is powered not only by structured data but increasingly important role is played by information that is unstructured, social and distributed via different channels. Subject of this communication is mainly related to the organization or its products, services, and employees. Channels include blogs, social media, emails or customer calls. The result is a stream of comprehensive and real-time data critical for an effective decision support and the improvement of the customer experience. Consequently, organisations implement analytical and meaning-based techniques which are perfectly suited to help them to bring together data across all channels in a timely and efficient manner. Today, companies are able to obtain a lot of information from the internet and use them to develop their business. We believe such knowledge-based intelligent system is an important part of the servitization process. In this paper we describe a novel approach for the customer communication supported by knowledge-based system enabling to establish targeted communication with customer. Later, we describe a system for the communication with customer, with a goal to provide customer the relevant information in the right time, through the right channel.

Key words: Big Data, Customer Experience, Information Extraction, Knowledge Management, Servitization, Social Media

1. INTRODUCTION

Today, if we want to buy any product or service, we aim to go on the internet and search for relevant information. We are keen to analyse reviews and experience of others on any channels available to us. (Kryvinska et al., 2014)emphasize an importance of the usage of information on the Internet and refers to the changing role of customers. Customers are getting more informed and more active and this offers servitizing organizations wider possibilities for bi-directional communication. (Stodder, 2012) refers to „The new frontier for customer analytics is social media." (Jue et al., 2009) point on the fact that Social Media change a business environment and are getting it more complex. Organizations must process more information, this needs more technology and provides more space for new issues and challenges. In addition there is an important dimension – globalization. Organizations operate in multiple countries with multiple cultures and multiple languages.

However organizations "can profit from a capability to collect and analyze this data and use it to improve one of key feature of the Servitization – strong customer orientation." (Molnar et al., 2014). Search, collection and data analysis are a paradigm of today.

Nowadays there is multichannel communication of customer with an organization and customer contributions (related to the organization or its products, services, employee…) in blogs, social media and so. The organization should collect and discover knowledge from collected structured or unstructured data and to use them for improving of customer experience or to acquire new and keep existing customer.

Whereas is communication with customer led through several channels and by many employees, organization does not benefit as much as it could from multiple interactions. Amongst various

possible causes, we underline the fact that communication via several channels and executed by many employees is not led and managed as a process with using a framework, which represents a holistic approach including knowledge creation and sharing.

The separate challenge represents Knowledge representation and reasoning. (Zhu et al., 2011) use the semantic web for knowledge management in the product domain in order to allow to access and integrate heterogeneous data across host semantic repositories, host rational databases, external public linked data. In addition this approach provides querying/reasoning, and authoring/updating services on the hybrid-data repository for engineers on the Web, and to visualize and manifest semantic data with different views.

More and more attention is given to the standardization and implementation of efficient mechanisms for the use of knowledge gathered in ontologies (Schubert, 2006, Jakus et al., 2013) concretely concern the development of ontologies and the mechanisms of their use as a base for reasoning (Jakus et al., 2013). This challenge is related to the development of sound and complete reasoning engine. This is powered by reality that Knowledge representation plays one of the key roles in the development of knowledge-based systems.

2. INFORMATION EXTRACTION AND REPRESENTATION

2.1 Sources of unstructured information

By the unstructured information we mean any information relevant to our products and services. This information is usually available publicly online, which implies a great importance for firms to understand it and eventually act based on it. If we speak of types of unstructured data we mean textual, visual and audio data from various sources.

First the user reviews, their importance is stressed by existing research showing the customer reviews matter for example for the profitability of movies (Chintagunta et al., 2010, Duan et al., 2008) or for the profitability of hotels (Ye et al., 2009). It is clear it is crucial for the company to capture and be able to interpret user reviews. Related to reviews, user comments may be seen as short user reviews, in that case is their relevance as important as of proper user reviews, even though they are in general shorter. Second reason why it is important to look at user comments is comments determine the popularity of the content they are related to (Reich, 2011).

For both reviews and user comments social networks are convenient and powerful channel. When speaking of social networks we usually mean the most popular networks Facebook, Twitter, Youtube, Pinterest or Instagram. These networks are being extensively studied by a number of researchers for example trying to analyze their social potential (Kwak et al., 2010) or try to relate data created by their users to financial markets (Bollen et al., 2011, Zhang et al., 2011). Another powerful public sources where users express and exchange opinion on our products are blogs, discussion boards and articles in electronic news services for both either as authors or as participant in discussion. (Akehurst, 2009) studied the impact of blogs on tourism organizations and found out consumers trusted more blogs than professional guides and travel agencies. (Kavanaugh et al., 2006) studied blogs in the context of political debate.

As existing research suggests user created content plays a very important role for customer decisions. This means opinions shared by our customers are important from the perspective of servitizing organization aiming to retain existing and attract new customers. Organization has to understand these and act when necessary or viable.

2.2 Methods of information extraction

Information extraction is a process of identifying facts in unstructured or semi-structured data and converting them into structured representations. These facts may be names of entities, their relations or events and tasks of the information extractions are.

- Named Entity Recognition
- Co-reference Resolution
- Relation Extraction
- Event Extraction

For a successful information extraction we first need to identify pre-defined named entities (Named Entity Recognition), then control for multiple mentions of the same entity in the text (Co-reference Resolution). After that we have to detect the relationships between entities identified in the text (Relation Extraction), the last task is to reveal events in the unstructured text (Event Extraction) and it is considered the hardest from all four tasks. These tasks may be performed within one textual document, at the document level or cross-document, for more details see (Piskorski and Yangarber, 2013).

In terms of methods you, we can divide information extraction methods to rule-based and pattern and supervised learning methods. Traditionally rule-based approaches are referred to as handcrafted systems and they may be simple hand-written patterns or advanced rule-based or example-based systems. Examples of rule-based approaches are FASTUS (Hobbs et al., 1997) or LaSIE-II (Humphreys et al., 1998), a great overview of rule-based information extraction systems is provided by (Chiticariu et al., 2013) who illustrate a disconnect between industry and academia, where industry implements the rule-based information extraction systems on a large scale, while academic papers focus on the Machine Learning Based systems.

Pattern learning methods are surveyed and described by (Muslea, 1999), these rely on a set of extraction patterns used to retrieve the information. More advanced, supervised learning methods, include maximum entropy models (Borthwick, 1999, Chieu and Ng, 2002) , decision trees (Sekine et al., 1998), support vector machines (Tong and Koller, 2002) and more. What they have in common is the use of automated, machine learning methods.

2.3 Methods of information representation

Information representation methods are methods used to represent structured information we have extracted from unstructured data from various sources and stored. We can represent these information either by producing raw numerical data with statistics or using the visualization. While raw numerical outputs may be useful for data analysts of the company, other stakeholders are better off reading visualized data.

The text visualization methods were collected and comprehensively assigned into several top-level categories by (Kuche and Kerren, 2014). You can reference a full list of 100 visualization techniques included in the study online (available at http://textvis.lnu.se/). This list includes for example IN-SPIRE Galaxies (Hetzler and Turner, 2004), FaceAtlas (Cao et al., 2010), Sentiment Relationship Map (Wang et al., 2013), Topic Competition Visualization (Xu et al., 2013) or ConVis (Hoque and Carenini, 2014).

3. THE MODEL OF INFORMATION UNDERSTANDING IN SERVITIZATION ORGANIZATION

Nowadays it is a common practice companies track customers through their lifecycle. The big challenge, however, is to track, process and answer to any opinion or comment raised by the

customer not only by the interaction with company's customer service, but publicly on the internet as well. It is more important for servitization company as it has to approach the customer care carefully in order to retain the customer of its services. In a proposed model, the company reacts to any detected situation according to the set of pre-defined rules for target communication.

3.1 Information and Knowledge

Today is the usual form of the communication between the organization and customers of type "Information - Information". This is simple query and answer communication, which in many cases doesn't offer the most relevant information to the customer as it is independent of other information created by the customer or other customers and what is available publicly from other sources (reviews, articles, blogs or discussion boards). We propose a model of the system able to understand the input from the customer and automatically prepare the most relevant answer using accumulated knowledge and the information about customer himself. This way company may not only provide better and faster information to the customer, but remind him additional products or services he may be interested in. We call this form of communication "Information – Knowledge - Information" and the process is described in the Figure 1.

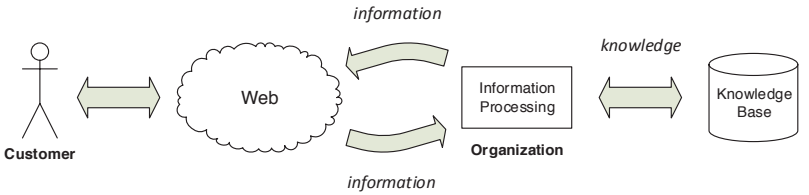

Figure 1: The Information – Knowledge – Information Flow

More precisely, the communication starts with customers who are communicating their experience or ideas about products and services either to the company (requesting information or complaints) or they publish it on the internet (reviews, user comments or opinions). Traditionally, the information flow directly from the customer to the company would be recognized by the company on a certain level, while a large part of the information available on the internet would remain unknown. In this settings the company is not able to provide as relevant information as it could. In our model, company retrieves the information from both, the communication with customers and internet, and creates the knowledge base. It can then use the knowledge base to react on the information available on the internet and also to improve its direct communication with customers.

3.2 Proposed architecture

In order to implement the "Information – Knowledge – Information" communication, a company has to be able to retrieve, process and understand a large quantities of unstructured data. In order to be able to cope with these requirements, we propose a following knowledge-based system [as shown in Figure 2]:

Proposed system uses unstructured data as the input, then it extracts the information form them using the rule engine. The main parts of this solution are Knowledge based represented by lightweight ontology (RDFS – Resource Description Framework Schema) and facts enrolled in POSL (POSL – Positional Slotted Language), Rule subsystems and the Reasoning engine. We also propose the use of customer data in order to provide more insights on the customer himself and visualization of data in order to provide the comprehensive information more clearly.

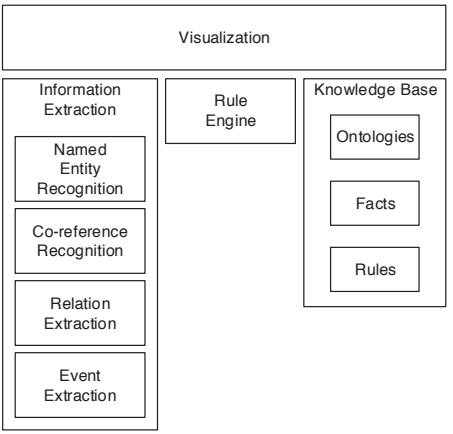

Figure 2: The functional blocks of proposed Knowledge-Based System

The input, raw text, is downloaded from the internet or other sources (such as emails or transcripts of the communication). Raw information is then processed using the information extraction system. This system performs also, among other tasks, the entity recognition and relation extraction. For more information on information extraction, please refer to (Cowie and Lehnert, 1996) or (Piskorski and Yangarber, 2013). The review of information extraction systems implemented for web information extraction is described in (Chang et al., 2006).

Information is then passed to the semi-automatic rules engine. Rules engine uses a set of pre-defined rules to process extracted information and produce structured data - "facts". Examples of rule based systems are (Skeppstedt et al., 2012) who used it for the entity recognition in health records or (Folorunso et al., 2012) who used it for mineral identification. Structured data (facts) as well as other information needed by system (ontologies and rules) are then stored in the knowledge base. If needed, they are retrieved and visualized. An example of this system is a system responding to customer queries in an autonomic way or as a knowledge base for the customer care team (online and e-mail support, call centre or personal contact point).

3.3 Example

Let us illustrate the benefit of proposed system on a simple example of customer review that starts as raw text, a publicly available review on a specialized website:

"We were planning to migrate to XY's cloud, we have tried to contact them 5 times but they never contact us back. We used the form in their webpage, we have received an email that said that customer care should be in touch with us in the next 24 hours but they never called us. They do not offer chat assistance or telephone assistance. They have very serious problems in this area as they have lost a big client and they do not even know."

We can clearly identify the user who is trying to migrate his services to XY and had the troubles contacting the company. Now while this is visible to people who read given website it is usually not visible to the customer care service of the XY. Should the customer contact the company again they will never know he already tried to contact them and posted a review on their services. Should he never contact them again, they would never noticed his intent to migrate to them and troubles with the communication. Figure 3 shows the process of the transformation of raw text into facts.

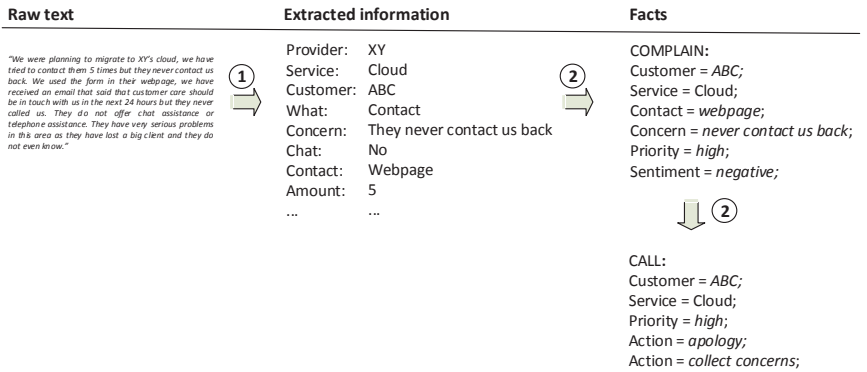

Figure 3: An example of the information processing

First, the raw text is processed to extracted information. The issue is the extracted information itself is only slightly better than raw text as it can be categorized and searched, but it does not provide direct and quick call to action needed in the case of customer care. This extracted information is therefore passed to the rules engine which creates facts and direct call to action using a set of rules. Facts can be shown to the customer care department or processed automatically by other systems.

Processed information (fact) can be represented in the POSL as follows:

Complain(who->ABC;
contact->webpage;
amount->5;
concern->never contact us back;
sentiment->negative;
priority->high).

Call(who->ABC;
reason->complain;
priority->high;
action->apology;
action->collect concerns).

4. CONCLUSION

In our paper we presented a model of knowledge-based system for enhancement and advanced understanding of communication between customer and servitizing company. Conceptually is proposed knowledge-based system utilising of information extraction based on the rules and knowledge management (knowledge representation and reasoning). This solution could help to improve the quality of the communication and perceive of the customer's behaviour by revealing information available via public sources and company channels and hence to improve whole customer satisfaction with provided services. From long term perspective, company also has the opportunity to build a large knowledge base and analyse complex information about its products and services from customers. This tool can be used to analyse products and services of the competition as well.

In the coming future, we would like to pay more attention on the following aspects, firstly we will develop a domain ontology for servitizing organizations. Further, we focus on the evaluation and selection of suitable tools for information extraction. Third, we will develop a sample framework covering based on proposed communication model and software architecture.

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"THIS BEER IS OFF!" - BUILDING A DIALOGUE GAME FOR SERVITIZATION

Victoria Uren & Panagiotis Petridis

ABSTRACT

Purpose: Development and evaluation of a prototype dialogue game for servitization is reported.
Design/methodology/approach: This paper reports the design of the iServe game, from user centered design, through implementation using the Unity games engine to evaluation, a process which took 270 researcher hours.
Findings: No relationship was found between either age or gaming experience and usability. Participants who identified themselves as non-experts in servitization recognized the potential of the game to teach servitization concepts to other novice learners.
Originality/value: The potential of business games for education and executive development has been recognized but factors, including high development cost, inhibit their uptake. Games engines offer a potential solution.

KEYWORDS: Serious games, game design, evaluation

1 . INTRODUCTION

Business Games have existed since the 1960s with Top Management Decision Simulator being considered the earliest well known example (Meier et al., 1969). Business games have gained a foothold as a tool for education and executive development, where their ability to engage and inform, as well as entertain, can contribute significantly to learning. Typical examples of these include, in the manufacturing sector, Siemens *Plantville* (Brownhill, 2012), which gives players the opportunity and challenge of running a virtual factory, and games for teaching the concepts of Lean Manufacturing (Vaz de Carvalho et al., 2014). We are particularly interested in determining and advancing the role of serious games in advancing the adoption of product service systems. A few management games exist which address some issues relevant to servitization, for example, the *Mortgage Service Game* (Anderson & Morrice, 2000), concerns services supply chains, and the EDIPS board game is designed to teach design of Product Service Systems (Nemoto et al., 2014). However, relatively few serious games exist in the domain of servitization.

One factor which inhibits the uptake of games based on computer simulation is the high development costs associated with game development. This factor is being addressed using new development tools and game engines, which significantly reduce the cost of game development. In this paper we report the development process used to produce a servitization game prototype using one such game engine, Unity (http://unity3d.com/, accessed on 3 March 2015) in section 2, in Section 3 we characterise the prototype using a management game taxonomy (Greco et al., 2013) to assess the sophistication of the resulting prototype, and report usability evaluation in Section 4. Section 5 summarises the findings and outlines future work.

2. DEVELOPMENT PROCESS

The prototype game was developed using a user centered design process (Greenbaum & Kyng, 1992). In user centered design the needs of users are considered from the outset and at every stage of the software development lifecycle, the aim being to produce a highly usable product which fits to the users' needs. Typically a cyclic design process is employed with prototypes being tested at the conclusion of each design cycle. For the prototype described in this paper the servitization experts in the team put themselves in the role of users, who were conceived as manufacturing managers: a group well known to several of the researchers. Feedback gathered during the evaluation reported here will be taken as user input for the second design cycle. The development process took an

estimated 270 researcher hours, the breakdown of which is given in Table 1, and activities conducted at each stage are reported below.

Stage	Person hours(h)
Game Mechanics	44
Scenario Development	44
Dialogue Scripting	132
Implementation	50

Table 1: Resources used for prototype development

1. *Game Mechanics* - The first step was to select appropriate game mechanics for use in the game. A workshop with ten participants, lead by the games researchers, introduced the servitization experts to the available palette of game elements, approaches to play and the crucial concept of learning points. The learning points are the objectives which a serious game is designed to teach. It was concluded that a dialogue game, using scoring to reward dialogue choices associated with the learning points was a suitable game design for the prototype which could be supported using the Unity games engine, an approach which should reduce the development time and cost required.
2. *Scenario Development* - Immediately following the game mechanics workshop a brainstorming session was held which identified several possible scenarios and associated learning points. For this exercise the team broke into three sub teams, each containing at least one game designer and at least one servitization expert. The sub teams presented their ideas to the whole group and the best scenario was chosen. This scenario begins in a bar where the beer is bad, and is inspired in part by the Beer Game (Sterman, 1989), a well known management game for teaching the bullwhip effect in supply chains. The goal of players would be to solve the problem of bad beer. The learning points would concern the Basic, Intermediate and Advanced Services model (Baines & Lightfoot, 2013) of servitization, which is used in the knowledge transfer workshops run by the Aston Centre for Servitization Research and Practice. This model has proven effective in communicating the nature of servitization to managers of manufacturing SMEs.
3. *Dialogue scripting* - An intensive two day workshop was held with eight of the participants from the earlier workshop, which went deep into on the selected beer scenario, to develop non-player characters with whom players could interact to identify solutions to the problem of bad beer and scripting detailed dialogues. Techniques used in the workshop included role playing and story boarding, with the different dialogue options being collected on script cards, and by recording the researcher's role-playing the dialogue. To reinforce the learning point, the highest scores were associated with dialogue options relating to Advanced Services, moderate scores were associated with dialogue choices relating to Intermediate Services, and low scores were associated with dialogue choices relating to Base Services. The design process involved role playing dialogues between the player (cast as a beer inspector) and various characters who would be encountered.
4. *Implementation* - Once the scenario writing and dialogue scripting were complete, three scenes and accompanying dialogues with a small cast of non-player characters were implemented in Unity (see Figure 1). Unity is a game authoring environment which supports the creation of interactive video games (Watkins, 2011). Unity is one of a generation of game authoring tools, which make the production of new games faster and easier. Using the story boards developed at the workshop, one game designer implemented the game, with input from one native English speaker to script the final dialogues in colloquial style.
5. *Evaluation* – the final stage of the user centered design cycle is evaluation and testing. This is reported in detail in section 4.

Figure 1: Interaction with the hotel owner at the point where the user must make the first service design decision, left showing the virtual bar, right showing dialogue implemented in Unity

3. CATEGORISATION

iServe was categorised using the taxonomy proposed by Greco et al. (2013), in order to situate it in the landscape of business games and assess its sophistication. Greco's taxonomy identifies and classifies the relevant elements of business games which incorporate aspects of serious games, management games and simulations. It has five major categories:

1. *Environment of Application* – iServe is a Stand Alone Simulation, played as a single player game, with an Arbitrary time representation, Finite teleology (it has a clearly defined end), and Self controlled Learning (it does not require teaching support).
2. *Design Elements of the User Interface* – iServe presents a Simulation in One Run, with only one round being played, decisions are strictly Sequential and Qualitative, Haste is absent (players can complete the game at their own pace), the simulation is Transparent Box (players immediately see the effect of each decision on the score, and its Appearance is 2D graphics. The user interface is Software Based, and Savability of the game state is None. The virtual environment, supported by Unity, makes iServe unusual for a business game – it has a Vagrant Perspective and Relative Positioning (players can move around relative to the environment and non-player characters).
3. *Target Groups, Goal, Objectives and Feedback* – iServe is an Open target game, although manufacturing managers are a target the game could equally be used with business students. The goal of the game is primarily Teaching (as opposed to skills evaluation), with an element of Research. The Didactic skills in the game are Conceptual skills, rather than soft skills, such as communication, or Hard Skills concerning detailed technical operations. The Challenge of the game is Identical for all players. The Final score display provides limited Individual Debriefing and Immediate Feedback, which is Incomplete.
4. *User Relation / Community* – Because iServe is a single player game, Interactions Among Players are Absent, Player Composition is Single Player and Player Relation is Individual etc. However, we would argue that, because of the role of non-player characters in the game, it is a Role-Playing game: players need to put themselves in the place of the beer inspector to succeed at the game.
5. *Model Characteristics* – The development of the underlying simulation for iServe is (currently) limited to scripted dialogue between the player and non-player characters. It has a Realistic Domain, is Deterministic (players are rewarded for making good decisions without any element of chance), it concerns a Special Area of Interest (Servitization) rather than a whole domain, is Without Influence of External Data, and Configurability is Absent. Finally, Fidelity is low. In Greco's taxonomy Fidelity is calculated by weighting six key elements from the taxonomy, which for the prototype were scored as follows:

    - Behaviour – Deterministic (weight 1)
    - Interaction – Absent – players interact only with non-player characters (weight 1)
    - Player composition – single player (weight 1)

- Challenge – Identical – the player can only make predefined choices (weight 1)
- Didactic Goals – Conceptual Skills (weight 1)
- Appearance – 2D (weight 4)

This gives the prototype a total weighting of 9 (minimum 6 - maximum 36), which places the prototype in the low fidelity category.

This categorisation indicates that, while the iServe game required relatively little time to get a prototype up and running, the current version is not particularly complex. To use the terminology proposed by Kriz and Hense (2006), the game suffers from "under-challenge". More work would be required, particularly on the underlying simulation model, to produce a business game which is adequately challenging for the target audience of manufacturing managers.

4. EVALUATION

The target audience of the game is managers in the manufacturing sector. Despite evidence to the contrary (ISFE, 2010), the perception persists that gaming is confined to younger age groups. Managers in manufacturing are typically older. Therefore, they might be argued to be an audience who would have relatively little gaming experience and who would be hard to reach via games. The usability of the iServe prototype game was therefore evaluated with respect to age and gaming experience. A further factor of interest was whether the level of knowledge about the servitization topic would impact learning outcomes.

A game test was carried out at the Spring Servitization Conference 2014 (SSC2014) (http://www.aston.ac.uk/aston-business-school/research/events/ssc2015/, accessed 3 March 2015). Participants were drawn from all attendees, who included both industry and academic attendees with a wide range of expertize in servitization, from professors of Product Service Systems and industry experts to MBA students and conference organizers. The cohort was dominated by participants who gave high ratings to their servitization expertise (34 score 3 or above, 11 score below 3), and most had relatively little game playing expertise (32 score below 3, 13 score 3 or 4, none score 5) (Figure 2).

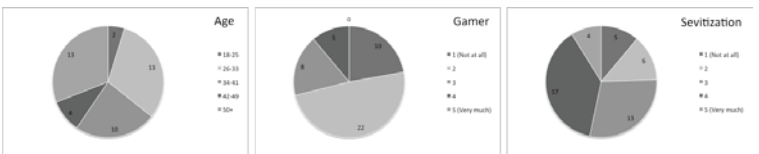

Figure 2: Participants' ages, gaming experience and servitization expertise.

Many of the participants were not regular gamers (32 of 45 players (71%) responded 1 or 2 to the question *"to what extent do you normally play computer games"* on a scale of 1 (Not at all) to 5 (Very much). This was an appropriate sample, since the target audience is manufacturing managers. If we assume the stereotypical manufacturing manager is an older male, then ISFE reports that 40% of 45-54 year olds and only 28% of 55-64 year olds will be gamers (ISFE, 2010).

Each participant was introduced to the game using a participant information sheet, and a researcher explained controls if the user requested it. The participant played the game to the end, when they received structured feedback on their performance. Game usability was measured by a self-report questionnaire with seven parts based on the past experience, overall user reactions, easy of use, playability, learning curve, comments and finally suggestions for alternative scenarios. The survey

combines 20 Likert scale questions (e.g. *"To what extent are you expert in servitization?"*) and 3 open ended questions (e.g. *"What do you think the game was trying to teach?"*).

4.1 Results

Table 2 presents the mean responses of the whole cohort to the key usability questions. Overall reactions were mid range with the exceptions of difficult-easy and rigid-flexible, implying the users found the game fairly easy but somewhat rigid. The latter is probably to be expected given the limited dialogue developed for the prototype. The mean responses for learning to play the game were above mid range, which is encouraging, given the limited numbers of gamers in the group.

Question	mean(s)
Overall reactions	
terrible-wonderful	5.2(1.8)
frustrating-satisfying	5.2(2.0)
dull-stimulating	5.4(2.1)
difficult-easy	6.2(1.8)
rigid-flexible	4.6(2.0)
Learning to play the game	
learning to operate the interface	5.8(2.4)
time to learn to use the interface	6.4(2.3)

Table 2: Mean responses over all participants

The High-D parallel coordinates tool (www.high-d.com/, accessed on 3 March 2015) was used for initial visual exploration of the data in this study. Visual analytics is used to explore data and rapidly identify trends and patterns (or their absence). Parallel coordinates (Inselberg, 2009) are a visualization approach in which multiple variables are represented by vertical axes with a polycurve (or polyline) representing the variable of interest (the axis for which is drawn on the far left). The power of the method comes from the analyst's ability to rapidly and intuitively compare large numbers of variables. Figures 3 & 4 present parallel coordinates visualizations comparing results for usability related questions. Unpaired t-test were conducted to support the visual analytics results.

4.1.1 Participant Age and Usability

Because manufacturing managers are typically older, the target age groups for the game were 42-49 and 50+. Preconceptions about video game users might suggest that older participants would have a more negative reaction to the game than younger ones. To explore this possibility, parallel coordinate analysis (Figure 3) for was conducted to explore possible relationships between the age of participants and their reactions to the game. The left hand axis shows Age Group. The remaining axes are from left to right: *terrible-wonderful, frustrating-satisfying, dull-stimulating* and *rigid-flexible* (all Likert scale (bad) 1-9 (good)). Each participant's responses are represented as a polycurve. The left hand plot shows, as polycurves coloured darker blue, the responses of participants from the target age group, 42-49 and 50+, with other age groups greyed out. The right hand plot highlights in brighter blue the age groups of more 'typical' gamers aged 18-25 and 26-33. Analysis of Figure 3 shows no indication that older participants had more negative reactions than younger ones.

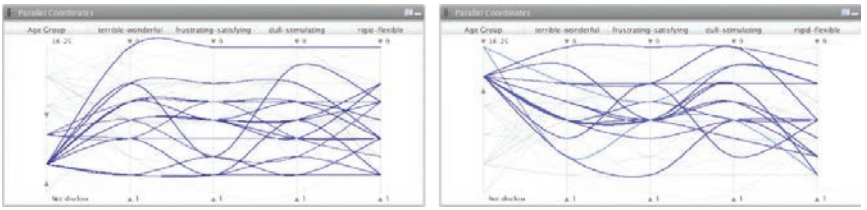

Figure 3: Left, responses of participants aged 42-50+. Right, responses of participants aged 18-33.

Following the visual exploration of the data, unpaired t tests were conducted to test the null hypothesis that there was no difference in the mean scores of younger (18-33) and older participants (34-50+) for the questions on overall user reactions, easy of use, playability and learning curve. No significant (5%) difference was found between the two groups on any of the questions.

The mean level of gaming experience declared by participants aged 18-33 was 2.4, based on answers to the question *"to what extent do you normally play computer games"* ((Not at All) 1 to 5 (Very much)). Participants aged 34-50+ declared average mean gaming experience of 2.0. An unpaired t-test was conducted to test the null hypothesis that there was no difference in the levels of gaming experience for the two groups and no significant difference was found at the 5% level. This is inline with evidence that gamers are not only found among the young (ISFE, 2010).

4.1.2 Gaming Experience and Usability

Figure 4 is a parallel coordinates plot of key usability responses visualized with respect to Gaming experience on the left hand axis. The remaining axes from left to right represent the *"Learning to operate the interface"* ((difficult) 1-9 (easy), *"Time to learn the Interface"* ((too long) 1-9 (very short)) and the overall reaction ((difficult) 1-9 (easy)). Each participant's responses are again represented as a polycurve. The polycurves are coloured with the most experienced gamers in the darkest blue. Note left and right hand plots show the same parallel coordinates plot but in the left hand plot the subset of participants (polycurves) who found the game easy to play (>5) is greyed out and in the right hand plot the subset who found the game hard to play (<5) is greyed out.

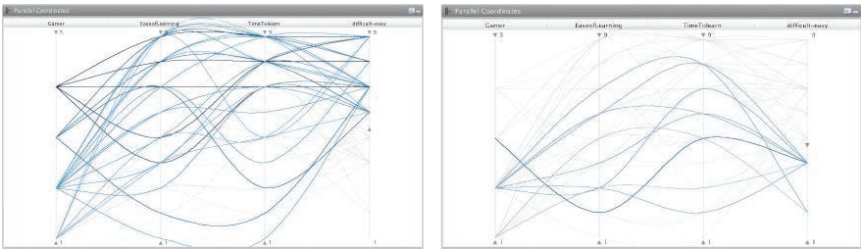

Figure 4: Left, responses of participants who reported finding the game easy to play. Right, responses of participants who found the game hard to play.

The visual analysis indicates that that the response to the game is not related to gaming experience for this group. Some players who rated their gaming experience as 2 or 1 found it easy. However, others, who found the game easy, rated the system below 4.5 for Ease of Learning and 4 rated it below 4.5 for Time to learn. Players who found the game difficult typically had little gaming experience, but not all rated the game as hard to learn.

Unpaired t-tests were conducted with the null hypothesis that there was no difference in the mean scores of experienced gamers (score 3-5) and inexperienced gamers (score 1-2) for the questions on overall user reactions, easy of use, playability and learning curve. No significant (5%) difference was found between the experienced and inexperienced gamers on any of the questions.

4.1.3 Servitization Expertise and Learning Outcomes

Finally, we assessed whether servitization expertise would impact on the learning outcomes for the game. The game test was conducted at SSC2014, and therefore a large portion of the cohort were servitization experts. Table 3 reports the mean values for responses to the two learning related questions. Participants who responded 1 or 2 to the question *"to what extent are you expert in servitization (1 (not at all) 5 (very much))"*, denoted as novices, gave higher scores to the learning outcomes than did participants who responded 3-5, denoted as experts. Both groups also gave higher responses to the question *"do you think a novice would learn about servitization from the game?"* than to *"did you learn about servitization from the game?"*.

Question	mean(s)	
	Experts (score 3-5)	**Novices (score 1-2)**
Did you learn about servitization from the game?	2.3(1.1)	2.8(1.1)
If you have some expertise in servitization, do you think a novice would learn about servitization from the game?	2.6(1.1)	3.4(0.9)

Table 3: Mean responses for learning outcomes

Unpaired t tests were conducted with the null hypothesis that there was no significant difference between the scores for the novices and experts. While there was no significant difference at the 5% level between the groups for the question, *"did you learn about servitization"*, there was for the second, *"do you think a novice would learn about servitization"* (P 0.049). This indicates that the novice players were more positive about the game than experts.

5. CONCLUSIONS

In their discussion of theory oriented evaluation of business games, Kriz and Hense (2006) draw a distinction between 'design in the small' and 'design in the large'. Design in the small concerns the evaluation of how well an individual game models reality or delivers appropriate learning outcomes. In this respect the iServe prototype shows promise for educating novices in servitization concepts, with more positive responses on learning outcomes given by the less expert participants. Design in the large, on the other hand, concerns the use of games to *'change existing dysfunctional situations'*. The low uptake of servitization in some sectors arguably presents such a dysfunctional situation. For serious games to make an impact in this area they need to be able to address the target audience of manufacturing managers, who are typically older, and may lack gaming experience. The evaluation results presented here suggest that virtual world environments of the sort provided by the Unity gaming engine may be acceptable to both older participants and those with little gaming experience. This is counter to preconceptions that games are only suitable for younger learners and opens the approach to the target audience of manufacturing managers.

Our prototyping experiment with Unity has demonstrated that playable business game prototypes can be developed in viable time frames using game engine technology. However, user responses were typically mid-range and categorization using Greco et al.'s taxonomy (2013), indicated the resulting game was not particularly sophisticated when characterized in terms of typical features of business simulation games. More work is needed to make a really useful and interesting game; the user centered design approach taken to develop the prototype naturally lends itself to cyclical

improvement and the evaluation results reported here will be used to develop further versions of the game.

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WILL ACCOUNTING INFORMATION BE RELEVANT IN THE SERVITIZATION PROCESS?

Andrea Tenucci & Lino Cinquini

ABSTRACT

Purpose: The paper aims at exploring and understanding the role of accounting systems in companies involved in the servitization process. Accounting is expected to provide information about costs and revenues of services actually or potentially provided by the company.

Design/methodology/approach: The research is based on two explorative case studies on Italian companies. Both companies are in the machinery manufacturing sector and are offering services jointly with the products. One is a large company (an electricity generation equipment manufacturer) and one is a medium size company (producer of solution for the nonwovens fabrics).

Findings: Our findings reveal that accounting is actually able to provide much more information on products than on services, but accounting information plays an important role in pricing product-related services. The two case studies show different level of development in practicing the construction of accounting information to support servitized environments and still a traditional approach to accounting measuring. Thus, understanding the economic and managerial performance associated with a strategy of servitization should require innovative management accounting tools and approaches able to support decision making process on services.

Originality/value: The paper investigates on the profitability of product-related services and which is the role of accounting in supporting these analyses. The cases showed in this paper highlight how servitization in manufacturing further emphasizes the insufficiency of the pure observation of costs for producing adequate management accounting information of product-related services.

Key words: accounting, servitization, pricing, costing

1. INTRODUCTION

Management Accounting (MA) is recognized as the discipline dealing with the provision of relevant accounting information for business decision making and organizational control (Horngren et al., 2001; Drury, 2012). Its research and principles largely refer to the paradigm of manufacturing. Notwithstanding progress in Services, they are generally considered as "special products" in costing, performance, decision-making and control, and service organizations has been underestimated as relevance and generally treated as special case of manufacturing industries. Further, the implications for MA of recent developments in issues related to servitization have not been explored in deep yet.

The paper aims at exploring and understanding the role of accounting systems in companies involved in the servitization process. Accounting is expected to provide information about costs and revenues of services actually or potentially provided by the company.

2. LITERATURE REVIEW

Focussing on the literature at the interface of management accounting and service in the 1990s, only few articles address the implications of service characteristics for accounting (Modell, 1996; Brignall, 1997). After, the service and servitization literature has significantly developed, but the role of accounting in this context is neither clearly revisited, nor sufficiently addressed. The few attempts to elaborate management accounting in servitization have been published in operations or marketing journals, so far with limited scientific or practical implications (see e.g., Grönroos and Helle, 2010; Laine et al., 2012). In all, the research attempt underlying this plan is expected to have wider impact as a basis for further considerations in this emerging stream of research.

Laine et al. (2012) providing a theoretical paper on the role of management accounting in servitization suggested that such role might be classify into justifying, defining and controlling the servitization. Moreover, it was argued that accounting could support servitization at three levels, which are the company level, the product/relationship level and the process level. The management accounting

information could serve in different roles at those levels, ranging from an answer machine to a source for inspiration (see Burchell et al. 1980, as used in Laine et al. 2012).

In the service literature, only a few papers discuss the overall potential for service business in different manufacturing and industrial service settings. This stream seems to follow the path initiated by Wise and Baumgartner (1999), which addressed the downstream business potential as a 'new profit imperative' for manufacturing. They discussed the different circumstances, under which different downstream potentials would exist and thus different servitization strategies should be followed respectively. In this vein, Hu and McLoughlin (2012) build their multiple case study report on the strategic management literature and propose a holistic framework for the companies seeking for new markets to their industrial services. They conclude that at least cooperation with the customers, different forms of innovations and support from the institutional forces, such as legislation support the companies in creating new markets for their services. However, instead of dealing with the roles of accounting and control in such a process of market creation, Hu and McLoughlin (2012) just discuss the 'control' of the companies over the new markets. However, the lesson learned from Hu and McLoughlin (2012) from the viewpoint of this paper is the fact that the companies should be aware of the business potentials under different circumstances in their customers' businesses. Accounting and control could help in creating such awareness.

Research in servitization has somehow suggested the point. Oliva and Kallenberg (2003), in discussing the major challenges a manufacturing company has to face to become service-oriented, pointed out the importance to create units of service provision with dedicated resources (sales force, service technicians) and an information system to monitor the business operations and to achieve accounting transparency for the new business. With this information system it becomes possible to highlight how important services are for the overall profitability of the firm. Possibly this service organization has to be run as a profit center (or a separate business unit) with profit-and-loss responsibility:" (…)Our interpretation is that the new organization effectively protects the emerging service culture – with its metrics, control systems and incentives – from the values and incentives predominant in the manufacturing organization."(p.167). In this respect, the importance of tailoring MA for servitization is considered also for the support it may provide to cultural change toward service in a manufacturing environment.

Recently, Lerch and Gotsh (2014) have addressed the importance to fill an "overhead cost trap" meaning that usually the manufacturer provides the services free of charge to the customer but includes the costs related to service in the product price. This way, the service benefit and service value are not obvious. As a consequence, the actual importance of service and the associated value of industrial services are systematically underestimated, and this leads to overpriced products and inferior service delivery, which diminishes the competitiveness of the product and leads to under develop service business.

Altogether, it may be argued that the analysed literature primarily examines the justification or definition of the servitization initiatives, without yet actually discussing the controls or the purposes of use given to accounting information in later phases of servitization. For the purpose of this research, there is the need to shed some more light on the utility of managerial accounting in servitization deepening the role it assumes into organizations.

3. METHODOLOGY

In order to address the aims of the research, an interpretive perspective has been applied. The qualitative research presented here is based on interviews and the further use of secondary sources. The project is exploratory in nature, so semi-structured type interviews has been selected in the data collection during the case study execution. A series of interviews with managers have been conducted in two servitizing companies. The interviews were digitally recorded and transcribed. The investigation has further benefited of the analysis of documents, reports and other company information publicly available or directly provided by the interviewed in order to triangulate primary evidence with secondary sources .

Two companies have been selected. Both are Italian companies belonging to the Machinery manufacturing sector and competing in the global business. To maintain the anonymity the two companies will be called Company A and Company B.

Five interviews have been conducted; two for company A and three for company B. The interviewed were the Financial Officer and the Customer Service Manager in company A; the Business controller, the

Long Term Service Agreement (LTSA) commercial Department Manager and the Risk Management Analyst in Company B.

4. FINDINGS FROM THE CASES

The findings of each case will be separately presented in the following subparagraphs.

4.1 Case study - Company A

The company is a world-leading producer of complete downstream solutions specialized in winding, packaging lines, palletizing and reel handling. The product range includes automatic positioning systems for cutting units and cardboard cores, unwinders and multifunctional lines with printing systems and the technology for airlaid production. The technology is used for processing nonwovens fabrics with a special focus on hygiene and medical products (spunbond, SMS and spunlace). It reaches a level of revenues of 42 Million euro (2012) employing about 100 people. It is considered the market leader having about 80-90% of the market share.

The company offers a wide range of services included in the "customer care" department: Assistance for Spare parts, Maintenance plans (planned and ordinary), Winding School, Online Service (Mysp@re), Baby Sitting, Upgrading Offer Service and Financial Services. About 20% (8 Ml€) of Total revenues is coming from Services. Such amount increased four times in the last five years and a company desire is to further extend such percentage in the near future.

Until seven years ago the company had an R&D department employing five people but the experience revealed that the coming projects were technically wonderful but far from the daily applicability and from the real problems of the customers. Then it was decided to reduce the department, the "Technical office department" absorbed the people working there. R&D is somehow considered to be within the "Customer care services". Nowadays the company develops new (or improved) solutions only according to customer needs. Once a solution is successfully implemented to answer a specific customer need, it is then offered and replicated to the other customers. R&D function is strictly related to the satisfaction of "new" customer needs. In the "Customer care services" department three employees (one electrical and two mechanical engineers) take care of service development. Service R&D is furthermore developed considering the customer of their customers in order to understand the quality requirements needed.

Accounting and control have two completely different ways of working in the products (capital equipment) and services. Regarding the former, the company has a tight control every quarter supported by the use of budgets and Cash flow management tools. According to the wide knowledge on the products, it is enough easy for the company to monitor the completion of the orders (on average 5 every year). On the service side the situation is extremely different. Due to the wide variety and number of services offered every year (on average 2,500), the company has a very loose control. The check of budget is on yearly base where the "actual" value is frequently divergent from the "budgeted" one. The forecast activity on services is much more difficult to the one of products.

Differences in accounting and control are also mirrored in the different ways the company set prices for products and services. The full cost of products is effectively defined. Then a certain mark-up is applied on it; salespeople are well aware of the minimum level of margin they have to respect to set prices. On the services side the method is different. The company has some idea of the service costs (mostly direct costs), but it is left to the ability of salespeople to apply the highest possible price according to the specific customer. There is a financial support for salespeople to calculate the amount of service costs to cover and the minimum level of mark-up to apply, but then it is a matter of the salesman. So the same service can have a very different price depending on the customer. For this reason the profit margin of services is triple respect to products.

" […] *if you consider that our the break-even point is about at 19 Ml €, and in case we reach the goal of increasing the revenues coming from services from 8 to 12,5 Ml €, given the service margin, we are able to reduce the break-even point […] this would mean that in March we could reach our break-even point*." (Financial Officer – Company A)

The company is well aware of the potential of services for increasing revenues and increasing profitability and it is confirmed by the following words:

"*Our company, with seventy years of story, has installed more than 500 machines. This means having an incredible potential consumer base for services […] if we will really improve our organization we could reach up to 50% of revenues from services […] and this is feasible in the future…*" (Financial Officer – Company A)

4.2 Case study - Company B

The company provides plant engineering for turnkey power plants, including process, mechanical, civil, installation and start-up engineering, helping customers define the features of new power plants. From manufacturing perspective the company is split into three product lines: gas turbines, steam turbines and generators.

It reaches a level of revenues of 1,117 Million euro (2012) employing 2,913 people.
The company is furthermore leading provider of services for all types of electric power plant, offering assistance at all levels of complexity for its own and third party machinery. It handles all after sales issues with a broad range of global services, ranging from repairs and spare parts, to on-site work including overhauls and upgrades, right through to fullservice or Original Equipment Manufacturer (OEM) Long Term Service Agreements (LTSA). About 28% of revenues is coming from services.

To the aim of this paper, the analysis of costing and pricing methods within the company for servitisation is presented. In particular, methods applied to LTSA are analysed.
LTSA consists in long-term contracts, which provide performance-based maintenance at a lump-sum price, including any type of maintenance necessary to maximize production and efficiency of the customer's machinery, to keep technology updated, and to share risk between OEM and the customer.

In the year 2007, the company made a big step forward regarding the offer of LTSA: not only, it offered LTSA to its equipment customers as an OEM, but thanks to the launch of the Original Service Provider (OSP) trademark, it extended its access to the industrial maintenance market: OSP combines both OEM and independent service provider (ISP) activities, in order to offer LTSA and other services also to operators of third-party OEM equipment . This step has been mainly achieved by the acquisition of two companies specialized in the turbine system production (one of the two is specialised in equipment of the competitor General Electric).

Also for the company, service offers have become an increasingly important source of revenues.
Already in the year 2006, one year in advance of serving also third-party equipment, LTSA were of importance: only counting for 1.6% of all service orders, the LTSA sales contributed to 58% of revenues generated from maintenance services (Table 1).

In order to stress the financial importance of LTSA and services for the company, a financial analysis of the period from 2007, the foundation year of the company OSP trademark, until 2013 was carried out. It covers the following ratios (Table 2):

- Revenues from LTSA over overall services revenues
- Revenues of services over total revenues
- Gross profit (GP) of LTSA over GP of overall services
- GP of overall services over GP of total revenues

Service Type	No. of orders	Total Orders Value (€)
Field Service	235	38,338,000
LTSA	10	251,143,000
Repairs	47	10,982,000
Solutions & Upgrades	15	21,201,000
Spare parts	278	59,086,000

Spare parts (other)	34	52,190,000
TOTAL	619	432,939,000

Table 1: Nr and Revenues from Maintenance services (company B)

Ratio	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
LTSA-Revenues/ Service-Revenues	27%	30%	28%	38%	51%	38%	31%
Service-Revenues/ Total Revenues	25%	25%	27%	29%	24%	28%	28%
GP-LTSA/ GP-services	23%	37%	27%	46%	62%	45%	25%
GP-services/ Total GP	33%	31%	39%	42%	42%	49%	48%

Table 2: LTSA relevance (company B)

Whereas proportional service revenues remained rather constant throughout the period analysed, there is a strong increase in LTSA-related revenues starting from 27% of service revenues in 2007, to 51% in 2011. Somehow then, in 2012, there is a drastic decline in LTSA revenues to 38%. Whereas it is not clearly stated in the annual report of 2012, what might have caused this drop in LTSA sales, the lost sales got compensated by increases in the solution and field services segments. Again, total service sales remained constant in comparison to previous years.

Looking at gross profits, LTSA sales contribute significantly to the gross profits of services, with up to 62% in the year 2011. In the financial year 2011 there was also a peak with regard to the gross profit margin of LTSA generated income, which was 40%. Not only LTSA, but services in general provide a strong source of gross profits with regard to overall gross profit: up to 49% in 2012, and 48% in 2013. Clearly, from a financial and economic viewpoint, company B can be equally considered a service provider, than just a power equipment OEM.

The LTSA payment scheme consists of the following single fees:

- Mobilisation fee: This first fee has to be paid within the preliminary acceptance certificate (PAC) and contains also the initial stock. The PAC is a provisional acceptance of delivery. Stated guarantees in the LTSA contract only apply starting from the final acceptance certificate (FAC).
- Annual fixed fee: The client has to pay an annual fixed fee which basically depends on the fixed costs occurred under the LTSA.
- Variable fee: This variable fee depends on the number of operating hours of the underlying gas turbine(s) of the LTSA and has to be paid from the first firing of a turbine.

Costing assumes a major role in LTSA pricing. In order to prepare a commercial quote of an LTSA, it requires a series of inputs coming from the Engineering Service Department (Maintenance plan and the General technical specifications of the LTSA and eventual particular machine interventions), from the Service Operations Maintenance Department (in particular the quote of the planned maintenance activities, based on the specific quotes from Field Service, the general technical specifications of the LTSA and eventual particular machine interventions and the quote of spare parts necessary for any scheduled and unscheduled maintenance), from Service & Operation Engineering Department (quote of additional activities such as diagnostics, performance test, ect.) and from Quality & Safety Department (quote of activities for quality & safety in-house and on-site).

To arrive at the cost basis for the quote of the LTSA, first, the prime cost is calculated. This includes all scheduled maintenance activities (calculated using a predetermined cost rate per direct labour-hour), spare parts according to activities performed and to guarantees, and complementary services. Starting from the prime cost, the price is built by adding complementary costs, contingencies and the margin. The complementary costs contain insurances for legacy issues, financial guarantees, contractual taxes and duties for intermediaries and ratification. Contingencies account for the consideration of risk related to the project. This can be considered an important connecting point between risk management & costing in a servitized manufacturing environment. The process of risk management includes several phases with

the objective to reduce the impacts of risk to the project performance by controlling and managing the causes of risk. Specifically, the steps are risk identification, risk evaluation, risk mitigation, contingency allocation, and risk reporting and review. Risk assessment aims at the evaluation of the actual risk remaining after any mitigation action. It provides a quantification of the impact of risk by the multiplication of potential damage by probability of occurrence (Figure 1). If necessary, contingencies become allocated to the total cost of the LTSA.

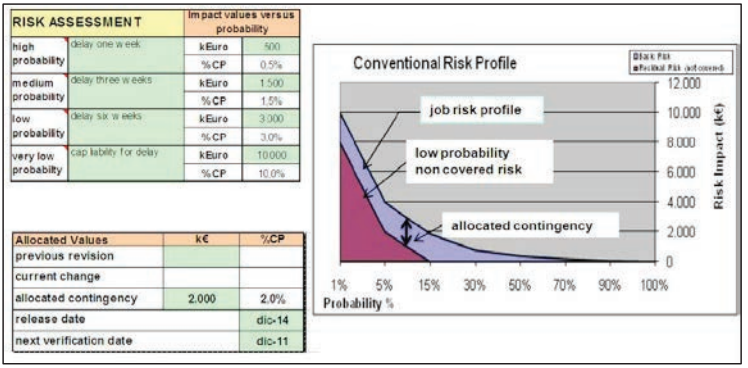

Figure 1: Risk assessment for LTSA

The sum of all prime, complementary costs and contingencies are then multiplied by a coefficient (a mark-up), to arrive at a total price proposal of the LTSA and thus the target revenues. Thus, company B applies a conventional cost-plus pricing method using a mark-up by which the cost gets multiplied.

Considering the long-term of contracts, a financial evaluation of LTSA is also needed to explicitly consider the time profile of a contract. To evaluate the financial performance of an LTSA project, a cash flow analysis is carried out. Any cash out- and inflow of the project is considered with respect to the year of the contract term, in which it occurs. Then, all cash flows get discounted to the present value, by application of the WACC as an appropriate discount factor. The Board of Directors adjusts the WACC annually in order to adjust it for increases or decreases of cost of debt and of capital.

By use of the ValCom software, the economic value added (EVA) of an LTSA quote is calculated in order to determine the value added of a project. EVA considers the fact that revenues need to cover both operating and capital costs of a business, plus tax expenses. It therefore provides the amount of income generated for investors and long-term creditors (Balakrishnan et al., 2009, Bamber et al., 2008). Hence, the EVA, as a key performance indicator (KPI), goes a step further compared to classic KPI like return on investment (ROI) or return on equity (ROE), which do not consider cost of capital or tax expenditures.

An improvement for pricing of LTSAs can be the introduction of value-based pricing and the consideration of value co-creation between supplier and customer. This way, Company B can overcome the dilemma caused by the combination of productivity increases and cost-plus pricing and is able to consider both supplier and customer productivity gains/losses in pricing decisions.

5. CONCLUSIONS

The two case studies briefly described in this paper show how accounting information is relevant if considering the pricing issues of product-related service assuming an increasing importance in manufacturing. The paper contributes to the literature by providing evidence of the relevance of accounting information to support decision making in servitization and addressing the potential for research and practice in this area, whereas only few contributes have recently focussed this issue particularly (Laine et al. 2012; Lerch and Gotsch 2014). The importance to develop an appropriate accounting approach to monitor service and achieve accounting transparency to the servitization of the

business is also confirmed as one of the major challenges a manufacturing company has to face to become service-oriented (Oliva and Kallenberg 2003).

We revealed in our case studies a lower amount on information related to services than those related to products. This is due to the greater experience on products as a traditional output of manufacturing companies and the difficulty, or impossibility, to reuse such experience on services. Furthermore, forecasting and stabilising service demand is extremely difficult for companies. But this should not be an alibi not to concentrate the effort for a development of service information. In this sense, we believe that accounting could have a crucial role in the process of service development. It currently provides some economic facts but it should further evolve and provide more reliable information on customers as well as on services and products in different life cycle stages.

In Company A the introduction of MA tools focussed on the servitized side of the business is still to come. There is the awareness of the topical nature of this issue, but lack of competence and internal resources to face it. Here Management accounting can be labelled as in "backward position" if considering the rate of the servitization process of the company. With respect to the pricing issue of services, a major role is played by salesmen sensitivity more than by consciousness of cost information. The accounting system has to evolve a lot in this sense and it would become easier when the company will be able to more accurately forecast the level of services demanded.

The case study on Company B provides some worthwhile insights from business practice of a large company on this topic. With a traditional costing system in place for cost allocation, Company B does not use a costing system specifically adapted to service costing. Rather, indirect costs get allocated on a traditional direct labour-hour basis only. The financial information required according with the servitized part of the business push company B toward an integration of different tools: particularly, the long-term orientation of service provision implies a risk analysis to be considered in a way to adjust the pricing definition, and a financial analysis that clearly introduce the time dimension in the evaluation of returns from the contracts.

In this respect, the Company B experience shows an approach that seeks to integrate a rather traditional costing system with other more advanced approaches, thus showing the awareness of the limitations of traditional MA approaches in servitization and the tension toward a more effective analysis. Management accounting in this setting is – in a sense - "stuck in the middle".

Company B tried to face the need to stabilise service revenues with the offer of long term relationships (LTSA), then it was able to use and integrate previously existing accounting systems.

In both the case studies we found some of the limitations and challenges that MA faces when approaching product-related service (Lerch and Gotsch 2014). We refer primarily to cost accounting challenge in allocating the cost of the departments involved in providing service, so to overcome the use of traditional cost allocation bases that do not correctly allocate costs to service long term contracts. Recent developments in cost management could be appropriately used to overcome this gap. To make an example, the introduction of (time-driven) activity-based costing not only could allocate indirect costs more accurately - being time the fundamental cost driver in service provision - but could also provide a tool for resource planning and process improvement by activity-based management (Kaplan and Anderson 2007).

Both Company A and B adopt a cost-plus approach in pricing services. Both stem from the prime cost configuration (even if in Company A it appears to be less structured), but Company B, due to its more advanced accounting system, further includes other different cost components.

Furthermore, the fact that in Company B prices are calculated by use of a conventional cost-plus method gives rise to the pitfall of negative performance impacts of efficiency improvements. If a firm uses a cost-plus pricing method and prices its services on the cost based on the number of direct labour hours, an increase in efficiency - i.e. a reduction in the number of labour-hours needed to perform a particular service - causes a decrease in revenues. "*Consequently, [...] productivity improvements are making pricing*

that is based on labo[u]r-hours obsolete" (Sturts and Griffis 2005, p. 56). Hence, the introduction of a value-based pricing model is recommended. This creates new challenges for both the supplier and the customer regarding the disclosure of sensitive data and internal, financial information (the concept of Open Book Accounting is recalled here, Kajuter and Kulmala 2005). Complementary challenges are also related to the monitoring of service benefit by qualitative measures (customer satisfaction and loyalty). In this respect, the cases showed in this paper address also how servitization in manufacturing further emphasizes the insufficiency of the pure observation of costs for producing an adequate management accounting information of product related services; rather, the service quality and service productivity (Gronroos and Ojasalo 2004) have to be carefully considered and integrated to make MA an effective system, far from abandoning MA information in decision making in these contexts.

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Case studies and empirical data

SERVITIZATION IN RAIL SERVICE PROJECTS: A SUPPLIER PERSPECTIVE

Uwe Kenntner, David K. Harrison, Babakalli Alkali, Bruce M. Wood

ABSTRACT
The implementation of the function project management is necessary to turn and manage the new demands to the rail service supplier business in a successful and professional way. Project management releases the company organisation and offers this company organisation and the customer opportunities to achieve success. To achieve these successes some topics need to get special attention in the projects. These topics, for example "take special care for the out of course parts (ooc-parts)" or "use Key Performance Indicators (KPIs)", and the resulting successes or wins are highlighted in this paper. Due to the wins, the implementation of the function project management represents itself a kind of "servitization". The contents of the available various project management literature are similar due to the literature relies to the same or similar standards worldwide. However there are differences in the quality of the content. Service projects are often as complex as projects in the new business (original equipment) and need the same management efforts and in consequence the corresponding education and trainings are required for the service project managers. For important new business projects the service project managers have to be involved to the new business projects to prepare the service projects in time. To enable the project managers to lead more and different projects in parallel and to be always aware about the current status of the projects, the right IT-tools should be provided by the organisations.

Key Words: Servitization, project management, service, rail, supplier.

1. INTRODUCTION, RESEARCH QUESTION AND METHODOLOGY

Service by manufacturers or suppliers for rail products was often understood in the past to be concerned with changing worn parts, replenishing lubrication or cooling fluids and to repair damages. Due to the idea of servitization, the globalisation and the high requirements of the international customers, the scope of different service products and the complexity in the rail industry increased very much, see figure 1. The management of these services was in former times usually done by the line organisation alongside, for example the sales, the design or the order management department. However more and more undertakings need to be handled as a project and therefore by a professional function of project management (Jakoby 2013, page VI). Therefore the function project management plays in a service-led competitive strategy an important role on the way to strengthen the relationship with the customer, to exclude competitors and to increase sales and profit (Baines, 2013). So within the last few years the meaning of project management in the rail service industry has significantly increased in importance. The author investigates in this paper the following two research questions: 1. Which topics need special attention in service projects in the rail supplier industry? 2. What are the resulting wins for the customers and suppliers itself? The available project management literature is answering the research questions only in general but not in the details and the practical applications which are necessary to make projects successful especially in the rail service supplier industry. Hence the aim of this paper is not to repeat only the already existing project management literature and standards. The methodology for the research questions are observations in the rail supplier industry for a period of more than ten years. The authenticity of the listed results is validated by the feedback of customers, management and project team members, by two successful performed reference projects in the UK (overhaul) and in Ireland (retrofit) and by literature review. Some information can´t be offered due to the author has to meet the company secret guidelines of all parties.

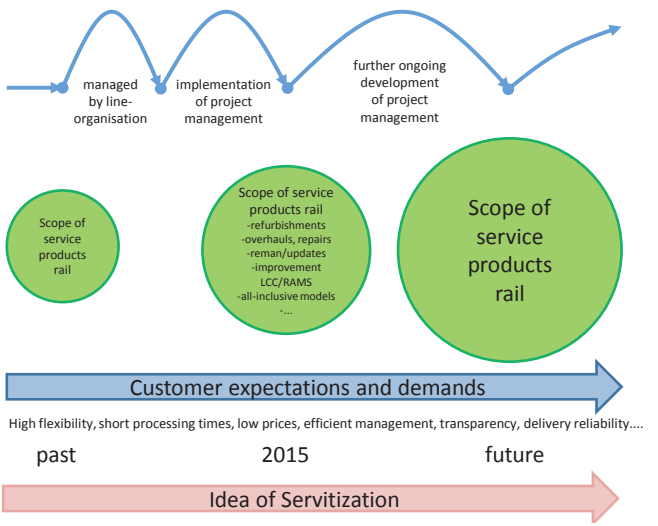

Figure 1: Development scope of service products rail and implementation of the function project management (own illustration, some ideas from Baines, 2013).

2. LITERATURE REVIEW

Relevant project management standards and methods are defined in the DIN 69901, ISO 21500, PRINCE2 (Projects in Controlled Environments), PMBOK Guide (Guide to the Project Management Body of Knowledge) and ICB (International Project Management Association Competence Baseline) (GPM 2015; Jakoby 2013, page 28-29). The reviewed literature in this paper refers to the DIN 69901 and ISO 21500 and deviates templates for the daily project work. Each of the three sources cover almost the same topics but with a different emphasis (Felkai/Biederwieden 2013; Hab/Wagner 2013; Jakoby 2013). In section 3 are comparisons presented between the results of the observation and the literature review.

3. CHALLENGES, TASKS AND TOPICS IN SERVICE PROJECTS AND WIN-WIN-EFFECTS

3.1 Act globally with global teams and global processes including the role of the customer

A new business is selling their products world-wide which means as well to be prepared for a world-wide service business and activities. Due to the necessity of short reaction times and to have the chance to communicate with the customer on-site, the number of project team members and the length of the process chain increased and as a consequence the complexity. In some companies the overall service project manager in the region reports directly to the customer and leads a project team including the service project manager of the business unit (BU). The service project manager in the BU leads and triggers the project team of the world-wide settled BU, see figure 2.

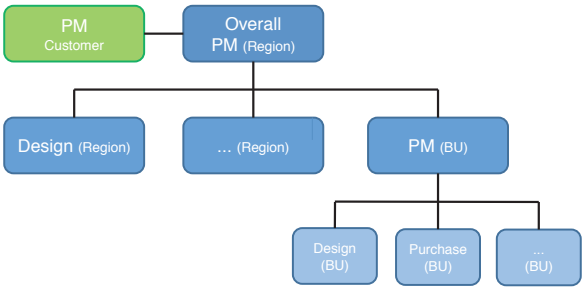

Figure 2: Possible project organisation (own illustration).

The task of the service project managers is to ensure a consistently, open, quick and efficient communication and documentation and to respect and to adjust to the cultural differences. *Win for customer* – one face to the manufacturer or supplier, short reaction-times, same culture and language. *Win for manufacturer/supplier* – clear defined tasks and structures, everybody is aware of what to do. *Comparison with literature:* Each of the three sources confirms the general structure of a matrix organisation and Hab/Wagner even includes the customer and the supplier. The two-stage logic of an organisation is not listed (Felkai/Biederwieden 2013, page 11-17 and 97-101; Hab/Wagner 2013, page 36-40; Jakoby 2013, page 92-101).

3.2 Design your projects transparently

A complete transparency is the basic requirement for successful projects. However, service contracts have meanwhile a lot of pages and contents about supply chain items, financial issues, provided components, required tests and documentation, liquidated damages etc.. Most of the contents have to be understood and transferred immediately to the internal and external interfaces. As well, it is important to have the same understanding between the different parties about the real scope of supply and the delivery conditions. This sounds obvious, but is not always completely clear in all projects. In case of a very challenging time schedule scenario with a large scope of supply with different delivery batches and not matching Enterprise-Resource-Planning-Systems (ERP-Systems) sometimes it could get difficult to keep the overview. *The task of the service project manager is* to demand a detailed take-over-report before operational control is taken over from the sales function and as well from other departments, for example the commercial colleague has to be asked to summarize the most important points of the contract in a few pages. Always when complete transparency is not present in the project, no matter what the process or activity is, the necessary transparency has to be designed by the project manager and the project team as quickly as possible before further steps are undertaken. This way there could be a simple logical analysis, overview or sequencing on a sheet of paper or the design of a simple tool in any program. *Win for customer and win for manufacturer/supplier* – status is always available, problems or open points are visible and therefore decisions or changes of direction can be made in time. *Comparison with literature:* Hab/Wagner demand a project take-over including a detailed documentation/checklist and Jakoby describes a project order protocol The high number of listed templates underlines the need for transparency and deviations from the project plan/targets have to be recognized in time and followed by matching measures (Hab/Wagner 2013, page 70-71; Jakoby 2013, page 75-81 and 249).

3.3 Save and offer enough flexibility

At the beginning of a project exists, of course always, a clear plan by the operator about when the service performances, as for example the delivery of parts or the performance of overhauls or retrofits, have to take place. This requires along the supply chain of "customer - system supplier -

supplier" that the operators get in the trains at the right time, the staff from all parties is available and all the suppliers keep their agreements. Since this is a very challenging task, sometimes the one or the other party can´t keep their given agreements. One example: The original plan was to overhaul 8 units per week. The trains arrive in time but the system supplier fails to keep the agreed time schedule due to quality problems. Importantly the overhaul program has to be finished within the originally defined time frame otherwise some trains would lose their license. After 3 months with a frequency of only 4 per week instead of the originally planned 8 the frequency for the remaining time frame has to be 12 per week. *The task of the service project manager is* to manage and enable the needed flexibility together with the line organisation and to keep the loss for all the other parties at a minimum. To ensure a very close communication between the different project managers and within the project team, to update the sequencing in the ERP-systems immediately, to find solutions with the internal and external suppliers, to speed up the processes by individual management and to prepare and fight for a "safety net" within the organisation and the project is necessary. *Win for customer* – incidents in the own supply chain or additional demands can be compensated by the supplier. *Win for manufacturer/supplier* – organisation is prepared for and not surprised, contracts with sub-suppliers could be arranged in a flexible way. *Comparison with literature:* Measures in case of schedule variances could be overtime, additional resources or shortening of subsequent process steps (Felkai/Biederwieden 2013, page 281). The creation of buffer time is necessary to compensate later in the project small variances to avoid a postponement of relevant milestones (Jakoby 2013, page 182). It is important to think about possible solutions and scenarios before the project starts and not when the problem occurs or has occurred.

3.4 Ensure and offer short delivery times and meet it

The delivery time for overhauls, retrofits or repairs determines for example the number of exchange mass/units and the overall time period of a program. Both issues are connected to costs. It is very important to meet the agreed delivery dates which can have, in case of delays, big influences to the complete supply chain. *The task of the service project manager is* to support the line organisation in meeting the agreed delivery dates by controlling and pushing the necessary decision demands in time and working out together, if necessary, a detailed procedure which allows a transparent and regular controlling. In general the line organisation should have the ability to do this by itself but in projects this could be different due to another complexity level. *Win for customer* – delivery in time, no downtimes in the workshops. *Win for manufacturer/supplier* – no liquidated damages, no confusion or exhausting speed-up programs.

3.5 Take special care for the ooc-parts – Availability and inventory management

At the beginning of a project it is not easy to forecast how many "not wear parts" are damaged or out of order. A test overhaul should be performed at one or two products to get a clearer picture and as well experience values from similar projects should be used. Clearly the real use of ooc-parts during the project has to be monitored in a very detailed manner to ensure that enough parts are available but not too much in order to keep the inventory on a low level. *The task of the service project manager is* to update in regular time intervals together with the supply chain manager the real use of ooc-parts and the consequences of decreasing or increasing the orders in the ERP-systems against the suppliers in reasonable batch sizes. Especially for "all-inclusive-models" the project success is depending on a good ooc-parts management. *Win for customer and win for manufacturer/supplier* – no production stops, low inventories at the end of the project, low prices/costs. *Comparison with literature:* One of the future challenges of the rail industry is to reduce the processing times and the risk of missing parts in the production (Dybe/Kujath 2000, page 57 ff.).

3.6 Offer product upgrades and improvement of LCC (Life-Cycle-Costs)/RAMS (Reliability-Availability-Maintainability-Safety)

The target or order of the operators and the suppliers could be to improve the LCC and RAMS of an already delivered product during the first or second overhaul or to overhaul a foreign product. In

these described two cases a development work and project as in the new business is applied. The task of the service project manager is, depending on the level or necessity of development work, to update or to re-develop together with the line organisation a bill of material, to perform finite-element-analysis-calculations (FEA-calculations), to produce prototypes and to do type testing, to choose new suppliers and to define, if necessary, new production scenarios. Win for customer – lower service and operating costs, professional execution. *Comparison with literature:* Respect the LCC from the beginning of the project and develop together with the operators customised maintenance solutions (Bombardier 2015).

3.7 Use KPIs

Several KPIs have to be defined to ensure to have at the end of the projects satisfying results. The KPI values have to be released by the project owner at the beginning of the project and to be controlled in regular steps by the project team during the project. According to the magic triangle (Jakoby 2013, page 74) KPIs for "delivery reliability" (time), "operating profit" (costs), "inventory" (costs) and "quality" (quality) are sufficient. Additionally the KPI "customer satisfaction" has to be considered. In case of the ERP-system is working anonymously (parts are not assigned to projects), the main challenge is to get the relevant values out for the project. Only the project manager together with the supply-chain-manager and perhaps the project management support can filter out the project relevant values from the overall data. *The task of the service project manager is* to update the current KPIs together with the controller, quality responsible, supply-chain-manager and the project management support, to compare with the targets, to define the right measures in case of deviations and to report regularly in the steering committee. *Win for customer and win for manufacturer/supplier* – full transparency, view on history of KPIs designs trust, easy to determine if the project is within the targets or not, decisions or changes of direction can be made in time, involvement top-management. *Comparison with literature:* Each of the three sources explains the magic triangle and describes different procedures for the controlling process (Felkai/Biederwieden 2013, page 54 and 279-281; Hab/Wagner 2013, page 10 and 144-145; Jakoby 2013, page 247-248).

4. EXAMPLES – ONE SERVICE PROJECT IN THE UNITED KINGDOM AND ONE IN IRELAND

The following two examples for service projects shall substantiate the explanations from 2.1 to 2.7 and complete the material presented.

4.1 A service project for final drives in the United Kingdom

Short description – Main overhaul for 800 final drives, see figure 3, frequency 8 per week, budget for remaining ooc-parts limited, liquidated damages agreed in case of delays.

Figure 3: One example for a final drive, as picture and sectional view.
Source www.voith.com

The project organisation looked as follows, see figure 4. The dashed lines show the direct cooperation of the different functions within the sub-project-teams in the region and the BU.

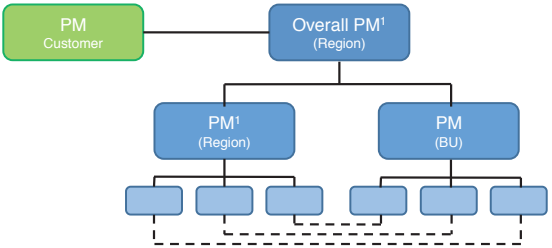

Figure 4: Project organisation, [1] Overall PM (Region) and PM (Region) should be the same person (own illustration).

At the beginning of the project the different ERP-Systems between the region and the business unit did not match in all points and therefore it was not 100% clear if the customer demands can be fulfilled and if not what is the critical path. Therefore a supporting tool on MS-Excel basis was designed by the project management with the columns “project demands”, “confirmed orders” and “analysis -> in line or acceleration necessary”. After the first third of the project the process run stable in the ERP-systems and the use of the described supporting tool was not any longer necessary. A regular weekly meeting with the colleagues from sales, supply chain management and both project managers helped additionally to get the project run. The meeting was moderated by the project manager in the BU. The KPIs “delivery reliability, operating profit, quality and inventory” were recorded over more than three years by the project management, see figure 5. In case of deviations measures were prepared to come back in line and in some cases the project manager had to escalate to the steering committee.

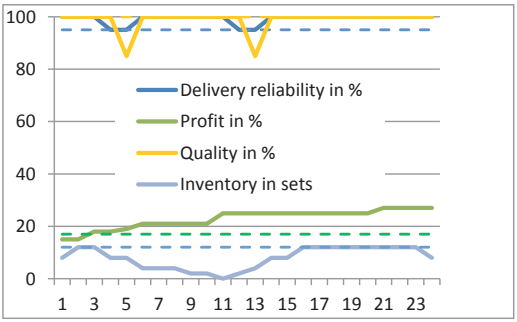

Figure 5: Key Performance Indicators (targets are dashed illustrated in the corresponding colour, x-axis = calendar weeks, y-axis = percentage, data are alienated and adjusted, own illustration).

For one ooc-part was a use expected of 15% but the reality showed a value of 65%. This ooc-part use difference was not foreseeable the beginning of the project, it was a substantial challenge to develop the supplier to deliver the fourfold quantity within the same time frame. As a lesson learned the starting quantity should be not only factor 2 or 3 of the monthly needed quantity but even 5 or 6. The real use of ooc-parts was monitored monthly by the project management support and the project manager. According to the result the quantities on order were consequently decreased or increased. The specification of the operator was very extensive and required to be checked and

commented by the responsible engineer and the project manager. The design was improved for an oil pan – instead of a welded design a bended and screwed one. Different tests ensured the function of the new component. This development step was controlled by a separated time schedule and milestone plan, driven by the project manager.

4.2 A service project for front ends in Ireland

Short description – Retrofit of front ends with a more repair-friendly concept for 62 trains, see figure 6, delivery frequency 5 per two weeks, original front ends have been produced by the OEM but not by the service supplier. A new repair-friendly front end of aluminium was developed including a supporting frame to fix on the front ends. The proven interfaces as service door and key were kept. The complete design is a new one and was FEA-calculated by the service supplier. The load parameters were developed between the operator and the supplier, the results afterwards discussed between the operator, the supplier and an independent company. Assembly tests with detailed prototypes at 3 trains were done in advance to ensure that no problems will occur during the series retrofit. Templates were used to find in a quick manner the relevant coordinates in the space. The project organisation was the same as in the first example, as well the communication structure and the controlling of the KPIs.

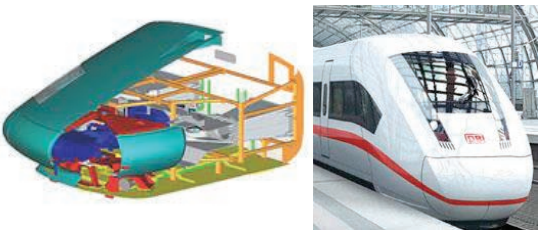

Figure 6: Two examples for a front end/nose – TALGO and ICx.
Source www.voith.com.

5. CONCLUSION AND PERSPECTIVE

The contents of the available various project management literature are similar due to the literature relies to the same or similar standards worldwide. However there are differences in the quality of the content. The results of the analysed literature and the positive feedbacks of the two successful performed projects confirm the observations and hypotheses in section 3. It is important to adopt the general project management standards for business (targets, operation, structure, tools etc.). Additionally it should be noted: To reach the targets and especially the customer demands/wins the described challenges and tasks have to be mastered in the rail supplier industry, an overall consideration is necessary and one person should have overall project authority. This person should know how the organisation is working, from the receipt of the order up to the end of the warranty period. Otherwise the service project managers have limited potential to steer the projects in the right direction. The project manager is for its project, the Chief Executive Officer (CEO) on time (Jakoby 2013, page 95). The tasks of a service project manager are meanwhile very similar to the tasks of a new business project manager. Respectively these service project managers have to get the appropriate training and education by their companies. Service projects have to be planned in detail and in advance. Therefore the service project manager should be already involved in the kick-off meeting of the new business project. A very important factor is the availability of corresponding IT-tools which avoid an exhausting definition or filtering of project data and allows the project

manager to manage more projects on the same high level. If it is too exhausting to filter out the data from the ERP-systems the danger exists that this is not done effectively.

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SOCIAL MEDIA ANALYTICS – MEASUREMENT OF SOCIAL MEDIA EFFECTIVENESS BASED ON THE EXAMPLE OF 'FACEBOOK KPIs'

Verena Metzger, David K Harrison, Bruce M. Wood & O. Gukhool

ABSTRACT

Today's business environment requires not only traditional marketing activities. Furthermore, companies are more enforced to implement social media activities in their business strategy in order to stay competitive and gain valuable insights of their customers. Within today's business environment, social media is seen as an efficient service that has to be used in order to get insights on customer needs and changing requirements and therefore be able to quickly react on them. Social media contains several channels that companies can use to get in contact with their customers easily but all social media channels that a company uses have to be monitored and measured in order to evaluate their effectiveness. Without implementing an effective monitoring and measuring process, social media activities will fail and will not result in the expected outcomes. This is not only a theoretical assumption since this is an approach that many companies already follow to avoid spending money in activities that are not bringing any added value to the company itself. Therefore the topic of "Social Media Analytics" that is highly discussed in literature also has a huge practical implication for companies using social media services actively on today's market place. This paper provides the service of using a social media monitoring and measurement strategy following a four step approach that is often used in today's business practice. In order to get a better understanding how this process is practically applied in today's business environment, 'facebook' will be used as a practical service example since this is a common social media channel of which most of the companies use services already.

Purpose: PhD paper

Design/methodology/approach: Literature Research

Findings: Social Media Analytics are key for social media success. Social Media measurement is a prerequisite for increasing effectiveness of social media activities.

Originality/value: Enabling Smart Infrastructure

KEYWORDS: Social Media Monitoring, Measurement Tools, Facebook KPIs

1. INTRODUCTION

This study examines and confirms that Social Media Analytics is a topic that is highly important within today's business environment. Lots of companies spend a huge amount of money being present in social media channels in order to start direct communication with their target groups. But without any monitoring, measuring and analysis, the company does not know if these social media activities are effective and if the money they invest is used efficiently. This paper is on the one side analysing exiting social media literature, based on a detailed literature research methodology in order to evaluate specific social media analytics strategies theoretically but on the other side evaluates and explains a social media analytics strategy that is already practically realized by many companies today. The authors of this paper will first define what can be understood of social media 'monitoring', 'measurement' as well as briefly explain what is meant by KPIs in order to build up a common understanding. Afterwards the authors will explain in detail a common social media measurement strategy following all phases that will be applied to a concrete example using the 'facebook' channel effectiveness measurement. At the end of the paper, the authors give a short outlook on different measurement tools that can be applied for measuring 'facebook' effectiveness.

2. DEFINITION OF SOCIAL MEDIA MONITORING, MEASUREMENT, ANALYTICS & KEY PERFORMANCE INDICATORS (KPIs)

2.1 Social Media Monitoring

Social media monitoring is the constant observation of content on specific social media platforms based on specific search criteria or topics (Heltsche, 2012). The result of this observation is a collection of finding spots compared with a short summary of the published content. Within the social media monitoring two different approaches can be defined: Open source screening or a search in which a pre-defined set of sources have been defined (Heltsche, 2012). Social media monitoring is also called 'listening to different social media channels with purpose' and should not be confused with the term measurement since monitoring does not contain any evaluation or measurement of data. Therefore social media monitoring only qualifies data but does not quantify it. (Lovett, 2011a)

2.2 Social Media Measurement

Oliver Blanchard (2011a) defines 'Social Media Measurement' as *'the systematic assignment of an empirical value […] to data'*. These measurements are created to focus on '*assigning values and hard numbers to any point of interest to the social media program'*. The overall social media measurement is based on specific social media metrics that can be divided into four different categories (Lovett, 2011b):

1. **Foundational measures:** Metrics that are valid across channels and measure all kinds of social media activities within a company. Examples: interaction, engagement, impacts, advocates and influences (Lovett, 2011b).
2. **Business value metrics**: These metrics are reflecting how social media efforts contributing to corporate goals like revenue, customer satisfaction and/or market share (Lovett, 2011b).
3. **Counting metrics:** Counting metrics are the lowest level of social media measurement. These metrics will measure for instance number of visitors on a homepage, followers on twitter or clicks and 'click through' rates of the own company homepage (Lovett, 2011b).
4. **Outcome metrics (Key Performance Indicators (KPIs)):** Outcome metrics are dependent on business needs and help companies to evaluate social media activities before, during and after the go-live of a social media campaign (Lovett, 2011b).

2.3 Social Media Analytics

John Lovett (2011c) defines 'Social Media Analytics' as *'the discipline that helps companies measure, assess and explain the performance of social media initiatives in the context specific business objectives'*. The author Andreas Werner (2013a) clarifies that social media analytics is far more than only an instrument to measure activities on web pages. With the context of social media analytics a measurement approach is used that is based also on external tools with data coming from interfaces with different platforms. Social media analytics in Werner's view (2013a) measure the transition from social media platforms and the and thereby resulting turnover.

2.4 Social Media Key Performance Indicators

Social Media Key Performance Indicators are specifically defined figures and numbers that are measuring the effectiveness of specific social media activities according to business objectives. (Del-Rey-Chamorrow et all 2003). Lovett (2011d) clarifies that not all KPIs are metrics and not all metrics are automatically KPIs. KPIs are only those measures that can be mapped back to pre-defined objectives and define the actual progress on them. *'Key performance indicators illustrate the effectiveness of a campaign or program as it related to specific targets'* (Blanchard, 2011b). The consistency of a KPI is always depending on what someone would like to measure. It can include for example number of website visits or clicks per hour on a banner advertisement. The list of KPI is almost unlimited depending on the expected goal that would like to be reached (Blanchard, 2011b).

3. ESTABLISHING A SOCIAL MEDIA ANALYTICS STRATEGY

In order to set-up an efficient analytics strategy and concept in today's business environment a four-step-approach should be followed (Blanchard, 2011a). It starts with an effective and continuous monitoring of social media activities, followed by a detailed measurement and analysis that results in a clear reporting process in order to visualize social media success in a comprehensive way (Blanchard, 2011a). These four steps connect the correlation between data observation, data collection, the gathering of insights and the final transformation of all information into business intelligence. In the following the author will describe each layer in detail.

Figure 1: Social Media Analytics Strategy

1. Social Media Monitoring has been defined as 'listening' process in order to get as much data and insights of conversations within the social media context as possible. In order to clarify why social media activities are being realized, Lovett (2011c) has defined a 'Triple-A-Mind-Set' that is based on **A**udience, **A**ctivity and **A**ctions. This concept helps companies to put their social media initiatives into the right perspective (Lovett, 2011c).

With the definition of the **'Audience'** a company can analyse who are their followers and fans and where do they interact with each other. It can also determine where the audience spends the most time for instance in forums, blogs or other social media platforms. Setting-up audience metrics also help defining demographic and social characteristics as well and can also identify different kinds of people who act as thought leaders. This means 'Audience' metrics can give a clear picture about who is active in social media channels and where a company can find them (Lovett 2011c).
Werner (2011b) defined three concrete monitoring areas in which a company should start monitoring its audience: the own 'company, with products and customers', the 'overall market' in which the company acts in and all the 'competitors' that are active on the market place. Monitoring of the own company, products and customers means searching for key words such as company name, product names, evaluation dimensions (such as product quality, service), specific company slogans and names of board members of other important employees (Werner, 2011b). Monitoring the own marketplace means observing all discussions that are somehow relevant to the own company and products (for example: a textile manufacturer should also monitor discussions about child labour even if the company is called a fair company without child labour at all to make sure that it can react immediately if something arises that can also damage the own company's reputation).

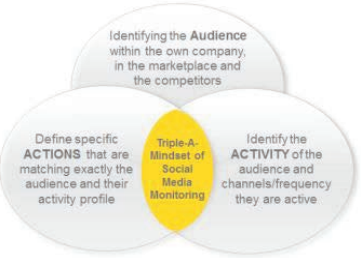

Figure 2: Social Media Monitoring

(Werner, 2011b) Monitoring the own competitors is not that complicated since a company can also use the same key words as they search for their own company. With this method, a company can evaluate the communication frequency in which people are talking about the own company or products or even about their competitors. This also helps identifying in which social media channels the audience is active (Werner, 2011b).

With the definition of the **'Activity'** a company can quantify all activities that have been created about the own brand, products and services identified by the audience or initiated by competitors. This mind-set area results in information how the audience reacts to difference campaigns, different messages and how they communicate and distribute information across different social media channels. It also reveals the level of attention towards the own brand. This can help a company to

find a way for approaching new customer groups, but also identifying new trends and new hot topics that might arise in the future (Lovett 2011c).
The last part of Lovett's (2011c) 'Triple-A-Mind-Set' is **'Actions'**. Within the context of monitoring, a company has the possibility to identify and recognize their audience groups, evaluate where and how active they are and which activities they are participating in, but also which actions the own company should take to achieve previously set business goals and desired outcomes. With an efficient monitoring process, a company will be able to collect valuable insights to establish new actions and new programs that have been exactly synchronized to their audience and their activities (Lovett 2011c).

After identifying the monitoring approach, the following section provides two examples for efficient social media monitoring tools, which will be briefly explained in order to get an understanding how social media activities can be monitored. Starting with social media monitoring, companies often use monitoring tools that are free of charge such as 'Google Alerts' that monitor the overall news such as newspapers, publications, magazines but also content of blogs and forums. The user can define as many alerts as possible. The search outcomes of pre-defined alerts will be sent via email to the user. This method is only useful for monitoring text documents since video channels, podcasts or other sound broadcasting service cannot be monitored via Google Alerts. With 'Google Alerts', the user will get only content that is available in 'Google'. This means for a complete monitoring, it is essential to also start using other tools (Werner, 2011b). Other search engines are able to monitor twitter as well as facebook posts. One of these tools is called 'TOPSY'. TOPSY enables the user to limit the search based on relevance, date and type of communication (e.g. video, photo). Additionally the user can define between different time scales (last hour, last day, last week, last month). With this monitoring tool the user is able to identify the development of discussions within a specific period of time that will be visualized in a comprehensive chart (Werner, 2011b).
2. After qualifying the data during the monitoring process, a detailed **Social Media Measurement** approach has to be followed in order to be able to quantify this data as well. Blanchard (2011a) has set-up two rules for social media measurement: *'Be precise and measure that matters.'* This means that objectives should be the starting point that has to be transformed into specific metrics that support the realization of these objectives (Blanchard, 2011a). To start with the definition what to measure Blanchard (2011a) recommends to clearly evaluating what can be measured and what must be measured. In most companies, different measurement objectives exist. While departments often follow a micro measurement approach (for example sentiment, positive/negative mentions, volume of specific key words, number of comments on the company's facebook wall and other sentiment related metrics) the management level often follows a macro measurement approach (e.g. number of followers, number of new fans, click-through volume, number of online purchases) (Blanchard, 2011a). In order to find the right measurement approach, both views have to be evaluated and combined. For quantifying monitoring results, most companies use defined metrics but also develop specific KPIs. All metrics as well as KPIs should match the company's business goals. With the establishment of social media KPIs, a company will set the benchmark for social media activities and will provide detailed insights on success and progress but also on failures (Lovett, 2011d). In order to calculate any KPIs Lovett (2011d) recommends establishing foundational measures first. These foundational measures focus on the following topics:

Interaction = Conversions / Activity
Interaction is a measurement of people who respond and are attracted to specific marketing initiatives. Any interaction has to be measures against a specific marketing action such as a blog entry for example (Lovett, 2011d).
Engagement = Visits x Time x Comments x Shares
Engagement is an estimation of the degree how a person participates on specific marketing topics or initiatives (Lovett, 2011d).

Influence = Volume of Relevant Content x Comments x Shares x Reach
Influence measures the power of one specific person to influence others on a brand, or topic. This can be seen as the most popular measurement for social media (Lovett, 2011d).
Advocates = Influence x Positive Sentiment
An advocate is a person that acts as a strong supporter for a brand or product therefore this measurement is focusing on a positive influencing effect. (Lovett, 2011d)
Impact = Outcomes / (Interactions + Engagement)
This is a measurement of the *'ability of a person to guide the outcome of desired events as measures against specific goals'* (Lovett, 2011d). This can be also defined as campaign ROI (Return On Investment).
The foundational measures are not a one-fits-all solution that can be applied to all companies. They should primarily give an indication and should be established based on the own business objectives.
The foundational measures together with the own business objectives are measureable through specific KPIs that need to be established. Lovett (2011d) has distinguished KPIs into different categories:
Exposure KPI, Dialog KPI, Interaction KPI, Support KPI, Advocacy KPI and Innovation KPI.
All categories include defined KPIs of which the category 'Dialog KPIS' will be briefly explained.

Dialog KPIs

Business objective KPI		KPI Calculation
Audience Engagement	=	(Comments + Shares + Trackbacks) / Total Views
Conversation Volume	=	Reach x Engagement
Unique Contributors	=	Total Individuals Participating per Campaign

Figure 3: Dialog KPIs

Starting a dialog with people in social media channels, means providing specific content to get the audience engaged into conversations. With the KPI 'Audience Engagement' a company can measure the share of visitors that are getting involved in communication around a marketing campaign for example while starting discussions on a specific topic. If the audience of different topics varies, a company can identify hot issues as well as topics that are less important. With the measurement of the 'Conversion Volume' a company can identify the number of unique visitors that communicate based on a specific brand or issue across one or more social media channels as well as the level on which they interact with each other. With the KPI 'Unique Contributors' the company measures how many persons got involved with launched social media activities. These are only examples but with speficic KPIs based on business objectives, a company can measure their social media activities effectively (Lovett, 2011d).
Lots of companies use specific measurement tools such as Google Analytics with which they can measure the transformation of web traffic from a social media platform to a company website, evaluate different social media channels seperately as well as the traffic specifically on the own webpage (Werner, 2011c). The results of most social media measurements are often displayed in forms of dashboards in which the measured outcome is visualized in different graphs, charts and tables. Most companis use enterprise solutions like 'Netbreeze', 'Sysomos' or 'Business Intelligence Group (B.I.G.)'. These are all tools that providing a clear and structured view on KPIs and visualizes them in an understandbable manner (Werner, 2011b).

2. The **Social Media Analysis** approach is based on teamwork of all departments measuring different social media outcomes such as Customer Service, Community Managers, Corporate Bloggers or for instance Sales Managers. Therefore the analysis needs to be seen as a full package of information that combines all different measurement areas in order to provide a comprehensive story of all program outcomes. Most companies use specific technology to create detailed dashboards but nevertheless technology cannot provide a full set of information with the right interpretation on that. This means the responsible persons have to be involved in the analysis process as well. A reporting for example can in fact be automated; but the analysis of data in order to understand how the data should be interpreted can only be done by humans (Lovett, 2011e). In Lovett's view (2011e), a social media analyst should have the following skillset: Understanding the own business and

industry, readiness to learn about new social media channels, strong and detailed technical understanding, willingness to work with different data sources and strong communication skills (Lovett, 2011e).

3. The last step of the overall social media analytics strategy is the **Social Media Reporting** process that communicates all findings and analysed outcomes to all relevant stakeholders. One can say that the reporting process is the key element and main function of the overall analytics process. It reports success but also failures to all stakeholders. Besides, it also keeps people alert and reports the most important highlights in a comprehensive way. In order to set-up a clear and comprehensive reporting structure and reporting process, Lovett (2011e) has defined five key components that needs to be followed:

- Create understandable reports: Data has to be clearly explained and visualized that all people in the organization quickly understand the results (Lovett, 2011e).
- Keep a report as simple as possible: The report should be created in the language that also non-technical people will understand. If a report is too complex people will not understand the outcomes of it (Lovett, 2011e).
- Only important information should be reported: Since most of the people within a company are quite busy, the report should only focus on the most relevant outcomes that are useful for everyone. If a report gets too long, people will lose interest in reading it (Lovett, 2011e).
- Automate reporting as much as possible: If a reporting will be automated the analyst can spend more time on analysing the data. Mostly social analytic technology already provides a reporting automation possibility that can also be used (Lovett, 2011e).
- Reports should be revisited on a regular basis and checked with recipients: Within conversation of the recipients, the analyst can evaluate if the report still contains the right information on the right level of detail and can adapt the report to their requirements on a regular basis (Lovett, 2011e).

4. MONITOR AND MEASURE FACEBOOK EFFECTIVENESS

Lots of companies already using facebook in order to start conversations with their customers and to gain insights but from an economic point of view these facebook activities also have to be measured in order to identify and define the success that is coming from a facebook page. Often companies already include a regular reporting for measured facebook activities that is based on a specific facebook KPI dashboard (Krömer, 2014). Krömer (2014) defines eight different KPIs that are differently weighted and that are calculating the overall performance index.

- Fans: The total number of 'likes' is an important indicator for the size of a facebook page but cannot give an indication if the performance of the channel is as good as expected (Krömer, 2014).
- Fan-increase per day: This KPI gives an indication about the daily page growing process. This KPI can be used to compare the own page with different pages for examples from competitors (Krömer, 2014).
- Posts per day: The number of posts that a facebook page receives per day indicates how active a company is using the facebook channel (Krömer, 2014).
- Talking about: This KPI results in the number of people that have been interactive with the facebook page during the last seven days. This KPI is often called PPTA (People Talking About). This includes for example likes, posts and shares. The size of the facebook page often determines the degree of interactivity with the 'fans' (Krömer, 2014).
- PPTA/Fans: This KPI results in the relation between the numbers of people taking about divided by the number of actual fans. Therefore a company can identify how active their fans are (Krömer, 2014).
- Page Engagement Rate: This KPI indicates the engagement of the own fans with the facebook page itself. This KPI is more reliable as the PPTA/Fans KPI since it will be calculated with the

overall number of likes, comments and shares divided by the number of fans and divided by the number of days on which the analysis timeframe is based on (Krömer, 2014).

- Post Engagement Rate: This KPI measures the reaction of fans to single posts and will be calculated by the sum of likes, comments and shares divided by the number of days and the number of fans across all posts. This KPI is important if a company would like to compare different pages that post content on a different frequency (Krömer, 2014).
- Average Response Time: This KPI indicates the average time between publishing a post through a user and answering this post through the company itself. This identifies the attention and reaction speed of the social media team. If response times are too long, users and fans can get frustrated that in the worst case can lead to a reputational damage for the company (Krömer, 2014).

These mentioned KPIs can be visualized in a dashboard that will provide a complete overview and comparison between different channels and companies for instance on a determined scale (1-10). Social Media Manager can also work with the KPI dashboard to benchmark KPIs that they think are the most important ones. A KPI dashboard is often divided into different layers. The first layer indicates the performance of all KPI without going into detail. The user of a facebook KPI dashboard can then on layer two determine his/her most important KPI that will be displayed in more details. On the third layer the user can see the exact performance of a specific channel, in this case facebook and will have all information mostly on a daily basis for example number of new fans per day or number of likes on a specific date. With the use of a facebook KPI dashboard, the Social Media Manager can have all needed information on different levels of detail in order to provide a clear and structured management reporting. The Social Media Manager can also gain important information for the company's own content strategy and can therefore adapt content that will be published across facebook perfectly to the target group. With the use of a facebook KPI dashboard, the own performance of the facebook channel can constantly be improved (Krömer, 2014). After the clarification on facebook KPIs, another facebook evaluation concept will be briefly explained. This concept is called the 'Facebook-Funnel-Concept' and demonstrates how the success of facebook announcements can be evaluated more detailed.

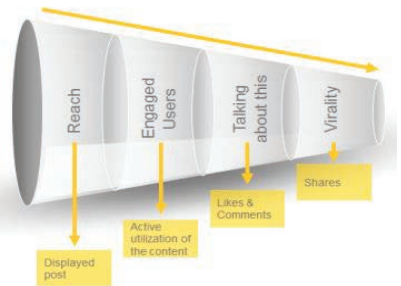

Figure 4: Facebook-Funnel-Concept

The funnel starts with the 'Reach' which means that a company posts some information on their facebook page, followed by 'Engaged Users' which is the number of people that have clicked on this post (Werner, 2011d). The aim is that people start getting interactive and informing themselves by reading the post the company has published on facebook. Sometimes facebook posts include pictures, videos or other links in order that engaged users click at least on one of the different options. The third funnel area 'Talking about this' is a much higher degree of interactivity with people. The main measurement on this stage is the number of likes the post have reached or even comments that people wrote about this post. The most important goal a company follows with a facebook post is 'Virality'. Companies are mostly fan focused but not all fans are real fans. Fans that only click on the 'like' button or comment on something are useful but not as important as fans that share this facebook post with their facebook community. With sharing a post a company can reach a much bigger community that might get interested in the company itself and will end up on the company facebook page again (Werner, 2011d). This concept should visualize the aim and goals behind posting specific content on the own company facebook page but should be seen only as an example since explaining the overall facebook measurement strategy would go beyond the scope of this paper.

In order to measure facebook effectiveness, different tools are offered on the marketplace that companies can use. Two of these tools will be mentioned since these tools are highly effective in this context: quintly.com and PageLever.

Quintly.com provides the possibility to evaluate all data on facebook not only for the own company but also for all competitors being active on facebook. This tool enables a company to identify potential activities that are planned from competitors. This helps companies a lot to quickly react to all relevant topics (Werner, 2011d).

PageLever is a tool that evaluates data in more details. It does not compare the own company with competitors but gives a clear and understandable view on the effectiveness of the own facebook activities. It is more seen as a dashboard solution. This tool also contains explanations in order to answer frequently asked questions that are directly linked to different statistical graphs (Werner, 2011d).

4. SUMMARY

Social Media Analytics are highly important for companies in today's business environment. Social media activities started on a low level but since companies have realised that they can increase their business effectiveness through social media activities, social media gained importance. Today companies spend lots of money in social media activities with the prerequisite that these activities have to be measured in order to identify and evaluate their success. Therefore social media analytics are more important than ever before and a clear monitoring approach, the right set of KPIs that result in a comprehensive dashboard, the right people that have the right skills to interpret the data and a clear reporting structure enable a company to use social media as an important and successful tool for future development and success.

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SERVITIZATION AND CO-OPETITION IN THE PHARMACEUTICAL INDUSTRY

Jose Ruizalba Robledo, Anabela Soares & Javier Morales Mediano

ABSTRACT

Purpose: The present paper aims at providing an outlook of the portfolio of services developed by the pharmaceutical distribution in Spain and Portugal by looking at the different types and levels of implementation. This paper also provides the research framework that is currently the base for the ongoing data collection, exploring the rationale behind the implementation of different types of services and co-opetitive relationships in relation to the pursuit of profit, the creation of barriers with competitors and the reinforcement of customer loyalty. The impact of these factors on the intention to increase the delivery of services in the future will also be analysed.

Design/methodology/approach: In order to address the research framework presented, a quantitative research methodology is suggested through the use of web-based questionnaires. After the identification and categorization of services in this industry, a questionnaire was developed in order to measure the presence of the identified services and their impact on the pursuit of profit, the creation of competitive advantages the improvement of customer loyalty, willingness to further develop these services and co-opetitive relationships. The sample includes Portuguese and Spanish pharmaceutical cooperatives and private companies, operating as wholesalers.

Findings: The empirical data is currently being collected therefore the present paper provides solely the analysis of the pharmaceutical industry in both countries and the classification of the services offered in this industry which was used as the basis to develop the questionnaire.The paper discusses how the pharmaceutical distribution sector has evolved in the past decades and how the concentration process has changed the rules of the market owned by big players who are taking the lead. Additionally, the portfolio of new services that have recently been developed throughout the industry are identified. Some differences between both countries have been found mainly in IT services. The recent establishment of second degree cooperatives generates new perspectives to the suggested influence of co-opetitive relationships.

Originality/value: The present paper is part of an ongoing research project which aims at providing both theoretical and practical implications:

1) The analysis of pharmaceutical wholesalers from a servitization perspective;
2) Application of Baines et al. (2013) classification to the pharmaceutical sector;
3) The adaptation and measurement of co-opetitive relationships within the servitization delivery;
4) Development of instruments to measure the level of implementation and the type of services which can be used in the future to make compared studies in other countries;

Key words: Servitization; co-opetitive relationships; pharmaceutical distribution.

1. INTRODUCTION

In the majority of developed countries, the service sector has become key to competitiveness, strongly contributing towards economic growth. This inclination towards services is also reflected in the industrial sector that exhibits organic growth through the development of new services. Still, the provision of added/additional services remains a major challenge for manufacturing firms, particularly if they have strongly engrained traditional business models (Brax, 2005).

Services have been defined as activities or performance provided to satisfy customer needs (Grönroos, 1990). Nonetheless, in an increasingly competitive market, customers expect more and whatever was before an order-winner quickly becomes a qualifier affecting the whole industry (for example the case of quality - Lee, Zuckweiler and Trimi, 2006).

Companies have adapted to these demands for added value and increased their product-service offerings, combining products and services to such a degree that it is almost impossible to separate them and clearly distinguish them. Complete bundles and packages - referred to as product-service systems (PSS) - are developed and they are so intertwined that customers struggle to distinguish between what is the product and what is the added service (Aurich et al., 2009; Schmenner, 2009). This is particularly the case for the pharmaceutical industry which had to find new ways to compete in a highly regulated market with static margins. Hence the focus of this paper on the servitization levels of implementation offered by Portuguese and Spanish pharmaceutical distributors. Additionally, strategical reasons for this implementation are analysed as well as the intention to develop the different types of services identified.

In addition to this, emphasis has also been placed in "service-driven global supply chains" (Youngdahl and Loomba, 2000) and the role of customer relationship management and "service relationships" (Rust and Chung, 2006) as well as the role of intra and inter-firm relationships management (Mena, Humphries and Wilding, 2009; Soares, Soltani and Liao, 2012). Following the trends identified in the review of the servitization literature (Baines et al., 2009; Lightfoot et al. 2013) this study focuses on servitization as a means to create added value to traditional offerings by developing new capabilities. This paper focuses particularly on servitization as an instrument to simultaneously create long term relationships with customers and entry barriers to competitors. By providing a combination of enhanced features to their customers, companies try to go beyond the core services strictly expected from them and establish stronger bonds with their customers, increasing switching costs and making it harder for competitors to reclaim competitive advantage.

An empirical methodology is suggested to achieve this, building upon a conceptual research framework. As part of ongoing data collection, this paper offers a descriptive analysis of the sector as well as a classification of the available services. Subsequently, the present paper is structured into five main sections: 1) Section 1 provided an Introduction of the research; 2) Section 2 provides a brief summary of the literature on servitization and co-opetition, suggesting a research framework for further empirical research; 3) following this, in Section 3 methodological aspects are discussed; 4) in Section 4, main findings for the Portuguese and Spanish industry are presented, providing a categorization of levels of services delivered in the pharmaceutical sector; 5) and finally Section 5 offers concluding remarks.

2. LITERATURE REVIEW

2.1. Servitization

First suggested by Vandermerwe and Rada (1988), the term servitization is used to refer to the competitive advantage created through the "process of creating value by adding services to products" (Baines, et al., 2009:547). Vendrell-Herrero, Bustinza and Arias (2014) affirm that servitization has been described as the provision of service as a complement to manufacturing and also commercialization of products generating higher economic margins. According to Gaspar and Bustinza (2014:225), servitization is related to the added services to a product whilst product-service systems (PSS) refer to the use of these services focusing on specific joint offerings. This is corroborated by Baines et al. (2013:638) which state that "servitization is the process of transforming manufacturers to compete through product-service systems (PSSs) rather than products alone". In an attempt to categorize services, Martinez et al. (2010) distinguish product-service offerings from peripheral up to the development of close relationship between buyers and suppliers. In turn, going beyond production competences, Baines et al., (2013) suggest a categorisation of services that includes base, intermediate and advanced levels of services. The main difference between intermediate and advanced service levels is that in the first the supplier does not get fully involved in the customer business whilst in the second he does. In intermediate services, the supplier can offer more or less complex services, but only when those services are formally requested by the customer and with the supplier not knowing in detail what is the true nature of the customer business.

Whereas, in advanced services, the supplier perfectly understands the nature of the customer business and some of the customer's business processes are embedded in the services offering.

In their review of the servitization literature, Baines et al. (2009:558) refer that the majority of findings comes from case studies and summarize the main reasons that lead organisations towards the implementation of servitization. These include financial (e.g. revenue stream and profit margin), strategic (e.g. competitive opportunities and advantage) and marketing drivers (e.g. customer relationships and product differentiation). In doing so, they identify that the motivations behind this approach and resulting benefits clearly go beyond profitability. By adding services to their product offerings, companies are able to set themselves apart from their competitors, developing sustainable and hard to copy advantages (Oliva and Kallenberg, 2003; Gebauer et al., 2006; Kowalkoski and Kindström, 2013). As such, this generates repeated purchases and customer loyalty (Correa et al., 2007). Creating this privileged relationship with buyers facilitates the promotion of further services and products which in turn contributes towards the increase of entry barriers and switching costs (Mathieu, 2001b). Brax (2005) has identified six main challenges in the development of product-service combinations related to product design, production, delivery, marketing, communication and relationship with clients. Consequently, the present research considers the impact of relationship management as suggested next.

2.2. Co-opetitive relationships

In the same way that it is not possible to discuss manufacturing without referring to supply chain coordination, it is not possible to discuss servitization without considering the relationships established within and between companies to provide these added value product offerings. This is particularly the case in the pharmaceutical industry, the focus of this research, in which wholesalers are organised under the form of cooperatives and private companies jointly serving the same market. As a result, these companies are forced to simultaneously compete and collaborate in order to satisfy their customers' needs. This is what is commonly referred to in manufacturing and operational research as co-opetitive relationships. The term 'co-opetition', first defined by Ray Noorda, CEO of Novell (1993; cited by Nalebuff and Brandenburger, 2002:4), has been used in the literature to refer to situations in which two competing suppliers (of a given buyer, for example Toyota) cooperate towards the achievement of common buyer goals (Wu, Choi and Rungtusanatham, 2010). Nonetheless, research as shown that co-opetitive relationships can occur within and between firms (Schiavone and Simoni, 2011). Hence, these relationships can be loosely defined as situations in which companies simultaneously compete for orders and cooperate for self-preservation towards the achievement of supply chain goals (Choi et al., 2002; Choi, 2007; Nalebuff and Brandenburger, 2002; Wu, Choi and Rungtusanatham, 2010).

2.3. Research Framework

Servitization and product-service systems (PSS) came to the forefront of research interests propelled by authors such as Brax (2005), Neely (2008), Baines et al. (2009, 2013a,b) reviews of the literature, studies and breakthroughs, calling for much needed further research in the field. In an attempt to contribute to this literature, this paper focuses on the implementation of servitization in the pharmaceutical industry. Building upon Baines et al. (2013) categorization of services (into Base, Intermediate and Advanced services) this research aims at comparing the levels and types of services implemented in the Portuguese and Spanish pharmaceutical distributors. In doing so, the suggested empirical research attempts to address the following research questions: RQ1. How is servitization applied in the pharmaceutical industry?; RQ2. How has the industry evolved in the last years in Spain and Portugal? To what extent has the economic crisis impacted on pharmaceutical distribution?; RQ3. What types of service categories are present in the pharmaceutical distribution of both countries and to what extent?; RQ4. How can the identified services be categorised against the three levels of service (Baines, 2013); RQ5. What is the impact of the different level of services in these three strategic factors: loyalty, creation of competitive advantages and profitability?; RQ6. What is the influence of loyalty, creation of competitive advantages and profitability in the willingness to increase the level of service implementation in the future?; RQ7. Is there any association between

the establishment of co-opetitive relationships and the implementation of different types of services, strategic factors and willingness to increase the service in the future? Figure 1 depicts the research framework suggested to unravel these research questions.

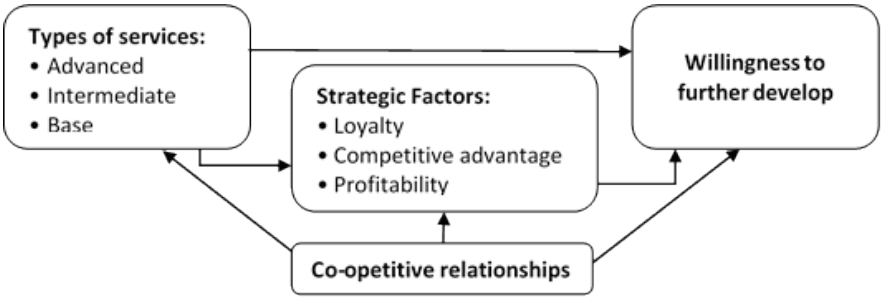


Figure 1: Servitization and co-opetition research framework.

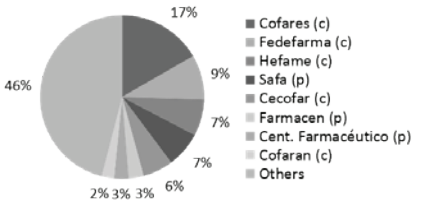
3. METHODOLOGY

As a means to answer the research questions and investigate the research framework proposed, an empirical web-based survey research is suggested. The survey addresses all the elements of the framework and was developed based on the categorization of services in the pharmaceutical industry provided in this document. Hence, for the purpose of this conference paper, a descriptive analysis of the sector is provided as well as a classification of the available services. For the currently undergoing data collection, several statistical analyses will be performed including contingency tables, comparison of means, association measures and multiple regression. Independent variables such as the type of company (cooperative or private), amongst other control variables will also be used to compare groups.

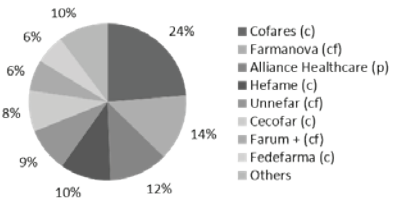
4. THE PHARMACEUTICAL DISTRIBUTION IN SPAIN AND PORTUGAL

The pharmaceutical distribution sector in Spain commenced its development between the 1930 and the 1960s, when 24 new distributors were founded. The majority of them were incorporated under the cooperative form integrated by pharmacy owners in specific regions. By the end of the last century, 32 out of the 41 players were still cooperatives while the rest were private companies. Although with some marginal corporate operations in the 80s and 90s, it has been during the new century that numerous corporate movements have occurred, including not only mergers and acquisitions but also different cooperative integrations and federations. All these corporate changes had a significant impact on the market split. In 1995 the top 8 companies had just over 50% of the market share what implies a fairly fragmented marketed, whereas in 2013 they increased to almost 90%. Figures 2 a) and
b) below illustrate these market share changes.

Conversely, the pharmaceutical distribution sector in Portugal did not start to flourish until the 1960s-1990s when more than 20 distribution companies were founded. From those 20 newcomers, 5 were cooperatives and the rest were private companies. As opposed to what occurred in Spain, the consolidation process commenced in 1985 and intensified in the early nineties with various takeovers by both private companies and cooperatives. Due to that early process of consolidation, the market was relatively concentrated by 2003 already when the top 7 wholesalers had close to 85% of the market share. That decrease in the market fragmentation has continued and in 2013 the seven biggest companies accounted for more than 90% of the market, as shown in figures 3 a) and b).

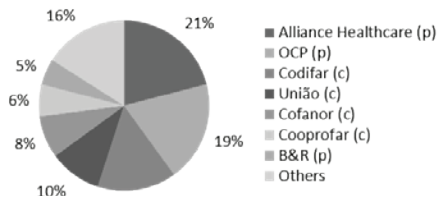


a) Market shares in Spain in 1995 (Compilation based on data from IMS, 1996 cited by Frías Jamilena, 2001).

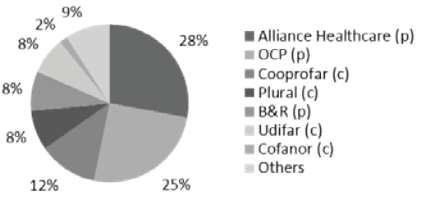


b) Market shares in Spain in 2013 (Compilation based on data from IMS cited by FEDIFAR, 2014).

Figure 2: Changing market shares in the Spanish market
(p) Private company / (c) Cooperative / (cf) Cooperative federation



a) Market shares in Portugal in 2003 (Compilation based on data from Rodrigues et al., 2005)



b) Market shares in Portugal in 2013 (Compilation based on data from Alliance Healthcare, 2014)

Figure 3: Changing market shares in the Spanish market
(p) Private company / (c) Cooperative / (cf) Cooperative federation

Although there are some similarities in both countries that certainly invite to prepare a common analysis of the pharmaceutical distribution sector, there are three differences that deserve to be highlighted: (1) The latter development towards a modern configuration of the Portuguese industry vs. the Spanish one; (2) The balanced presence of both private companies and cooperatives in Portugal compared to Spain, where the importance of cooperatives is notably higher; (3) The even higher level of concentration experimented in the Portuguese market due to an earlier period of consolidation.

Nevertheless, it is also reasonable to believe that in both markets, Spain and Portugal, there are two key and common reasons behind the consolidation process described before. Firstly, the direct impact of new legislations introduced as a result of the reductions of public budget dedicated to medication.

This in turn affected sales prices and contribution margins defined for wholesalers. Secondly, the reduction of public health spending also resulted in additional strains for pharmacies in terms of delays in reimbursements from the government, which indirectly impacted to wholesalers as billing periods and stocks increased. Thus, consolidation of the industries was the natural response to the new circumstances. An evolution aimed to not only look for economies of scales and cost reductions but also to enhance the portfolio of services that can be offered to the pharmacies, which led to the servitization process of this sector that is here under analysis. Another important factor that has contributed to the servitization process is that, in both countries, the commercial margin of pharmaceutical distributors is regulated and fixed by the administration (Frías 2001). Since they cannot increase their margins they have to grow through other strategies and the most used has been the development of new services.

A preliminary analysis of the services portfolio of the most relevant Spanish and Portuguese wholesalers has resulted in five different groups of services depending on their content and/or area

of focus. Although the majority of services identified have been found in both markets – Spain and Portugal – the level of implementation is remarkably different. In Portugal only 7 out of the 26 identified services are offered on average compared to 14 services in Spanish companies. For example, whereas Portuguese companies have shown a limited introduction of services related to IT (which is offered apparently by only one out of the seven leading companies), Spanish companies seem to be one step ahead in this area, especially cooperatives which very often include some kind of IT services in their portfolio. Nevertheless, the extent of implementation of these services will be tested in the empirical part of this research.

4.1. Classification of service levels

Adopting Baines et al (2013) service levels categorisation, the three levels of services in the pharmaceutical distribution industry have been defined as follows: a) Base Services: refer to the distribution itself. In this case, the customer only values the supply of products that basically comprises the logistics of storage and delivery. There is not much value- added proposition and therefore few differentiation between companies is possible; b) Intermediate Services: added services that tend to add-up to the delivery of base services. These improvements are in a related field to the base service already provided such as the supply of complement products/services in the pharmaceutical industry. That means that all the tools and services provided to improve the supply chain in terms of time, accuracy or cost should be considered as Intermediate Services. That includes, for example, IT services (installation and running of specific software) aimed to manage stocks, orders and more frequent delivery services; c) Advanced Services: the outcome of these services goes beyond and is not limited to something related to the Base Service. The service offered creates enhanced value, that is, it engages "the customer in a relationship that has closer association with strategic repositioning and business process outsourcing than to sales of products and services" (Baines and Lightfoot, 2013:65). The portfolio of services identified in the pharmaceutical industry includes five Categories as detailed in Table 1.

Services group	Description	Service Level	Services included
1. Core services	Services related to the core activity of sale and distribution (storage and delivery)	**Base**	Services related to the core activity of sale and distribution: Other health products distribution; Other not health products distribution; Special and urgent deliveries; Vaccines services; Dispose of medicines; Laboratories returns.
2. IT services	Sales, installation, maintenance and training of IT systems	**Intermediate**	Services aimed to introduce the utilization of IT systems: ERP software; Software maintenance; Hardware maintenance; training related to IT
3. Other professional services	Accountancy, business advisory, HR, etc.	**Advanced**	Other professional services: Administrative and accountancy; Management advice; HR and recruiting; Marketing and communication; Loyalty programs.
4. Training and dissemination	Training about different contents and publications (magazines, technical notes, etc.)	**Intermediate**	Training and dissemination services: Management training; Technical training; Social networks and internet; Magazines; Other publications.
5. Third parties services	Agreements with third parties to incorporate their services in the wholesaler offering	**Advanced**	Services provided by third parties: Financial services; Renovation and decoration; Occupational risk prevention; Data protection; Private label manufacturing.

Table 1: Levels of services groups

5. CONCLUSIONS

The pharmaceutical sector has a crucial economic and social impact, playing an essential role in the provision of medical and health care, particularly due to the R&D investments required for the development of new medication (Frías, 2001). As such, and because the European regulations are

still lagging behind in terms of industry standardisation, it is imperative that we understand how the pharmaceutical industry currently operates and more importantly how servitization is approached in such a competitive market. The present paper outlined a framework that suggests co-opetition, strategic factors and willingness towards development as key variables for the pharmaceutical industry. Key categories of services provided in the pharmaceutical industries were also identified based on a sample of Portuguese and Spanish wholesalers. Further consideration and categorization of each of the five categories in each of the 3 levels of service needs to be developed. Future research should consider whether or not all the services included in a group of services are necessarily part of the same category or not.

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IDENTIFYING NEW SERVICE OPPORTUNITIES IN THE INTERNATIONAL MARKET: A CASE STUDY OF A UK SERVITIZING COMPANY

Aleksandra Mackowiak, Anne MacIntosh, Jillian MacBryde & Steve Paton

ABSTRACT

Purpose: The purpose of this paper is to challenge the assumption that organisations solely focus on a continuous extension of service offerings when looking for worldwide opportunities in the service market. In exchange, we introduce the term 'custom servitization'.

Design/methodology/approach: This investigation is part of the bigger research project compromising a number of rich case studies of UK servitizing and high value manufacturing companies operating in international markets. In this paper we will focus on an in-depth literature review, combined with a range of primary data from a Scottish medium-sized company, a global leading innovator in laboratory gas generation industry. The firm is involved in business-to-business sales and features relatively knowledge intensive products at the core of a range of various servitized offerings, with a remarkable sustained growth over the last five years. The data was gathered using a mixed methods approach including semi-structured interviews, documentary analysis and direct observations of in-company processes and employee activities.

Findings: The reported company manages multiple business models and various marketing channels and provides a range of different service sales for various customer segments all over the world. The case firm appears to take a very structured approach to sensing and seizing opportunities and this is underpinned by the level of global feedback received from their service network. The research findings suggest that even within a single firm there are varying levels of servitization that co-exist across individual customer relationships. The analysis indicates that this variation is driven by varying degrees of receptiveness to servitization within individual customers. Moreover, a firm's ability to engage in servitization depends on the extent to which customers are willing to trust the firm.

Originality/value: This paper contributes to a greater understanding of key sensing activities in the product-centric setting in the wider international context. The in-depth case study shows varying levels of servitization co-existing within a single firm, termed as 'custom servitization'.

Key words: Servitization, Custom Servitization, Service Opportunities, Sensing, Case study

1. INTRODUCTION

The difficulty with being unable to compete with low-cost economies has forced manufacturers within developed countries such as the UK to reposition themselves so that they are no longer reliant on low-cost operations and efficient economic infrastructure for success (MacBryde et al. 2013). One of the ways to potentially overcome this issue is to create and deliver "solutions" rather than pure products and focus on continuous adaptation to adjust firms' bundled offerings to growing customer demands, commonly known as servitization (Kowalkowski and Kindström 2013). Servitization encourages product-based organizations to look for new service opportunities in an attempt to generate higher sales and profit margins and create new growth opportunities (Gebauer and Fleisch 2007). The development of a new service business extends the existing set of operational and dynamic capabilities for designing, manufacturing and selling products (Baines et al. 2009). Dynamic capabilities refer to the need for companies to continuously scan and monitor market trajectories of their competition, supply network and customers in order to sense and seize opportunities (Teece 2007). Yet, firms still lack appropriate mechanisms to capture value and capitalise on service opportunities. Moreover, most existing studies share the assumption that expanding service portfolio will simultaneously trigger service business growth. In practice, little has been published about the processes and activities that can be employed to scan the external environment, identify new service opportunities and threats and interpret from both existing market information and new customer data. Existing literature suggests that dynamic capabilities are enabled and driven by such

processes. In this paper, our interest lies in the sensing activities that companies adopt when searching for emerging service opportunities in the global markets. Based on an in-depth analysis of a case study, we aim to challenge the assumption that product-based firms take up a single position along the product/service continuum and hence offer a specific business model and the same range of service offerings for all of their customer segments. We examine to what extent service sensing activities can be employed for various customer segments, introducing the term 'custom servitization'.

2. LITERATURE REVIEW

The literature review provides an insight into how organisations identify key activities to explore new service opportunities in international markets. This section is based on an extension of the work by Kindström et al. (2013), which has added to the four main areas to produce six clusters: customer base, external service system (supply network, competitors and external actors), internal employees, business processes and routines, performance management and technology exploration.

2.1 Customer base

Collecting information about current and potential customers is particularly vital for the provision and development of services (Edvardsson et al. 2006). Integration of services provides an opportunity to create and maintain long-term relationships with the clients. A greater customer intimacy through product-related services e.g. maintenance or training, assists with the process of stimulating and creating new knowledge. Determining the source of that knowledge is becoming critical for companies with service expertise dispersed across geographical boundaries. Sensing specific service opportunities may arise from understanding local customer needs (Kowalkowski et al. 2012) in a particular country. By gathering and applying valuable knowledge about the customer base, organizations can gain client satisfaction (Windahl and Lakemond 2006) and improve the adoption or modification of new physical products, which in turn leads to greater repeated sales (Mathieu 2001). Continuous feedback loops of interaction between service engineers, marketing/sales managers and the customers can help gain useful information about the company's selling proposition (Brax and Jonsson 2009) and feed them back into the production development/engineering team. This in turn can be applied in designing, modifying and differentiating new products as well as triggering new service initiatives.

2.2 External environment

Companies must take a more comprehensive view of the environment in which they need to compete and constantly observe and react to changes outside an organisation (Teece 2007). It is crucial to initially employ information-gathering routines that help observe service offerings and market behaviour of competition (Fischer et al. 2012). It can be done by developing competitive intelligence - having key informants knowledgeable of the market and dispersed all around the world. External information about customers and new technologies can be also gathered from the supply network. Sensing key service partners, suppliers and subsystem integrators plays a vital role in external opportunities searching. To sense a service opportunity overseas, firms must build up strong ties with other parties in an external system such as local contractors, legal parties and consultancy firms. It is also critical to continuously monitor legislators, regulators, governments and financial institutions operating in foreign countries (Teece 2007). Moreover, companies could direct their sensing efforts at a wider service system compromising distributors, service partners, system integrators, third party service providers and dealers. New service opportunities and knowledge can be sourced from universities, research institutes, start-up communities or professional associations.

2.3 Internal employees

Individuals at all levels within an organisation are encouraged to search for and capture ideas internally (Bessant and Tidd 2008) as well as explore distant and unrelated industries or untested service markets. Scheuing and Johnson (1989) suggest various creativity techniques such as brainstorming and screening as a means of identifying promising ideas. Yet, firms providing product-

related services such as maintenance and support, installation and consulting services may face difficulties in supporting both the product and service sales businesses. This implies that sales employees and service technicians should be trained and empowered to make the effective use of selling service offerings (Tether et al. 2012). Staff need to be widely encouraged to understand how both the customer and organisation can benefit from providing customized service solutions to its clients; the commitment being described as 'employee pull' (Gebauer et al. 2005). Sensing requires managerial insight and vision in expanding the potential of an extended service business. Entrepreneurial leaders need to have an individual insight and develop six senses to capture new opportunities. Sensing capabilities include activities that promote a culture of open communication, and create knowledge about the organization's readiness to capture value. The filtered data should flow to the individuals capable of making sense of it (Teece 2007) and specific traits such as learning, interpretation and creative activities developed and disseminated across the firm. Some highlight the importance of creating new organisational roles and systems that should be assigned to particular individuals and departments and put in place to capture often latent customer demands in the service market (Chesbrough and Crowther 2006; Kindström et al. 2013). The impetus for new ideas and initiates may be driven by local enthusiasts in subsidiaries all over the world by appointing 'service champions'.

2.4 Business processes and routines

While internal staff bring individual specific knowledge embedded in their distinct skills and expertise, the tangible resources and infrastructures involve virtually all the codified data and information of the firm – thus can be treated as collective repositories of codified knowledge. To ensure the searching process is dispersed and stays within the organisation, a systematic and structured process for external service searching should be put in place, e.g. a process for gathering and analysing information about the new markets (Fischer et al. 2012). Winter (2003) suggests establishing new policies and documents as a defined process for searching new services and products. Moreover, determining latent customer demand can be significantly enhanced by the application of data analytics. As such, process-mapping exercises can aid establishing new ways of improving current search process, e.g. mapping of semi-invisible services (Paulk et al. 1993).

2.5 Performance measurement

In order to seize and leverage potential opportunities in the service markets, these initiatives need to be properly analysed and evaluated (Berchicci 2013). Manufacturing firms tend to manage the service business in an unstructured and informal manner. Thus, they often fail to distinguish between the turnover, profitability and sales from product and services business, leading to new services being not visible in financial statements or performance measurement systems (Gebauer et al. 2005). Therefore a creation of structured process and performance measurement for service development may result in viewing services in a more transparent way and highlights that service sales drive future product sales.

2.6 Technology exploration

The technology is a crucial enabler of advanced product-centric services (Baines and Lightfoot 2013). Scanning and identifying new technological opportunities leads to new solutions for customers. The adoption of IT and ICTs in service delivery enables to gather and exploit the data about customer behavior and their needs. Moreover, the use of ICTs help monitor equipment, improve the maintenance functions and support systems. Technology sensing does not only involve investments in R&D, but also translating technology advancements into shaping and creating new service propositions (Den Hertog 2010). Top managers need to encourage employees from different hierarchical levels to scan and look for new specialized technological developments both in their local industry and externally beyond the known market, in unfamiliar and unrelated industries (Enkel et al. 2011). Furthermore, cooperating with external ICT specialists can lead to a creation of new technical platforms. In the global market, it is crucial to integrate the internal technical platform with central

information system subsidiaries' or service partners platforms to gather more adequate data about the installed base of existing products (Dodgson et al. 2006).

3. RESEARCH DESIGN

This paper gathers and analyses data on how a UK medium-sized company applies specific service sensing activities to lever new opportunities in various overseas service markets. The questions were devised based on the six clusters identified in the earlier literature review. A leading innovator in laboratory gas generation, Peak Scientific designs, engineers and manufactures tailored on-demand gas hydrogen and nitrogen generator solutions for the Liquid Chromatography Mass Spectrometry and Gas Chromatography markets. The company has shown sustained growth, growing around 30% year on year over the past five years. Peak Scientific has offices in many countries across the world with almost 370 employees, together with a network of authorized distributors and service partners in 70 countries. Selecting a single case study precludes the possibility of generalizing the findings in a wider context. However, an individual case allows the researcher to learn intricate details of how a particular process is working, rather than averaging the effects across a number of cases. It also offers a great chance to observe and evaluate in-depth non tangible and complex phenomena (Kennedy, 1979) and provides a more accurate knowledge of the existing processes and activities in the particular sector.

3.1 Data Collection

The data was gathered using a mixed methods approach including semi-structured interviews, documentary analysis and direct observations of in-company processes and employee activities. The company provided extensive access to key informants at different hierarchical levels and functional areas. The interviews were conducted amongst the Managing Director and those responsible for sales and marketing, service, new product development, engineering, operations and HR and supplemented with financial data, organisational charts, brochures and memos from observed meetings. Multiple data sources were used in this investigation to enhance theoretical triangulation.

4. DISCUSSION

Traditionally, the case company was characterized by arm's length relationships. However, the Managing Director realized there was a huge missed opportunity in selling service contracts with the products. It was the first trigger for the company to actively and carefully search the global markets to expand their service business portfolio and generate new opportunities for value creation. Currently Peak Scientific takes up multiple positions along the product service continuum and offers a range of different service sales for various customer segments: the spare parts, service delivery and commercial contracts sales. The company evidently follows the 'custom servitization' path, transitioning from 'services supporting products' to 'services supporting customers' (Baines and Lightfoot, 2013).

4.1 Customer base

It is crucial to understand customers' key features to quickly identify the demand and offer the right services. Through intuitive understanding of various markets and the responses from the annual questionnaires, the company has become very good at developing a range of servitized offerings for a number of different customer segments. Unlike large part of servitization literature suggest, they had to manage multiple business models and marketing channels in one organisation, rather than providing the same services to all their clients. For instance, the case company would go and sort out the problem, even if it was predominantly the customers' problem. They discussed the issues with the OEM after but wanted firstly to ensure that the customers are constantly supported, either by basic services or customized solutions. The company understood that by providing the whole proposition - uninterrupted gas supply solution to their customers rather than a single product, they could build up trust and closer partnership and grow together with partners as a business, which ultimately results in extending the service contract. For other customer segments, the value proposition differentiating Peak from other competitors evolved around the unique service: excellent

service response time to get the machine repaired anywhere in the world within only 72 hours. According to the Managing Director, "gradually we will have a situation where the world will be covered by Peak engineers … the wealth for the business will come from servicing".

Through monitoring and focusing on local customer needs by country rather than globally, Marketing and Sales Director realised that the customer profiles have changed over time. They discovered that not all of their customers perceived the actual value of the service in the same way or as they had been expected to. Thus, in some emerging markets clients were willing to pay more for a reliable premium product supported by quality after sales service than in others, suggesting varying levels of servitization co-existing within a single firm for different customer segments in different countries. Being a global company, it became critical to understand cultural differences in foreign offices. Close collaboration of local field engineers and customers was enhanced by the appropriate training of engineers to act as trusted advisors when proposing a new service to their clients and led to substantial modification in the design and delivery of services for different customer targets.

4.2 External environment

The ability to market relevant and competitive services and products in a timely manner has become critical if firms are to remain competitive (Teece 2007). Via gathering relevant marketing intelligence, (Kindström et al. 2013), the company carefully scanned the wider global service system in the competitive gas generator market and realized their biggest industry competitor, Parker, did not have the global service infrastructure at the time. As providing quality service in the global market from company's headquarters became challenging, the company applied data analytics and benefited from dynamic managerial experimentation (Augier and Teece 2009). The Service Director felt that the firm has to physically be located near its customers so they set up a network of staff throughout the world to enable to create the global service network supporting their clients. They firstly worked with distributors who sold their products and service to a particular level. However, the management team identified a growing problem that in some places distributors provided poor servicing of Peak products, which directly affected the firm's overall reputation. It required a significant investment for the company but proved to be a successful move as the company has gradually taken over from distributors, opened new offices worldwide and gained complete control over their products.

Sensing another beneficial opportunity in the external market was facilitated by employing dynamic managerial and creative capabilities to engage in scanning, exploring and interpretative processes within an organisation itself (Augier and Teece 2009). Despite huge profit margins from spare parts and service delivery (scheduled maintenance service, condition monitoring service, repair, training), on some occasions Peak Scientific has considered the performance-based contracts for different international markets. For example, scanning and monitoring the government legislations in foreign markets resulted in offering the generator loans in terms of monthly-rental payments to universities in Spain. "Government put infrastructure to universities to get stuff done … we've taken a big health of the contract". Noticing such an opportunity created a long-term message for a relatively new set of customers overseas.

In order to expand the range of service offerings to different individual customers and leverage existing opportunities in the international markets, it was critical to contact the legal experts in overseas regions. Sensing potential opportunities was enhanced by increasing the number of senior managers in the offices all around the world that reported directly to the service manager in headquarters. The top management encouraged sales people to maximise their territory and, when appropriate, move from distributors. In practice, most existing research strongly emphasize that manufacturing firms struggle or even lack a good approach to selling services. Peak Scientific experience was similar; the Sales Team predominantly focused on product sales rather than selling service contracts e.g. offering free installation or a free-year warranty once the product has been purchased. Thus, companies are required to provide training and research across the teams to fully

understand and articulate customer service needs. The case company created a separate service business unit responsible for selling the contracts, reflected by similar examples in the literature (Fischer et al. 2012). Second, moving from distributors simply meant taking over a considerable share of their service partner's market. Peak Scientific sorted that situation by maintaining long standing relationships with their distributors. When it came to overtaking their distributors' market, they decided to make a payment as an appreciation. As the management claimed, it was not an easy process and it required a very close and proper contact with the suppliers.

4.3 Internal employees

Searching for new opportunities requires appropriate management of different sources of information, building models and testing scenarios so that the unmet or latent demand for service needs can be translated and further conceptualized in the following seizing phases. To leverage potential service opportunities, companies must ensure cross-functional coordination of their sensing data. The case company sourced market information by buying the reports on market size. By having key informants that collaborated and spoke directly to their customers, the employees gained valuable data about their forecast plans and markets which in turn facilitated the establishment of new service requirements. Developing a closer relationship with customers was initiated by sensing a need to set up a new cross-organizational team - the Product Management team responsible for market research and scoping various product ranges. Also, looking for new services was facilitated by employee empowerment and the opportunity for teams to own their part of the business. The Service Director noticed different cultural habits in the overseas offices around the globe and thus the need to manage and appraise people in different ways.

4.4 Business processes and routines

Overcoming a narrow search horizon in terms of scanning and exploring service opportunities can be challenging for management teams previously bound to traditional problem-solving competences (Teece 2007). Thus, to avoid the risk of vulnerability of few individuals with proper cognitive skills, organisational processes and routines related to sensing service opportunities should be put in place within a firm. For instance, the case company recently implemented a three level escalation policy for their service, the final being replacement of a faulty compressor with a new brand unit. This also had the opportunity for the company's operations and engineering teams to establish the reason for faults.

4.5 Performance measurement

One of the ways to sense latent demand for service is to send out the annual questionnaire to all the customers. At a company level, the Service Manager run a particular project that involved cross-functional teams across the organisation to figure out what customers expected and how to exceed those expectations. As the company grew bigger, there was a need to formalise systems and procedures.

4.6 Technology exploration

Technological changes often result in new solutions for customers. In this company's case, the main driver causing changes in the mass spectrometry industry was the increasing use of a particular process as an analytical tool which meant a reliable source of gas was required. To seize that opportunity, Peak Scientific put the employees into the global market to try to convert their customers over from buying gas cylinders to generators. As a result, the company has plans to significantly increase turnover, of which a large part will be derived from selling more service contracts to customers who have purchased a Peak generator.

5. CONCLUSION

The research extends the existing body of knowledge on servitization by identifying and organizing key sensing activities into six clusters in the product-centric settings by considering the range of servitized offerings to various international markets. An in-depth analysis of a successful gas

generator manufacturer contributes to the understanding of a number of sensing activities reported in this paper and other firms across various industries may explicitly or implicitly employ those in the real life setting. In fact, sensing involves an entrepreneurial set of activities that includes probing new markets around the globe, gaining knowledge about competitors' offerings, exploring technological advancements, and recognising and understanding both global and local customer service needs (Teece 2007). The evidence shows a case company is clearly engaged in servitizing to some extent with various customer segments and successful at looking for new opportunities for value creation. Peak Scientific appears to take a very structured approach to sensing and seizing opportunities and this is underpinned by the level of global feedback received from their service network. The management determines customer preferences and discovers new channels by applying a set of sensing activities: gathering market information and maintaining competitor intelligence. Through continuously being aware of changing customer demands and requirements, the case company has learnt how to adapt to the environment and introduced proactive changes to services, employed new marketing and sales capabilities and launched new selling propositions. However, the companies need to be aware of different perceptions towards sensing capabilities globally and the extent to which service opportunities can be explored in particular countries due to different cultures, competitors' market and regulations and legislations.

Another contribution lies in challenging significant assumptions in most current studies in the field. Previous literature on servitization exhibit a bias towards adding higher value to a core product through the addition of service offerings and in turn companies taking a single position along the product/service continuum. The reported company managed multiple business models and various marketing channels in one organisation and provides a range of different service sales for various customer segments all over the world. The research findings suggest that even within a single firm varying levels of servitization co-exist across individual customer relationships. The further analysis points out that this variation is driven by varying degrees of receptiveness to servitization within individual customers. The actual value of service delivery and design is perceived differently by various customers, largely dependent on the country of origin externally and business units internally. Moreover, a firm's ability to engage in servitization depends on the extent to which customers are willing to trust the firm. These trust levels themselves are variable and this produces the segmented servitization approach described previously, coined by us as 'custom servitization'. The case company has deliberately tried to engender trust from some of its customers by over-providing. In the short term, it may be more economically defensible to treat a repair as an independent financial transaction but the firm appears willing to go above and beyond the minimum obligation. The level of servitization described in this case study relies on a global presence which comes with the associated costs and logistical challenges of delivering on time anywhere. However, the findings of this single case research study cannot be widely generalized but might promote a wider discussion of academic community and practitioners around the phenomenon called 'custom servitization'. Our future research emphasis will expand the scope and focus on a wider understanding of the contextual factors and underlying processes influencing 'custom servitization' process using interpretative and comparative multi-case approach across a range of various sectors.

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SERVICES AND SERVITIZATION: PROVISION IN THE SAUDI PUBLIC HOSPITAL SECTOR

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ABSTRACT

Purpose: The primary purpose of this paper is to consider the use of servitization, and the importance of taking care in its implementation, within the Saudi public healthcare sector. This will considered here in an incident concerning the maintenance of oxygen tanks, as well as the King Abdullah Medical City (KAMC) more generally, and largely, the latter being the focus of most of the research work.

Design/methodology/approach: The research carried out for this paper involved collecting information from secondary sources as well as primary data drawn both from the initial research trip to Saudi Arabia and two informal interviews with Human Resource (HR) staff conducted over the phone and by email. The wider research selects an action research, case study approach to help enable local-level improvements and amelioration of potentially wider organisational issues.

Findings: The preliminary findings are outlined at this stage; it is expected that the full qualitative and quantitative findings of this mixed methods research will be available for analysis in 2016.

Originality/value: A dearth of studies focusing on servitization in a healthcare context has been identified in the literature.

Key words: Servitization, Lean Thinking, Healthcare, Saudi Arabia, ERP

1. INTRODUCTION

A ubiquitous and inevitable gap separates theory and practice since implementation is never a 'one size fits all' process, but should always be unique and context specific (tailored to the individual environment or specific service users). This gap requires careful bridging because failure may lead to tragic consequences in terms of patient safety. For example, recently a Saudi hospital employed servitization for the supply and maintenance of tanks of oxygen and other gases tragically leading to a trauma surgeon being left ill-equipped to save a young person's life due to a technician mistakenly labelling nitrogen dioxide as oxygen (Okaz 2013). Here, the situation should have been more carefully considered, leading to the adoption of a holistic approach to the outsourcing of this crucial service. This might have been achieved through incorporation of in-house safety checks within the quality control or maintenance departments to complement (and critically verify) the outside company's work as a safeguard in order to eliminate human error. It is likely that this would then have rendered the resultant shut-down of the entire hospital unnecessary; meaning that the inefficient cessation of all services could have been avoided. This example is interesting and pertinent to the context since it was not a medical mistake, but rather a technical error and failure of communication. A hospital or other health services provider, be this a private or a public organisation, always retains public liability and thus must consider patient safety with every step it takes. Management must keep this at the forefront of their minds at all times (Gaba 2004). The case study for the broader doctoral research is the Saudi public sector hospital, KAMC. This selection was confirmed, in part, due to early indications that employees here were more adept at communicating than their counterparts in other healthcare institutions. This was drawn from an informal interview conducted with the HR Quality Manager during the first research trip with wide experience in the field at a range of healthcare providers.

2. BACKGROUND

Schmenner observes that the concept of servitization precedes later lean thinking. He defines servitization as "charging for the flow of services from a manufactured product and not for the product itself" (Schmenner 2012: 263). In accordance with Baines and Lightfoot (2013)'s approach to

servitization, the clear division of manufacturing and service-based corporations should be rendered less distinct. Their definition of this term emphasises the importance of greater tailoring of services offered. Therefore, it is imperative that KAMC keeps its service users (primarily its patients, but also its staff) in mind at all times during the process of deploying greater servitization, and tailors its approach to them. A holistic way of thinking about both the service user and the organisation in its entirety is mandated by this reading of the concept.

2.1 Servitization in a HR Healthcare Context

In the pattern of what occurred with the oxygen tanks, when a tragic mix-up took place, we can start to see a framework emerging for an improved way of implementing servitization safely. The potential increase in the Human Resource department's outsourcing of consultancy and advisory services, such as retirement planning or advice, must be implemented with the requisite checks and balances to ensure that employees' pensions are not unduly put at risk. This would include, as a minimum, retaining at least one experienced member of staff with expertise in the field of pension planning and investments. This would make certain that inappropriate or unnecessarily risky advice from an outside consultant is not unwittingly followed, jeopardising the financial security of the latter stage of employees' lives. Naturally, it must be remembered here that the hospital has a clear and evident responsibility to its staff as well as to its patients. Any inefficiencies in the doubling up that this approach requires are more than cancelled out by the avoidance of catastrophic, and highly inefficient, consequences. With a technician's error, these consequences include the potential shut-down of the whole hospital, which is what happened on that occasion. Furthermore, (potentially prolonged) strike action, as well as lowered employee retention figures are possible. These might well result from employees learning their pensions had been halved in value, due to management blindly following an outside consultant's poor advice. Similarly, it is within the purview of KAMC, or any other health services provider, to outsource the health and safety element of its employee training. However, the institution itself retains responsibility for ensuring the adequacy of this training in terms of both patient and staff safety. Thus, it is important that HR employees continually and thoroughly review the impact of any such training as part of its continuing employee development. Adaptability, continuous learning and the acquisition of new skills are important to both servitization and achieving lean processes (De Cnudde et al. 2004; Martinez and Turner 2011). Even something which may initially possibly seem fairly innocuous, such as refectory/canteen services, can have a potentially devastating impact on both patient and staff safety, and on the efficient running of the hospital as a whole. This is because if outsourced to a company with an unreliable hygiene record or poor health and safety training for its own employees, this might even, in a worst-case scenario, result in the temporary cessation of all hospital services. As such, it is critical that prior to hiring an outside catering contractor, this company is sufficiently researched. In addition, spot checks must be carried out by a permanent member of hospital staff who has undergone the necessary training. This is currently being done by KAMC's Investment department.

Analysis of informal interviews from the initial information-gathering research trip also indicates, encouragingly, fairly low employee resistance to change and the recent removal of two redundant management levels. Organisational culture, as well as the hierarchical structure and wider context of the institution, have been identified in the literature as key barriers to servitization (Hou and Neely 2014). Thus, these positive indications in these areas form part of why this hospital is being used as the case study for this work. This understanding was gained as a result of the first research trip which included descriptive data obtained through observational work to ascertain what the current situation is like, and to start to formulate ways in which it could be improved. This is critical as any organisation must successfully incorporate change and flexibility in order to become lean and effective (De Cnudde et al. 2004). A recent study recommends revisiting and re-examining (possibly increasing) existing servitization in healthcare, finding increased versatility of product/service mixes, reduced operational risk and boosted productivity (Velikanov et al. 2014). The efficiency and effectiveness of service delivery, as well as the expense involved, can all also be enhanced through

increased use of servitization (Baines and Lightfoot 2014). These naturally bring with them a competitive advantage. There is an observable trend moving in the direction of servitization within healthcare services delivery exceeding a similar trend in other industries. This is despite a dearth of academic research and case study work within the literature on this subject (Mittermeyer et al. 2011). This identified gap in the literature is what this work is intended to fill. Furthermore, concerning decreasing health hazards, it has been observed that a more developed insight into introducing and continually improving product-service solutions is required (Abdalla et al. 2005). Neely and Benedettini (2010) also conclude that further work into the specific challenges posed by and benefits derived from servitization, in areas other than manufacturing, will amount to a valuable contribution. Healthcare providers must meet the challenge of increasing demand for dynamic, practical, sustainable and patient-focused institutions. This is often coupled with the additional challenge presented by budget cuts, especially during the ongoing financial crisis (Morrison 2014). However, this is not likely to be a serious consideration for KAMC, as will be seen. The aimed-for improvements of this research may well help meet the challenge identified here.

Healthcare delivery generally, and within Mecca particularly, evidently needs the efficiency savings that servitization and/or lean practices can facilitate. Clearly however, this demands sufficient research identifying challenges and ways of overcoming them safely. Velikanov et al. (2014) identified the importance of hospitals both understanding the strengths and weaknesses of new services and initiatives, and retaining the autonomy to determine optimal solutions for their own individual problems and perceived needs. HR's possible expansion of outsourcing consultancy, advisory services and health and safety training must constantly consider public liability. After recently inquiring at the Health Economy department of KAMC the researcher learned that the legal advisors are in-house which arguably helps to ensure that liability issues are covered. In tendering outside contracts including canteen and cleaning services, the sole consideration is cost, with contracts consistently awarded to the lowest bidder, which is a matter of concern, as no consideration is given to the quality of the services that will be provided. However, the hospital's Investment department has responsibility for carrying out follow-up checks with these companies and imposing monetary fines if they breach the terms of their contracts and do not provide services as agreed.

3. ENTERPRISE RESOURCE PLANNING (ERP)

ERP involves using one software system to assimilate every service, process and department within an organisation. ERP is thus a way to sort out, standardise and describe the services required for successful and efficient planning and running of the organisation to enable it to utilise its interior understanding of itself to make exterior gains (Blackstone and Cox 2005). Despite four fifths of private Saudi hospitals now using ERP, KAMC is something of a pioneer in the public sector in that its Human Resources (HR) department is beginning to implement ERP. It is not however, highly unusual in doing so within Saudi healthcare delivery. In fact, in a recent study of private sector Saudi hospitals, it was determined that 83% of them either have implemented, or are in the process of implementing, ERP (Abukhander 2014). This broad move towards using ERP within Saudi healthcare, coupled with the wider trend identified above of healthcare providers using servitization more than other industries and lack of work in this area (Mittermeyer et al. 2011), helps in understanding the rationale behind the choice of this research topic. This means that it has the potential to make a valuable, and needed, contribution to both theory and practice. A recent broad study found that that servitization is typically more beneficial, and brings with it fewer risks, in complex areas of work, as opposed to more simple and straightforward ones (Neely and Benedettini 2010). Although the focus of this research study was on manufacturing firms, since healthcare is undeniably a complex arena, it is clear that servitization also has the potential to bring benefits to this context.

It has been concluded that: "not only do products take on service characteristics through servitization, but with extensive use of IT in services, services may take on some of the characteristics

typically associated with products, that is, standardization, storability, and separation of production and consumption of the service" (Barrett and Davidson 2008: 3). There are appreciable benefits to a healthcare context: Abukhader (2014) found that over three- quarters of private Saudi hospitals using ERP achieved the advantages cited in the literature. In addition to the enhanced understanding of the internal working of the organisation, the standardizing effect and so forth. noted here, within healthcare delivery, the literature indicates that there is another significant advantage to be derived from ERP implementation: IT used in combination with electronically-stored medical records- permits medical personnel to use profiling information to recognise patients who would optimally benefit from certain interventions; this works similarly to profiling information within market research being used to recognise potential customers. Additionally, staff are able to increase the tailoring of an individual patient's prescribed drugs using such profiles (Fichman et al. 2013).

4. SAUDI ARABIAN GOVERNMENT SPENDING

The government budget has been increased over the years meaning that the domestic Ministry of Health (MOH) budget has likewise also risen. [Table 1 shows] that, aside from a brief reduction in the budgetary healthcare provision coinciding with the start of the global economic downturn (in terms of the percentage of funds allocated to MOH), there has been a steady and continuous increase in both the total government spending and the MOH Budget as a proportion of this. It has been concluded that servitization typically provides a buffer against factors including financial instability (Neely and Benedettini 2010). The general government spending increase means that there is greater potential for the implementation of additional policies. However, the potential benefits to the service users must always be considered as a critical aspect of decisions regarding the allocation of financial resources; greater abundance of funding does not automatically equate to service improvements.

Year	Total Saudi government Budget(SR)*	MOH Budget (SR)	MOH Budget %
2007	380.000.000	22.808.200	6.0
2008	450.000.000	25.220.000	5.6
2009	475.000.000	29.518.700	6.2
2010	540.000.000	35.063.200	6.5
2011	580.000.000	39.860.200	6.9
2012	690.000.000	86.500.000	12.5

Table 1: MOH budget (MOH 2013) Table of the MOH Budget for the years 2007-2012, as Compared to the overall State Budget (in thousands of Riyals): £1= 6.5 Saudi Riyals (SR)*

5. THE STRUCTURE OF HEALTHCARE SECTORS IN SAUDI ARABIA

Through the imposition of centrally formulated policies and a regulatory structure, the MOH controls to a large extent the delivery of all healthcare within the country, be this public or private, although naturally its management of the public sector is more all-encompassing and the private sector healthcare providers retain a greater degree of autonomy. The state provision of services covers all levels of healthcare (primary, secondary and tertiary) free of charge to the public and to those

temporarily resident in Saudi Arabia. This includes quality control through monitoring the performance of public sector employees as well as both curative and preventative medicine, and the development of new approaches through research efforts. Various agencies, including the National Guard, provide healthcare solely for their own staff and their families, with the exception of emergency care provision which is open to all, [as shown in Figure 1] (Ministry of Health Portal 2013).

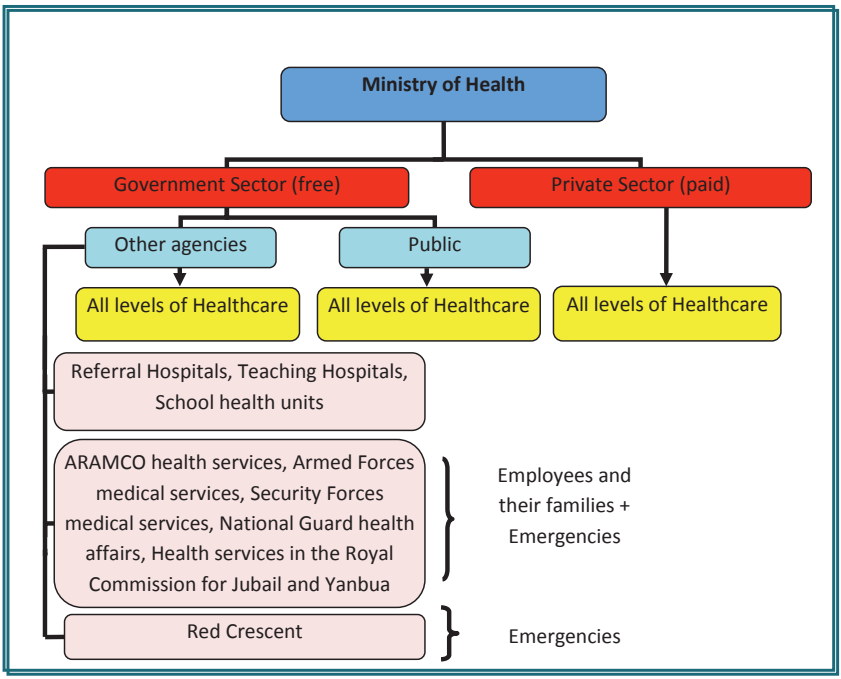

Figure 1: Structure of Saudi Health System (Ministry of Health Portal 2013)

Given recent growth of both Muslim populations (demographic data indicates these exceed two billion) (Muslim population 2014), and communicable diseases globally (seeming proliferation of pandemics), safely delivering effective, efficient healthcare in Mecca has never been more important; ranking highly on the political agenda. KAMC is a fairly new, flagship public sector hospital coping with an influx of millions of regular and sporadic pilgrims entitled to free healthcare. According to figures from city officials, the number of pilgrims to the Holy City (Mecca) has reached about 20 million annually, and is expected to increase to 30 million following completion of expansion projects within the city (Okaz 2014). This is a huge number, particularly when considered in its proper context: Mecca's permanent population is only 1,675,000 people and the population of the whole country is itself almost 30 million people. This figure is rising by an average of 2.3% yearly (Albejaidi 2010; World Population Statistics 2013). Approximate figures for numbers requiring medical attention are difficult to obtain, but if we consider that according to the Organisation for Economic Co-operation and Development there are 3 hospital beds per 1000 people in the UK, and that this is low for Europe, since Germany has 8.3 per 1000 and Poland has 6.6, then we can start to appreciate the size of the issue (Guardian 2014). If we average these three example figures out we obtain 5.97 hospital beds per 1000, which means that Mecca would currently require almost 130 thousand hospital beds to cover current pilgrimage figures, with this potentially rising to almost 190 thousand post-expansion. Consider the country's total demographic: Saudi nationals account for

46.1% of the total workforce, with non-Saudis accounting for the remaining 53.9% percent. Within these figures, there is a marked public/private split: immigrant workers make up 60.2% of private sector employees, whereas, Saudis make up 86.1% of government sector employment (Ministry of Economy and Planning 2007). The permanently international nature of the Saudi population, along with the aforementioned large-scale migrations, and the specific health challenges posed by this reality (such as unvaccinated workers from countries with poorer healthcare provision) combine to result in the spread of diseases spreading if they are not adequately dealt with. This helps to explain the purpose of the research by assisting to establish its value; improvements to public healthcare service delivery are evidently needed given the scale of the contextual challenges presented. The Ministry of Health's provision incorporates quality control, research development and new initiative responsibilities.

6. DISCUSSION AND METHODOLOGY

This paper highlights the ongoing move toward servitization in the Saudi healthcare context. Presently, a major study has been planned in collaboration with the King Abdullah Medical City Hospital with the approval of the Saudi authorities. The initial work is being carried out with the HR Department, who are both willing and enthusiastic to enhance their service offering to their user community. It is anticipated that the qualitative and quantitative findings of this major study will be disseminated next year. The research goal of the overall study is to discern what benefits lean thinking can potentially bring to Saudi healthcare and to consider culturally specific implementation challenges. The associated objectives designed to help achieve this goal are: investigating the operational process of a typical hospital; establishing which quality tools are currently applied; determining the limitations of current systems; investigating the potential of lean thinking to enhance hospital operations, taking into consideration the cultural aspects; determining how effectively KAMC's budget is utilised; ascertaining the current standard of services; and determining how frequently new services and innovations are introduced. An inductive research approach will be used in this work and an interpretivist philosophical paradigm will be adopted with regard to the nature of the research objectives. However, given the importance of ascertaining problems in the current systems and gaining a broad understanding of the organisational culture of KAMC, mixed methods will be used in the collection of the data. It is anticipated that ten informal semi-structured interviews will be conducted with HR personnel and further, that a survey data capture method will be used, predicted to incorporate a questionnaire for approximately one hundred respondents across all departments. The data from the questionnaires will be analysed using the widely used Statistical Package for Social Sciences (SPSS) (Saunders et al. 2009). Observational, thematic and statistical analyses will be utilised, and triangulated to decrease bias.

7. CONCLUSIONS/FURTHER WORK

In sum, this paper is in essence a preliminary discussion of examples of servitization in healthcare, with a focus on Human Resources, and it recommends that King Abdullah Medical City give serious consideration to adopting a holistic approach to the outsourcing of its services. Advantages of both servitization in general and Enterprise Resource Planning specifically have been noted in terms of their implementation in a healthcare context, which in turn, result in additional benefits for patients. These benefits include an enriched understanding of the internal structure and working of the organisation and a more personalised approach to individuals' healthcare needs and treatment. In terms of the advantages of servitization, they are found to include decreased operational risk and cost, enhanced competitive advantage, productivity, and increased efficiency and effectiveness of service provision. The high priority that the Saudi government has given of late to healthcare has also been noted. This has helped to secure free universal healthcare both for the country's permanent population, and for the large numbers of pilgrims coming annually to Mecca. The researcher is on a journey to help to implement lean thinking within Saudi public sector hospitals. KAMC has been chosen as a case study, but it is hoped that recommendations offered here may be extended to other hospitals, once the aimed-for improvements have been achieved.

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TRANSITION TOWARDS SERVITIZATION IN CONSTRUCTION: A CASE STUDY IN HEALTHCARE

William G. Robinson & Paul Chan

ABSTRACT

Purpose: This paper aims to demonstrate the role played by the ongoing technological development of products in conditioning transitional practices towards servitization and hence why empirical studies must devote greater attention to what the product does when examining transitions towards servitization.

Design/methodology/approach: A case study methodology is applied to a healthcare project in the United Kingdom to explore how ConstructCo were making the transition towards greater servitization. We used activity theory to explore technological development of Mechanical & Electrical products as a tool for mediating human action towards greater servitization.

Findings: By tracing out these technological developments we show how the Mechanical & Electrical products acquire three emergent properties. These are identified as: complexity, criticality and intelligence. These properties are conditioning our interviewees to develop new transitional practices.

Originality/value: Our research highlights the need to explore the role played by technological properties in shaping transitional practices towards servitization. Furthermore, by tracing out the relationship between emergent product properties and conditions for servitization, we suggest that construction is not lagging per se, because industry-specific conditions are pivotal to the conceptualisation and development of servitized offerings.

Key words: Servitization, technological properties, activity theory, construction, M&E products

1. INTRODUCTION

Servitization describes the transformation that product-orientated firms undergo as they pursue service-based operations. The extent to which these firms re-position their business activities towards aftermarket opportunities can vary so Baines et.al (2013)'s framework emphasizes the importance in making a distinction between these varying levels of servitization. Research has now begun to articulate in considerable depth the key aspects that firms must consider when they make the transitions between these different levels of servitization. Supplier relationships, organisational structure, organisational culture, revenue models and contractual frameworks are all identified as key areas of focus. However, commentators often overlook the role of the manufacturer's product when considering how transitions between these varying levels of servitization play out in practice. In this study, we draw upon an ongoing case study of how servitization is incorporated within the building of a new healthcare facility. Manufacturers of mechanical and electrical products in the construction industry have typically been perceived to struggle to capture significant value in the product aftermarket. Nevertheless, in this case study we observe how ConstructCo have begun to shift the emphasis towards developing life-cycle solutions, underpinned by customized functions or outcomes. We draw upon activity theory to explore the role played by products in mediating human actions towards more servitized objects (see. Engestrom, 1999). Our findings suggest that specific characteristics (product complexity, product criticality and product intelligence) of the mechanical and electrical products are conditioning the organisational processes of ConstructCo towards the delivery of advanced services. From this we theorise whether industries like construction aren't lagging behind per se because industry-specific conditions are pivotal to a product's acquisition of these technological properties.

2.THEORETICAL BACKGROUND

Provisions of spare parts and equipment repairs have always provided product manufacturers with significant supplementary revenues. Manufacturers have always been active in the product aftermarket in some capacity, but trends towards servitization suggest that they are now transforming their organisations to deliver new types of services (Ulaga & Reinartz, 2011). Recent trends suggest that the lucrative revenues some manufacturers are now generating from these product aftermarket opportunities is now compelling these firms to shift their entire business operations more comprehensively into service sectors (Wise & Baumgartner, 1999). Servitization is the term, first coined by Vandermerve & Rada (1988), used to describe the transformation that product manufacturers undergo as they pursue these new service-orientated operations. Numerous authors have now began to develop a distinction between those services that have historically been offered by product-orientated firms and those typically associated with servitized operations. Mathieu et.al (2001) differentiate those services that support the product from those services more commonly associated with servitized practice that support the client. Ulaga & Reinartz (2011) deconstruct this typology of services down in greater detail. They deduce that we must categorise services into 4 segments: product life-cycle services, asset-efficiency services, process-support services and process-delegation services. More recently, Baines et.al (2013) began to unpack these differing levels of servitization by classifying them in terms of base, intermediate and advanced services. Base services are explained as those services focusing on the provision of a product, intermediate as those designed and delivered to maintain a product's condition and finally advanced as those focused on delivering a capability through the medium of a product. By developing these three levels of product-service offerings, the transition from pure-product manufacturer to product-service provider is broken down into more manageable intervals.

Understanding how firms manage the transition between these different levels of servitization has become a key concern within the servitization literature. Organisations must develop a clear service culture (Olivia & Kallenborg), which filters right down the organisational hierarchy. There is emerging evidence (Gebauer et.al, 2009) suggests that organisational structure can have positive effects on developing a service culture and business performance when making the transformation towards product-service provider. More specifically, they identify the imperative to develop a separate division within the organisation devoted to service delivery. Equally important is the need to instil greater service orientation within existing product-orientated departments of the organisation. Martinez et.al (2010) explore the need for new performance measurements and the pivotal role they can play in translating strategic intent into operational reality. As organisations move away from purely product-based operations they are compelled to understand that added value in the aftermarket lies increasingly within their interactions with other actors in their value chain (Storbacka et.al 2011). Not only is value-co-created in the through-life interactions with their customers but equally in the way they interact with their supply chain (Windahl & Lakemond, 2006). There is a need to shift away from traditional supply chain practices underpinned by cost-focused procurement routes and towards procurement routes that incentivise a greater focus on creating value for the customer through the life of the product. Lyals (2014) explores the role played by value-driven supply chain practices in enabling an aero-engine manufacturer to deliver advanced services. Transforming contractual relationships with customers is instrumental in creating a business case for the delivery of advanced services (Ng et.al, 2009). It necessitates a radical re-assessment of how firms intend to make money (Bonnemerier et.al 2010). Whereas traditional business models tended to reward equipment manufacturers with greater revenues when their products failed, servitization requires firms to generate revenue on the basis of delivering customized outcomes which are determined by the reliability, efficiency and availability of their products over an extended period of time (Ng et.al 2009)(Caldwell & Settle 2011).

By unpacking the key aspects of the transition towards servitization, the literature offers key insights into the hurdles that manufacturing firms face, as well as the types of capabilities that firms must

develop, when they make the transition through these different levels of servitization (basic, intermediate, advanced). However, when unpacking these different challenges and capabilities, the role played by the actual products in conditioning management practices towards greater servitization is often neglected. In fact, a recurring theme within the literature is that as firms pass through the different levels of servitization the importance of the product diminishes. It is evident within the literature that advanced services are commonly associated with products that have distinct inherent properties. These properties are identified as product complexity (Nordin et.al, 2013), product intelligence (Vendrell-Herrero et.al 2014) and those products that acquire critical properties because of the environments of their use (Lay 2014). Whilst these properties have been identified within the literature, the role these properties play in conditioning transitions between these different levels of servitization is often overlooked. Therefore, more attention should be paid towards the role played by emergent properties of the actual products when addressing how a firm's transition towards advanced services delivery plays out in practice.

3.RESEARCH DESIGN

3.1 Activity Theory

The literature review highlighted the lack of attention paid towards the product aspect of product-service offerings when observing transitional practices towards greater servitization. The aim of this paper was to understand the role played by the technological development of assets in conditioning transitional practices towards servitization. We used two key concepts within Engestrom's activity theory to frame our research design and explain our findings (Engestrom, 1999). Firstly, that tools (instruments) are essential in shaping the way human beings interact with reality. Secondly, activity theory (Engesterom, 2000) makes a clear distinction between short lived goal directed actions and collective object-orientated activity systems. Activity theory argues that short lived goal directed actions can only be understood and interpreted once they are viewed in the context of the wider collective activity system. A change in collective activity is driven by a "deeply communal motive" (Engestrom, 2000). Drawing upon these concept's we can depict servitization as a socially constructed practice in which new technological developments represent the instruments mediating interaction of individuals within ConstructCo and their supply change in respect to new objects of activity. As we will explore this new object is now increasingly maintaining the availability and performance of these energy centre technologies.

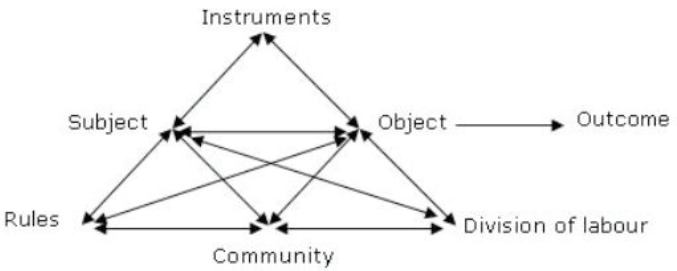

Figure 1 - Engestrom's activity theory (Engestrom 1987)

Activity theory is typically composed of 6 main components and we use Hartmann & Dewulf (2009)'s translation of Engestrom's work:

1) *Subject:* refers to persons involved in human activity.
2) *Object:* the societal motive of activities which defines them and separates them from other activities.

3) *Tool:* the physical or conceptual artefact through which an individual's interaction is mediated.
4) *Community:* Individual action is embedded in communities.
5) *Rule:* mediates the interaction between the community and the object.
6) *Division of labour:* the mediating aspect of the relationship between the community and the object of an activity.

3.2 Case study Background

The case study focuses on those Mechanical & Electrical systems that are located within the confines of the hospital's energy centre on a healthcare project in the United Kingdom. These systems (refer to figure 2) are typically referred to as primary energy conversion systems and refer to those systems and technologies that convert primary energy sources (gas, electricity etc) into useful energy streams (usable heat, usable cooling, usable power). Traditionally, the emphasis was upon ConstructCo and its supply chain to design, manufacture and install the equipment in the energy centre (base services) and then elements of the supply chain would provide periodical preventative maintenance, spare parts and reactive maintenance (intermediate services) during the operation and maintenance of the building. On this particular healthcare project ConstructCo were engaging with their supply chain to explore the viability of a new service model geared towards the delivery of advanced services. No longer would their operations be focused on the delivery of products (e.g. Boiler system) but now ConstructCo were exploring the viability of selling the building client the function's that these products deliver to the building (e.g. useable heat).

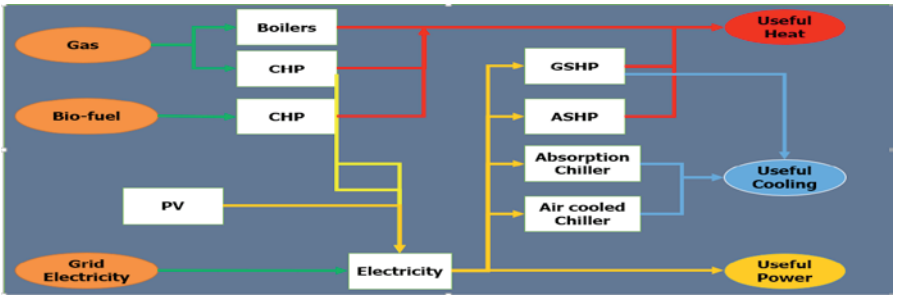

Figure 2 - Layout of the energy centre technologies

3.4 Data collection

The research draws predominantly upon 16 semi-structured research interviews. The case study is part of the wider research exploring servitization within ConstructCo. These interviewees were selected by tracing out the different actors that were enrolled (see, Latour 1986) by the energy centre technologies over the projected life cycle of the project. They included project participants within ConstructCo and across the project supply chain. The purpose of these interviews was to understand the interviewees' perspectives towards the viability of this new service model. In the interviews we explored: (1) how the new model would change their everyday practices, (2) the suitability of the products within the energy centre as a platform for this new service model, (3) their motives towards greater servitization and (4) where contradictions were evident between the proposed new service model and their current everyday practices. Interviews were also supplemented with case study documentation which included schematic drawings, predicted equipment life-cycle costs, technical submissions, O&M manuals and design specifications to provide the researchers with a clearer understanding of the structure, function and criticality of the technological systems in the case study.

3.4 Data Analysis

The research team thematically coded the resulting transcripts. In the context of this paper we were particularly interested in how our interviewees referred to the technological and lifecycle properties of pieces of mechanical and electrical equipment as they probed both the implications that this service model would have for their everyday practices and the logic of adopting this new service model. We wanted to know how technological developments specific to these energy centre products and this project were conditioning our interviewee's to think in a more servitized way. We traced these technological developments through 3 clear categories. These were the product characteristics that these developments had seemingly enabled the energy centre technologies to acquire: increased complexity, increased criticality and increased intelligence.

4.FINDINGS

In this section we assume that the collective object-orientated activity within ConstructCo and its supply chain is now the delivery of advanced services. This is in the form of selling usable cooling, heat and power at a fixed hourly rate. The total maintenance costs, utility costs and capital costs are packaged into this one fixed hourly rate. We use activity theory to explore how the changing object of activity means the mechanical and electrical products (the tools) acquire new emergent properties, which then condition the everyday practices of our interviewees (the subjects):

4.1 Product and system complexity

The organisation's transition towards servitization is naturally forcing ConstructCo to take into greater consideration the life-cycle requirements of the technologies within the energy centre. They and their suppliers are now focusing their efforts on ensuring the availability of useable heat, cooling and power to their customers within certain performance parameters. These performance parameters are being determined by the demands of the customer through the medium of the NHS's energy targets. Throughout interviewees' accounts we observe how this new object of activity is conditioning the mechanical and electrical systems within the energy centre to become more complex. Below we pick out two examples of our interviewees' references to increasing product complexity in terms of variety of technologies and greater systems interdependency. Participant A refers to a greater variety of technologies. He refers to the fact that previously usable heat (object) would have been produced via boiler systems but now a combination of Ground Source Heat Pumps, CHPs and Boilers now work in unison to deliver this single outcome.

"you've had to become more knowledgeable about other products, not just pipes and pumps and boilers…. You're looking at ground source heat pumps and CHP and PV photovoltaics." (Participant A - Product sales manager – CHP manufacturer)

Whilst participant A introduces the idea of an increased level of variety, Participant D is more concerned with the greater interdependency between different systems:

"The absorption chillers we use are slightly different to a refrigerant cycle, but you actually – it uses a different medium where you actually pump heat into it. It's a different way of actually generating cooling. It's very inefficient compared to an air-cooled chiller. However, because we've got lots of heat, we're generating lots of CHP engine heat, we can afford to use a small amount of heat to actually generate cool." (Participant D – Design Manager)

In this example, we observe that the most efficient way of generating usable cooling is dependent on the amount of run-hours of the CHP.

This emergent complexity is now shaping the development of new practices within ConstructCo. Participant A refers to the fact that ConstructCo are now learning about new more energy-efficient technologies. Meanwhile, Participant D reflects on the development of new system integrative

practices that are enabling ConstructCo to understand in greater detail the interdependencies between different sub-systems when they are inoperation.

4.2 Equipment Criticality

The perspectives of our interviewees suggested that the implications of product failure over the lifecycle began to become more prevalent in our participants' everyday practices. Certain prod ucts within the energy centre under specific conditions began to acquire critical properties:

"One chiller, two circuits, and if that goes down it affects the sterilisation units in the hospital." (Participant – F aftermarket sales manager)

This chiller acquires critical properties in the hospital context because the consequences of usable cooling not being delivered to the theatre are costly. The next interviewee explores another aspect of equipment criticality.

"Generally speaking, the bigger the plant, the more end-users for that power there are ….. So you could say the larger the equipment the more important maintenance …. the more expensive it will be replacement component wise , if it goes down the more it impacts, the cost of it is huge, it's supplying a lot more parties." (Particpant N – Service manager)

In building environments such as hospitals, the equipment is typically larger and cost implications of equipment downtime are more severe. The participant then continues:

"I skip down and work out what are all of the components that could potentially fail for this equipment…….and what is the typical failure rate, say for example 1/10, 1/10 of this equipment is going to fail over the course of the year. What is the value for that?"

We observe how the criticality properties of plant are conditioning this interviewee in his everyday practices to understand the likelihood of failure of this particular product.

4.3 Product Intelligence

Servitization research explores the role played by diagnostic and prognostic sensors in enabling the delivery of advanced services (Baines et.al 2011). Servitization is driving the need to develop a clear boundary around the performance of the energy centre which is separate to the performance of the mechanical and electrical equipment in the hospital external to the energy centre and the usage processes of end-users. ConstructCo are installing energy sensors on all equipment within the energy centre right down to the component level to develop an energy management platform which can facilitate the development of this boundary. In so doing the participant below observes how the interaction between the M&E products and the energy management platform means the products develop emergent intelligent properties. The M&E products do not change but the shift in activity towards selling use means the products acquire a human-like property of intelligence.

"why we're designing a platform to deliver this, if the demands change, the actual energy solution will divvy up to actually deliver that. But what we will have to do then is disseminate that information. Say, for instance, we've only allowed for half the hospital to run twelve hours a day and the client has decided there's a change in requirements and the whole hospital, the whole year runs 100%. So that system will deliver the energy to the client, because the client will need it, but we need some mechanism to actually say, "Well, you know, that department, acute kids department, that was the energy that we were responsible for, because recently it was going twelve hours, but that other energy, within another twelve hours, we have to collect and say, "Well, actually, that's because you've run that department." (Participant J – Environmental manager)

The intelligence of the product is actively conditioning the way in which this interviewee thinks about how they will develop transparency for the customer when illustrating whether the energy centre is fulfilling its performance requirements.

5.CONCLUSIONS

As suppliers of the mechanical and electrical products seek to sustain their competitiveness, the imperative is growing for companies to move up the value chain and expand their portfolios to provide more service-oriented offerings. The literature provides insights into how key aspects of their organisational processes must be transformed on the path towards greater servitization. However, there is a paucity of research that focuses on those companies that are in the intermediate stages of the process of tackling the challenging transition towards advanced services delivery. Our research draws upon case study data to explain the ways in which new objects of activity (geared towards servitization) were conditioning the emergence of key technological properties over the prospective lifecycles of the energy centre equipment. These technological properties were in turn mediating people within ConstructCo to act and think in a more servitized way. Therefore, the contribution of this article to the servitization literature is two-fold. Firstly, Baines et.al (2013) provide a useful framework in enhancing our understanding of what the transition between different levels of servitization entails. In this paper we argue that we can effectively build upon this framework by paying greater attention to the role of the product in these transitions. This will enhance our understanding of how these transitions play out in practice. Numerous authors (Baines et.al 2011) (Ulaga & Reinartz, 2011) have discussed why the intimate relationship between a product and its manufacturer enables the manufacturer to acquire a unique advantage in the services aftermarket. However, we argue that future research must deconstruct in greater detail how strategic motives towards servitization are influenced by the affordances of those emergent technological properties which are products of technological development and situated use. Secondly, our findings raise some particularly interesting questions for practitioners within industries, like construction, where the motive and logic to deliver advanced services is seemingly less obvious. Capturing environments where equipment performance is perceived to be more critical and where interdependent technologies support a wide array of functions may stimulate greater opportunities for firms within these industries to capture greater value in the aftermarket.

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SMART SERVICES INITIATIVES IN PRODUCT-CENTRIC COMPANIES

Mario Rapaccini & Paolo Gaiardelli

ABSTRACT
Purpose: This paper investigates the linkages between servitization strategies and digital technologies, pointing out the characteristics of technology-enabled services (i.e. smart services) offered by manufacturing companies.
Design/methodology/approach: An extensive literature review is provided to build a theoretical framework linking servitization strategies and digital technologies.
Findings: Digital technologies have different role as they enable incremental, product-dominated servitization rather than radical, service-oriented/customer-centric servitization.
Originality/value: this paper represents the first attempt to shed light on the linkages among digital technologies and servitization strategies, building on interdisciplinary research on technology-driven service innovation, servitization of manufacturing companies and on studies from service dominant logic and service science.

Key words: technology-enabled services, servitization strategies, ICTs, digital technologies, smart services.

1. INTRODUCTION

Digital technologies are radically changing the way services are delivered (Ostrom et al. 2010, Davis et al. 2011) so that it is said that "the service revolution and the information revolution are two sides of the same coin" (Rust 2004, p. 24). Although innovation driven by new technologies is examined so far in service management research (Barret et al. 2015), scholars dealing with servitization of manufacturing firms have still "a limited awareness or appreciation of the use of information and communication technologies that are enabling many servitized manufacturers to deliver sophisticated product-centric service offerings" (Lightfoot et al. 2013, p. 1421). Despite previous research widely debated on servitization (Oliva & Kallenberg 2003, Neely 2008, Baines et al. 2009), few studies have focused on the role of digital technologies (Kowalkowski & Brehmer 2008, Kowalkowski et al. 2013, Grubic 2014). This paper aims at filling this gap as it investigates: 1) the linkages between servitization strategies and technology-enabled service-based offerings (hereafter, smart services); 2) the characteristics of smart services initiatives in B2B and B2C settings. The rest of the paper is, therefore, organised as follows. Section 2 introduces previous studies on servitization together with a brief review of the literature dealing with digital technologies in service innovation. Section 3 presents the research framework, which is discussed in Section 4, while Section 5 draws some conclusions and points out limitations and avenues of future research.

2. THEORETICAL BACKGROUND

This literature review is composed of two sub sections, which cover servitization strategies and digital technologies in servitization.

2.1 Servitization strategies

A wide range of internal and external factors can influence servitization strategies (Cook et al. 2006). Moreover, extent literature suggests that ideal trajectories to shift to a service-based business do not exist (Ulaga & Reinartz 2011, Kowalkowski 2014). Research also confirms that companies embarking upon a servitization journey move within a continuum, characterised by varying levels of product-service sophistication (Lay et al. 2010), in which multiple positions are possible at the same time. Many models, adopting different perspectives and combinations of descriptive characteristics,

have been suggested to illustrate how the change of product-service offering translates into differing levels of servitization (Oliva & Kallenberg 2003, Smith et al. 2012, Baines & Lightfoot 2013).

However the majority of accepted classifications focus mostly on customer support services provided to industrial equipment (i.e. in B2B settings). Another perspective - more general as it refers to both B2C and B2B settings - is taken by Tukker (2004), who clusters product-services in three main types, each one characterised by a specific value content and by different degrees of goods ownership, use and the decision making power. Product-oriented services enhance the utility that the ownership of the product delivers to the customer during the overall product life cycle (from pre-sales to dismantling). Use-oriented services that include leasing, renting and pooling schemes), do not entail a direct ownership of the product-service solution by the customer, who has the faculty to directly use the solution provided and owned by an external party. In case of result-oriented services the provider supplies a complete solution to fulfil a specific need of its customer, who does not use directly the solution, but takes advantage of its main outcome. In this paper, we adopt this latest model to classify the degree of servitization of a manufacturer.

2.2. ICTs and servitization

In general terms, digital technologies are claimed to be key in the servitization of manufacturing firms (Kindström & Kowalkowski 2009, Storbacka 2011). For instance, Raddats et al. (2015) affirms that a contribution to service success requires investments in information and communication technologies, while Ulaga & Reinartz (2011) state that advanced ICTs are crucial to develop capabilities to collect, analyse and interpret field data from installed bases. Digital technologies in servitizing firms include condition monitoring systems (Turunen & Finne 2014), mobile devices and appliances for employees and customers of service divisions (Fano & Gershman 2002), information systems that enable field operations (Kowakolsky et al. 2014), CRM and ERP systems (Storbacka 2011). Geum et al. (2011) and Park et al. (2012) agree that firms leverage technologies to integrate and combine product and services, in order to deliver higher value with relevant social and environmental benefits (Tukker 2004, 2013). In their shift to a service business, manufacturers focus firstly on technologies that increase the efficiency of service operations (Agnihothri et al. 2002,Kowalkowski & Brehmer 2008), due to the standardisation of the service delivery process (Brax & Jonsson 2009). Then, as service orientation becomes more intense, ICTs are used to differentiate, extend and complement the company's offering (Kindström & Kowalkowski 2009, Belvedere et al. 2013) and subsequently to get a competitive advantage. Harmon et al. (2011) show that firms can exploit technologies to design solutions that are radically new, in order to create breakthrough innovation and influence the forming and functioning of the entire service ecosystem (Lusch & Vargo 2014). The more the actors engaged in services shared data and information via digital technologies, the more knowledge generates and spreads across, thus favouring open innovation (Mustak 2014).

Another topic examined by scholars concerns the impact of technology on customer-provider interfaces (Kowalkowski & Brehmer 2008). Technology infusion, in fact, induces automation that, in turn, releases distance and opening hours constraints, thus favouring the raise of self-service and super-service options (Campbell et al. 2011). Subsequently, technology-facilitated services show reduced costs and higher efficiency due to fewer customer-provider interactions. However, the decrease in human contact can lead to noteworthy dissatisfaction as long as customers face negative experiences with the technological interfaces (Bitner et al. 2010).

Despite the conspicuous amount of researches dealing with technology-driven service innovation in service business, this argument remains largely unexplored in the domain of product-centric servitization. Remarkable exceptions are provided by Allmendinger & Lombreglia (2005), Antioco (2008), Baines & Lightfoot (2013), Kowalkowski et al. (2013), Belvedere et al. (2013). In particular Antioco (2008) and Kowalkowski et al. 2013 state that new technologies may impact differently on service orientation. While Services Supporting Products (SSPs) can be easily standardized to offer a

"digital version", Services Supporting Customers (SSCs) always show a big deal of variety due to people interactions and customer-specific situations. Thereby, "technology may not be appropriate in the context of an SSC business orientation given that these services are directed at the client and customized rather than to the product and standardized" (Antioco et al. 2008, p. 351). A similar duality appears in Wünderlich et al. (2013), who claim a lower customer acceptance of what is called "high-tech services" in comparison to "high-touch services". The first are fully or partly automated and can be delivered with few or no human contributions, such as smart self-services. The second are - conversely - smart interactive services in which customer and provider collaborate through a technological support. For instance, in case of collaborative remote maintenance of an industrial equipment, the field technician interacts with a remote specialist to diagnose and repair the machine. As shown by Rapaccini et al. (2014), there is growing interest for experimenting new technologies - such as Augmented Reality - in these applications. Another issue concerns the definition of smart services. Allmendinger & Lombreglia (2005) define smart those services that - due to product awareness and connectivity - are "fundamentally preemptive rather than reactive" (p. 2). As sensing technologies, connectivity and computers become integral to products, customer support is delivered on the basis of what products unveil about their status. As long as billions of data are collected, insights about how customers use products to create value are gained (Porter & Heppelmann 2014). Authors theorise that manufacturing firms can make a big deal of money exploiting these incredible knowledge (Evans & Annunziata 2012). For instance, GE uses these data to provide decision support services via a cloud platform that is expected to reach more than $1 billion revenues in 2015 (Iansiti & Lakhani 2014). Opresnik & Taisch (2015) suggest, therefore, the emergence of big data strategy in servitization. Up to now, however, prevailing applications of ubiquitous computing are finalised to develop diagnostic systems (Grubic et al. 2008, Grubic 2014), tele-maintenance (Jonsson et al. 2008) and support logistics (Dekker et al. 2013). In particular, solutions for remote condition monitoring of complex industrial equipment are remarkably spreading in UK (Grubic et al. 2011) as well as in US (Aberdeen 2014). This raises questions about what really customers expect from this kind of smart services (Paluch 2014, Grubic 2014), and in what cases these technologies are not accepted (Walker et al. 2002, Wünderlich et al. 2013). To the first concern, Baines and Lightfoot (2013) suggest that remote monitoring systems must monitor, transmit, store, analyse, and respond, this latter function establishing "any necessary actions that are required (e.g. repair, inform customer, arrange maintenance)" (p. 17).

3. RESEARCH FRAMEWORK AND DESIGN

3.1 Research framework

Building on the reviewed contributions, we structured the research framework to examine the role of ICTs in servitized firms [as shown in Table 1].

3.2 Research design

Since our research focuses on a how- and why- type question about a contemporary phenomenon not yet thoroughly researched, a case-based approach was selected as the most appropriate methodology (Yin 2009). First of all, we defined our conceptual framework, based on literature review (Voss, Tsikriktsis & Frohlich 2002). Then we selected our cases form a population of potential companies that have a well-known history of adopting servitization and smart services. Specifically, we selected five manufacturers that could bring an exhaustive description of the treated issues and thus allow a comprehensive vision of the investigated phenomenon in diverse industries. On the other hand, we chose companies that do not show any redundancy among them. During case studies, data were gathered in the field. The methods, instruments, procedures and general rules to be followed in carrying out the data collection were included in the case study protocol, obtained by synthesising the conceptual framework into semi-structured interviews, that were carried out by two of the authors in order to increase the reliability of the study, interviewing a number of

management personnel at all the case companies, e.g. CEO, CTO, Head of Strategic Innovation, Service Director. Supplementary methods of data gathering were also used to triangulate the data obtained from the interviews, also strengthening the construct validity of our study. The results were finally used to build and discuss the theoretical framework related to smart services for servitization. Because of space constraints, description of cases is not included in this paper.

Criteria	*Options*			
Degree of servitization	Product-oriented	Use-oriented		Result-oriented
Prevailing business logic	Good-dominant, technology-enabled innovation is company- and/or product-centric		Service-dominant, i.e. technology-enabled innovation is driven by customer, value network and ecosystems (open innovation)	
Type of innovation	Incremental and conservative, purposed to exploit state-of-the art service technologies in product-centric businesses		Radical and disruptive, purposed to create "blue ocean" market and to change the company's business model	
Type of technology	Enterprise information systems (ERP, CRM, service management systems, asset management systems, field force automation, contact centre/help desk technologies	Health management systems, remote condition monitoring, systems, diagnostic & prognostic		Mobile applications, smartphones - customer registering, demand for and access to services, ubiquitous/wearable computing
Technology is applied to/for	*Product* Detect incipient faults, prevent outages and improve recovery activities (due to early problem resolution)	*Logistic* Support service provider process, increase efficiency and save resources of field operations	*Delivery channels* Enable demand for services anytime - everywhere and access to the resources of the service system	*Value creation process* Support customer and contextually collect data about actual needs
Service options and level of automation	Automated service M2M high tech services *"the machine will do it for you"*	Super-service H2M high tech services *"I'll do it for you"*	Self-service M2H high tech services *"do it yourself"*	collaborative services H2H high touch services *"let' do it together"*
Data sources and types	Products, product status, operating conditions, incipient faults	Service process - technicians and work order status and availability, fieldwork programs, spares parts logistic	Customers - service requests, booking, notification of arrival, product usage, contracts, dynamic pricing, billing and invoicing	Environment/ecosystems, resource status and

Table 1: The role of ICTs in enabling servitization of manufacturing companies (morphology framework)

4. DISCUSSION

In this section we show how ICTs are actually used to support different levels of servitization. A first situation that was observed in our research refers to a kind of "digital servitization" that appears "product-dominated". In this case, the focus is on those technologies that can enable the development or improvement of technology-enabled product-oriented PSSs (Tukker 2004). In fact, a growing number of manufacturing companies - especially in B2B context (Grubic 2014) - use ICTs to become more responsive in providing base/intermediate services (Baines & Lightfoot 2013). By introducing sensors, connectivity and awareness into new products, as well as injecting latest technologies into the existing installed bases, firms can deliver smart services in the form of longer/better customer support super-services (Campbell et al. 2011). In such a situation, ICTs is leveraged to save resources and – at the same time - differentiate the quality of the company's offering. Thus, if adopted successfully, digital technologies can affect the orientation of the firm towards a service business (Kowalkowski et al. 2013). However, innovation of the company's offering is inherently incremental, as suggested by Oliva & Kallenberg (2003). In fact, introducing remote monitoring, diagnostic and health assessment, service logistics traceability, firms can deliver faster product recovery, achieve higher availability of products and spares, as well as a more efficient deployment of field-force. In these cases, the company's information system needs to be extended

and integrated to handle new kind of data, such as entitlements of service contracts, knowledge repositories for product troubleshooting, availability of technicians and spares across the field service network, etc.

In addition to the type of digital servitization described above, we observed other situations in which technology is introduced to address unexplored customer needs. Subsequently, radically new business models can be enabled. Sensors and connectivity embedded into products are used not only to monitor health conditions remotely, but also to record intensity of use, activate pay-per-use billing and enable automatic payment. In these cases, digital technologies facilitate the development of smart services initiatives that meet the characteristics of use-oriented PSS (Tukker 2004), in which products can thus be leased, rented, or even shared among multiple customers. Our research shows that these kinds of innovation are more common in – but not limited to - B2C settings, and require more active participation of customers as the whole service process is often delivered in the form of self-service (Campbell et al. 2011). In case these initiatives are based on shared products, customers use smartphone apps or smart cards to demand for and access to the offered services anytime/everywhere. On the supply side, ICTs are used to manage the ecosystem resources and preventively adapt capacity and match demand peaks. Capabilities of connecting customers – besides products –brings manifold opportunities for extending the service system boundaries, deliver services to every location where customers could move, and collect continuously data about their needs and their willingness to pay for new services. Therefore, this kind of digital servitization is undoubtedly driven by service-dominant logic approach. Last, it has been observed a third use of technology to deliver platform-based services, in which the provider leverages technologies to interconnect manifold resources – not only its products and it customers, and create a service-business ecosystem. Although less common, this kind of digital servitization allows to the platform provider to exploit data in order to offer advanced services such as remote configuration and process optimization, that are central to the development of outcome-base PSS offerings. Our research shows that these services are necessarily based on agreements between customer and provider about value expectations and outcomes, and usually require a combination of automation and interactivity (i.e. technology-enabled value co-creation).

5. CONCLUSIONS

By using digital technologies, manufacturing companies that are shifting to a service-based business can get more aware of their customers' true needs and develop more powerful channels to deliver smart services. This research shows that various technologies can be key for servitizing firms in respect to the kind of service-based offerings. Although more research is needed to confirm these findings, contribution of this paper is twofold: a) it clarifies concepts from interdisciplinary research that are crucial to examine technology-driven service innovation in servitizing firms, and puts in relation digital technologies to the kind of product-service offering; b) it shows the different characteristics of smart service initiatives by manufacturing companies. Main limitation of this study comes from not considering the generative power of digital technologies, that can facilitate combinatorial innovation by the actors engaged in the service system (Barret et al. 2015). This is also the first suggested avenue of future research.

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Servitization adoption and organisational transformation

IMPLICATIONS OF ADOPTING A SERVITIZATION STRATEGY: THE CASE OF A PRE-TRANSFORATION PERSPECTIVE

Federico Perillo & Angela Marqui

ABSTRACT

Purpose: Faced with higher pressure from global competition, increasing costs and decreasing profit margin, traditional manufacturing companies are seeking to expand their profitability through servitization strategies. However, how to shift from a manufacturing business model to a services-led one, delivering advance services, requires several organizational changes, named here as the servitization transformation. The main purpose of this article is to create a map of benefits and implications of a servitization strategy for a UK based business unit of a global manufacturing company.

Design/methodology/approach: This paper is based on literature review and interviews.

Findings: The findings presented in the paper describe what we have identified as main points to look at when planning a transformation process. We concluded that the process of servitization implies new challenges for the servitized organization. Such challenges were widespread over several core business processes. For our case company four areas were highlighted: Offering; Customer Relationship; Sales Process; and Distribution Network.

Originality/value: This paper will contribute to understand the benefits of servitization process and to diffuse the debate around Product-service systems across a business unit of a global organization.

Key words: Servitization of manufacturers, Servitization, Product-service systems.

1. INTRODUCTION

A gradual change in the characteristic of manufacturing firm, in the last decades, has provided a new way of creating and capturing value (Visnjic Kastalli *et al.,* 2013). According with Kindström and Kowalkowski (2014), the contribution of service sector to gross domestic product (GDP) in developed countries like UK, France, Germany and USA is around 70%. Even economies that have historically been dominated by manufacturing approach are now experiencing considerable service growth; for instance, more than 40% of China's GPD results from service activities (Ostrom *et al.,* 2010). Therefore, several traditional manufacturing companies have been establishing servitization process in order to compete through product-service system (PSS).

In this context the servitization of manufacturing is the ability of a firm to innovate its business model by increasingly offering services integrated with their products, which can be seen as a paradigm shift (Baines and Lightfoot, 2013). Baines *et al.* (2013) provides several examples of organizations that are able support their customers with a full range of service, such as Alstom, IMB, Rolls-Royce and Caterpillar. According to the authors, these services can be divided into three categories as follow:

- Base services. Those focus on product provision.
- Intermediate service. Those focus on maintenance.
- Advantage service. Those focus on outcome assurance.

Mostly, the opportunities for servitization are not fully explored by traditional manufacturing companies. Despite of the percentage of GPD growth from service sector in the past decade, many product-centric organizations are still focused on traditional product innovation to address the challenges posed by

global competition (Ostrom *et al.*, 2010). This means that the innovation model of many manufacturing companies is still centred on the product. Even though there has been a transformation toward integrated system based on customer-centric model innovation, the innovation approach is still focusing on new product development while there is a lack of insights from innovation in services both in traditional manufacturing and service industries (Ostrom *et al.*, 2010). Although service innovation research has achieved resounding success inside the academic community, the potential for research output in the subject of servitization is by large still unexplored, especially when compared with product innovation (Carlborg et al., 2014).

The main purpose of this article is to create a map of benefits and implications of a servitization strategy for a UK based business unit of a global manufacturing company. By doing so, we expect to contribute to the under researched area of business model innovation through servitization of manufacturing. The research presented here is based on literature review and interviews on a case-based research. The business unit analysed for the case is a business unit of a multinational manufacturing organization that operates within the UK market. The discussion presented does not describe observation of an implementation, but what we have identified as main points to look at when planning a transformation process.

The remainder of the paper is structured as follows: Section 2 presents a summary of the potential financial benefits and marketing benefits that could result from the adoption of servitization extracted from literature. Section 3 focuses on the business context describing the status "as is" of the business unit under analysis and describes how the data were collected and analysed. The results of the study and the relative details are discussed in Section 4. Finally, last section presents the conclusions of the work and the opportunities for further research.

2. BENEFITS OF ESTABLISH SERVITIZATION – INSIGHTS FROM LITERATURE

This session presents the potential Financial Benefits and Marketing Benefits that could result from the adoption of servitization, which are discussed as follow.

2.1 Financial Benefits

The academic debate around financial benefits coming from servitization is growing. As pointed by Baines and Guang Shi (2014), it is difficult to quantify the financial performance of servitization. Companies are reluctant to share the amount of revenue increased. There are business evidences that adoption of services from OEMs helps to improve financial performance as a result of cost reduction, within the rage of 25-30%, which is attributable to the services of the manufacturer (Baines and Guang Shi, 2014). In addition it is possible to achieve a growth in services revenue in the region of 5-10% per year for OEMs activities (Baines and Guang Shi, 2014). As described by Mathieu in 2001, General Electric Capital Service was able to achieve 60% of its profits from service activities. Moreover, GE was able to rise up revenue from services from 16.4% in 1980 to 60% in 2001 (Mathieu, 2001).

Companies that have adopted servitization tend to maintain the revenue stream and to improve the profitability especially in those sectors where the product requires a difficult installation procedure (Baines *et al.*, 2009). Nevertheless, financial benefits are available only if the manufacturing companies are able to setup a pricing strategy that can cover the costs of delivering the services (Mathieu, 2001). In summary, in order to realize the financial benefits from a servitization strategy companies need to have an accurate measure of the costs associated with the delivery of services and, at the same time, being able to adopt the right pricing.

2.2 Marketing Benefits

Marketing Benefits arise in several forms. First, they are related with the ability to appeal the client through advantage service (Mathieu, 2001). Second, marketing opportunities arise in the context of service for selling more product unit (Baines *et al.*, 2009; Gebauer and Fleisch, 2007) and consequently to gain market share. Therefore, as argued by Mathieu (2001), before making purchasing decisions customers usually consider which services an organization can offer. The level of quality of the service is a driver for long-term relationships and to maintain ongoing affiliation (Mathieu, 2001). Indeed, in business-to-business relationships, the adoption of a servitization strategy in manufacturing firms have been influenced by customers' expectations (Mathieu, 2001) and there is an increasingly request for new services (Baines *et al.*, 2009).

There is some sort of correlation between services offered and customer loyalty (Baines *et al.*, 2009). A supplier should contemplate that more and more customers expect to obtain design service solutions that are bespoken, customised and fit with their requests (Mathieu, 2001). If service business development is not well managed it may drive a decline of the firm performances (Visnjic Kastalli *et al.,* 2013; Baines and Lightfoot, 2013). The reasons inferior financial performance can be attributed to lack of top management commitment, scarcity of appropriate technology infrastructures, poor capabilities and insufficient organizational changes (Visnjic Kastalli *et al.,* 2013).

3. RESEARCH METHOD AND BUSINESS CONTEXT

3.1 Research Method

The research design followed a qualitative approach. Such design emphasizes the perspective of people involved with research issues, the description of context where the studied phenomena happens and the time line of events (Bryman, 1989; Yin, 2003). One remarkable characteristic of qualitative approach is the flexibility for application of carrying out the investigation through the use of observation, interviews and document analysis (Bryman, 1989). We adopted interviews as data collection instrument. The open questions interview questionnaire is presented in Appendix A.

3.2 Business Context

The business unit analysed for the case study is a business unit of a multinational manufacturing organization that operates within the UK market. The organization is able to deliver high quality products in the field of power management to its customers globally. The business unit located in UK develops and manufactures power electronics and critical circuit protection with distinctive and innovative features. Whilst the strategy of the company is based on a customer-centric model, the business unit focuses on serving customers with superior products. Management's actions and strategy focus on customer satisfaction. As a result, the company has achieved high performance by offering to customers a unique and distinctive value.

Despite the distinctive value delivered to customer through products, the degree of servitization as a process of transforming manufacturers to compete through advantage service and PSS in the organization is low. The business unit can provide base services like product/equipment provision, spare parts provision and warranty. The total revenue of the business unit comes exclusively from product sales and the base services activities are embedded in the product at the moment. In this context, services are seen as a cost from the manufacturer point of view and as free from the customer point of view. Historically, the business unit has been a component manufacturer selling components through distributors and intermediate buyers.

Again, as evidence of a non-servitized environment, new business opportunities are explored into the area of product/market diversification, showing a potential area in which benefits from servitization should be analysed. In this context, the following section discusses the potential implications of servitization for the business unit focus of this study. The focus here is to map implications of adopting a servitization strategy within the context of the business unit. Given the fact that this paper is based on literature review and interviews, the discussion presented does not describe observation of an implementation, but what we have identified as main points to look at when planning a transformation process.

4. IMPLICATION OF A SERVITIZATION STRATEGY WITHIN THE BUSINESS UNIT

Servitization is a transformation process (Baines and Lightfoot, 2013). This requires that some functions within an organization are re-designed and also activities of change management must be considered. This shift requires the development of new skills, competencies, processes and capabilities that must involve organizational transformation in order to capture and create value (Parida et al., 2014). Value creation and value capture are two main core functions of the business model of a company (Chesbrough, 2007). However, as Euchner and Ganguly (2014) describe, business model innovation only appears when new capabilities will disrupt the competitive dynamics of an industry. Hence, in this context, business model innovation is process to adapt and strength the business model over time (Euchner and Ganguly, 2014) and also to change it and its embedded parts, in response to internal and external solicitations (Kindström and Kowalkowski, 2014).

Transformation of the business model is vital for the future success of service activities and it has great potential to create long-term competitive advantage (Kindström and Kowalkowski, 2014). Our case study focuses at the business unit level, rather than at corporate. Only factors at business model and value chain level that are fundamental for driving a pilot project for our business context are taken into account. From our interviews, we have identified four main factors focus of concern as follow:

- *Offering;*
- *Customer Relationship;*
- *Sales Process; and*
- *Distribution Network*.

Each one of these factors is briefly discussed in the following section.

4.1 Offering

According to Gaiardelli *et al.* (2014), product-service offering are categorized along three main dimensions (product-, use- and result-oriented services) and characterized by three main factors including product owner, product user and product decision maker. Despite this research involves several metrics and specific service description, our purpose is mainly to identify those solutions that are suitable for our business context. It is possible to identify several services that the manufacturer could provide. Those are training and consulting service including on-site system installation in the most energy-efficient configuration, help desk and advice regarding product choice or to support customer to manage a product during the lifetime like maintenance contract, extension of warranty period, inspection, diagnosis and upgrade to new technology/product (Gaiardelli *et al.*, 2014).

A crucial aspect is underlined by Kindström and Kowalkowski (2014). They suggest that a firm has to develop its services coherent with its product portfolio. Therefore, the organization must be able to capture the demand variation for services across the market and internally standardize its service

approach (Kindström and Kowalkowski, 2014). Moreover, the firm should integrate product-service system; this includes building both services and products in homogenous way, to predict business opportunity in order to leverage a common strategy between services and products to achieve synergies for competitive advantage (Kindström and Kowalkowski, 2014).

4.2 Customer Relationship

Customer interaction is essential for successful customer solutions (Kindström and Kowalkowski, 2014). It is possible to identify different degree of customer interaction: internal, external and interactive (Gebauer *et al.*, 2006). A firm should be able to use external factors, like for example company reputation and brand, in changing customer perception. Hence, customers would trust the company's ability to deliver high quality products together with excellent services (Gebauer *et al.*, 2006).

The interaction between an organization and its customers can be enhanced and maintained by continuous communication (Gebauer *et al.*, 2006), recognizing the importance of intangible solutions, evaluating interpersonal skills, developing a service-related climate and culture (Gebauer and Fleisch, 2007). Hence, internal changes are needed to understand customer benefits of a service (Gebauer and Fleisch, 2007). In order to improve the customer embeddedness, Kindström and Kowalkowski (2014) suggest adopting a proactive approach.

Furthermore, to develop a long-term relationship, the organization must be reliable to perform before a service failure or during the maintenance process, to determine how to act according with different situations and finally to create a genuine behaviour by willing to respond and react to the shifts of customer needs (Kindström and Kowalkowski, 2014). Additionally, strong customer relationship might develop a complete market view respect of customer needs, market volume and future service trends (Gebauer *et al.*, 2006).

4.3 Sales Process

The traditional approach of selling process for a product-based organization might be a barrier for a new selling technique. It is really difficult for a manufacturing company to integrate product selling scheme with a new way to sell its novel services (Kindström and Kowalkowski, 2014). In our context, customer-centric approach is already a value for the firm. Therefore, customers are involved into the value proposition of a product design, they can share resources or provide the richer information.

One challenge for manufacturers moving into a servitization transformation, that is also a challenge for the case company, is ability of the company to adapt sales competencies from selling products to sales of product-service systems. Salespeople need to be aware of the potential benefit that servitization could bring to the company (Kindström and Kowalkowski, 2014).

However, as argued by Gebauer and Fleisch (2007), sales managers are reluctant to changes. To overcome this internal resistance the organization must involve its sales people in the formulation of service strategy. In this way, they become familiar with services and they feel comfortable to communicate the value of services to the customers (Kindström and Kowalkowski, 2014). Also, this requires that appropriate training is provided to salespeople in order to convince customer to buy a service (Gebauer and Fleisch, 2007). In this framework, the coordination between sales department and back-office specialist, that is able to support customers, is essential and it requires that sales and product manages might have common goals (Kindström and Kowalkowski, 2014).

4.4 Distribution Network

Mainly there are two ways to distribute a service: using a direct approach, e.g. internal resources, or through intermediates like external partners. A direct approach is the front of customer interface. By adopting this approach an organization might found out critical information about customers, service operation and market (Kindström and Kowalkowski, 2014). Moreover, it is evident that using an external partner for service distribution has the disadvantage of customer interface (Kindström and Kowalkowski, 2014). In this case, an opportunity of direct contact with the customers is missed and it is difficult to create a strong relationship and customer loyalty (Kindström and Kowalkowski, 2014).

A third way to distribute services would be possible by establishing a separate business unit with the organization, on the other hand, this creates barriers related to organizational structure which can be difficult to overcome (Gebauer and Fleisch, 2007). This issue arises when sales managers are dissatisfied with a new service strategy because they are afraid of a potential loss of power (Gebauer and Fleisch, 2007). External approach is also suitable in order to better control costs. In fact, managers are highly risk adverse especially when they move in an area where they are unfamiliar so, they prefer to invest in current operation (Gebauer and Fleisch, 2007). Therefore, setting up autonomous distributors might help to better control direct costs associated with each service and also establish a better pricing strategy (Gebauer and Fleisch, 2007). Once the business unit will become familiar with the new business approach, it is possible to create a direct distribution in order to establish intimate and exhaustive customer relationship.

5. CONCLUSION

The contribution of this paper is to underline the benefits, in term of revenue and customer relationship, which a business unit of a power management corporation could achieve. The analysis of the literature and the interviews helped us to consolidate our understanding that the servitization transformation requires the development of a new business model, new strategic competences and company culture.

Nevertheless, in order to benefit from servitization and to evaluate future implementation at corporate level, the business unit analysed could drive pilot projects for a specific product or product line. In such conditions servitization process could be easily monitored and corrective actions might be taken. Moreover, the current context of the business unit suggests that a few small changes are required in order to drive pilot project in the area of service-manufacturing.

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APPENDIX A - INTERVIEW QUESTIONNAIRE

1) What is the current status of Business Unit (BU) in servitization?
2) What service do you offer to the customers, please? Do you have pre- or after sale support?
3) Is it possible to identify the revenue that it is generated in the BU coming from servitization activity?
4) What is the future strategy of the BU for servitization?
5) What are the elements of performance that you would like to improve though a servitization strategy?
6) Do you think customers can be part of setup a future Operations Strategy for servitization?

STEPPING FROM LEAN TO SERVITIZATION

Ian Machan

ABSTRACT

Purpose: This paper explains a logical extension of a popular and widely used definition of lean to enable it to encompass the provision of advanced services along with products from established manufacturers. It includes a revision to the mapping approach currently employed.

Design/methodology/approach/Findings: The initiation of the work stems from a consulting assignment undertaken by the author in 2009. Further thought since then leads to the evolution of a set of logic that brings together servitization and lean approaches to business transformation, informed by a relevant literature research.

Originality/value: The coherent adaptation of prevalent lean approaches and the original application of a wider mapping tool can be used by both academics to analyse case studies and for consultants and practitioners to engage and deliver on client servitization assignments. In particular there are two key changes in moving from Lean to Servitization. The first of these is a change from a short-term product transaction way of thinking to a longer-term relationship commercial approach. The second is the introduction of Investment Stream Mapping as the tool to use in order to capture and re-design the longer-term commercial relationship that is required to be successful at Servitization.

Key words: Servitization, Lean, Investment Stream Mapping

1. INTRODUCTION

Lean thinking has dominated, along with six-sigma, and their amalgamation "lean six-sigma" the improvement culture of the manufacturing sector for over twenty years. Increasingly sectors outside of manufacturing such as banking and healthcare, more traditionally service based in nature, have also embraced it. Womack and Jones (1996) introduced the term lean thinking in their book of the same name after investigating Toyota, Tesco and 50 other companies.

Though servitization, a term used by Rada and Vandermerwe (1988), pre-dates lean as a descriptor and has a industrial following with prominent companies such as Rolls Royce, it has yet to make a similar impact on the global or UK scale. If servitization is to fulfill the transformational opportunity that it offers for many traditional manufacturing businesses then it has to bridge across from the academic world to the industrial in the minds of practitioners.

Frequently the introduction of an alternative transformation is met with skepticism, or over-exuberance as the new solution to all problems, or just a new buzzword, as described and listed by Hopp and Spearman (2000) "..For example, MRP, MRP II, ERP, JIT, CIM, FMS, OPT, TQM, BPR". In reality those, such as the author, with long memories in the sector know, links and commonality abound between the buzzwords.

This paper explores one of the most well known lean definitions and introduces broader commercial terms to argue that with those modifications lean thinking is intellectually consistent with servitization. Thus for practitioners and business transformations, servitization does not replace lean but can extend and improve existing training and skills deployment. The successful use of lean tools, many of which pre-date the lean period, requires skill. People that have been trained to use those tools in the name of lean, and have practiced to become competent can re-use those skills, extended into an arena outside of traditional supply chain and factory boundaries.

The exploration and extension of lean to servitization, follows a brief review of some relevant literature. The implications from the extension are discussed and the broader Investment stream mapping is introduced to move beyond traditional value stream maps. An anonymised case study, based on a consulting assignment with a client in 2009 explains how this alternative mapping was used. The conclusion includes some potential research next steps.

2. LITERATURE RESEARCH

The literature research that follows provides some background to this paper and is focused around four key areas: business and supply chain management, agile/lean, servitization and value stream mapping.

2.1 Business and Supply Chain Management

Christopher (1992) states that "the goal of supply chain management is to link the marketplace, the distribution network, the manufacturing process and the procurement activity in such a way that customers are serviced at higher levels and yet at a lower total cost". Servitization needs to include supply chain management and more if it is to be successful at underpinning a business transformation. And yet the silo-ing of initiatives often precludes many key areas. Just one example would be product design, surely at the heart of business growth. Reinertsen (2009) clearly sees that his approach to product development flow: "..bears many similarities to the methods of lean manufacturing and could be labelled lean product development". Kowalkowski and Kindström (2013) explored the wider business model required to successfully implement servitization and concluded that inadequate alignment between elements of that business model would explain why servitization may fail to gain traction

Supply Chains are frequently described in terms of factories, stock, suppliers and agreements. This is to miss the very heart of what make supply chains work and evolve. It misses the hardest part to change and the hardest part to maintain: people. Gattorna (2006) proposes that supply chains are 45/45/10 – human behaviour, systems technology and asset infrastructure. Despite not being an empirically derived split it does re-emphasise the practical benefit of re-enforcing previously learned lean thinking, rather than looking to replace it with a servitization specific outlook.

2.2 Agile/Lean

Rather than repeat a long review of lean thinking in the public domain, it is worth briefly considering agile, potentially the largest internal schism in supply chain and lean thinking. Stratton and Haigh (2002) described the distinction between agile and lean as a result of the trade-off between investing in responsive capacity and protective inventory. In their paper they consider speed of response and market uncertainty as key drivers towards agile solutions moving away from lean approaches that emphasise low variation in demand. As explored later servitization provides an alternative to agile due to more engaged customers with longer-term horizons.

2.3 Servitization

The Baines et al. (2009a) review of servitization literature and the book by Baines and Lightfoot (2013) is comprehensive at capturing the established literary and industrial state of affairs. The plea to have a more integrated operational strategy to successfully apply product-centric servitization concluded by Baines et al (2009b) pre-dated Kowalkowski and Kindström, but is consistent with them.

An Anglo-centric bias is always a risk, but a recent paper by Matthieu and Milet (2014), looking at the servitization of French Manufacturing firms, reminds us that it has traction elsewhere. A desk based research into over half a million French manufacturing firms concluded that over the period 1997 - 2007, those firms increased their service offering in general with 83% of firms providing services as well as products and one third of those providing more services than goods.

2.4 Value Stream mapping

Value Stream mapping has a historical pedigree that would surprise many lean practitioners. Gilbreth and Gilbreth (1921) were probably the first to publish and described their process charts as ".. a chart for visualizing a process as a means of improving it." They went on to emphasis the inter-related nature of the subdivisions that make up the whole, previewing the systems approach.

Schonberger (2001) charts the evolution of Process charting over the last 100 years up to and including value stream mapping, while commenting that "it is a top-notch tool". Rother and Shook (2003) in their graphic book Learning to See, with a forward from Womack and Jones, is still a major landmark in the recent field. However it scopes its system around the product and product related information flows required to deliver a product to a customer. Service applications are not considered. Mao (2014) introduced the idea of value chains into the servitization of manufacturing and this broadens the scope of a stream or chain from one of just a single dimension to multiple parallel streams, which are required to meet a servitization offering.

3. STEPPING LEAN TO SERVITIZATION

The introduction and literature research have set out the benefit and rationale for extending lean thinking to encompass and underpin servitization. More correctly lean can be seen as a subset of servitization thinking due to its broader commercial setting. This section will start from an accepted definition of lean and step towards servitization.

"After interactions with many audiences and considerable reflection, we concluded that lean thinking can be summarised in five principles:
Precisely specify value by specific product, identify the value stream for each product, make value flow without interruptions, let the customer pull value from the producer, and pursue perfection."
Womack and Jones (1996)

The first change would be to replace the term "specific product" by a more generic term "customers' requirements". Use of this term recognizes that we are talking about more than a product-based transaction. Both words are plural because in most cases there will always be more than one requirement and in any buying organization more than one customer. This latter point is explored more in the following section. Those requirements may extend in time before and after a physical product is delivered (design and development, contractual arrangements, financing, servicing, recycling being examples).

This change from a possibly one off, product based transaction, to a longer-term relationship between supplier and customer is a key differentiator with the servitization approach. It encompasses all of the commercial as well as product-centred activities required to be successful in winning servitization contracts.

The second change is to the term "value stream". The author coined the term "investment stream" in 2012 and proposes that change now. The customer, in paying money and providing attention to a supplier, will have also invested time and effort, possibly travel, in finding and buying a product. When a customer contracts for a service, even more than for a product, they are creating an association with its brand. This is an emotional investment. This builds on the product transaction to relationship change highlighted in the previous paragraph and provides a tool to capture the detail of those changes.

Being part of a servitization model means that a customer has also bought into the method of delivering the product to their point of use and of course paying for it in some way. The customer is

almost certainly accepting a range of warranty, service support and upgrade policies. It is engaging in advanced services buying. These are significant investments in a business-to-business relationship.

These investments of thought, trust, time and emotion are in addition to the money paid out for the explicit functions of a product. Hence the next change would be to replace “each product” by “each of the requirements”. For each requirement there would be a matching investment stream.

The final change in the definition is an obvious but subtle one. In place of producer comes the word supplier, recognising that it is not just a product that is being pulled from the business.

Hence the revised statement would read:

Precisely specify value by the customers’ requirements, identify the investment streams for each of the requirements, make value flow without interruptions, let the customers pull value from the supplier, and pursue perfection.”

Retaining use of the words value, flow, pull and perfection maintains the improvement ethos at the heart of lean transformations and allows a measurement system that can still relate to monetary currency as well as customer satisfaction. This time however those words and approach can be broadened to encompass all of the activities required to deliver for a customer, not simply a product, and to provide a framework for both design and continual improvement.

There is an inherent danger in those requirements that may need addressing in advance of product delivery. Pull is still in the definition and therefore requires a supplier to design its investment streams to meet a customer’s requirements, not to simply push out new technology or tender documents.

4. INVESTMENT STREAM MAPPING

The revised value stream term is investment Stream. This is because it emphasizes that the supplier and customer are both involved in a more significant and probably longer-term investment style relationship, not merely a product transaction. Value stream mapping therefore becomes investment stream mapping (ISM). The approach taken by the author in constructing an investment stream is to first properly understand what each end product/service means to that customer and to understand from a customer’s point of view what they are about to invest in with a supplier. These investment streams are interdependent, as recognized by Gilbreth and Gilbreth, and Mao, and are necessary to design the right servitization model.

An investment stream to meet a customer requirement will probably be in existence long before a product sale takes place. Examples of investment streams such as this might include bespoke product design, customer specific telemetry, electronic point of sale (EPOS) system design. In particular the contracting methods, design of procedures and financing models made available will need to be in an advanced state of preparation before they can be placed in front of a customer. Contracting with government departments or other large organizations will require a legal framework and pre-tender documentation which are essential to successfully contracting an advanced service offering. Large advanced service contracts would have key pre-contract, contracting and advanced service delivery phases.

Raising these different functional requirements should also now make clear why there would always be multiple customers. In most organizations, the functional split will result in a customer fielding accountants, procurement, lawyers, and quality assessors each looking to satisfy their part of the requirements.

With multiple investment streams and multiple customers all operating in parallel, but not necessarily to the same timescale, the whole system of designing and contracting an advanced service with a business customer can be captured. Of course different business customers may have different investment stream maps due to their different requirements. Some investment streams may be more important, have more leverage than others. If there are variations between customers, the map captures the whole of a key account, and allows the visibility to manage that we have come to expect of value stream maps and value stream leaders.

Investment Stream Mapping is proposed by the author as a key tool in capturing and exploiting the required longer-term commercial approach required for servitization.

5. CASE STUDY

In 2009 the author was consulting for a large US business in their China manufacturing site. The aim was to train staff in value stream mapping and create a value stream map that described the factory operation. This would provide a vehicle for continuous improvement.

After basic training was completed the exercise of constructing the value stream map began. The Chinese and English participants captured the complexities in traditional fashion on large pieces of paper. After defining the customers of the factory and the requirements/value delivered to them, the maps were drawn from right to left until eventually encompassing raw materials and other inputs.

Unexpectedly for the senior management on the site a large number of activities and effort were required to deliver value and customer requirements that were unrelated to the product delivery. In addition to shipping product by container ship (a pure product stream) to its downstream logistics customers, the factory identified three further streams.

The first was the provision of forecasting and supply/demand analysis that had been re-located to the factory as part of an off-shoring exercise. This was a complex process delivered to a corporate management and sales group. The second was the preparation of factory financial controls, including budgeting, reporting on actuals, variances etc. This was delivered to corporate finance in the US. The third was a group of activities to maintain compliance with regional, national and corporate standards and regulations.

As the size, complexity and cost of these three additional streams of work were detailed; it became apparent that they were a necessary pre-requisite to enable the product delivery. They were not in the context of this factory non-value adding. They were a significant overhead to the site and featured as both inputs and parallel processes to the product stream. By mapping the extra streams the management team were able to identify improvements to these in addition to more traditional value stream enhancements.

Although in this case the supplier and many of the customers were internal to the same organisation, the extension of the value stream to the wider nature of the factory's operations provided a first trial of a non product based value stream, which led to the investment stream mapping approach.

In this case study we see the two key proposals of this paper demonstrated. This first is recognition that the factory was involved in more than a short-term pure product manufacture supply; it was a long-term strategic supplier for the business. The second was the identification of important activities required to maintain that strategic supply, outside of the product delivery. The use of an embryonic Investment Stream Mapping approach uncovered those activities and provided a framework in which they could be assessed and re-designed.

6. CONCLUSIONS AND FUTURE RESEARCH

This paper in providing a link between lean and servitization, initiated by a case study experience in the field in 2009, aims to provide an approach that builds on skills and tools developed for lean implementation. In particular there are two key proposals to take the servitization literature. By showing a consistency and evolution, servitization practitioners should find it easier to obtain traction in re-designing business models to deliver advanced services at both a strategic and implementation level. Those that may be skeptical of another buzzword can be disarmed. The first of the key differences proposed in this paper is the change from product transaction to longer-term relationship commerce.

The second key difference proposed by this paper is Investment stream mapping as a return to a holistic process mapping approach that can tackle the whole of the advanced services design. The lack of new suitable symbols that could most easily communicate standard process steps will come from exposure and use by different people. The one case study was successful in identifying activities that were hidden and not easily explored before the mapping exercise was completed. Similarly the extent to which mapping different servitization business models can be standardized to allow analysis is an area open for further work.

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TOWARDS CONTINUOUS GROWTH IN INDUSTRIAL SOLUTIONS BUSINESS: DEVELOPMENT OF A SERVITIZATION LOGIC FOR CONQUERING THE MARKET CHALLENGES

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ABSTRACT

Purpose: The paper examines how a business division within a global supplier company advances the understanding of service-oriented strategy as a lever for competitiveness. This contributes to the discussion on the complexity and uncertainty relating to implementing servitization practices in industrial supplier organizations.

Design/methodology/approach: In this ongoing study collaborative and clinical research approaches are applied. The study involves interviews with 14 senior managers, senior executives, and operational key resources, about complexity and uncertainty during strategy transformation.

Findings: We propose seven adaptation mechanisms in order to manage the value chain so that it is most beneficial for the servitization. These mechanisms reduce the uncertainty in the change process, and drive the organization towards embedding the operational processes for delivering knowledge-intensive business services.

Originality/value: The grounded idea of the adaptation mechanisms is to manage the challenges in the change process, and drive the organization towards embracing the processes for delivering knowledge-intensive advanced services through adaptation, by conquering the market challenges, and enabling long-term financial growth.

Key words: Solutions business, Servitization, Service-orientation, Adaptation mechanisms

1. INTRODUCTION

Today's competitive and turbulent markets drive industrial manufacturing- and technology-based businesses to develop innovative new services and product-service systems (Raddats et al., 2014; Baines et al., 2009a) to their portfolios, in order to conquer market challenges and reach successful long-term growth. These businesses seek additional value in their offerings through servitization (Vandermerwe and Rada, 1988), which is a widely recognized term for the phenomenon of creating value by adding services to products, and is primarily customer oriented. In essence, advancing into offering solutions including advanced services (Mathieu, 2001), implies that companies face the challenge of making technologically superior products, in parallel with ensuring that customers use them as designed (Markeset and Kumar, 2003). In other words, companies then aim to build continuous revenue streams by identifying needs, creating solutions, and delivering to market utmost business performance following from operational excellence and use of the solutions they provide to their customers. Such solutions serve as platforms for innovation not only in products and services, but also in business models (Ulaga and Reinartz, 2011; Nordin and Kowalkowski, 2010). For many industrial companies having their roots in manufacturing and/or project business where scientific progress have led to that products and services are far more complicated, delivering service-intensive solutions is a complex and even uncertain task.

A considerable amount of literature on developing and delivering solutions has recognized the role of integration in project business (Wikström et al., 2010; Liinamaa and Wikström, 2009; Davies and Hobday, 2005), and also points out the difficulties and integration challenges that suppliers face when they attempt to adjust their activities to bear the widened scope and increased performance requirements of their supply (Kowalkowski et al., 2009; Hobday et al., 2005). This change in the delivery process, where it is in the performance of the installed base that the fulfilments of customer needs is realized, calls for a deep understanding of the mechanisms for the new institutional

settlements, in order to create homogeneity of the emerging organizational forms among counterparts. In order to study this issue, this paper addresses the following research question: How does a knowledge intensive, product-based organization develop a servitization logic? We argue that effective servitization logics can only advance through adaptation mechanisms that facilitate the management of the level of complexity and uncertainty in the value chain so that it is most beneficial for the transformation into servitization.

2. LITERATURE REVIEW

As research reveals, companies face barriers, problems and obstacles, i.e. challenges, when transforming their strategic and contextual direction towards services (Raddats et al., 2014; Hou and Neely, 2013; Eggert et al., 2011; Leseure et al., 2010; Baines et al., 2009b; Oliva and Kallenberg, 2003). Complexity thus stems from the fact that delivering services, i.e. implementing service-oriented strategy in the organization, requires additional capabilities in terms of structure and behaviour, not less in terms of skills and expertise, which are different from those that traditional product manufacturers possess. Service management literature refers to these phenomena as the need to establish organizational culture supporting service orientation (e.g. Gebauer et al., 2010).

On one hand, service is a unique act and, as compared to rigorous approvals and quality control in tangible industrial product manufacturing, can hardly be tested before the delivery to the customer. On the other hand, services can be standardized only to a certain extent. For example, the maturity level of the customer to operate and use the solution at maximum performance level may vary with respect to different experience, competition and underlying motivation of the customer. Thus, identifying needs for, creating, and delivering complex service-intensive solutions requires integration of multiple competences from the suppliers as well as establishment of service-oriented mind-set, tools and processes in ever more convoluted ways. As for instance Galera-Zarco et al. (2014) note, in-depth studies are needed on how especially project-based firms improve their organizational structures to adapt more accurately to the process of servitization.

Extended solutions scopes are a result of increased and shaped understanding of the technological product knowledge and change in organizational cultures during the last decades (e.g. Davies and Frederiksen, 2010). According to literature, a majority of these factors relate to organizational (Vandermerwe, 1994), operational (Baines et al., 2009b), customer (Kowalkowski et al., 2009; Oliva and Kallenberg, 2003), and financial (Hou and Neely, 2013) management of service deliveries. Lack of knowledge or ignorance of these factors creates uncertainty about the current state of affairs, about the needed management actions and their consequences, as well as inability to predict and affect the future business development.

As argued in the literature (Perminova et al., 2008; Atkinson et al., 2006), uncertainty is a fundamental trait of complex solution delivery projects that needs to be addressed. One example is customer-related uncertainty, which manifests itself in lack of understanding of the customer's values and the inability to identify which services are needed to resolve the customer's needs. Consequently, business opportunities that can be explored through offering solutions may be lost. Indeed, offering service-intensive industrial solutions presents an opportunity to improve revenues for both suppliers and their customers by providing value-adding life cycle support (Eggert et al., 2014; 2011). However, one potential challenge is in whether the supplier can position itself as a capable service provider from its customers' viewpoint. In other words, there needs to be motivation for the customer to buy supplier's offering. Furthermore, transition from the predominant manufacturing-oriented to service-oriented strategy requires specific customer-focused resources and capabilities from the industrial suppliers (Ulaga and Reinartz, 2011; Eggert et al., 2011). This can for instance relate to the supplier's ability to utilize the information on the customer's installed base as a key element in supporting service-related processes. The lack of it hinders decision-making from the supplier's point of view by increasing customer-related

uncertainty (Perminova et al., 2008). One solution to this challenge is building a loyal and trustworthy relationship with customers supporting supplier's orientation towards service provision and emphasizing the value of their offering to the customers. This can be done through enabling a dialog between suppliers and their customers to formulate the value and co-create the solution jointly (Kowalkowski et al., 2012; 2009). Simultaneously, such approach requires the supplier to establish the internal processes and procedures that would enable customer orientation, integration being one of them.

3. RESEARCH DESIGN

Our research calls for an in-depth understanding of how a servitization logic is developed in a knowledge intensive, product-based organization. Therefore, we have chosen to adopt collaborative and clinical research approaches (Shani et al., 2008; Schein, 2001), in addition to a systematic combining approach (Dubois and Gadde, 2002). This qualitative, exploratory and explanatory single case study is collaborative and clinical in the sense that we as researchers have not only acted as passive observers. We have for the last year been, and are currently actively participating in designing and developing the service-based approach by participation in workshops and daily activities of the practitioners, and by studying the process documentation, contracts and other relevant sources of information, thus increasing the validity of the findings. A single case study is sufficient to produce new knowledge provided it is representative of practice and builds upon rich data (Crouch and McKenzie, 2006).

The solution, or servitized offering, that the global supplier company (hereafter called Company) aims to provide consists of several systems and a service package that facilitates optimal systems use and, consequently, value creation by customers. The Company aimed at developing a solution that goes beyond conventional products and services, striving to solve a larger scope of customer problems by combining elements of the customer's business model into the solution.

Our insights, through the active participation in the transformation process, allowed us to create a deep initial understanding of the present routines, procedures and processes in the matrix organization. The organization is encountering high levels of uncertainty, and a high number of challenges as it advances and embeds the new service-oriented strategy. By transforming the vision into practice the management steers operations and business transactions, i.e. realizes the business model in daily operations. In order to translate vision into practice, a strategy to increase awareness and mutual understanding of the management team members for approaching a new business, by innovating the business model, was chosen. In order to do that, we conducted 14 interviews with senior executives and managers, and a number of interviewees on operational level to better understand the commonalities and differences in the current views. Each interview was semi-structured, and lasted on an average 60 minutes. Respondents represented managerial levels of different functional areas. Through the collaborative research approach, including interviews, we identified a number of categories of challenges that emerged as the most frequent and critical, in addition to the servitization vision of the management in the current business context. The data was categorised through content analysis and triangulation. After the analysis, the findings were relayed to the respondents and key resources participating in the study at the Company in order to ensure the correctness in the representation of the findings. Thus, we were able to study the integrative processes in order to manage uncertainty.

4. FINDINGS

As the major finding, we propose adaptation mechanisms embedded into seven categories of challenges in order to manage the complexity and uncertainty in the value chain that arise from the situation when the two contradicting strategies (established product-oriented vs. intended service-oriented) collide during order fulfilment, as it is canvassed in figure 1. The mechanisms drive this

transition process, as they reduce the uncertainty in the change process, engage the actors, and escalate the organization into service-orientation through strategy embracement. Based on the analysis of the data, we identified several key challenges which contribute to increasing uncertainty and complexity if not addressed properly. These challenge categories, and relative numbers of critical challenges are: 1) Concept (26%); 2) Resources (31%); 3) Process (17%); 4) Legal (8%); 5) Communication (11%); 6) Stakeholders (6%); and 7) Research and development (1%). The adaptation mechanisms that are proposed in order to manage the challenges in these categories during the value chain, are discussed next.

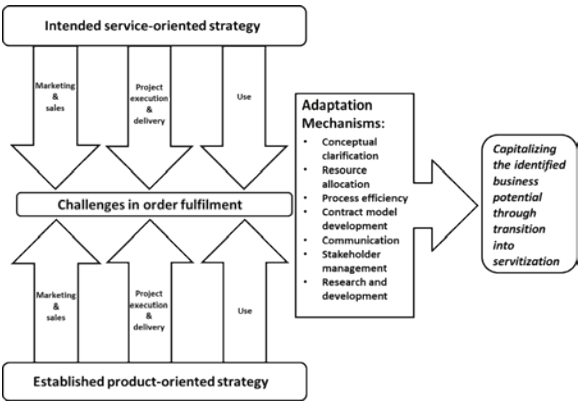

Figure 1: Adaptation mechanisms in the transition to service-oriented strategy.

4.1 Conceptual clarification

As the results indicate, clarification of the concept for organizing and approaching the new business area proved to be one of the most important areas for enabling service-oriented vision to become practice. As the established business model of the Company is rather manufacturing-oriented, it supports drawing resources to activities in the order fulfilment and project deliveries that are important for product performance. This can be highlighted by the lack in managerial approach for engaging the people to address the increased scope definition, which includes the transformation in design and manufacturing processes towards services. The lack of experience in delivering larger and more complex scopes in terms of advanced technology and service strategy means that the resources should be allocated for service-oriented activities in order to develop necessary competences and skills as well as established grounds for better profitability of services.

"Approaching a new business area requires a total shape up of the managerial approach" (Senior Executive).

4.2 Resource allocation

The strategy transformation clearly seem to affect how the resources in the organization are allocated as a result of the transformed approach to market, sell, execute and deliver the solutions in a service-orientated way. This includes both the primary operational and supporting resources in the organization, with respect to their quantity and quality, and measures. Service-orientation dictates a different approach to fulfilling the order compared to just conforming to the plan on product-level. It relates to how the responsibilities are shared between functions, units, task, and finally the individuals fulfilling the orders. This calls for anchoring the new strategy among the allocated resources, in order for each one to fulfil the task in the delivery process. In the situation of

limited organizational resources, the established and intended strategies can provoke internal competition if not conflict of interests among unit and individuals. It might become necessary for the supplier to invest in new resources with new capabilities and skills, or to train existing resources, in order to carry out the necessary processes that rise from the strategy transformation.

"As the delivery scopes grow, certain qualities become more central than other, meaning that the roles and responsibilities between functions, units, tasks and individuals shift" (Sales Director).

4.3 Process efficiency

Our data shows that there are numerous challenges and unclear themes related to the project execution and delivery processes that contend from the fact that in service-orientation the delivery model is generated by the solution it delivers, and not only in terms of design and manufacturing of components. This relates to the multiple levels of knowledge-bases that should be developed, including deep technological product knowledge, understanding of the customer's service needs and knowledge about the surrounding contextual interfaces, such as needed collaboration between the sub-suppliers and individuals delivering the solution. Moreover, detailed investigation and developing understanding of the elements and their critical dependencies should be carried out by the supplier in order to be able to manage and forecast challenges and information and data accuracy, which affect order fulfilment and process efficiency.

"The value generator in service-orientated strategy becomes more fragile than in product-orientation, due to increased complexity and uncertainty" (Sales Director).

4.4 Contract model development

The results indicate that the traditional and existing contract schemes cannot accommodate the emerging business models. As the business transactions enlarge as a consequence of the increased delivery scopes, the contracts in service-oriented business become more extensive. The quantification of risks during order fulfilment thus grows, which in turn means that the supplier would benefit from managing the contract and following it more rigorously during the transforming business transactions. This transformation may benefit from a modular contract negotiation process that would change the dynamics of the negotiation process, as it would align the sales and contract negotiation processes in a modular way already during initial sales, and thus it would create a platform for the supplier and the customer to govern the solutions transaction during the project execution and operations. This legal transformation further calls for communication throughout the supplier organization, in order to develop contract readiness internally.

"When the investment (scope) increases, the customer's interest changes and there is a need to re-allocate the changing responsibilities between the parties" (Senior Legal Counsel).

4.5 Communication

According to the findings, in order to escalate the understanding of the strategy transformation, communication regarding the business model innovation and the business plan, and its potential in the meta-organization and in its environment on different levels becomes vital. Communication in the organization in order to clarify the emerging strategy on conceptual and on operational level for anchoring the message across the network is important from a capability point of view, for communicating the transformed roadmap for the business case fulfilment.

"The communication needs to be transformed into contextual parameters" (Sales Manager).

4.6 Stakeholder management

One challenge for the supplier is to enable information sharing among the other parties involved in the solutions delivery, which becomes critical for the order fulfilment. Even though the supplier and

sub-suppliers pursue a common goal in the delivery project driven by varying levels of service-orientation, they might find sharing certain information hurting their competitive advantages. If securing information sharing is not always possible through the contract, it can be enabled by securing interactions with the partners driven by a joint value proposition to the customer. The joint value proposition, however, requires the partners to share their interests and the supplier to manage the dynamic interfaces between them based on how deep insight into service-driven minds the counterparts pursue.

"This implies close collaboration with key counterparts, such as the customer, the key actors and sub-suppliers, and understanding the varying interests and dynamics of the stakeholders, and how to manage the joint vision" (HR Manager).

4.7 Research and development

It is also clear from the results that there is a need to reflect the R&D activities in the new business model. From a research and development perspective, as a consequence of the change in processes, interfaces change. This transition seems to require new operations models for the research and development activities and processes, in order to meet the future calls for industry specific developments.

"The standard models need to be validated from a feasibility point of view, in order to meet the requirements that the service-oriented strategy transformation calls for" (R&D Director).

5. DISCUSSION AND CONCLUSIONS

This paper addresses the discussion on service-intensive solutions, and the complexity and uncertainty relating to implementing servitization practices in an industrial supplier organization. Our findings suggest that there are seven adaptation mechanisms that may facilitate the management of the level of complexity and uncertainty in the value chain so that it is most beneficial for the servitization. Developing professional service-oriented practices clearly calls for developed managerial and operational models, especially in this case of advanced services (or services supporting the actions of the client, in Mathieu's (2001) terms). Current research into service strategies (Raddats et al., 2014; Eggert et al., 2011) shows similar results. In the service-oriented approach, the critical processes, actors, information flows, and data utilization during order fulfilment throughout different functions (and re-organizing between functions) need to be identified by the supplier on a detailed level, in order to increase process efficiency that is required for service-orientation. The knowledge regarding how each individual element in the processes affect the overall order fulfilment, and how each of the individual actors' actions and tasks relate to the overall process efficiency is critical to clarify. This finding is supported by previous research into integration (Liinamaa and Wikström, 2009; Davies and Hobday, 2005) so as to ensure the performance of the solution as a result of managing and achieving integration during the development and delivery of the solution. Following this service-oriented reasoning, when the supplier focuses on building exclusive understanding about the customer's business, the solution can be designed and built so that it performs on maximal potential, and generates and enhances business opportunities. This is in line with the concepts of "value-in-use" (Vargo and Lusch, 2004; Levitt, 1972).

5.1 Managerial implications

The implications for practice that arise from this research are the seven adaptation mechanisms that are proposed as findings, and are discussed from the experiences of the Company under study: conceptual clarification; resource allocation; process efficiency; contract model development; communication; stakeholder management; and research and development. The adaptation mechanisms are aimed to support the suppliers in reducing uncertainty during the transformation process by recombining existing and new capabilities, and directing the value of the solutions they

are developing and offering, when promoting the capitalization of the identified business potential through transition into servitization.

As the data is from an ongoing process under transformation, we can present results that are conditional on this particular stage of the transformation only. However, already at this stage we can argue that the seven adaptation mechanisms that we propose as key findings support the value co-creation process and management of the service-orientation, while taking into consideration and even overcoming the market challenges.

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SERVITIZATION ADOPTION AND ADOPTERS: Evidence from the Spanish Manufacturing Sector

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ABSTRACT

Purpose: This paper explores the adoption of servitization and whether there are differences between the patterns of behaviour of adopter firms in a servitization-intensive sector (NACE 28 - Manufacture of machinery and equipment) and firms in other manufacturing sectors.

Design/methodology/approach: The study combines quantitative and qualitative methods of data gathering. The empirical evidence comes from the Spanish sub-sample of the European Manufacturing Survey (EMS) 2012 edition. As a complement we conducted seven interviews with companies that produce machinery located in Catalonia (Spain).

Findings: The manufacturing sector has different servitization behaviour from that of the servitization-intensive sector. In particular, the manufacturers of machinery and equipment have a wider extent of servitization. For all the companies studied, the majority of the services that they offer are product oriented and are designed to improve the functionality of the offered product, while customer oriented services are less common.

Originality/value: The value of this contribution is the ability to offer recent and relevant figures about servitization practices in the manufacturing sector, as well as addressing the research-practice gap by using interviews to capture firms' experience regarding their servitization activities in operational terms.

Key words: servitisation, product-related services, manufacturing, EMS, Spain

1. INTRODUCTION AND NOTES FROM RELATED LITERATURE

Sustained value creation has been and continues to be a firm's ultimate objective and an important vehicle for the socio-economic progress of society. The most recent advances in business modelling research and rationale have shed light on how firms detect, capture, create, maintain or change value, and, ultimately, deliver it to customers (Achtenhagen et al. 2013).

Even before the development of the concept of the business model, introduced as such by Peter Drucker and developed by Magretta (2002), servitization - first described in Vandermerwe & Rada (1988) - appeared as a practice or activity that had certain potential for the achievement of value creation and delivery. Most recently servitization has been described as follows: "Servitization is, however, much more than simply adding services to existing products within a few large multinational companies. It is potentially about viewing the manufacturer as a service provider" (Baines & Lightfoot 2013) and it has often been related to business models and business model innovation (Maglio & Spohrer 2013, Kindström & Kowalkowski 2014).

Despite of its potential and gradually increasing interest from policy-makers, academics and practitioners, survey data is still scarce. (For a review on quantitative approaches and tools in servitization, see Bikfalvi 2013). Also, existing data shows low levels of implementation/use of servitization. A recent and comprehensive literature review written by Boehm & Thomas (2013), formulates a research agenda in relation to combined Product-Service Systems (PSS) naming the following aspects: integrating results from other disciplines, clarifying the terminology, changing perspectives, explicating the methodology, concretizing results, conducting an evaluation, extending international collaboration, overcoming the research-practice gap, changing research design, enhancing the set of research methods, and identifying future PSS.

The servitization experience in companies is a gradual and dynamic process resulting in different levels of complexity when managing and orchestrating the service business model. According to Kindström & Kowalkowski (2014) this includes eight basic elements, namely service offering, revenue model, development process, sales process, delivery process, customer relationships, value network and culture, gathered under the overarching strategy and company structure. Of all these elements, in this paper, we focus our attention on the service offering.

Advances in the body of knowledge about servitization inevitably trigger attempts to classify, map and characterize companies according to different criteria. Some examples include the work of Ulaga & Reinartz (2011), Bikfalvi et al. (2013), Baines & Lightfoot (2013) and more recently Kindström & Kowalkowski, (2014). The necessity to employ a taxonomy is driven by the willingness to better understand key differences between services and further relate them to relevant concept to detect possible variation. For the purpose of our study we use the taxonomy proposed by the last authors, because their work was published so recently, because they have a recognised status in the field, and because their framework is easy to apply as well as conceptually complete. A graphical representation of that typology of service offerings is presented in Figure 1.

Service focus				
	Customer process	Process Support Services	Process Availability Services	Customer Solutions
	Product	Product Lifecycle Services	Product Availability Services	Product Performance Services
		Input based	*Output based: Availability*	*Output based: Performance*
			Revenue model	

Figure 1: A taxonomy of service offerings (based on Kindström & Kowalkowski, 2014)

It is in this context that we aim to explore servitization adoption and differences between the patterns of behaviour of adopter firms in a servitization-intensive sector (NACE 28 - Manufacture of machinery and equipment) and firms in other manufacturing sectors. Our aimed contribution is threefold: i) we bring *quantitative evidence* on levels and types of servitization, ii) we detect *sectoral patterns* of servitization behaviour, and iii) *how* companies face the practice and challenges of servitization. For the purpose of our contribution we use survey data and interview insights from manufacturing firms in Spain gathered using a hybrid approach which we describe in the following section.

2. METHODOLOGY

2.1 Quantitative approach

The data employed in this paper have been collected from the European Manufacturing Survey (EMS), an initiative of the Fraunhofer Institute for Systems and Innovation Research ISI, Germany, started in the beginning of the 1990s (ISI, 2015). International since 2003, EMS collects relevant information every three years about product, service, process and organisational innovation in European manufacturing establishments with more than 20 employees. It also aims to complement official innovation survey information with data related to innovation diffusion, emerging trends and modernisation techniques in manufacturing. It is mentioned in Hong et al. (2012) in their survey about innovation surveys as an additional methodological effort aimed to complement other national and international initiatives.

EMS is characterized by the following aspects: i) holistic and applied in approach, ii) detailed and dynamic in application, and iii) harmonized and updated in constructs and results. First, we highlight

the richness of the topics covered and the possibilities of constructs that can be computed. One of the most challenging aspects remains the generation of constructs that are universally applicable indifferently of firms' structural characteristics (size, sector, country). Second, the survey tool is characterized by a high level of detail, especially in terms of individual organizational and technological concepts and information that goes beyond monosyllabic yes/no type of answers. Third, its core questions or backbone, common all over the EMS participant countries, contributes towards a survey objective of collecting standard data through a common data collection tool and method. In addition, each participating country can include its own interests, and add novel or country-specific questions.

The questionnaire is organised in thematic block of questions. The service block covers three aspects. First, companies are asked if they *offer product-related services*, including eight options: design, consulting, project planning; training; leasing, renting, finance; operation of the product/equipment at/for the customer; technical documentation; installation, start-up; maintenance, repair; and software development. Second, we request the share that *services invoiced* (directly and indirectly) represent in the total turnover (%). Third, *service innovation* is tackled by asking companies if *new service offerings* have been introduced and the share of turnover generated by them.

For the purpose of this contribution we use the Spanish sub-sample of data consisting in 169 entries for the 2012 round. Of these 30 belong to NACE 28, Manufacture of machinery and equipment. The fieldwork was done in May-September 2013 and more than 4,000 companies received the paper questionnaire. Previous publications using the same methodology and focusing on servitization are Lay et al. (2010), Bikfalvi et al. (2013) and Dachs et al. (2014).

3.2 Qualitative approach

In order to enrich quantitative results with case study findings, a qualitative approach was adopted. Case research enables researchers to immerse themselves in rich data and reflect on the longitudinal or dynamic progress of an establishment or phenomenon. Cases are descriptions of particular instances of a phenomenon that are typically based on a variety of data sources (Yin 1994), and cases can range from historical accounts to contemporary descriptions of recent events (Eisenhardt & Graebner 2007).

Seven case studies have been selected for the purpose of the present contribution. Their descriptive features are included in Table 1. The CEO and/or Production Manager attended the interviews, this phase resulting in more than 30 hours of in-depth interviews. Prior to the interviews, secondary sources of information from the Internet, press releases and media were collected by examining the corporate website, annual reports and various texts of the participating companies. This data collection was especially useful in familiarizing the researchers with the firm and its mission, vision and activity.

Nevertheless, the primary methodological instrument was an open-ended interview, which was used during the face-to-face interviews in the respondents' daily workplace. The interview focused on the topic of servitization. It included the same sub-topics as the questionnaire (service offerings, new services and impact), but complemented those with additional how, why and why not questions. They were aimed at collecting respondents' opinions about servitization as a competitive advantage and positioning, servitization evolution, innovation in service offerings, drivers and difficulties. All these aspect are considered to be of great interest and complexity, especially when collecting data about them through a harmonized, international, multi-sector and multi-topic survey.

	Case1	Case2	Case3	Case4	Case5	Case6	Case7
Main product	Flexible packaging machinery and solutions	Tailor-made designs of individual machines and comprehensive washing and drying projects	Manufacture of machines for cleaning and sanitation of boxes and other containers for food products	Design and manufacture of machinery, equipment and complete facilities	Equipment designed to stock the aluminium profiles and feed them into the heating furnace	Design, manufacture and marketing of machinery for the industrial hygiene (washing and drying)	Pumps, mixers and valves, components, equipment, made of stainless steel
B2B	Food industry	Food industry	Food Industry	Cheese industry	Aluminium industry	Food Industry	Chemical and dairy products
Year of foundation	1954	1986	1961	2001	1984	1981	1983
Employees (2012)	350	30	40	33	80	32	400
Production locations	Spain Italy Brazil	Spain	Spain	Spain	Spain	Spain	Spain India
Share of sales abroad (exports)	96%	20%	30%	90%	90%	40%	82%
Family owned and managed	✓	×	✓	×	×	✓	✓
Guiding principle	*Committed* to the Planet	*Clean* and *sure*	How can we be *closer* to the customer?	We want to *automate* the customer's manufacturing processes	What *(more) can we offer* to clients that they do not have?	We are more expensive than rivalry but we are able to trigger *loyalty*	We offer customers *proximity* and personalized *solutions*

Table 1: Characteristics of cases

4. RESULTS AND DISCUSSION

Service offerings adoption (percentage of companies that claim to be offering a service) is shown in Table 2.

On the one hand, the eight concrete services considered by EMS are distributed in a balanced way among the categories of the selected taxonomy identified in the literature review above. This finding points towards the consistency of the EMS servitization proposal. On the other hand, looking carefully at the figures, we observe that the most frequently offered services are technical documentation (58%), design, consulting, project planning (53%) and installation/start-up (46%). Less frequently offered services are leasing, renting, finance (11%), software development and operation of the product/equipment for the customer (12%). A possible explanation might be found in the current economic situation, especially regarding financial arrangements, and the complexity of the service offer for the latter. These results refer to the manufacturing sector in general.

Data referring to the machinery producers show an increased adoption in almost all service areas considered, except for the most complex type of service, namely operation of the product/equipment on the customer's site, with only 15% of the companies offering this service. Half of the services, mainly product-oriented services, have figures above the level of 85%. These findings have a double implication, i) in terms of the (still unexhausted) potential to offer these services, and ii) the near universal nature of some services – like documentation, start-up and maintainance - in an intensively servitized sector, where the complexity of the product naturally demands such services.

	Input Based				Output based			
					Availability		Performance	
Process oriented (improve customer processes)	*Design, consulting, project planning*		*Training*		*Leasing, renting, finance*		*Operation of the product/equipment at/for the customer*	
	53%	75%	37%	65%	11%	20%	12%	15%
Product Oriented (improve functionality of product)	*Technical documentation*		*Installation, start-up*		*Maintenance, repair*		*Software development*	
	58%	100%	46%	95%	28%	85%	12%	55%

Note: figures in grey cells represent results corresponding to NACE 28

Table 2: Product-related services offered by manufacturers (EMS Spain 2012)

In general, all the interviewed companies recognise the importance, underlying cost and potential of servitization. One CEO explains "*We sell products. Nowadays, to sell the product we have to have a good product. Most of our rivals have an undoubtedly good product, which further means we have to differentiate. This means us doing things that others don't do, which further translates into staying close to the customer. For us this happens through service and service orientation*".

From the interviews we find that most participants agree on the difficulty of the servitization challenge, beyond the basic set of services that have traditionally been offered. A relevant intervention is illustrative of this direction: "*It is difficult for us to transform from a manufacturing firm to a service provider. During all our existence we have been regarded as a producer of machinery and, historically, our product included service. Our regular clients make no distinction between the two. This drives the consequent difficulty, not to say impossibility, of generating income from services*".

Asking companies about the evolution of the services offered and new service offerings, four out of the seven respondents highlighted the need to adapt to new technologies or advances in the technological fields that are incorporated in their product. This mainly happens through remote control services (monitoring and intervention), web platforms and interface communication, applications or services emerging from firms' willingness to align with green and environmentally friendly trends such as end-of-life and recycling services.

Interestingly, three companies referred to two new services as clear evidence of their willingness to adapt to the current economic situation and pressure to increase sales by any available means. One interviewee commented: "*We take back or facilitate the re-insertion of our old products. We manage to introduce second hand products in the market, so to sell used machines to new customers, below the market price but good enough for their purposes*". Another CEO explained: "*We organize visits to the facilities of existing customers. This option allows us to show our solutions running in a specific place. Actually, the current customer is the best testimony and offers the best guarantee for a potential customer. We try to optimize as much as possible these visits "in situ". For example, if a potential customer comes from Canada we arrange a visit to Portugal and visit our 4 business customers in one day. The cost of this service is shared: the potential customer must cover travel expenses, while we provide all the rest. The basic objective is that customers get to know us and our product. In some cases the service is completed by the ability to pass tests of traditional production in this existing industrial installation*".

Another innovative service described in the interviews is referred as a business planning service. In one respondent's words, "*We provide the complete business plan for the customer before acquiring the equipment. We actually offer our advanced know-how and experience in the sector. This service pack typically includes market research, the need for investment evaluation and rate of return on investment calculation, even prior to commissioning of the turnkey factory. We can also provide a team of technicians for an initial period of operation of the plant (from 6 months to 1 year) for training local staff and leave the facility running at full load. Normally a project of this type covers a period of 1-2 years*".

Finally, facilitating a complete customer project in collaboration with other partners to improve the facilities of the final installation is explained as a value added service. One of the respondents mentioned, "*Investors from certain emerging countries want to create a business. For example, they want to set-up a cheese factory. In this case we work with other entities, organizations and/or companies to give them the integral solution. We have the knowledge of most of the equipment required, but obviously we lack knowledge of the process. We complement our area of expertise with other agents from our habitual networking*".

5. CONCLUDING REMARKS

The findings presented above provide evidence of whether and to what extent the manufacturing sector has differentiated servitization behaviour in its different sub-sectors. Machinery and equipment manufacture appears to be distinct, and is a particularly servitization-intensive sector, where, as expected, we observe a broader extent of servitization.

A cautious interpretation demands that we take into account certain nuances when relating servitization and manufacturing, since signs of sector-specific servitization behaviour have been detected. There are at least two **academic implications** of this result: i) understanding the influence of a basic structural characteristic, such as sector of activity, on servitization should be regarded and analysed in isolation first, while interaction with other structural and organisational characteristics of the firm should be taken into account, and ii) global surveys focusing on detailed service offerings should pay attention to and conduct qualitative studies prior to fieldwork, since the inclusion and/or

exclusion of concrete services might bias the results about the firms' experience. A continuous engagement with companies, through interviews and dialogue, will provide academics with the latest types of service offerings in the form of service innovations. From the interviews it was also evident that intra-sectoral differences in servitization use and implementation exist. **Practical implications** of our results are not explicit at this stage of research since we only consider a structural variable (sector). Further investigation is needed on more and rather operational aspects should be taken into account. Linking servitisation to outcomes would be a valuable and strong argument towards its adoption.

As with any research, our study has some limitations. The relatively low number of responses to the survey in Spain is one of the main handicaps that we faced. Although the selection of one specific sector as an advanced servitizer is justified by our findings, the results remain limited to this unique contrast. Obviously, adding complementary sectors would produce more evidence about how and to what extent sectors of activity and/or groupings of sectors influence service offerings. A more exhaustive analysis of the interviews, especially to detect intra-sectoral variations in servitization and their relationship with performance would undoubtedly produce richer evidence of the intra-sectoral differentiation.

Despite the limitations, the contributions of the paper are three: i) we produce evidence about service offerings of manufacturing firms showing how practice matches theory, answering the call to reduce the research-practice gap, while all the services considered are positioned and distributed along the different categories of the considered taxonomy, ii) we use data from a survey, and this complements the existing body of knowledge which is dominated by qualitative studies, and iii) we use a combined methodological approach of qualitative and quantitative methods, which is valuable and highly to be recommended. Identical items in the questionnaire and in the interviews give us hints to understand better respondents' perceptions and compare them with the intended understanding, improving terminology, layout and content of the questionnaires.

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THE SERVITIZATION JOURNEY OF MANUFACTURERS OF ADVANCED ANALYTICAL EQUIPMENT: EXPLORING AND EXPLOITING KNOWLEDGE AND CAPABILITIES

Thomas Frandsen & Jawwad Z. Raja

ABSTRACT

Purpose: This paper presents a framework for understanding the different strategic options available to firms providing advanced analytical equipment. Of interest are the challenges in moving towards a servitization business model in search of resilient revenue and expanding market base.

Design/methodology/approach: Research in the area of servitization assumes a linear approach to moving towards greater service provision and customer solutions. In this paper, challenges are highlighted in shifting from providing products and associated services for specialist R&D functions to making offerings more scalable for production operations of customers. Developing the ability to exploit knowledge from advanced service offerings to providing fully fledged solutions is an ongoing endeavour that requires the development and reconfiguration of specific capabilities. Attention is also drawn to the need to focus on the 'strategising' processes multiple actors in situated contexts engage in to shape strategic activity.

Findings: The paper presents potential trajectories available to managers for generating resilient revenue and expanding the market. Four options are outlined and discussed: product manufacturers, serviceability, scalability and solutions.

Research limitations/implications: The framework presented requires validation through further research. Case research being undertaken to bridge this gap is briefly discussed.

Originality/value: The paper seeks to contribute to the growing literature on servitization by advancing knowledge on the challenges and trade-offs facing manufacturers of advanced analytical equipment when venturing into services and solutions business models. Of particular relevance is the dynamic balance that firms must strike between maintaining established product-focused modes of operating, whilst at the same time aspiring to develop capabilities and knowledge to exploit in other markets.

Key words: servitization, integrated solutions, R&D, strategizing, ambidextrous organisations, dynamic capabilities

1. INTRODUCTION

Persuasive arguments are presented in the extant literature that exhort the benefits for manufacturing organisations to move beyond product delivery towards the provision of services over extended periods (e.g. Wise & Baumgartner, 1999; Oliva & Kallenberg, 2003). Numerous examples of organisations are presented as exemplars of having successfully made the 'shift' towards services within the aerospace and engineering sectors. Examples include Rolls Royce's 'Power by the Hour' in aerospace. Such cases commonly depict a change in the underlying business model and attention has also begun to turn towards new service business models (Visnjic Kastalli *et* al., 2013). Of relevance here are the discussions in the literature on servitization (Vandermerwe & Rada, 1989) and provision of integrated solutions (Davies, 2004). Strategies in support of such trends emphasise the need for organisations to develop new capabilities to exploit opportunities. Much of the literature assumes that manufacturers can move from pure product delivery to increased service provision along a continuum (e.g. Oliva & Kallenberg, 2003). The reality however may be one in which organisations are required to operate multiple business models within different arenas (Cohen et al., 2006). Simple assumptions of strategic positioning within certain markets may owe more to issues of path dependency and the ability to reconfigure operating routines. It may be that externally acquired businesses that emphasise services are not as simple and straightforward to

translate into other contexts. The ability to transfer capabilities from one context to the next may also be limited by the industrial context and/or regulatory environments. As such, the move towards services may be better understood by adopting a 'strategy as practice' lens to examine the processes of strategising (Jarzabkowski, *et al.* 2007; Whittington, 1996).

The purpose of this paper is to present the background to ongoing research being undertaken to understand organisations attempting to change business models in support of greater service provision. The research forms part of a large-scale project into the competitiveness of Danish firms in respect of servitization. Firstly, the research is positioned against the broader literature on servitization and integrated solutions being advocated as a means of achieving competitiveness. Particular focus is given to the literature on dynamic capabilities and strategy in trying to understand how organisations attempt realise the strategic vision of enhanced service provision. It is further argued that any shift in strategy is conditioned by previous investments, experiences and ability to balance exploitation and exploration of technological capabilities. Secondly, we introduce a conceptual framework for understanding the strategic choices organisations may be confronted with in attempting to move from their traditional core business towards exploring and exploiting new opportunities; and the challenges these present. Lastly, brief consideration is also given to the adopted research approach and the nature of ongoing work. The empirical findings of the work will be presented elsewhere.

2. BACKGROUND LITERATURE REVIEW

2.1. The shift towards servitization and integrated solutions

In recent years there has been a drive among manufacturers to move towards the provision of services to compliment their core offerings (e.g. Wise & Baumgartner, 1999; Oliva & Kallenberg, 2003). It is argued that services provide greater value for the customer (Oliva & Kallenberg, 2003; Raja et al., 2013; Baines & Lightfoot, 2014). In some respects, manufacturers have always provided some form of after-sales or customer support to allow the customer to gain maximum value from the offering (Lele & Karmarker, 1983; Raja *et al*., 2013). However, manufacturers are urged to go further and provide more extensive provision of services as a means of competitiveness (Foote *et al*., 2001; Oliva & Kallenberg, 2003; Gebauer & Friedli, 2005). Services such as installation, repair and maintenance for the most part have been considered as complementary to the sale of the core product offering (Bowen *et al*., 1989). The provision of more extensive service offerings are argued to provide new opportunities for growth and profitability for organisations rooted in mature industries (Wise & Baumgartner, 1999).

The research literature is almost unanimous in proclaiming that the move from product delivery to the provision of integrated product and service offerings requires a significant transformation in the ways that firms are organised (cf. Leiringer *et al.*, 2009), especially in the delivery of advanced services (Baines & Lightfoot, 2014). As such, the extant literature suggests that in order to realise greater service provision organisations need to restructure business units to emphasise the importance of services (Gebauer & Friedli, 2005). It seems naïve to assume that the espoused 'shift' comprises a bounded transition between two steady-states, i.e. *from* product delivery *to* service provision. While there is a growing literature on how to organise for servitization, there is scope for better understanding the diversity of product-service configurations and the business context in which different business models appear to be viable.

In addition to the literature on servitization, there is a significant body of work on 'integrated solutions' (e.g. Davies, 2004; Davies & Hobday, 2005) and 'solutions' (e.g. Tuli *et* al., 2007; Cova & Salle, 2008). Here, 'added value' for the customer is argued to be provided by customising solutions that address specific customer needs (Tuli *et al*., 2007; Brady *et al*., 2005). This stream of literature

advocates the development of new capabilities that go beyond providing additional services to complement product offerings. In certain cases this may mean taking responsibility for operations traditionally performed by customers. To do so requires different sets of capabilities to operate in different marketplaces, including systems integration and solution selling (Davies *et al*., 2007).

2.2. Capabilities for changing contexts and strategising

In emphasising the capabilities that are necessary for integrated solutions, Davies & Hobday (2005) draw extensively from evolutionary economics and resource-based theories of the firm (e.g. Penrose, 1959; Nelson & Winter, 1982; Wernerfelt, 1984). These theories adopt an internal focus on firm level resources. This is in contrast to the strategic positioning approach of the 80s (Porter, 1985), which would seem to resonate more with the linear models of moving from one state to another found in parts of the servitization literature.

Of relevance is the literature on dynamic capabilities which argues that sustained competitiveness emerges not from the internal resources themselves which a firm possesses, but rather the ability of the firm to reconfigure operating routines (Teece *et al.*, 1997). A key point within the dynamic capabilities view is that competitive advantage arises not from its assets as such but the interplay between its asset position and its managerial and organisational processes (Teece *et al.*, 1997). These managerial and organisational processes are influenced by the asset positions of the firm (e.g. technological, reputational, structural, financial assets); they are also influenced by previous investments and established routines, which shape the strategic alternatives available (Nystrom & Starbuck, 1984; Hamel & Prahalad, 1994). In this sense, the path an organisation has travelled is an important consideration in understanding where it wishes to go. Penrose was early in recognizing this reciprocal relationship between development of resources and the capabilities of the organization in which they are used, as she notes: "*The services that resources will yield depend on the capacities of the men using them, but the development of the capacities of men is partly shaped by the resources men deal with. The two together create the special productive opportunity of a particular firm*" (Penrose, 1959, p. 78). Consequently the ability of the firm to simultaneously develop its capabilities and change its resource configurations is critical to its development. In this regard the dynamic capabilities perspective emphasizes asset orchestration as key managerial capacity to enhance value is by assembling unique combinations of co-specialized assets through which complementarities can be realized (Helfat *et al*., 2007).

Internally developing or acquiring new capabilities undoubtedly involves strategic decision-making. It is surprising then that the literature on solutions does not seem to draw upon the broader strategic management literature. Assumptions of moving from one steady state to another are increasingly challenged within the broader strategic management literature. Indeed, much current thinking within the context of organisational studies questions the very existence of 'steady states' of organisation, preferring to focus on the continuous process of 'organising' (Tsoukas & Chia, 2002). Priority should be given to studying change from within the organization by researching how habits change as the result of localized adaptations through the experiences of individuals within organizations. Of particular relevance here then is the recent emerging literature stream on strategy-as-practice emphasizing strategizing over strategy (e.g. Jarzabkowski & Spee, 2009; Whittington, 1996) as an alternative perspective on strategy to that of the mainstream. Rather than taking the perspective of the organization as decision maker strategizing is seen as an organizational process in which practitioners through the tools of practices are engaged in praxis, "the flow of activity in which strategy is accomplished" (Jarzabkowski & Spee, 2009). Attention within this perspective is drawn to how actors construct and enact strategy (Pettigrew et al., 2002; Aggerholm *et al.,* 2012). Such a 'strategising' view emphasises multiple actors situated within certain contexts as active participants that *"shape strategic activity through who they are, how they act and what practices they draw upon in that action"* (Jarzabkowski *et al.*, 2007, p. 10, italics in original). Thus,

there is a need to focus on the situated nature of practices in which activities are performed to identify dynamic capabilities (Green *et al.*, 2008).

Then, in order to understand how organisations attempt to conceptualise and enact a servitization/solutions strategy, a view which privileges the situated nature of strategising may be more fruitful. It has the potential to explain why organisations may adopt different strategies for different parts of the business. It should also be noted that firms are frequently made up of multiple business units, which comprise distinctive arenas where ideas of strategy are continuously contested with reference to different market sectors. Each arena will be characterised by differing priorities and institutionally-embedded modes of operating. More importantly, the recognition that different business units are shaped by different path dependencies and in a process of continuous adjustment in response to an ongoing process of mergers and acquisitions (Leiringer *et al.*, 2009). Such acquisitions may in part reflect a planned intent to acquire new capabilities for integrated solutions, but numerous other agendas also undoubtedly influence the decision-making process.

2.3 Exploring and exploiting capabilities in multiple contexts

In his seminal article March (1991) pointed to the trade-off within organizations between activities of exploitation and exploration, which present managers with the difficult task of achieving an effective and sustainable balance. The tendency to emphasize exploitation carries the risk of thrusting the organization into a competency trap. This occurs as exploitative activities, which tend to be effective in the short term, compete with explorative activities for the same resources thereby undermining the organizations ability to adapt in the long-term. The ambidextrous organization has been suggested as one way for managers to deal with the paradox that the crumbling of once successful firms is often caused by the firms continued investments in the competencies that was once the source of its success (Tushman & O'Reilly, 1996). According to O'Reilly & Tushman "*ambidexterity is a specific capability embodied in senior leadership's learning and expressed through their ability to reconfigure existing organizational assets and competencies in a repeatable way to adapt to changing circumstances*" (2008, p. 200). Consequently it implies that the firm manages to invest simultaneously in developing its competencies through continuous innovations and in exploring avenues for discontinuous innovations. This is typically achieved through operating multiple business units concurrently, with different objectives, structures, incentives and cultures while sustaining an overall culture to tie the company together. As an ability to simultaneously pursue emerging and mature strategies, ambidexterity is closely related to dynamic capabilities, specifically the ability to sense and seize opportunities and reconfigure resources (O'Reilly & Tushman, 2008). In the literature however, ambidexterity has predominantly been treated as a structural solution to the organizational problem of balancing exploitation and exploration, largely neglecting how ambidexterity is practiced through the actions and interactions of individuals following multiple competing logics (Jarzabkowski *et al.*, 2013). Adopting a practice lens on service strategy development would enable a significant attention to the situated practices through which firms adopt or revert from servitization. In an attempt to better understand the servitization context using established theories we develop a conceptual framework based on the above discussion.

3. CONCEPTUAL FRAMEWORK

Within the servitization literature emphasis is increasingly placed on the strategic role of services to manufacturing firms (Gebauer, 2008; Lightfoot & Gebauer, 2011). This includes the formulation of service strategies (Gebauer et al., 2010), transition trajectories of manufacturing firms (Matthyssens & Vandenbempt, 2010) and the relation to operations strategy (Spring & Araujo, 2009). A frequently espoused view in the literature on servitization is the stability in revenue such a strategy provides as well as opportunities to expand the market base (e.g. Visnjic Kastalli *et* al., 2013). The matrix below is one means of attempting to capture the strategic intent of firms providing advanced analytical equipment. To do this, we have classified the strategic intent according to two dimensions: (i) how

stable revenue looks in the short-term and/or long-term, (ii) how expanding the market by selling to different parts of the customers' value chain. Each quadrant is explained below.

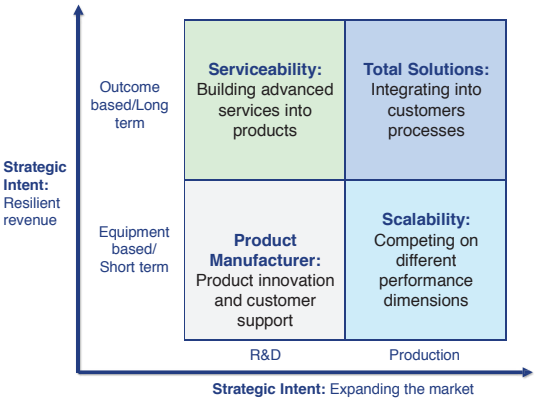

Figure 1: Strategising in multiple simultaneous dimensions

Product manufacturer: This is the position of most traditional manufacturers of advanced analytical equipment with the majority of revenues from selling products used for research and development (R&D) and quality assurance (QA). Due to the cost and complexity in use of advanced analytical equipment, the primary application is found within R&D and QA function of such product manufacturing organisations. Application often requires the specialist knowledge of engineers and access to the equipment is through purchase. For these types of organisations, 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 tightly integrated with the product characteristics. Such support is frequently a prerequisite to ensure the functioning of the products.

Serviceability: As part of the strategic intent towards generating resilient revenue the possibilities of providing enhanced service offerings are enabled through remote monitoring capabilities and offered as smart services. Part of the challenge for organisations is building in services into their product offerings. Advanced services could involve the access to equipment based on alternative ownership arrangements resembling fleet management solutions or pay per use arrangements. A key challenge is how to convince customers to enter long-term service agreements, which involves developing the necessary capabilities and service mind-set among sales personnel.

Scalability: With an intent to expand the market by exploiting the product, the literature suggests targeting alternative parts of customers value chain. For manufacturers of analytical equipment this implies using existing products and capabilities to develop a product market targeted at the production line of customers. This involves enabling the seamless integration of analytical equipment into production lines to meet the requirements of customers. A key strategic question of expanding the market is how the characteristics between R&D and production differ and their implications. Additional questions of relevance involve which customer segments to target, the degree of complexity of equipment for different contexts and differences in performance criteria upon which the organisation is measured.

Total solutions: Here the strategic intent is to change the underlying business model whereby customers may be locked-in and outsource their operations. This entails providing a customised solution that meets the specific need of a customer 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 customers' production line may be constrained by not having access to decision-makers at the right tier or regulatory constraints. Other challenges may involve the extent to which the customer considers outsourcing operations a core activity of its business. The research literature discusses at length the need for relational capabilities necessary to convince customers to acquire solutions. The ability to provide such an offering may entail learning and development capabilities, or acquiring them externally through mergers and acquisitions or partnering with other organisations.

The matrix is one way of illustrating the opportunities and challenges manufacturers of advanced analytical equipment are faced with. It suggests that these OEMs may choose different or multiple trajectories, as indicated by the arrows in Figure1. Research is required to understand service strategy configurations, the alignment with business strategy and transition opportunities. The predominant view is largely one of changing business models towards 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 differentiated business strategy. Capturing such dynamics requires rich empirical material and a theoretical foundation whilst enabling a sensitivity and openness to capture the contextual complexity of such dynamics (Alvesson & Karreman, 2007).

3. RESEARCH APPROACH AND NEXT STEPS

Based on the above, an in-depth exploratory qualitative case study approach (Flyvberg, 2006) has been adopted to understand how manufacturers are attempting the 'shift' towards the provision of enhanced service offerings for advanced analytical equipment. Particular attention is given to understanding how the different business divisions within the firms being studied strategise and enact different service strategies. An abductive approach was adopted, characterised by an iterative and ongoing process of engagement with both literature and empirical data (cf. Dubois and Gadde, 2002). Access has been secured across two large Danish manufacturers of specialist analytical equipment who operate in niche markets in which they predominantly target business customers. The companies have a long history of product innovation and are both renowned for superior quality and product excellence. To date, a total of 17 interviews have been conducted across the two organisations. Respondents within the cases have different backgrounds and varying degrees of seniority across the two organisations. The interviews were recorded and lasted on average between 60 and 120 minutes. Where deemed necessary, specific points made in the interviews were followed-up to clarify particular issues. Extensive reference was also made to archival sources, including published annual company reports, external documents and relevant marketing material. The researchers further made numerous visits to corporate headquarters, viewed product show rooms, gleaned insights into the production operations and partaken in numerous informal conversations in the staff cafeteria with employees. Initial findings have been validated through day long workshops with senior managers in the case organisations. The research is ongoing and further interviews are scheduled to supplement the initial exploratory research with more focused attention on specific issues. The final results emanating from this study will be reported elsewhere.

4. IMPLICATIONS FOR PRACTICE

The literature on servitization has emphasized that the transition towards provision of advanced services is a challenging endeavor. This increases some of the problems of organizing, part of which involves scaling up service delivery. While the context of this study may not be generalizable to a wider context we find in this particular example this is not the full story. Rather the strategic efforts involve two steps; first to reduce the complexity of the product offering to allow for durability and secondly an addition in terms of the business model thereby introducing new complexities. Whilst the literature suggests that servitization involves an addition to products, we find that it requires reconfiguration of products before additions can be made which have strategic implications.

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WHY CAN'T EVERYBODY COPY ROLLS-ROYCE? A DEMAND SIDE PERSPECTIVE ON THE DIFFICULT PATH TO SERVITIZATION

Marin Jovanovic, Mats Engwall & Anna Jerbrant

ABSTRACT
Rolls Royce's Power-by-the-hour® concept has gained status as an archetype for manufacturing companies attempting to add value to their offerings through a transition to services. However, is the Rolls Royce value-in-use model actually an appropriate role model for all manufacturing companies? This paper is based on a comparative case study of two service transition initiatives at a premium brand, capital equipment manufacturer. In spite of the same organizational setting, the same corporate management, and the same servitization strategy, the two initiatives had opposite outcomes. By applying a demand-side perspective, the paper challenges the general applicability of Rolls-Royce as the ideal role model for servitization and reveals some significant challenges for a manufacturing firm trying to move from the value-in-exchange model, to value-in-use. Finally, paper associated two types of product-service synergy to servitization strategies, subsequent and simultaneous synergy.
Purpose: Paper question general applicability of Rolls-Royce as the ideal role model for servitization of manufacturing by comparing two different servitization trajectories, one very similar to Power-by-the-hour® and one sufficiently dissimilar.
Design/methodology/approach: Exploratory case study of two different servitization initiatives
Findings: Servitization toward value-in-use is affected by value chain structure, product operations and value propositions
Originality/value: patterns of similarities and differences between servitization initiatives

Key words: servitization, demand-side, exploratory case study

1. INTRODUCTION

Power-by-the-hour® was introduced by Rolls-Royce in 1962 to support the Viper engines by offering a fixed cost per flying hour. This successful transition from a goods-dominant to a service-dominant logic (Ng, et al., 2012) have intrigued many other capital equipment manufacturers to embark on the trend for service transition (Oliva and Kallenberg, 2003; Davies, 2004; Fang, et al., 2008). More than 50 years later, successively more manufacturers are exploring various pathways to replicate this model: to deliver, to guarantee, and to charge for value-in-use, rather than for the classical logic of value-in-exchange (e.g. Vargo and Lusch, 2004; 2008; Lusch, 2011).

Today, Rolls-Royce's Power-by-the-hour® concept has gained status as an archetype for manufacturing companies attempting to add value to their offerings through a transition to services. However, is the Rolls Royce value-in-use model actually an appropriate role model for all manufacturing companies? Is it generally applicable to every market and every product? Previous research has shown that the challenges for transforming a manufacturer into a product-service provider are multidimensional (Martinez, et al., 2010). In spite of its popularity, several manufacturers have encountered impinging obstacles when trying to transform to the value-in-use model (Visnjic Kastalli & Van Looy, 2013) and several examples of manufacturing companies who have experienced negative return on their service investments (Gebauer, et al., 2005).

The first wave of servitization case studies were trying to capture the shift from products to services by studying first-movers (Davies, 2004), through a number of emprical cases, such as GE, ABB, Alstom, Ericsson, IBM, Rolls-Royce, Thales and Xerox, the potential in industrial services, or product-

service systems, were brought to the forefront (Chesbrough and Rosenbloom, 2002; Davies, et al., 2006; Visnjic Kastalli and Van Looy, 2013; Baines and Lightfoot, 2014). Adhering to this trend, many manufacturers are today searching for answers to the more operational questions: "How can we servitize specific product lines?" Although research on servitization has increased dramatically during the last decade, so far little is known about service transitions for products less reliant to servitization (Raddats and Easingwood, 2010).

With some rare exceptions (Smith, et al., 2014; Visnjic, et al., 2015), previous research on servitization is anchored with the manufacturing company as point of departure. This supply side perspective is engrained in the traditional idea of configuring internal resources to deliver a servitized offering (Heineke and Davis, 2007). Consequently, the primary focus of operations scholars has been on methods to organize internal resources for an effective and efficient delivery of products and their associated services (Baines, et al., 2009).

This paper is based on a comparative case study of two service transition initiatives at a premium brand, capital equipment manufacturer. In spite of the same organizational setting, the same corporate management, and the same servitization strategy, the two initiatives had opposite outcomes: while the first initiative - servitization of the company's compressor business - was highly successful; the second initiative - servitization of the company's road construction equipment business - was highly problematic. From a supply side perspective this difference in outcome was puzzling; it could not be explained by any internal, organizational contingencies of the company. Instead, it was caused by exogenous factors related to product's value-in-use, i.e. to its utilization by the customers in their value creation processes. Hence, while the logic of the compressors business resembled the logic of the Rolls-Royce engine business, the business logics of road construction equipment, were significantly different.

By analyzing these differences, the paper challenges the general applicability of Rolls Royce as the ideal role model for servitization and reveals some significant challenges for a manufacturing firm trying to move from the value-in-exchange model, to value-in-use. It reveals how the preconditions for the customers' value-in-use of a product, profoundly affect the possibilities for servitization. Thus, it pinpoints how product value-in-use, outside the direct control of the supplier, can increase, or decrease, the potential of service transition strategies. To summarize, the paper addresses the following research question:

How is a service transition strategy influenced by the product's value in use?

The rest of the paper is structured as follows: Section 2 discusses theoretical foundations of the servitization shift in manufacturing. Section 3 describes the research design and how the case study has been conducted. Section 4 presents the results of the empirical investigation and discusses the key similarities and differences between two different service transition initiatives. Section 5 includes discussion, captures main contributions and proposes future avenues for servitization research.

2. THEORETICAL FOUNDATIONS

The phenomenon of servitization in manufacturing has gained massive attention in academia during the last decade (e.g. Baines, et al., 2007; 2009; Neely, 2008; Baines and Lightfoot, 2013). While research has explored the historical perspective on manufacturing-service integration (Schmenner, 2009), different taxonomies of services offered by product firms (Cusumano, et al., 2014), service innovation for product firms (Carlborg, et al., 2014), servitization as a business model innovation (Chesbrough, 2012; Visnjic, et al., 2015), as well as different characteristics of solution offerings

(Nordin and Kowalkowski, 2010; Storbacka, 2011), the transitional step to go from manufacturing to services are still underexplored (Jacob and Ulaga, 2008; Parida, et al., 2014).

Traditionally, after-sales services has been understood as a valuable opportunity for complementing the tangible products (Porter, 1985). In the first wave of servitization research, however, it was claimed that physical products were becoming less profitable, while downstream service activities provided increasingly attractive profit margines (Wise and Baumgartner, 1999). Servicing the "installed base" of delivered products (Oliva and Kallenberg, 2003) was commonly refered to as the entering step in managing the transition to services. In much of the literature, servitization was conceptualized on a product-service continuum where the value was implicitly understood as increasing while climbing toward the service end point (c.f. Tukker, 2004; Mathieu, 2001; Martinez, et al., 2010; Raddats and Easingwood, 2010).

3. METHOD

3.1 Research Design

This paper is based on an extensive exploratory case study (Eisenhardt and Greabner, 2007). The design was choosen in order to approach the studied phenomenon as close as possible (Dyer and Wilkins, 1991; Stake, 1995) and is in line with most previous research on servitization (c.f. Baines, et al., 2009; Martinez, et al., 2010; Finne, et al., 2013).

The case company was a major equipment manufacturer with an explicit servitization strategy at the top of its corporate agenda. Following Eisenhard and Graebner's (2007) advice to choose empricial phenomena of "polar types" in order to observe extreme contrasting patterns, the focus was set on the servitization attempts at two different business areas. Thus, the case selection strategy was on the basis of maximum variation (Flyvbjerg, 2006) within the same organizational context.

The research method for collecting empirical data was based on multiple sources: direct observations, semi-structured interviews, documents, and archival records (Yin, 2003). The study applied an insider–outsider design (Bartunek and Louis, 1996) with one of the authors acting as the insider closely following the service transition. The approach was inspired by ethnographic methodologies (Fetterman, 2009), with the insider spending one day of a week at the case company, during 7 months (February to August 2014). The other authors acted as the outsiders, reflecting on observations from a distance and met periodically with the insider to discuss observations, tentative findings, and directions for future empirical work. During the whole emprical work, the insider had a full employee-level access to all company vicinities, its offices, work shops and personell, as well as internal documents, including operational and financial reports.

4. FINDINGS

The company is a world-leading major manufacturer of high value capital equipment, such as innovative compressors, construction and mining equipment, power tools, and manufacturing assembly system. Among its customers, the company is well-known for its premium brand, based on technological innovation and product quality. The corporate headquarters are situated in Sweden, but the company holds leading positions at markets all around the world.

Two business areas (divisions) were in focus for the study: Industrial Compressors Equipment and Road Construction Equipment. At the time of the study, the compressors divison accounted for nearly half of the company's total revenues, which was approximately three times higher than the revenues of the construction division.

4.1 Summary of the two divisions

The company had an explicit corporate strategy to grow by developing its market position as a global capital equipment manufacturer within specifically selected market niches. Being on the market for more than 140 years, the company was well respected for its high quality products, its long tradition of technology leadership, and its long-term relations with its customers. The company was a classical product supplier for professional customers (B2B), where high product quality, in combination with high dependability of spare parts, and a well-developed infrastructure of service shops for product maintenance were the primary order-winners. However, the high product quality also meant high product prices and there was major concern of an emerging number of aggressive, primarily Asian, competitors providing the market with similar products, with reasonable quality, but for significantly lower prizes both for the products and the spare parts.

Consequently, in the year 2008, the case company introduced a dedicated Service Division at the compressor division. The aim was to acquire stable revenue streams and closer contacts with the customers. The strategy was twofold: to serve all compressors at the company's installed base and to "climb the service ladder", from traditionally being selling spare parts, to offering full service contracts. The strategy became quickly a major success. After three years, the services had increased by 30 %. Today, six years later, the Industrial compressor unit reports more than 40% of its revenues coming from services. In addition, the service offerings have become more sophisticated, from primarily providing spare parts, to reach some of the highest steps of the service ladder, such as outcome-based contracts and predictable maintenance offerings.

In the year 2011, following this pioneering and successful servitization of the compressor business, a similarly dedicated Service Division working on service development was deployed at the road construction division. However, this business was found significantly more difficult to transform. In spite of the strategic intention, top management commitment, and the same road map as for industrial compressors, the services had only increased with 5 % after three years.

Thus, the road construction division, operating within the same corporate framework, with the same people, same strategy, and same servitization approach, could not at all achieve the same level of performance as the compressor business. The company followed all best practice knowledge sharing procedures, but they were obviously insufficient to tackle the service transition for road construction equipment. Thus, this traditional supply-side perspective, using the manufacturer's internal processes as a point of departure, has to be complemented with a demand side perspective, taking the product's value-in-use into account.

4.2 Applying a Demand-Side Perspective

The products of the two divisions were sold on two markets with distinctively different dynamics. While the products of the compressor division were used any type of company or business in need for compressed air, the products of the construction division were used by building contractors, where the skill of operating construction equipment was an essential part of their operations. Hence, the customers of the compressor division were prone to accept service contracts, since operating compressors was not a part of their core business. The customers of the construction equipment, on the other hand, owned a substantial knowledge base and rich experience in operation the equipment.

At the compressor division, compressors were usually sold directly to the end users, so it was relatively convenient to substitute the physical product, with rental and provisioning of services contract. Except for the case company and the client, there were no other actors involved. The attempts to servitize the construction equipment business, however, increased competition in the value chain, since the case company risked competing with some of its major customers, i.e.

wholesalers and major equipment rental companies. The competitive advantage of this kind of "middlemen" was their close proximities to the end users of the construction companies. Furthermore, while the demand for compressed air was relatively stable, the demand for construction equipment fluctuated due to seasons and the need in ongoing construction projects. Construction projects differ in size and scope and most road construction is undertaken during summer. Consequently, this seasonality of the customer-side business adversely affected the acceptance of long-term service contracts.

For the compressors business, the unique selling point of service offerings was to minimize energy and operational costs for customers by leveraging product usage data. It created new value by analyzing data while product was running (i.e. Data-as-a-Service, Analysis-as-a-Service) and enabled predictable maintenance service contracts based on the collected data. Apart from "proactive" service offer, which was simultaneous, it also created a win-win solution by reducing customer's operating costs (e.g. energy consumption). For the road construction equipment business however, the service offerings, such as financial solutions (i.e. payment convenience), extended warranty, inspections, trainings and/or critical-part insurance solutions, were all focused toward reducing the total cost of ownership for the customer over the product lifecycle. They were all "reactive" in nature with no direct added value to end users' business processes.

Furthermore, also the operations of the products were distinctively different between the two divisions. The compressors were stationary, installed in controlled, in-house environments, and designed with a self-contained technology and a high level of automation. The road construction equipment, on the other hand, was primarily operated outdoors at different remote construction sites, by personnel of different construction companies. In addition, in-house repair and maintenance services undertaken by either the rental companies or the operators at the building contractors also affected the service contract penetration and service margin negatively.

5. DISCUSSION

This paper was led by the following question: "How is a service transition strategy influenced by the product's value in use?" By analyzing two different servitization initiatives within the same organizational setting, our findings challenge the general applicability of the Rolls-Royce model, the fragship transition case of the first wave of servitization.

Even though the study has some obvious limitations in its research design, it provides an illustration of why the second wave of servitization might be difficult to master. The case illustreates the complex interactions between product market characteristics and servitization transition and indicates how a servitization strategy needs to be aligned with the product market characteristics for making a succesful shift to services. Assuming that these findings are generally valid, they have several implications for both theory and practice.

The industrial compressor business successfully leveraged the case company's product-specific knowledge, while the construction equipment knowledge was spread across the entire industry, which decreased the case company's competitiveness on the service market. Search and information costs and information asymmetries (Williamson, 1985) significantly affected the service penetration. As argued by Boisot (1998) ownership and control of knowledge assets is a key requirement for securing competitive advantage. Consequently, if company is not able to convert intellectual resources into a service output (Quinn, 1992) servitized offer will run a risk of being perceived as a "make or buy" decision from the customer-side viewpoint (Alvizos, 2012).

One of the conclusions could be that service transition initiative to value-in-use is more predisposed to some products due to their in-build characteristics. Specifically, we associated two types of

product-service synergy to servitization strategies, subsequent and simultaneous synergy. A general implication is that we need further studies of various products that are difficult to servitize. Do difficulties in servitization depends on the industry, product technology or value chain structure? How has other firms successfully or unsuccessfully managed their servitization initiatives? How do the condition for servitization differ depending on the industry, the nature of technology, and system level?

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ORGANISATIONAL COMPETENCE FOR SERVITIZATION: CHALLENGES AND DETERMINANTS

Tim Posselt, Angela Roth, Oliver Fuhrman & Frank Danzinger

ABSTRACT

Purpose: With this study, we aim to contribute to the understanding of organisational competence for servitization. By investigating the challenges faced by servitizing companies within their organisational system elements, as well as the causal interrelations between them, we identify determinants of organisational competence for servitization.

Design/methodology/approach: Data was gathered during semi-structured interviews with eleven service managers of eight servitizing companies from the machine-building industry. Alongside the interviews, which were the primary source of information, internal presentations, marketing material and web presences of the participating firms provided a rich source of information that formed the empirical basis of this study. The results were discussed and validated during a full-day focus group meeting.

Findings: The study reveals two determinants which encompass challenges in multiple organisational elements and thus strongly impact organisational competence for servitization: Firstly, the competence to formulate a market-oriented service strategy and to develop and sell services successfully depends on challenges regarding the acquisition and leveraging of customer knowledge during service encounters. Secondly, the competence to deliver services successfully is linked to organisational challenges concerning operational speed and flexibility.

Originality/value: Our study provides implications for literature by uncovering interdependencies between the various challenges of servitization, and by linking challenges to corresponding organisational system elements. For managers, we provide valuable guidance through the explanation of determinants of organisational competence for servitization and their related challenges.

Key words: Servitization, Organisational Competence, Challenges, Competence-based View

1. INTRODUCTION

Servitization creates new competitive ground for manufacturers by providing various financial, strategic and marketing-related opportunities (Gremyr et al., 2010; Mathieu, 2001). Success and financial benefits through a move into service provision, however, are not a logical consequence of the move itself. Indeed, servitization can cause a “service paradox”, i.e. increasing investments in the service business, and thus higher costs, without yielding sufficient returns (Gebauer et al., 2005; Neely, 2009). To avoid this, servitizing companies need to develop certain customer-centric competences in order to successfully provide integrated systems of products and services (Baines et al., 2009; Miller et al., 2002; Windahl et al., 2004). Neely (Neely, 2009) mentions “concerns about our understanding of the organisational capabilities needed for service design and delivery”, Martinez (Martinez et al., 2010) states that “the adoption of product-service strategy requires, among others, acquisition of new capabilities that enable the organization to compete in new service spaces”, Gebauer and Fleisch (2007) recommend an analysis of “the gap between existing internal competencies and those required for increasing service revenue”, and Windahl’s (Windahl et al., 2004) analysis suggests “that companies need an extended set of competences to succeed in providing integrated solutions”. However, as Neely (Neely, 2009) points out, there is a lack of knowledge concerning these competences.

A number of studies have investigated the corresponding challenges companies face when adopting a servitization strategy. For example, Johnstone et al. identified customer orientation and information management as requirements for servitization (Johnstone et al., 2009) and Baines et al.

(Baines et al., 2009) links challenges in servitization to questions of service design, organisational strategy, and organisational transformation. Martinez (Martinez et al., 2010) uses a single-case study approach to develop a "Five Pillar" model, which includes five categories: embedded product-service culture, delivery of integrated offering, internal processes and capabilities, strategic alignment and supplier relationships. While extant research provides insight into the "landscape" of challenges and developed frameworks for structuring these challenges, however, many of these studies remain conceptual in nature or relate to a single case study, which limits the generalizability of findings across organizations (Nudurupati et al., 2013). Furthermore, the dynamics and causalities between the challenges have not been a focus of previous research, which limits the application of its results for managerial purposes. We thus aim to contribute to servitization literature by answering the following research questions:

- How can challenges of servitization be structured along internal system elements of the organization?
- How do interrelations of challenges translate into measures of building organizational competence for servitization?

2. THEORETICAL FOUNDATION

In order to achieve the aforementioned structuring of challenges within the organization, we build on the Open Systems View of the Firm (OSV) as a conceptual framework (Sanchez and Heene, 1996, 2004). The OSV is theoretically grounded in a competence-based perspective, and conceptualizes internal system elements of the firm (strategic logic, management processes, resources, processes, products), which both enable and constrain the ability of an organization to build and leverage competences (Sanchez and Heene, 2004). Furthermore, it recognizes important elements of the firm's environment: resource markets, product markets, competitors and external advisors. Figure 1 displays the internal system elements of the OSV which are relevant within the context of our study:

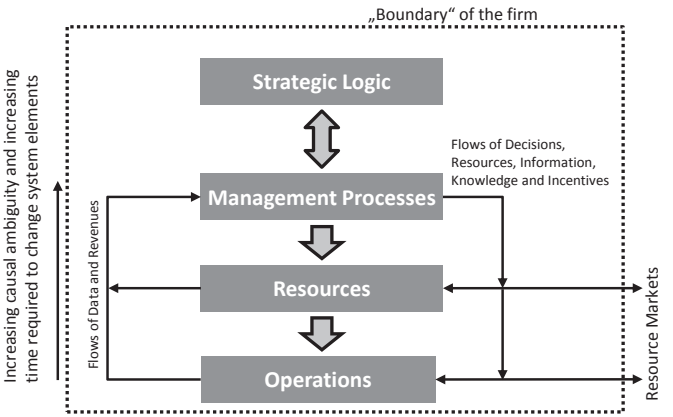

Figure 1: Model of the firm as an Open System, adapted from Sanchez and Heene (Sanchez and Heene, 2004).

The state of the system elements displayed in figure 1 affects the way organizations can be managed. In this setting, strategic changes are motivated by managers who perceive strategic gaps between the current state and the desired state of the system elements of the organization (Sanchez and Heene, 2004). Thus, we define the strategic gaps which managers perceive as the organisational challenges which have to be overcome in order to create competitiveness. Based on the OSV's logic

for defining and implementing strategic change (Sanchez and Heene, 2004), we define our analytical framework for the identification of strategic gaps as follows:

- **Strategic logic**: challenges regarding the ability to make decisions about who will be served by the firm (*target customers*), what will be offered to the customers (*service offerings*) and how the products and service will be provided for the customers (*key activities*).
- **Management processes:** challenges regarding the coordination of resources (*organization design*), the monitoring, evaluation and reward of resource providers (*controls and incentives*), the ability of resource providers to provide more, better or lower-cost resources (*stakeholder development*), and the execution of systematic changes in the way the firm thinks and acts (*transformative processes*).
- **Resources:** challenges regarding the resources used by the operation (*technology*, *employees*, and *knowledge*).
- **Operations:** challenges regarding the core operational processes of the organization (*service development, service sales* and *service delivery*).

The strategic gaps identified within these system elements trigger actions of competence building and competence leveraging, which aim at achieving the sustainable deployment of resources in ways which help the organization to achieve its goals (Sanchez and Heene, 2004). According to the logic of the OSV, actions within the strategic logic affect the desired state of management processes, which in turn determine the nature of resources and operational processes. However, changes in higher system elements are subject to greater causal ambiguity and longer response times, thus imposing significant liabilities in an organization's ability to change in dynamic environments. The structuring of challenges along the OSV's system elements thereby enables an investigation of the effects of competence building and leveraging actions for servitization.

3. METHODOLOGY

The research adopts a qualitative, multiple case study approach to establish an in-depth understanding of the challenges of servitization. Data was gathered during semi-structured interviews with eleven service managers of eight servitizing companies from the machine-building industry. The participating firms accounted for revenues between 60 and 390 million euro and employ between 600 and 2600 employees. All interviews were audio recorded, transcribed and categorized with help of qualitative data analysis software MaxQDA, as suggested by Miles, Huberman and Saldana (2013). Alongside the interviews, which were the primary source of information, internal presentations, marketing material and web presences of the participating firms provided a rich source of information that formed the empirical basis of this study.
Interdependencies between challenges were identified via MaxQDA's "Code Relations Browser". A relation was defined as valid when two codings directly overlapped and the connection between these codes was meaningful (thus excluding enumerations without direct causal connection). Sets of interrelated challenges – henceforth called "determinants" – were derived by grouping challenges according to the interrelations they shared. Following the hierarchical logic of the OSV, in which actions in higher system elements cause effects in lower system elements, challenges on the level of operative processes constituted the starting point for the investigation of relationships. The results were discussed and validated during a full-day focus group meeting.

4. RESULTS

4.1 Challenges of Servitization

In the following sub-sections, we present the results regarding the challenges of servitization according to the causal relationships indicated by the arrows between the system elements in figure 1.

4.1.1 Strategic Logic

The major challenge mentioned by the participants with regard to the strategic logic is the difficulty to generate the necessary knowledge on individual customer needs. The lack of customer knowledge impedes the capability to make informed decisions about **target customers**, **service offerings** and **key activities**. One service manager explained the importance of understanding the individual customer context, as well as the challenge of obtaining and utilizing information about this context through front-line employees:

"I am opposed to classic, rigid market segmentation. [What I want to know is] the customer's philosophy: how open is he [to our offerings]? And especially: which needs does he have right now? (…) But a customer won't tell you this if you simply ask him. However, in certain conversations, these things come up. (…) Especially sales and service employees with a good relationship to the customer possess such information. But are they aware of that and do they document it? So there might be certain employees who have the information [about customer needs], but they are not the ones tailoring our offerings [who need this information]."

Another participant emphasized the need of market feedback in decentralised service networks:

"Talking about 'local for local' doesn't just refer to the service employees themselves, but also to the services they deliver. I cannot say today, that services which work well in Germany will work just as well anywhere else. That definitely won't work out. And that's where we need more feedback and transparency from the market (…), which we need to generate in a concerted way from our sales channels and service employees."

It is important to note the mentioning of sales and delivery staff and their role in generating relevant information during service encounters, since this is a pervasive factor with strong impact on the results of this study. The second challenge of formulating a strategic logic is directly related to the aforementioned lack of information about individual customer needs. Here, a lack of information about customer performance measures is the main constraint:

"The transparency about how much the costs are [for a machine hour] is still lacking on behalf of our customers. (…) According to which criteria should we measure ourselves? According to what will the final tally be made?"

In this way, the difficulty to assess individual customer needs and to quantify the value proposition of service offerings together restrict the supplier's ability to assess the potential of alternative **service offerings** and **key activities**.

4.1.2 Management Processes

The main challenge of **transformational processes** is the implementation of a cultural change within the organization. The new culture should include a mind-set for speed and efficiency, as one interviewee vividly explained:

"Service was never a separate division in our company. And now you've got someone who has broad authority, but the organization isn't ready yet, the mind-set is still product-oriented. (…) In service, we have between 5.500 and 6.500 operations per year, our machines trigger maybe 70 to 100. Now we have to get all these processes through our organization fast, clean and efficient. And that is a matter of mind-set within the organization which poses a challenge to us and with which we are confronted daily. There's a certain sense of incomprehension for these matters."

Challenges concerning **stakeholder development** are strongly related to the firm's employees. The firms installed specific training programs covering topics such as psychology and conflict management, as well as teaching people social skills to foster communication with customers and economic background to improve the employees' understanding of customer problems. However,

classic technology-related trainings remain important. Such intensive human resource development programs underline the increasingly demanding roles of front-line service employees. One interviewee even claimed a new term for service delivery and sales employees alike:

"Developing employees to become full solution-consultants, that is the challenge."

Challenges regarding **organisational design** refer to the institutionalization of the service business and the implementation of new positions, roles and processes. Institutional issues cover the installation of a separate service unit as a profit-center, the implementation of a functional group dedicated to service development, and the integration or separation of service and product sales. The implementation of a decentralized service network in close proximity to customer locations was mentioned as a challenge regarding the organization's ability to respond quickly to customer requests. The introduction of new positions, roles and processes is a widely mentioned challenge which includes cross-functional and cross-departmental cooperation as well as widened areas of responsibility for front-line as well as back-end employees. An analysis of relations to other challenges revealed that such measures are caused by the need to create a customer-centred and quick organization, and have widespread implications on the effectiveness of operational processes.

The implementation of new **controls** is a challenge concerning the monitoring of resource effectiveness. Our results suggest the implementation of a full-scale performance monitoring including financial (e.g. service profits), customer-related (customer satisfaction) and process-related factors. The latter were the most widely implemented performance indicators and were designed to monitor the speed and efficiency of service delivery. Furthermore, multiple firms had a system in place which monitors the estimated qualification demand and the status-quo of employee qualifications:

"We have a function-related demand monitoring in place, in which we note how many construction managers we have, how many service technicians and so on. We rate every employee with levels one, two and three and assess if we have a quantitative or qualitative problem. According to this assessment we make a plan of how to develop the employees for their functional demands. (…) The challenge here is to identify the structure of such a demand landscape."

Similar to stakeholder development and controls, **incentives** for resource providers focus on front-line employees. However, only two of the eight companies reported service-specific incentive systems. The incentives in use included commission payments for service sales, variable performance bonuses which depend on motivation, flexibility and solution competence of employees, and the first visit success rate of the team. Multiple respondents, however, mentioned the need to motivate employees to take up service positions, because of long hours, extensive traveling, and the need to engage with many individual and profoundly different customers.

4.1.3 Resources

Innovations in information and communication **technologies** open up new possibilities for industrial service provision. However, implementing these technologies poses challenges of data and information utilization, as well as the digitalization of service delivery processes:

"A new role for us will be the condition monitoring of machines via remote technology. A key factor here will be our ability to handle large amounts of data and make relevant information available to our customers – to transfer machine information into valuable service information."

"A big task is to assess which systems we need for the service processes we have defined. And then to determine which end devices our service technicians will be equipped with."

As we outlined above, roles and responsibilities for **employees** are more demanding due to direct contact with the customer during service provision and the offering of solutions which consist of

both services and products. Consequently, there are considerable organisational challenges regarding the availability of qualified employees as a key resource of the firm:

"It will be difficult to find suitable employees who really are able to sell services. I need an employee who can answer technical questions (…). On the other hand, he must be able to think sales-oriented and work in a structured manner. And it has to be someone who – and this refers to the ability to communicate – is able to carve out the value of our services, to sell this value to the customer."

4.1.4 Operations

Challenges on the operational level of the organization concern matters of product creation and product realization. Regarding product creation, **service development** requires transformational processes of cultural change:

"In my view, the company is not ready yet to talk about service development in a certain depth, the mind-set is just not there yet. In order to get there, the service business has to be established and strengthened more, and the significance of service for the organization must be consolidated."

Another challenge in service development is the design and implementation of a systematic service development process. After implementation, however, firms encountered problems regarding idea generation and the information needed from front-line employees:

"The core of this [identifying opportunities to improve] lies in service sales and development: where are our deficits in service delivery and where are the needs?"

The relevant processes for product realization in servitization are service sales and service delivery. Our interviewees reported that the major challenge in **service sales** is communicating the value of services to the customer. This was linked to the intangibility of services and plays a particularly big role in services which impact the customer's internal processes:

"What makes service sales particularly challenging is (…) convincing the customer of the value, as in the improvement achieved through our services. This is exceptional because the customer does not want to interfere with functioning processes. So we have to convince him that our solution (…) is better for him."

Here, the importance of retrieving in-depth information about customer needs and preferences plays a vital role:

"We question the customer: is he sure about servicing his machines himself? And we inform him about the risks, potentials and advantages he has if he uses our services. We ask him what is most important to him, and that's a whole new kind of consulting. It is service consulting, and not just technical help. And in our view that is the entry ticket into successful service sales."

In order to leverage possibilities of customer information gathering in service sales, employees take over new roles and responsibilities, which in turn require new training measures:

"Take for example a salesman for spare parts. There's a great deal of potential [in his interaction] with the purchaser. [But it depends on] how he builds the relationship, how he asks questions and so on. For these employees we need a specific training program."

Regarding **service delivery**, challenges related to the aforementioned need for speed and flexibility, as well as customer communication. The former was particularly important for services which aim at maximizing machine availability:

"[A machine builder who provides services] must, above all, be quick nowadays. (…) We used to have downtimes of multiple days, now we're talking about hours. Today, no industry will accept a machine which is down for a full day."

Consequently, if time becomes a critical factor for service provision, this has implications for multiple organisational elements. On the level of management processes, a decentralized service delivery network needs to be implemented along with new roles for employees and processes for service delivery. On the level of resources, a greater reliance of organisational competence on technology as a key resource was detected:

"The expectations regarding quick solution finding are currently on the rise. We won't be able to avoid tackling this through software and artificial intelligence, in the widest sense. We will need expert systems, which analyse certain contexts and suggest solutions. We won't be able to avoid this because humans, by themselves, won't be able to handle it."

This, again, raises qualification requirements for front-line employees with regard to technologies:

"We need employees with a higher level of qualification, who are able to become acquainted with the technologies we use. If they don't possess this ability, it will get very, very tough. There's the possibility to lift skilled workers on that level, but our experience tells us that there will be a higher requirement regarding qualification levels in service in the future."

4.2 Determinants of Servitization

A total of 82 interrelations were identified involving the 10 challenges on the level of operational processes. Among these challenges, the responsiveness and speed in service delivery (18 interrelations), and the identification of customer needs during service sales (15 interrelations) accounted for 38% of all interrelations. Both challenges are dependent on the managerial processes of implementing new positions, roles and processes and employee training, but rely on otherwise unconnected networks of challenges. While responsiveness and speed in service delivery is connected to a number of challenges aiming at providing machine availability to the customer, the identification of customer needs is part of a network of challenges aiming at acquiring and utilizing information about the customer. In the following sub-sections, we briefly outline both networks of challenges as important determinants of organisational competence for servitization.

4.2.1 Customer Information Utilization

As a determinant of organisational competence for servitization, the capability to utilize customer information organization-wide is connected to challenges on all levels of system elements either as part of the challenge itself or as a prerequisite for overcoming a challenge. Information about individual customer needs is required on two levels of the OSV: Firstly, as an input for the assessment and formulation of a strategic logic, precisely to make decisions about which customers to serve and which services best target their needs. Secondly, on the operational level, customer information is valuable as a guideline for service development and as an input for individual consulting during service sales. Such information is acquired in direct customer contact, primarily during service sales, but also during service delivery. This poses challenges on the level of management processes, because new roles for employees have to be defined and new processes of customer interaction and internal information processing have to be implemented. On the level of resources, this results in an increase in the requirements for front-line employees due to soft skills and consulting capabilities becoming more relevant. These challenges, in turn, can be met by monitoring the employees' level of qualification and developing training programs according to qualification deficits. Furthermore, the existence of incentive structures is needed in order to motivate employees to engage with individual customers on an in-depth level.

4.2.2 Responsiveness and Speed in Service Delivery

Responsiveness and speed in service delivery as a determinant of organisational competence includes challenges on the levels of management processes, resources, and operational processes. It

refers to the capability of a servitizing firm to meet customer demands in a timely and effective manner. It resonates in service delivery processes, where the goal to achieve high machine availability creates the challenge of anticipating and quickly reacting to performance problems. This requires digitalized service processes, both in the back-office and in direct interaction with the customer, as well as the availability of information technology for remote monitoring and maintenance. On the level of management processes, the implementation of a decentralized service delivery network as well as an organisational culture which embraces speed and flexibility are important antecedents. Furthermore, the employment and training of data evaluation staff is a prerequisite for the effective use of technologies. Due to the focus on process efficiency within this determinant, a detailed monitoring of service delivery performance indicators such as e.g. "cycle time" and "first time success" should be in place to review resource and process performance and give insight into necessary adjustments.

5. DISCUSSION

Our results show that a wide range of challenges are related to two distinct sets of competence building activities. Firstly, the identification and utilization of customer needs directly influences the firm's ability to implement a customer-oriented strategy. According to the logic of the OSV, the strategic logic has an effect on the nature of all other system elements of the organization (Sanchez and Heene, 2004), and thus determines the existence and nature of any challenge positioned in a lower system element. Secondly, responsiveness and speed in service delivery relies on a number of adjustments on the levels of management processes and resources which are aimed at overcoming an organizational setup in which process speed traditionally played a minor role. This determinant strongly influences organisational competence in the firms which participated in this study, since those firms rely on a strategic logic based on the customer need of maximized machine availability. However, for firms whose customer needs imply service characteristics which are not based on supplier responsiveness, different challenges and determinants might emerge.

6. CONCLUSION

Previous research on the challenges of servitization presented and analysed categories of challenges mostly as stand-alone determinants of successful servitization, e.g. in the form of separate pillars (Martinez et al., 2010). With this study, we aim to contribute to the understanding of organisational competence for servitization by analysing the interrelations between challenges, thereby providing additional insight into the organisational transformation needed for servitization. The structuring of challenges along the system elements of the OSV allows for an investigation of the competence building and leveraging processes aimed at achieving overall organizational competence, and thus provides a perspective on servitization which has previously not been applied in literature. For managers, our study helps build awareness of the various challenges of servitization and their interrelations. In this spirit, the two determinants presented in this study provide insight into how challenges of servitization translate into measures which aim at building organizational competence for servitization. Furthermore, since managers tend to manage those facets of a situation which can be measured, they often focus on adjusting lower system elements such as operational processes (Sanchez and Heene, 2004). The determinant of customer information utilization and its related challenges, however, provide insight into the strategic role of individual customers' needs for the design of the organization's value creating system, and thus promote the need to manage the strategic logic of the firm accordingly.

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Value systems and organisational structure

HOW THE VALUE PROPOSITION IMPACTS SUPPLY CHAIN MANAGEMENT: PRELIMINARY EVIDENCE FROM A SERVITIZED ORGANISATION

Fred Ponsignon, Blandine Ageron, Laura Phillips, Olivier Lavastre

ABSTRACT

Purpose: to explore the impact of servitization upon the characteristics and management of the supply chain. A conceptual framework is derived from a review of the supply chain and servitization literatures. It suggests a relationship between the type of the customer value proposition and supply chain management (SCM).

Design/methodology/approach: We perform an exploratory case study to determine if "there is something interesting enough to justify research". The study examines the impact of product warranty provision upon the supply chain.

Findings: the case study findings indicate that the provision of product warranties creates several challenges in the supply chain. This suggests that servitized value propositions affect SCM.

Originality/value: This research is one the first studies to explore the relationship between value proposition and SCM in a servitized context. It reveals that even the provision of one of the most basic and ubiquitous service element, product warranty, has implications that go beyond the manufacturer-customer dyad.

Key words: supply chain management, value proposition, warranty, case study

1. INTRODUCTION

Servitization describes a move by manufacturers from offering product-centric value propositions to ones that rely on service elements that support, complement or enhance the product or equipment. Baines *et al.* (2009) define servitization as "the innovation of an organisations capabilities and processes (…) through a shift from selling products to selling integrated products and services" (p.561). These services range from basic add-ons such as maintenance, repair services and spare parts provisioning to advanced offerings including availability and outcome-based contracts. From a provider's perspective, this shift brings about a change in business model (Kindström, 2010). Intellectual enquiry into business models identifies a clear distinction between value proposition and value creation (Zott and Amit, 2010). The former resonates with the product and/or service offering while the latter resonates with a production or delivery system perspective. Servitization therefore describes a change of business model that involves specifying a new or enhanced value proposition and configuring the value-creating system that delivers it. The literature describes different categories of business models positioned along a 'product-service' continuum. Tukker (2004) depicts three main categories of servitized value propositions. Product-oriented services refer to situations where the ownership of the product or equipment is transferred to the customer and a service arrangement is provided to "ensure the utility" of the artefact over a given period of time. Use-oriented propositions relate to situations where the ownership of the product or equipment is retained by the provider who sells the "function" of the product to the customer, such as leasing of office equipment. The manufacturer sells the 'availability' of the product and customers pay only when the equipment is in use. Result-oriented propositions represent situations where the provider sells "results" rather than "functions". In other words, the customer purchases "utility" as an outcome instead of the "function" of the product and typically there is no-predetermined product or equipment involved. The customer and provider collectively focus on establishing a desired outcome or result. In outcome based contracts, the customer pays only when the desired outcomes from product or equipment use have been achieved. Oliva and Kallenberg (2003) argue that manufacturing organisations that produce core products and equipment, with service elements

purely as add-ons, are located at one extreme of the product-service spectrum. As firms move along the continuum they incorporate more product-related services into the value proposition, the relative importance of service elements increases and the relative importance of tangible goods decreases (Baines *et al.*, 2009). At the other extreme, service providers whose products are merely add-ons to services are found (Gebauer and Friedli, 2005). Penttinen and Palmer's continuum (2007) classifies value proposition in terms of their degree of completeness. A more complete offering exhibits higher levels of service, which they define as the application of specialized competences (knowledge and skills) through deeds, processes, and performances. This 'service' is applied to the customer's 'problem'. The position of an organisation on the continuum is determined by the extent to which customer problems are solved and by the amount of additional work left to the customer. Windahl and Lakemond (2010) adopt the dimension of product to process oriented offerings to describe servitization. This dimension represents a change in value proposition from product efficacy at one end of the continuum (i.e. does the product work?) to product efficiency and effectiveness within the customer's use processes at the other. Day (2000) conceptualises the servitization continuum based on the nature of the buyer-seller relationship. Following the general relationship marketing literature, he suggests that relationships between providers and customers can range from discrete transactions to relational exchange. Finally, Baines and Lightfoot (2013) describe three categories of value propositions, referred to as basic (i.e. product provision), intermediate (i.e. maintenance of product condition) and advanced (i.e. capability delivered through product performance). These various perspectives on the nature of servitized value propositions are summarised in Figure 1.

Furthermore, there is widespread agreement that servitizing the value proposition results in changes to the resources and processes that comprise the organisation's value-creating system (Smith *et al.*, 2012). Building service capability is a significant challenge which requires the adoption of a different operations management approach (Johansson and Olhager, 2004). For example, as servitized firms integrate a mixture of product and service production systems, they increasingly face challenges typical of service operations such as increased customer-induced variability, as well as a requirement for innovation, flexibility, and customisation (He and Lai, 2012). Baines and Lightfoot (2013) explore the operations practices and technologies in four manufacturing organisations that have successfully servitized. They find that delivering advanced services requires the deployment of novel operational capabilities. These include building product remote monitoring capacity, integrating activities with the customer's processes, aligning performance measures to individual customers, co-locating and distributing facilities throughout the customer's operations and developing the front-liners' service mindset. Furthermore, Windahl and Lakemond (2010) contend that when firms increase the relevance or share of service elements in the value proposition the boundaries of activities performed by providers and customers change and providers become part of customer processes. Specifically, providers rely heavily on customer resources and close collaboration between these actors is required to achieve desired outcomes (Guo and Ng, 2011).

Whilst operations management scholars have explored various facets of the servitization phenomenon over the past 15 years, most studies investigate servitization from the perspective of the provider and its customers. This focus is not surprising; this form of business model innovation involves changing the customer value proposition and the provider's operational system, processes and resources. However, Bititci et al (2004) argue that value propositions address the entire supply chain rather than only the next stage customer. The supply chain represents an extended view of the organisation's operational boundaries that includes all of the actors who participate in implementing the customer value proposition. Additional effects from servitization are therefore expected beyond the boundaries of the customer-provider dyad and further up the supply chain. For instance, the use of digital tags and sensors to track and monitor product performance in use situations significantly affects the nature and intensity of flows within the chain of supplier organisations. This raises

interesting questions about the characteristics of these flows as well as about their management. Based on the above, we argue that implementing a service-oriented value propositions also result in changes to the entire supply chain and to the way it is managed. Academic research investigating the effects of adopting a service-centric business model on the characteristics and the management of the supply chain has been limited until now (Bastl *et al.*, 2012). Against this background, the purpose of this research is to explore the impact of servitization upon the characteristics and management of the supply chain.

2. THEORETICAL BACKGROUND

2.1 Supply chain management in a servitized context

This section focuses on recent studies that address supply chain management (SCM) in servitized organisations. Johnson and Mena (2008) suggest that supply chains which support the provision of servitized value propositions are different to those that support pure products or services. They study the challenges and opportunities facing the SCM function of five servitized organisations. They define SCM in a servitized context as "the management of information, processes, capacity (people, equipment and facilities), products, services and funds from the earliest supplier to the ultimate customer" (p. 30). They draw on the process reference models for service supply chains and product supply chains to develop a process framework for servitized supply chains, which they then explore empirically. Their framework includes the following core processes: information flow management, customer relationship management, supplier relationship management, demand management, production management, order delivery management, financial flow management, returns management and end-of-life, product development management and risk management. Their findings reveal that these processes were important and applicable to varying degrees in the case organisations. Specifically, they note the role of information flow management processes in allowing information and knowledge exchange between firms as well as the role of risk management processes in ensuring that risks are spread across the supply chain. Lockett *et al.* (2011) conduct an exploratory case study into the effect of product service systems on the upstream supply chain. Specifically, they select two distinct value propositions, one traditional contract and one service-product contract, and compare and contrast the relationships between the manufacturer and two supplier organisations. They examine these relationships along several dimensions such as structure (i.e. information and data flows), supplier engagement in provider's strategy and delivery, alignment of incentives, information sharing in delivery, and life cycle considerations related to delivery. They observe significant differences in the supplier-provider relationships relating to product provision and to product-service provision on two dimensions only. They conclude that successful servitization requires aligning incentives across the entire supply chain and sharing information effectively. Bastl *et al.* (2012) set out to explore the characteristics of buyer-supplier relationships in a servitized context. They collect case study data to examine the intensity or degree of information exchange, operational linkages, legal bonds, cooperative norms and adaptations in the relationships between a servitized organisations and two separate, but similar, suppliers. They find no evidence about changes in information sharing practices and some evidence about the emergence of cooperative norms. They observe more significant changes concerning the importance of contractual agreements that specify the obligations and roles of both parties and the intensity of process and systems integration between the provider and its suppliers. Chakkol *et al.* (2014) carry out a single case study of a truck manufacturer and its supply network. They focus on three categories of value propositions that represent varying degree of servitization (i.e. basic product offering, product and service offering, full-service solution). For each value proposition they explore the configuration of the associated supply network in terms of the type and number of actors that are involved in co-creating value as well as the characteristics of the networks including the type of relationships, the level and purpose of coordination and information-sharing and the nature of exchanges (e.g. materials/equipment, skills, information, knowledge, data flows and reports). Their findings reveal that each value proposition has different supply network configurations and characteristics. This

short literature review reveals that servitization does have an impact upstream but that the magnitude of this impact is not as significant as what may have been expected. Fine grain analysis of previous research findings seem to indicate that the servitized organisation can be reluctant to engage more closely with its suppliers. This may suggest a maturity issue and that further effects may be found as servitization becomes increasingly established over time. For instance, Bastl *et al.* (2012) note that provider's behaviours take a long time to change.

2.2 Managing the supply chain in a servitized context: towards a research framework

In this section we propose a research framework that outlines the possible contingencies and characteristics of supply chains in a servitized context. Table 1 synthesises and defines the main themes and associated characteristics that have been discussed in the mainstream SCM literature (e.g. Autry *et al.*, 2008, Bowersox and Daugherty, 1987, Kim, 2007, Narasimhan *et al.*, 2008). A full list of references is not provided here due to space restrictions but is available from the authors upon request. Many of these themes have not yet been addressed, theoretically or empirically, in the servitization literature. They thus offer a useful platform for future research. For each theme, scholars can explore three interrelated research questions: i.e. what are the characteristics (i.e. what does the supply chain look like), why do we observe these characteristics (i.e. why does the supply chain look like that?) and how have those characteristics come about (i.e. how is the supply chain implemented and managed).

Themes	**Characteristics**
Supply chain configuration	Chain or network; Main actors; Length and complexity of the chain; Stability of the chain; Supplier base; Main relationships, exchanges and flows
Information sharing	Level, quality, purpose, type and effect; Information flow management process
Manifestations of relationships	Type of relationship; Collaboration; Dependency; Trust; Proximity; Facilities and their location; Suppliers' engagement in the organisation's strategy; Negative effects of partnering within the supply chain; Vertical integration
Supplier relationship management	Formalisation, including contracts and legal bonds; Control mechanisms and governance; Conflict management mechanisms ; Work methods; Coordination mechanisms; Alignment of incentives; Performance measurement and value demonstration; Relationship management processes
Innovation	Type of innovation; Suppliers' involvement in innovation; Resources and competencies dedicated to innovation; Innovative capabilities
Risk	Type of risk; Consequences of risk; Risk management
Human resources	Skills and knowledge; Attitudes and behaviours; Empowerment; Co-location of employees; Project team
Process management	Financial Flow Management; Customer support Production Management; Returns Management and End-of-life; IT systems

Table 1: Supply Chain Management: main themes and associated characteristics

This suggests that research is needed to provide an understanding of how multiple organisations within a servitized supply chain coordinate their operations to support a customer value proposition. Chakkol's exploratory work (2014) indicates that the effects of servitization on the supply chain are more pronounced for service-oriented value propositions than for product-oriented propositions. This finding resonates with a service design study that empirically shows that offering different value propositions (e.g. standardised versus customised) require executing service delivery systems with markedly different operational characteristics (Ponsignon *et al.*, 2011). Thus, supply chains

supporting the provision of different value propositions are likely to operate differently as suggested in the conceptual framework below. We formulate our research questions as follows:

Is SCM contingent on the type of servitized value proposition it supports? And, if yes, how is SCM affected by the implementation of a service-oriented value proposition?

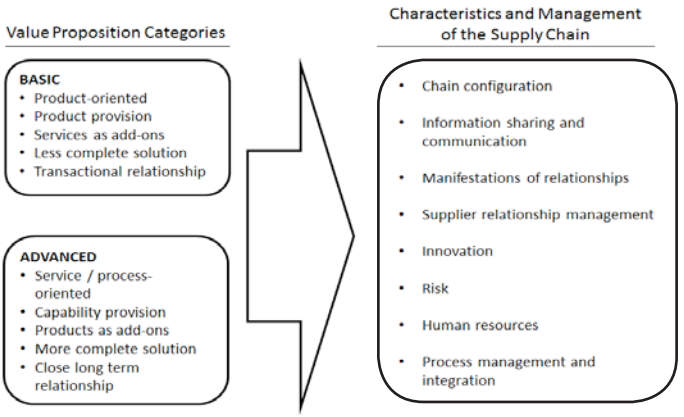

Figure 1: Conceptual framework

3. RESEARCH METHODOLOGY

This work aims to explore how servitized value propositions affect SCM. We adopt a single case study design to address the research question. Our exploratory case aims to shed light on the relationship between the customer value proposition and SCM and to determine whether "there is something interesting enough to justify research" (Voss et al., 2002). Additionally, the study one allows us to become familiar with the case organisation's history, business context, business model and key people; and build trust with the organisation's management.

As for the case selection, we engage with a servitized organisation that faces SCM challenges. The case organisation is a world leading provider of product identification and traceability solutions. It offers inkjet, thermal transfer, laser, and print and apply label systems. It provides a range of technical services and support for its printing and coding products in 120 countries. It offers three main categories of value propositions to its customers. First, the basic service offering, termed 'standard', is designed to maintain the performance of the equipment. The offering covers customer warranty and preventive maintenance costs. On-site maintenance visit includes a laser power evaluation designed to increase overall system performance and lifetime. The second offering, termed 'premium', aims to secure the customer's investment and expenses. It covers both the repair and maintenance of the equipment. In addition to the features of the 'standard' offering, the premium package offer an extension of the initial manufacturer warranty during a total period up to 60 months. Third, the organisation offers a 'premium uptime' package that guarantees an equipment availability ratio of up to 99.9%.

To explore the relationship between value proposition and SCM, we need to focus on a specific value proposition, or a particular service within a proposition, and examine if and how the implementation of this proposition, or service, affects the supply chain. We therefore elect to explore the challenges that the provision of a basic service, product warranty, creates in the supply chain. Murphy *et al.* (2004) points out that "the purpose of a warranty is to establish liability among the two parties (manufacturer and buyer) in the event that an item fails. An item is said to fail when it is unable to

perform satisfactorily its intended function when properly used". Since most products are sold with some sort of warranty, we expect to generate insights that are relevant to a large number of manufacturing organisations. The dataset consists of an unpublished report of a previous research project coordinated by one of the authors, five face-to-face interviews with key informants and a workshop involving two researchers and five senior managers of the case organisation. The 60-page long report examines the role of customer and supplier warranties and how their interactions affect the management of the supply chain. The interviews explored the emergence and development of servitization within the organisation as well as the challenges that arise as a result of going downstream. We interviewed the head of services twice, the head of SCM, a marketing manager, and a logistics manager.

4. FINDINGS

The case organisation operates an assembly-to-order production process to manufacture printing and coding equipment. It then sells the printing equipment to its customers and offers them a warranty of a 12- to 18-month duration (i.e. customer warranty) for these products. When the customer warranty is activated, it initiates a repair and/or replacement process that is performed on the customer's premises, at the organisation's repair centre or at the original supplier of the defective part. External suppliers provide a range of components and modules that are assembled into the final equipment that is then delivered to the customer. Most of these parts are provided with a supplier warranty, which involves either repairing the part or providing a new one when a part fails. Supplier warranties represent significant cost saving opportunities for the case organisation. It is worth noting that customer and supplier warranties are distinct and independent from each other. Nonetheless, it is very common for the final equipment and its component parts to be covered by both a supplier and a customer warranty. When the equipment used by the customer fails, it is therefore often covered by these two warranties. If the part that breaks down comes from an external supplier and is under warranty, the activation of the customer warranty initiates the flow of the defective part from the customer all the way up to the original supplier who is responsible for repairing the part or providing a new one, as illustrated in Figure 2 below. In these cases, the part qualifies for supplier warranty recovery. The data suggests that the case organisation is unable to recover the cost associated with the supplier warranty when a component of the printing equipment that is used by a customer and qualifies for supplier warranty breaks down. In other words, the case organisation is unable to recover the parts cost when a product or part covered by a supplier warranty and used by the customer fails. This evidence suggests that the activation of a customer warranty for coding equipment that is simultaneously covered by supplier warranty, a basic service, has implications for the management of the warranty chain. The warranty chain describes the actors and activities that are involved in managing the warranty. It mirrors the supply chain. This evidence therefore supports our contention that the implementation of servitized value propositions creates challenges in the supply chain.

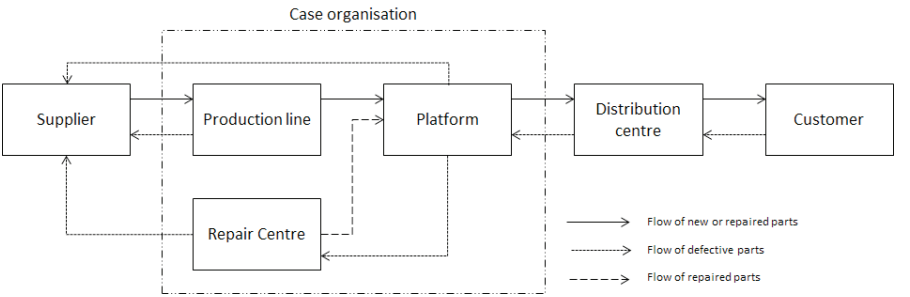

Figure 2: The flow of parts in the warranty chain

5. DISCUSSION AND NEXT STEPS

The findings support the contention that SCM is affected by the provision of services. In doing so, our study contributes to the nascent literature addressing SCM challenges in a servitized context (e.g. Bastl *et al.,* 2012; Chakhol *et al.,* 2014). Our main theoretical contribution is to extend this literature by showing that offering a basic service attribute to the customer (i.e. product warranty) has implications for the upstream supply chain which needs be managed. Specifically, we show the importance of developing a process for warranty recovery management. We also highlight the nature and role of the warranty chain which mirrors the supply chain. Since virtually all manufacturing organisations include a warranty in the customer value proposition, our findings are likely to resonate with a large number of servitized organisations.

We intend to conduct a follow-up longitudinal study within the same organisation to identify the changes in the supply chain that result from the implementation of an advanced service as well as to capture and theorise the dynamics of these changes. According to Voss et al. (2002), researchers conducting longitudinal studies participate "in formulating and observing organisational change", which facilitates the identification and description of the phenomenon studied from a process perspective. A longitudinal study design will enable us to justify and explain the mechanism through which SCM is affected by the implementation of a service-oriented value proposition.

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GIVE ME A KIBS: POLICY INSTRUMENTS MEDIATING THE RELATIONSHIP BETWEEN SERVICE KNOWLEDGE FIRMS AND SUSTAINABLE MANUFACTURING SUPPLY CHAINS

Esteban Lafuente, Yancy Vaillant & Ferran Vendrell-Herrero

ABSTRACT

Purpose: This study seeks to evaluate the mediating role of policy instruments in the the relationship between KIBS and employment creation in new manufacturing businesses.

Design/methodology/approach: The data used in this study come from three different sources. First, information on both the knowledge-intensive orientation of the entrepreneurial activity and the employment created by new manufacturing firms is obtained from the Global Entrepreneurship Monitor (GEM) datasets for Spanish regions. This information source is robust at it contains more than 176,000 observations. Second, data dealing with policy instruments—the stock of manufacturing firms and the total number of freights transported—were obtained from Eurostat databases. Third, macroeconomic variables were obtained from the Spanish Institute of Statistics. Data from the three sources allow us to build a panel dataset including the 17 Spanish regions during 2006-2012, which totals 119 region-year observations.

Findings: The results strongly suggest that building rich and diverse manufacturing business environment and appropriate infrastructures mediate the relationship between KIBS and the sustainability of manufacturing supply chains. The work offers implications for academics, policy makers and practitioners.

Originality/value: This research fills an important gap on servitization literature focusing on 'when' and 'how' new manufacturing businesses—which cannot internalize service offering—outsource those activities to Knowledge Intensive Business Service firms (KIBS).

Key words: KIBS, sustainable supply chain, entrepreneurship, policy instruments.

1. INTRODUCTION

In enhancing their competitive advantage manufacturers have shifted their focus from products to integrated solutions, including both products and services (Matthyssens and Vandenbempt, 2008; Baines and Lightfoot, 2013). Vandermerwe and Rada (1988) dubbed this business model servitization. The anticipated benefits of servitization approaches include more stable revenues, profitability, and corporate growth (Smith et al., 2014). Yet, servitization is a complex process, and positive results cannot be guaranteed (Neely, 2008).

Certain aspects dealing with the level of analysis, the type of organization, and the characteristics of the analysed services dominate mainstream literature on servitization. First, existing studies mostly examine the servitization phenomenon from a microeconomic perspective. Despite administrations in the US and Europe acknowledge the potential transformative power of service innovation (European Commission, 2011), the analysis of the territorial impact of servitization processes based on meso or macro approaches remains, to the best of our knowledge, empirically unaddressed. Existing literature is also silent with regard to the role of public policies in encouraging the development of service-oriented strategies among firms as a driving force fuelling sustainable territorial performance. While research on the policy mix of innovation and competitiveness is growing (Magro and Wilson, 2013), there is little explicit analysis of how these policy mixes might relate to servitization processes at regional or national level.

Most literature on servitization has focused on the integration of product-service portfolios within the same organization, but there is a dearth of research on businesses that do not have internal resources, such as SMEs or new manufacturers. In this sense Arnold et al. (2014) found that

developing an appropriate service sector (i.e. finance, consulting) has been a key driver for the massive increase of manufacturing competitiveness in India. This reinforces the idea that service provision does not need to be integrated within organizational boundaries; and that territories can benefit from the development of service sectors. In our case we assess how the knowledge intensive business firms in Spain (KIBS) helps to enhance the competitiveness of the new manufacturers.

The remainder of the paper is structured in four parts. First a theoretical background is introduced leading to the statement of hypotheses and a model plot. Second, the method is described drawing upon the combination of different datasets, including the 17 Spanish regions for the period 2006-2012, which totals 119 region-year observations. Results are presented in part three. Finally, the fourth part presents the conclusions and implications.

2. **THEORETICAL UNDERPINNING AND HYPOTHESIS DEVELOPMENT**

From a strategic management perspective, the business model is the essence of an organization's strategic approach and refers to the design of the value creation, delivery and capture mechanisms employed by the business to attract customers to pay for value and convert payment to profit (Teece, 2010). The primary objective of this paper is to scrutinise the economic impact—in terms of employment creation—resulting from the integration of advanced services into manufacturing processes. The successful implementation of this business model will highly depend on the organisation's internal resources.

In theoretical terms the proposed analysis matches the resource-based-view of the firm (RBV), which posits that businesses develop different competitive advantage—using their access to resources and capabilities—and this explains performance differences among competing firms (Teece, 1980). In this well-established framework resources are transferable while capabilities (or the way are combined and transformed) remain inside the organisation and hence cannot be transferred. This implies that manufacturing firms may not have the necessary resources to internally develop a servitization strategy, thus making the acquisition of those resources from the market—i.e., outsourcing—a desirable alternative. New manufacturing firms are exposed to liability of both smallness and newness, thus the internalisation of service activities in their value chain through KIBS might prove itself an optimal solution to develop these services.

Muller and Zenker (2001) describe KIBS as professional services firms providing knowledge-based and high intellectual value-added services mostly to other small and medium sized manufacturing firms. One example of the knowledge provided by KIBS is the management of large samples of digital information, namely big data. According to Opresnik and Taisch (2015) this information adds significant value to manufacturers offering especially in B2B relationships by providing customers with tools that can be used to enhance cost saving policies and develop more informed strategic decision-making processes.

Innovations with high consumer value perception stimulate new demand and enhance the generation and retention of rents. Those processes require a clear understanding of the consumer (O'Cass and Ngo, 2011) and in manufacturing settings consumer engagement depends on the degree of service provided (Spohrer and Maglio, 2008). Small and medium manufacturers do not have the internal capabilities and knowledge to incorporate advanced services into their value chain, and they need the collaboration and co-production of KIBS in those processes (Lessard, 2014). This means that the vigour and sustainability of the manufacturing supply chains may depend on the presence of knowledge intensive services available in a reasonable geographical proximity. We construct our first hypothesis based on this statement.

Hypothesis 1: Knowledge intensive business services will have a positive impact on the sustainability (in terms of employment) of new supply chains.

However, value creation to customers may not be directly linked to the process of value or rent appropriation. For SMEs specific external conditions facilitate the retention of those rents in the long-run, which are by definition set outside the business boundaries. Indeed, literature concerning innovation development within SMEs has traditionally paid attention to the role of public policies. But, what public policies are we talking about?

Recent literature has identified two different policies that boost innovation among SMEs. First, science and technology policies which include R&D incentives and human capital development (Parrilli and Elola, 2012). Second soft policies enhancing the interaction and collaboration between firms operating in the same sector, or at least participating in the same supply chain (Aranguren et al., 2014). We do not neglect the validity of those public policies in enhancing product development and productivity, but we understand that other policy instruments are more relevant when the goal is the value co-production of KIBS and manufacturers and the subsequent generation of employment. In particular, we seek to analyse the mediating role of manufacturing environments and transport infrastructure.

Vigorous manufacturing environments imply the existence of agglomeration economies. Increased competition and the availability of more suppliers and customers produce a learning effect, which has a direct effect on firm productivity, and thus on business sustainability (Andersson and Lööf, 2011). In addition, the improvement of public infrastructures have been linked to economic growth (Munnell, 1992), and this is especially relevant for manufacturing firms whose activities rely on transport systems to access local and international markets for both acquiring specific inputs and selling their products (Rodrigue et al., 2013). Overall, we hypothesize that the manufacturing environment and transport infrastructures provide opportunities for the successful engagement of KIBS and new manufacturers. All empirical relations are shown in Figure 1.

Hypothesis 2: Policy instruments, measured as the manufacturing environment and the transport infrastructures, positively mediate the relationship from knowledge intensive business services to the sustainability (in terms of employment) of new supply chains.

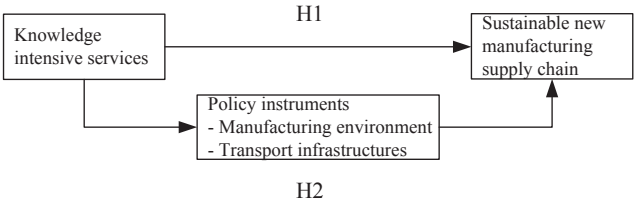

Figure 1: Research model

3. DATA AND METHOD

The data used in this study come from multiple sources. First, information on both the knowledge-intensive orientation of the entrepreneurial activity and the employment created in new manufacturing firms at the regional level were obtained from the Adult Population Survey of the Spanish Global Entrepreneurship Monitor (GEM) during 2006-2012. The GEM project began in 1998 as a joint initiative of the London Business School and the Babson College to create an international entrepreneurship research network. Today, more than 70 countries take part in this research initiative, making the GEM project a world reference in the entrepreneurship field and a highly

valued source of information for academics and policy makers. A comprehensive description of the GEM project and its methodology is presented in Reynolds et al. (2005).

In the case of Spain, the survey was conducted in each of the Spain's 17 Autonomous Communities by a leading professional market investigation and public opinion service firm selected and monitored directly by the International GEM Consortium. The sample was built based on a multiple stage sampling method using the Bellview Fusion computer-assisted telephone interview system. In the first stage, a random selection of municipalities was collected according to population quotas. In the second stage, telephone numbers corresponding to the different municipalities were randomly obtained from the annually updated 'España Office v5.2' database of fixed and mobile telephones. Finally, individuals aged between 18 and 65 inclusive were randomly selected by the mentioned software. The final sample used to reach the aim of this study contains 176,609 observations from Spain between 2006 and 2012.

Second, macroeconomic figures—unemployment rate and Gross Domestic Product (GDP) per head—were obtained from the Spanish Institute of Statistics. In the case of the GDP per head, values are expressed at constant 2012 prices and are deflated with respect to inflation. Third, data on the variables related to the configuration of the industry, stock of manufacturing firms and the total number of freights transported by air, road and maritime means were obtained from Eurostat.

Data from the three consulted information sources allow us to build a panel dataset including the 17 Spanish regions for the period 2006-2012, which totals 119 region-year observations.

The relevant variables for the empirical analysis are employment creation in new manufacturers as a measure of 'sustainable new manufacturing supply chain'; and the proportion of KIBS over total number of new companies in each region as a proxy measure of 'knowledge intensive services'. Policy instruments are measured with the stock of manufacturing firms and the freights transported. Table 1 provides summary statistics for these variables.

Variable	Mean	Std. dev.	Minimum	Maximum
Rate of KIBS business formation	0.1951%	0.2622%	0.0000	1.7081%
Employment of new manufacturing firms	3.0626	2.2533	0.0000	14.2857
Stock of manufacturing firms	12,718.39	11,497.44	2,062.00	48,436.00
Total transport of freights (thousands of tonnes)	23,231.37	29,499.04	0.0000	119,595.00

Table 1: Descriptive statistics

The mediation hypothesis proposed in this study is tested using the approach proposed by Surroca et al. (2010). This method consists of the implementation of a two-stage modelling strategy. All specifications are estimated by fixed-effects regression models. This modelling strategy helps overcome collinearity and endogeneity problems. By construction, the correlation between the estimated instruments and the mediating industry variables is low, thus preventing multicollinearity problems in model estimation (Wooldridge, 2008). The use of fixed-effects models controls for the potential endogeneity problems emerging from the correlation between the independent variables and the time-invariant region-specific unobserved heterogeneity. Additionally, all variables used in the model specifications (instruments, industry-related and control variables) are introduced as lagged terms (*t-1*) to avoid potential endogeneity problems linked to reverse causality.

4. RESULTS

This section presents the results of the empirical analysis. Additionally, results in Table 2 report the average variance inflation factor (VIF) for each regression. Results for this diagnostic test indicate that none of the models suffer from multicollinearity problems, as VIF values are below the commonly used cut-off threshold of ten.

Results in Model 1 of Table 2 provide evidence supporting Hypothesis 1. In particular this model does not consider the mediation of public instruments and show a positive and significant relation ($p<0.05$) between the rate of new KIBS and employment enhancements in manufacturing firms. Additionally, results suggest that the KIBS' regional firm formation rate positively impacts the stock of manufacturing firms and the total number freights transported (not shown in Table 2). This is a first necessary condition for testing the mediation effect of the policy instruments. Results in Model 2 of Table 2 show that the mediation of the industry configuration variables is strong. More concretely, the coefficient of the rate of new KIBS formation becomes insignificant whereas the parameters linked to stock of manufacturing firms and freights transported has a positive effect on the regional rate of new KIBS businesses ($p < 0.05$).

	Average employment creation in manufacturing firms	
	(1)	(2)
Rate of new KIBS firms (*t-1*)	0.3613** (0.1491)	0.3969 (0.3846)
Stock of manufacturing firms (*t-1*)		1.6773** (0.8499)
Freights transported (thousands of tonnes) (*t-1*)		0.1825** (0.0842)
Unemployment rate (*t-1*)	0.0894 *** (0.0340)	0.0834*** (0.0191)
GDP per head (*t-1*)	2.3028 * (1.1958)	2.5368* (1.5233)
Time dummies	Yes	Yes
Intercept	–5.0678 (4.3868)	–3.4723 (2.4508)
R-square (within)	0.2637	0.3248
F-test	7.53***	9.90***
Average VIF	2.61	6.14
Observations	102	102

Robust standard error is in brackets. *, **, *** indicate significance at the 10%, 5% and 1%, respectively.

Table 2: Fixed effects regression results: Mediation effects

5. CONCLUSIONS

This research provides evidence about the relevance of Knowledge Intensive Service Business (KIBS) on enhancing new manufacturing development. This is an important contribution to servitization literature, silent on the implementation of advanced services on new or small companies. This result offers 2 important recommendations for small and medium manufacturers:

- Location decision is important since local ecosystem and infrastructure determines at a high extent the conditions for firm sustainability.
- Outsourcing the service function to KIBS is strategically optimal when the company does not have enough experience and internal resources.

This research also has a policy orientation and provides relevant insights. The results demonstrate that the relation between KIBS and new manufacturers depends on two important policy

instruments: stock of firms and frights transported. This gives a clear indication that policy makers must assure the development of appropriate infrastructures and business environment. However, Future research avenues on servitization in SMEs need to shed light on other issues, responding in particular to the following questions:

- Are there any other policy instruments (i.e. technology or cluster policy) that stimulate sertvitization in SMEs?
- Which are the elements that form the relation between manufacturers and KIBS?

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THE USE OF EQUIPMENT LIFE-CYCLE ANALYSIS TO IDENTIFY NEW SERVICE OPPORTUNITIES

Shaun West and Adriano Pascual

ABSTRACT

Purpose: This paper describes a methodology that has been used successfully to assist two manufacturers in identifying opportunities for developing services based on the equipment they sell. This approach helps to link both product and service development in a more holistic manner.

Design/methodology/approach:

Each workshop started with a theoretical introduction to the equipment life-cycle (using an approach based on the total cost of ownership) with the car as an example. The participants were then invited to consider two cases in the following order:

i. the equipment life-cycle analysis of a car;
ii. the equipment life-cycle analysis of specific equipment (relevant to the team from a particular manufacturer).

After mapping out the life-cycle, the participants were then asked to identify service opportunities based on different life stages in the equipment's life-cycle. The customer value proposition canvas was used to help them to understand the customer's needs at each stage and to align their service value proposition accordingly.

Findings: The first case allowed the participants to work together in a way that was non-confrontational. By doing so they were able to learn how to use the tool to develop a deeper understanding of how product-services systems are viewed by the owner rather than the supplier of a piece of equipment. The shift of focus, from a supplier-oriented to a customer-oriented point of view, allows a company to react to new trends improving its competitiveness.

The second case built upon their newly acquired servitization understanding allowing the participants to consider how their customer's needs change during the full operational life of the equipment. The equipment life-cycle the participants constructed provided them with a new framework to identify new, different or additional services during the operational life of the equipment, including:

- new services that they did not provide;
- timely injection of new technology to reinforce their monopoly position on the equipment;
- end of life options to prevent cannibalization from the second-hand market.

Using this simple visual approach based on the 'customer value proposition canvas' is it possible to identify new services or to develop ways to inject new technologies into the installed base of equipment. This allows manufacturers to identify, create and deliver customer value over the full operational life of the equipment.

Originality/value: This approach provides a methodology that allows manufacturers to start to visualise clearly how their customers use the equipment that they have supplied enabling their teams to discover new services and then to create the customer valuation. Use of the car as an example provided a neutral platform allowing them to become accustomed to the tools before moving into their own products and the services required to support them.

Keywords: Servitization, equipment life-cycle, value proposition.

1. INTRODUCTION

Neely (2007) states that manufacturing in developed countries is under intense pressure from new competitors and that manufacturers cannot longer compete purely on cost. He also views servitization as a way to compete through diversification against these challengers and a way to hold or even grow the profitability. Cohen (2006) confirms that services have, in general, higher profitability than the core manufacturing businesses.

Even though the concept of servitization appears to be essential for the survival of today's manufacturing companies, it seems that it is not fully established. Manufacturing firms often have difficulty understanding the service needs of their customers for the full operational life of the equipment supplied (Baines and Lightfoot, 2013 and Fischer, 2012). To investigate this problem, three workshops were held with two different firms. During the workshops the equipment life-cycle was considered using on the total cost of ownership approach (Ellram, 1993) and the customer value proposition (Anderson, 1999 and Osterwalder 2014). The objective of this approach was to identify new services and associated customer value propositions. The use of these tools was as a prototype for encouraging a Service Design Thinking (Stickdorn, 2012) approach to increase the openness and creativity of the participants.

The main sections in this paper include a literature review where the two tools are introduced; a methodology section describing how the 3 workshops sessions were arranged, a section that describes and discusses the results; and closes with sections for conclusions and recommendations.

2. LITERATURE REVIEW

2.1 Equipment life-cycle based on the total cost of ownership

The total cost of ownership (TCO), sometimes called life-cycle costing, is a cost management methodology that analyses all costs associated with the equipment during its life. Ellram (1993) describes this for capital equipment and recommends that all of the life-cycle costs should be considered, including the equipment disposal. Wynstra (2005) takes this a step further saying that the costs drivers or tasks, which the customer (or the owner or operator) is exposed to, should also be included. Wynstra (2005) also provides a supporting and updated framework that identified some of the activities and when in the life-cycle the different phases occurred. Hurkens (2004), takes the TCO model a further step forward by considering the total value of ownership concept (TVO). The relationship between price, TCO and TVO is shown in Figure 1 and is similar to the modelling approach used in project finance where all costs and revenue streams are considered, albeit on a single piece of equipment basis.

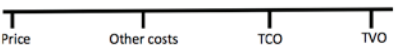

Figure 1: Evolution of cost models identified by Hurkens (2004)

Singh (2008) describes how the operational life of the equipment can be broken down into distinct activities (or cost drivers): planned and routine maintenance, emergency-breakdowns and repairs, and renewal. This breakdown would include all necessary spare parts that may be required during the operational life of the equipment. Singh's (2008) list does not include other activities e.g. leasing, financing or rental activities that may be required, whereas the TVO model of Hukens (2004) could also be thought to include these 'financial' value adding activities. Stockgi (2012) presented the generic equipment life-cycle in a visual form shown in Figure 2 although it fails to identify CAPEX (or capital expenditure) related costs during the operational period focusing purely on OPEX (or operational expenditure) costs.

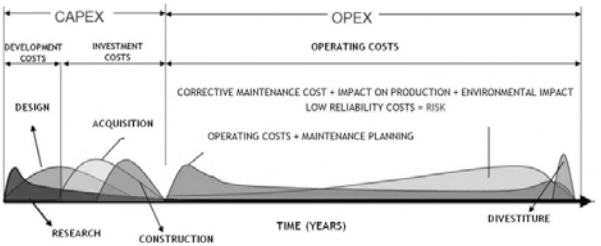

Figure 2: CAPEX and OPEX on a generic lifecycle (Stockgi, 2012)

Understanding all the components or cost drivers for the total cost of ownership provides the supplier with a detailed understanding of costs and possible value added opportunities (Wynstra, 2005). Wynstra's (2005) paper also confirmed that only a few suppliers identify value-added services on the basis of TOC throughout the life-cycle of the equipment.

2.2 Customer value proposition

Anderson (2006) makes it clear that suppliers should focus on value rather than simply costs and in particular, create clear customer value propositions for the products and services that are offered. This should be either at a customer level or a segment level. Osterwalder (2014), also acknowledges the importance of understanding the customer for a successful value proposition. He provides a visual design-oriented approach to create the value proposition that Anderson (2006) recommends. According to Osterwalder customers will experience pains and gains when performing a task or a job. A successful value proposition will increase the gains for a customer and reduce their pains. However, it is important to prioritize both the pains and gains and to address only the most relevant for the customer. A combination of Anderson's (1999) concepts of price paid and the value received is compared with a modified version of Osterwalder's customer value proposition. In this modified version, the value creation/destruction is compared to the gains and pains (Figure 3).

2.3 Best practice in workshops

Workshop success can be improved by using structured visual approaches to decision making according to Stickdorn (2012). Further analysis can (and in some cases must) be completed outside of the workshop with the full team or part of the team reforming to review further the analysis. Stickdorn (2012) recommends that multi-disciplinary teams should be used in a workshop environment to ensure that wide ranges of inputs are captured and so that commonly held assumptions can be challenged. Where possible a 'user' should also be included in the discussions.

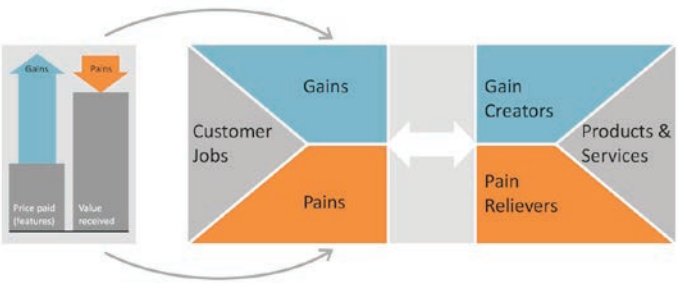

Figure 3: Value proposition design
based on Anderson (1999) and Osterwalder (2014)

3. Methodology

Two different firms were selected for the workshops to allow prototyping; the participation of the firms was needed to provide direct feedback of the applicability of the tools being tested. Both workshops

were introduced in a similar way to reduce the variability, first with some theory and then a test case based on the car. They were then provided with the opportunity to use the tools based on products that they offer to their customers. A log was made of the sheets created and a list of new ideas to work on at a later stage.

3.1 Selection of the teams and team members

Mixed teams were used for the workshops to provide a wider range of inputs with the expectation that fewer issues were likely to be missed out as a result. Selection of the teams was based on the brief: "teams should be interdisciplinary and should include service employees, colleagues who interact with the customer or even customers themselves.".

3.2 Workshop structure

The generic agenda for each of the workshops was:

1. Introduction
    - To ensure a minimal level of service understanding.
    - To share information on service know-how.
2. Car example
    - To provide a 'safe' environment to learn:
      - Cradle-to-grave equipment lifecycle.
      - Customer value proposition for one important activity.
3. Own product
    - To provide a cradle-to-grave equipment life-cycle.
    - To provide a customer value proposition for one activity.

The agenda was designed so that everyone would have at least a limited understanding of services and opportunities to work together. The teams were instructed to work together using Post-its in a creative risk-free environment based on the approach described by Stickdorn (2012). This was deliberately used to allow all participants to take an active role in the process. Poster-templates were also used so that the team members could actively engage in the workshop. A blank template was used for both the car and the company-specific equipment life-cycle. Figure 4 shows an example of the completed life-cycle of a car using the poster template from the workshops. Figure 5 provides an example of the value proposition for the car associated with the modification of the car from petrol to biogas.

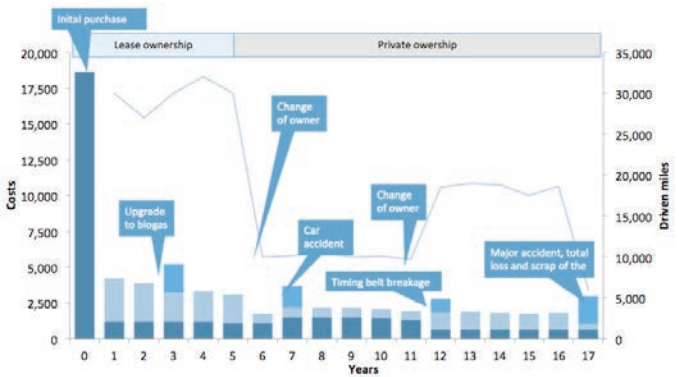

Figure 4: Cradle-to-grave life-cycle of a car

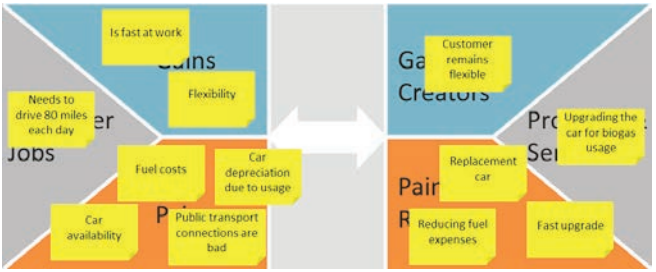

Figure 5: Value proposition design for a car engine upgrade/replacement

4. Results and discussion

As described by Neeley (2007) and Cohen (2006) it is essential for manufacturing companies to understand the service needs of their customers. Without this understanding they will offer the wrong services with little value addition or no service at all. The combination of the two tools presented will allow suppliers to gain a more comprehensive image of their customers and to align their service offer accordingly. This section describes and discusses the results from three workshops using the cradle-to-grave equipment life-cycle combined with the customer value proposition.

The two companies were from very different segments with different specific products and services (Table 1). Nevertheless, both were able to use the tools to identify new services for their customers. The life-cycle helped them to identify appropriate points in time for the injection of the new services (including options for end of life) and the value proposition design allowed them to align their ideas with their customer's needs.

	David Brown Gears	**Skan**
HQ	UK	Switzerland
Sales	120GBP Total / 70% service	80MCHF / 20%
Employees	700 total / not given	320 / 70 services
Segments	Industrial gear boxes	Medical and lab equipment
Workshop focus	1. Gearboxes for coal mills (engineered)	1. Isolators (engineered) 2. Flow cabinets (standardised)

Table 1: Overview of the two companies

4.1 Visualisation and mixed teams

The workshop participants valued the structured visual tools to help them identify the services required for the operational life of the equipment. This finding was in agreement with the literature and the author's experience of running workshops. Prior to using the visual framework some participants had some difficulties describing the full range of services and their timing.

The use of mixed teams helps to provide a range of inputs from more technical to commercial ideas and is in agreement with Stickdorn (2012). It provides an opportunity to service teams to describe customer value more clearly to their colleagues. More experience is required to identify the 'optimal' team mix for such workshops although the use of customers in the process was considered in a positive manner.

4.2 Feedback on the car example.

The use of a car as a neutral example to allow the participants to become comfortable with the tools was a very helpful one. It provided a framework where the groups were able to grasp the concepts that are required:

- they identified the services and in some cases started to provide estimates of costs;

- with a detailed example they were also able to identify the customer value proposition both at a rational and on an emotional level.

4.3 Feedback on the company specific examples

All teams were able to (with different levels of success) identify services, using the cradle-to-grave life-cycle, that equipment owners and operators require to achieve the outcomes they were demanding. Some participants expressed their surprise in being close to the product and still being able to identify new services. The mixed teams used the cost drivers identified by Singh (2008) to create groupings of associated tasks. This led to a visualization of the cradle-to-grave life-cycle similar to the Stockgi (2012) approach in Figure 2.

Interestingly, using the newly discovered activities one group started to construct a total cost of ownership model for a new 'rental' business model. The format of the cradle-to-grave life-cycle template provided a format where they could, as a team, visualise the necessary tasks and start to 'model' the costs. Both companies identified the equipment end-of-life phase as a potentially under-explored opportunity that may have benefits for both the customer and the supplier.

The importance of response with emergency access to spare parts came to light when discussing the customer value proposition. Using mixed teams helped the customer pains and gains to be clearly described for access to spare parts in an emergency: two teams agreed to redesign their processes. The objective of their redesign was to make it easier for the customer to contact them and then to ensure the appropriate information was exchanged, allowing the spare part to be more rapidly supplied with less risk of an error.

4.4 Lessons learnt

The combination of the cradle-to-grave equipment life-cycle with the customer value proposition provided a visual tool around which the teams could discuss and improved communications amongst those present. At each workshop the following new ideas were discovered:

- end life opportunities – control of the second-hand market;
- upgrade opportunities – triggers for upgrades;
- service triggers that come from spare parts sales – providing new sales opportunities.

The approach improved customer understanding by identifying:

- that some customers may have the initially purchased the wrong equipment;
- some customers need more assistance before they can purchase services;
- that the tools can help to understand the value propositions of today's services better;
- that customers in the same segment may experience different pains and gains (suggesting segmentation may not be correctly applied).
- that trigger point and events in the lifecycle are essential to identify appropriate points of time for new technology or services injections

4.5 Integration of the equipment life-cycle with the customer value proposition

The life-cycle shows how the customer is using a specific product and when the costs occur and is in general agreement with the TOC/TOV models described by Ellram (1993), Singh (2008) and others. The model also helps the supplier to understand what activities or tasks the customer encounters during the full lifetime of the equipment. Together with the value proposition canvas based on Osterwalder (2014) this approach provides a powerful methodology to identify key opportunities for services during the life of the equipment. It can help to identify areas where costs can be reduced or other service areas where it is becomes possible to increase the perceived value of the service offering. An example for the car life-cycle with the customer value propositions overlaid is given in Figure 6. The examples developed by both firms only considered single events and were considered confidential.

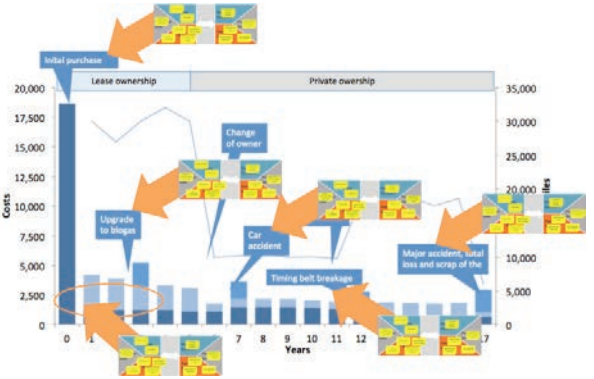

Figure 3: Every activity should have a customer value proposition associated with it

It was clear after the workshops that all of the tasks should have a customer value proposition associated with them and this is confirmed by Anderson (2008) and Osterwalder (2014) who state that a customer value proposition should be created for all products and services. Before the workshops, it was considered that this might not be the case. However, the insights that it provides into customer drivers suggest that good practice would require this. Side discussions concerning the customer journey during the creation of the customer value proposition suggests that this may also be a useful tool to be employed where the customer interactions are either major pains or gains.

4.6 Anticipated extensions to this methodology

It is anticipated that by extending this methodology it should be possible to:

- estimate the total market value and identify the share of spend (or faithfulness);
- forecast sales with timing of owner's spends;
- identify trigger points for conversions, modifications and updates;
- combine with the customer journey mapping.

5. CONCLUSIONS

The prototyping of the combination of the two tools was successful. Using the equipment life-cycle generated from the total cost of ownership in a visual way and combining it with Osterwalder's (2014) customer value proposition was considered an interesting approach as a prototype. The workshops proved helpful for the firms, enabling them to identify new services and to understand why customers may require them. The three teams from the two companies were able to identify new ideas using this approach and understand how their customers might benefit from the new (or improved) services.

The approach was experimental, but discussions with the teams and their managers suggested it proved useful in helping them to discover new/hidden services for their products. Discussions also suggested that there were potential improvements and extensions that could be developed without increasing the complexity of the process.

6. RECOMMENDATIONS

The tool should be improved and used in a number of additional workshops to provide it adds value to service development. Most important to understand are its limitations – when to use it and when not to use it. In particular it is recommended to consider the following improvements to this methodology to:

- test the combined cradle-to-grave life-cycle and customer value proposition for a number of industrial products;

- test the anticipated extensions (eg market valuation, sales forecasting, share of spend and upgrade trigger points) with manufacturers;
- work with a product development team to understand the 'optimal' time to upgrade from the manufacturer's perspective;
- add to the methodology the customer journey (at least for emergency response activities);
- use review the business models associated with delivery of each customer value proposition.

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IDENTIFYING (TERRITORIAL) TENSIONS IN THE SERVITIZED VALUE CHAIN

Jamie Burton, Vicky Story, Judy Zolkiewski, Chris Raddats, Tim S. Baines & Dominic Medway

ABSTRACT

Purpose: To understand the tensions that servitization activities create between actors within networks.

Design/methodology/approach: Interviews were conducted with manufacturers, intermediaries and customers across a range of industrial sectors.

Findings: Tensions relating to two key sets of capabilities are identified: in developing or acquiring (i) operant technical expertise and (ii) operand service infrastructure. The former tension concerns whom knowledge is co-created with and where expertise resides. The latter involves a territorial investment component; firms developing strategies to acquire greater access to, or ownership of, infrastructures closer to customers. Developing and acquiring these capabilities is a strategic decision on the part of managers of servitizing firms, in order to gain recognized power and control in a particular territory.

Originality/value: This paper explores how firms' servitization activities involve value appropriation (from the rest of the network), contrasting with the narrative norm for servitization: that it creates additional value. There is a need to understand the tensions that servitization activities create within networks. Some firms may be able to improve servitization performance through co-operation rather than competition, generating co-opetitive relationships. Others may need to become much more aggressive, if they are to take a greater share of the 'value' from the value chain.

Key words: servitization infrastructure, capabilities, territory

1. INTRODUCTION

Servitization is recognized as a mechanism for manufacturing firms to achieve revenue growth and develop competitive advantage as their core markets stagnate, products become commoditized and global competition increases (Baines et al. 2009; Vandermerwe and Rada 1988). However, it is clear from extant literature that profits, generally assumed to be an outcome of servitization activities (Antioco *et al*. 2008; Wise and Baumgartner 1999), are not guaranteed. Financial outcomes are mixed (Baveja et al. 2004) and firms can struggle to realize even modest benefits (Brax 2005; Gebauer et al. 2005; Oliva and Kallenberg 2003; Reinartz and Ulaga 2008; Windahl et al. 2004).

Many servitizing firms focus on increasing capabilities (Raddats and Burton 2014) in up-stream (building relationships with other OEMs) and down-stream (getting closer to customers) activities. This process potentially involves manufacturers appropriating both operant and operand elements of other suppliers' activities, leading to changes to and potential tensions in the relationships between network actors which could impact the success of servitization. New lenses are needed to explore the complexities of the process; hence the concept of 'territory' (Brighenti 2010) is introduced to provide further insight into these dynamics.

2. LITERATURE REVIEW

Servitization is recognized as a network activity, particularly when it involves the delivery of advanced services (use- or results-orientated product services systems [PSS]) (Tukker 2004). An advanced service is: *"a capability delivered through product performance and often featuring; relationship over extended life-cycle, extended responsibilities and regular revenue payments"* (Baines and Lightfoot 2013 p.22). Value is created through activity delivered by actors both internal and external to the focal manufacturer (Kowalkowski, Kindström and Witell 2011). Thus, successful servitization consists of manufacturers (historically OEMs with product-related expertise) developing capabilities involving a network of actors working together, to create an improved value outcome (Raddats *et al.* 2014). If

customer processes are taken over, then the manufacturer must develop new service approaches (Paiola *et al.* 2012) and integrate products/processes from multiple actors (Davies, Brady and Hobday 2007). This could involve developing improved relational capabilities (Baines and Lightfoot, 2013; Storbacka 2011). As such, a manufacturer may develop 'internal' capabilities, 'external' capabilities (outsourced) or 'mixed' (capabilities co-developed with other actors) (Paiola *et al.* 2012).

The focal manufacturer's perspective is generally dominant when considering this servitization capability development (e.g. Ulaga and Reinartz 2011). Manufacturers assume responsibility for undertaking processes that other actors previously performed for themselves (Mathieu 2001; Spring and Araujo 2013). The problem with this perspective is that while it considers manufacturers' effectiveness at developing new capabilities, it does not consider the perceptions and likely responses of other actors involved in the network, to this servitization activity.

The process of developing new service capabilities in order to create value for the manufacturer involves investment in operant and operand resources in existing, and wider, geographic territories on a temporary or more permanent basis (Gertler 1995). This process can cause internal changes in both manufacturers and customers in terms of activities, processes and focus, meaning that the manufacturer's capabilities and activities potentially overlap with activities of other actors in the value chain. Co-creation of value can take place with the interaction of the operant and operand resources of two parties (Cova and Salle 2008). This may be the case where roles and activities have been negotiated and assumed over a long time period. We contend, however, that during the servitization process tensions occur as the manufacturer attempts to develop capabilities that involve them moving into 'spaces' historically occupied by other actors. Thus, rather than pure realization of immediate and beneficial co-creation of value for all parties, tensions emerge as manufacturers attempt to servitize, which can destroy value. Actors may not want to engage in co-creation of value as they strive to defend 'territory' they perceive as theirs. The suggestion is then, that as firms servitize, they create flux in relationships and potentially the wider network.

This highlights a potential gap in industrial marketing literature with respect to articulating the fluidity of the exchange environment and draws attention to spatiality, territory definition and boundary setting in affecting exchange. There are, of course, some exceptions to this gap. Network horizons research suggests a bounded space within which actors interact, sitting within a more global total business environment (e.g. Holmen and Pedersen 2003). Research examining actor position within industrial networks (Henders 1992; Johanson and Mattson 1992) also implicitly recognizes the notion of space existing at the point of interaction between actors and Henders (1992) identifies the temporal aspect to this space. But, as outlined above, servitization often requires firms to move into new territorial spaces within their (dyadic) relationships. In terms of defining the notion of 'territory', Brighenti (2010, p53) suggests that it "is better conceived as an act or practice rather than an object of physical space". As such (territorial) space can encompass many aspects, including political, legal and economic elements (Sassen, 2006). Thus, "territories exist at a multiplicity of different scales and degrees of visibility, in a state of constant proliferation and transformation" (Brighenti, 2010, p54). In terms of servitization, territories could include most activities that one actor perceives as their own through, repeated activity; for example: logistics management services, product maintenance, service provision and training.

Thus, this research contends that whilst some firms may be able to implement servitization strategies in order to improve performance through co-operation rather than competition, (generating what have been termed co-opetitive relationships, (Bengtsson and Kock 2014)), servitization can also create tension in the relationships between the actors involved. Through the process of servitization, actors may be perceived as invading territorial spaces that are seen by other actors to 'belong' to them. "Territorial practice is an imaginative mechanism whereby someone is initially recognized as an

intruder or insider (or other equivalent qualification) in relation to one's territory" (Brighenti 2010, p58). According to Brighenti (2010), territory also has 'expressive and functional components, the latter including such key concepts as power, resource access, control and defence. Thus, the existence and consequences of the resulting friction, tension and potential resistance when actors perceive their territories to be threatened, may help to explain why servitization has not always been successful in creating increased value for businesses.

Thus the following research questions emerge: Do tensions in servitization arise when one party (the manufacturer) attempts to assume a position of power within a particular *territory* and other parties perceive their power, in an over-lapping territory, is being threatened. If so, can the particular territories, where tensions emerge, be identified, and associated implications for servitizing businesses highlighted?

3. METHODS

A qualitative approach was adopted due to a paucity of understanding of the nature of territorial spaces critical to the process of capability development in servitization. Thus an exploratory approach was adopted, to shed light on the underlying causes of human action (Miles and Huberman 1994) with regard to territory. Nine, in depth, semi-structured interviews were conducted with senior executives across nine UK business-to-business (B2B) organizations that have experienced servitization as prime manufacturer, customer or intermediary. The prime manufacturers selected in these networks were those: (i) providing advanced services, (ii) with a manufacturing heritage and (ii) a technological innovation pedigree. Managing directors or key sales/service/strategy personnel of the prime manufacturers were contacted and interviewed, or they suggested interviewees at the organization and/or at other organizations in their network. At the customer organisations Managing Directors or Operations/Supply Chain Directors were interviewed. High-profile industrialists and key strategic personnel, from a number of industrial contexts, were purposively sampled in order to build a representative sample of respondents capable of delivering informed insight on the spaces involved in developing the capabilities driving servitization in advanced services.

Semi-structured interview guides were developed, including questions around organizational change required to implement servitization, and enabling/inhibiting factors. Respondents were guided towards providing narrative stories (Gabriel and Griffiths 2004), that contextualized their organizational servitization experiences. Interviews were recorded, transcribed and sense checked by respondents before being thematically coded. Template analysis (King 2004) was applied; loose *a priori* capability codes emerged from literature (King *et al*. 2002). These were then implemented as an initial template that was then added to (in particular with emerging territorial codes) during the research, as suggested by King (2004). The template developed via iterative analysis of the servitization experience narratives and relevant literature, allowing the researchers to identify emerging territorial/tension themes via detailed examination of the text (Crabtree and Miller 1999; King 1998). The resulting output was a set of over-lapping territories where different forms of tension, resulting from the servitization process, could be identified.

4. RESULTS

The results, summarised in Tables 1 and 2, show a multiplicity of territorial spaces, in which, or related to which, tensions can be identified which may hamper attempts to successfully servitize and increase value for the focal manufacturer. Table 1 below identifies tensions internal to manufacturers and customers; as actors within both organizations strive to defend their territories.

Territory: between actors INTERNAL to:	**Tension**
Manufacturer **Between all staff within manufacturer and between management and staff.**	Product focused culture threatened. Staff or particular SBUs reluctant to engage or senior management do not want to go too far into particular services markets for strategic/ cultural reasons.
	Financial cost-based decisions by accountants to protect SBU budgets lead to failure to deliver solutions which have the potential to create more value than can be saved through cost-cutting.
	Danger of cannibalizing customers' territory and thus product sales through service innovation: creates tension between product and service SBUs.
	Increased pressure from managers on their staff to learn new processes in order for the firm to successfully operate in a new territory.
	Manufacturer's retention of upskilled staff in order to dominate market space in terms of expertise can be threatened: Trained staff may leave to join competitor, thus strengthening their territorial presence whilst weakening the focal firms'.
Customer **Tension related to (i) surrendering or (ii) regaining territory (related to customers' staff), to or from, manufacturer or (iii) retaining dated operand infrastructure which thwarts implementation of new service systems**	Will not purchase/ reduce purchase frequency if they have the operant capability to challenge process or to self-serve doing a particular process cheaper for themselves.
	Internal friction from staff within potential customers who act against adopting servitized offerings to protect their jobs.
	Internal procurement staff may be risk averse (to avoid internal tension) and therefore avoid pushing for changes needed to servitize.
	Restrictive operand IT systems of the customer may prevent implementation of certain services.
	Risk of over-outsourcing critical operant expertise: the customer may want to bring people back inside their business

Table 1: Tensions relating to territories internal to Manufacturer or Customer

Table 2 below identifies tensions relating to territorial issues outside the focal manufacturer.

Territory: EXTERNAL to the manufacturer	**Tension**
Tension between competitors and manufacturer	Increasing battle for territorial space between suppliers in the supply chain if the entire market is shrinking.
	Competition as a barrier to territorial servitization: use of local service.
	Larger geographic market territories (e.g. U.S.) harder to reach physically with service offers and contain more local small competitors.
Tension between Intermediaries and manufacturer	Basic servicing of 'commodity' operand resources offered by cheaper 'man and van' operators threatens manufacturers who need to develop sufficient installed base in order to make service offering financially viable in the market space.
	Higher specification technical support- remote monitoring/ predictive monitoring being 'designed in' by primes to protect territory by dissuading customers from using cheaper local service providers. High innovation costs could push prices higher than customers can afford – allowing space again for cheaper local providers.
	Intermediaries' territorial space dependent upon the success of the prime. Pressure from other component suppliers on prime to defend joint

	territory by investing to defend the main product platform.
	Dependency on 3rd party capabilities in order to occupy new territorial space: Operand service infrastructure and operant technical expertise.
	Friction and resistance as firms take over management of intermediaries' supply chains.
	Mergers and Acquisitions in the supply chain due to tougher market for intermediaries reducing number of operators. Potential for their prices to then escalate as they build monopoly positions in the market.
Tension between customer and focal manufacturer	Pressure for increased geographical territorial coverage in servitization from the customer: Tensions build over provision of complete geographic coverage by supplier vs maintaining profit from these extended activities.
	Tension over what is and is not included in service agreements (and, therefore, extent of territorial space surrendered to the manufacturer, versus kept in house) because of a lack of service/operation cost transparency- the customer not knowing what/when/how/the cost of what the manufacturer is doing for their fee.
	Pressure from customer for operant skills transfer-they want the knowledge of how to service products themselves in order to take back operational territory.
	In periods prior to contract renewal customer may share less insight with a manufacturer to ensure parity between competing suppliers. This retraction of co-creating activity equates to a reduction in the manufacturer's territorial control in this period, which can reduce the efficiency of value co-creation.
	Manufacturers need to defend the product life span of large plant and this provides a lever for their customer to encourage them to keep working together. It is in the interests of the manufacturer to extend the product's lifecycle in order to sell more product to defend their brand's territory in the market
Tension between manufacturer and government influence over the legal environment	Legislation controlling transfer of contaminated product across geographical borders restricts business processes and decisions to enter particular geographic spaces.
	Political interpretation of EU Legislation and subsequent implementation and adoption in the UK is perceived as too restrictive compared to other countries, restricting processes.
	Over complication and excessive number of 'partners' in public private partnerships due to legislation

Table 2: Tensions relating to territories External to Manufacturer

5. DISCUSSION AND CONCLUSION

This study is one of the first to specifically address the tensions arising at the intersection of actors' perceived territories, for advanced services. The development of advanced service offerings should enable customers to better perform their business processes (Baines 2013). However, to ensure co-creation of value, firms need to develop new approaches to service specification, delivery and payment (Baines and Lightfoot 2013), that account for network actors' potential reactions to perceived territorial threats. Template analysis has facilitated the identification of overlapping and related territorial tensions to the successful provision of advanced services. Territorial tensions should be a concern for servitizing firms at internal, external micro (customer/ intermediary/manufacturer) and macro environment (political legislation) levels. Future research should investigate how the impact of these tensions might be minimised.

5.1 Implications for Practice

Managerial implications of this research include the need for manufacturing firms, developing advances services, to better understand how their actions might be perceived as territorial aggression and to also develop capabilities to determine which 'territories' they should help their network to defend and which they may need to challenge. Strong leadership is needed to re-position the company as a provider of advanced services in the eyes of its key stakeholders in such a way, and with sufficient transparency, that all parties, be they employees, suppliers, intermediaries, shareholders, customers and customers' employees, can see that any territorial advantage they may need to sacrifice will be compensated by a resulting long-term value gain. All actors in the manufacturer's network potentially possess unique, complementary capabilities for the co-creation of value through developing advanced services (Raddats, *et al*. 2014). Equally they all possess the potential to disrupt this value creation if they feel that their territory is under threat, and the change associated with the servitization process is inherently perceived as threatening by many.

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Business models

BRIDGING SERVICE DESIGN TOOLS AND BUSINESS MODEL INNOVATION FOR SERVITIZATION IN B2B CONTEXT

Anastacia Simonchik, Ion Iriarte, Maya Hoveskog, Fawzi Halila, Daniel Justel

ABSTRACT
Purpose: explore the applicability of service design tools in early phases of BMI for servitization in B2B context
Design/methodology/approach: conceptual paper
Findings: In early phases of BMI for servitization, service design can help to explore the sum of the use situations building the whole service experience for customer value identification, as well as provides instruments for experimentation and prototyping during value proposition design. Further empirical studies are needed for identifying functionality of various tool-kits relative to phases of BMI for servitization.
Originality/value: this paper is among the first steps towards outlining possible integration of service design tools into early phases of BMI which would support managers in "how" to practically approach designing product-service value propositions during servitization transformation.

Key words: servitization, business model innovation, service design

1. INTRODUCTION

Servitization is a complex process aimed at "*the innovation of an organization's capabilities and processes to better create mutual value through a shift from selling products to selling product-service systems*" (Baines, Lightfoot, Benedettini, & Kay 2009, p. 548), and it has numerous challenges, e.g. designing product and service system, changing manufacturer's capabilities, production and delivery processes, shifting business model etc. (Vladimirova et al. 2011). If not managed successfully, these may lead to a decline in manufacturer's performance (Visnjic, Van Looy, & Neely 2013).

Business model innovation (BMI) as one of the ways to servitize (e.g. Visnjic et al. 2013) allows to approach servitization transition from a holistic business transformation perspective, i.e. innovating industry, revenue and/or enterprise models (Giesen, Berman, Bell, & Blitz 2007). While some companies in such mature industries as automotive, defence, aerospace (e.g. Rolls Royce, Hilti) have successfully gone through such transition, many less mature industries are just starting with it and need guidance. However, both research on BMI in general (Keränen & Jalkala 2013; Schneider & Spieth 2013) and with focus on servitization (Baines et al. 2009) have not paid sufficient attention to applicability and availability of different practical tools, techniques and methods that are relevant for BMI for servitization. Thus, the purpose of this conceptual paper is to explore the applicability of service design tools in BMI for servitization in B2B context.

Service design offers tools that have roots in a new way of thinking about value (Vargo & Lusch 2004; 2008), which allows capturing reliable data about customer needs (Moritz 2005), creating, visualizing and sharing complex product-service systems (Morelli 2006; Segelström 2013), as well as prototyping future situations of services (Blomkvist 2014). Service design, interacting with service operational management and service marketing (Sangiorgi 2009), has already influenced the way that services are designed in some service sectors (e.g. healthcare, mobility, finance, telecoms). That is why service design has been proposed as a potential methodology, offering a toolkit to support manufacturers in servitizing (Sangiorgi, Fogg, Johnson, Maguire, Caron, & Vijakumar 2012; Iriarte, Justel, Val, & Gonzalez 2014).

BMI represents a complex, collective, cyclical social process emphasizing active experimentation with changing business model components (Hoveskog, Halila, & Danilovic forthcoming). Even though it is iterative and cyclical, researchers (e.g. Euchner & Ganguly 2014; Bhavé 1994; Sarasvathy 2001; Blank 2013; Frankenberger, Weiblen, Csik, & Gassmann 2013) identify certain sequential phases in business model experimentation, which can be broadly grouped as design and realization processes. In this paper we focus on the early phases of BMI for servitization, i.e. the initial design processes, which involve identification of the need for innovation in terms of customer value and designing possible value proposition alternatives, which fit this need (Frankenberger et al. 2013).

This paper is among the first steps in investigating the potential contributions of service design for BMI for servitization and outlining possible integration of service design tools into the early phases of the transformation process. This would support managers in "how" to practically approach designing product-service value proposition during servitization transformation, and hence, contribute to the call of Baines et al. (2009) for providing more guidance, tools and techniques on how manufacturing companies can deal with developing integrated product-service systems during servitization transition.

The rest of the paper is organized as follows. First, we give the overview of business model innovation with focus on the processes in the early phases and describe in more detail the goals of servitization. Second, we give the overview of service design, the selected tools and techniques and their functionality. Finally, we discuss conceptually the potential contributions and possibilities for integrating the presented service design tools into the process of BMI for servitization.

2. BUSINESS MODEL INNOVATION FOR SERVITIZATION

The business model concept focuses, firstly, on value creation for customers in terms of what value will be delivered and for whom, and secondly, how this is to be done in terms of the main activities and key resources utilized in-house or in partnerships with external actors (Chesbrough & Rosenbloom 2002; Johnson 2010; Lambert & Davidson 2012; Teece 2010; Zott, Amit, & Massa 2011). A company's business model is often viewed as a vehicle to execute the chosen strategy with particular set of resources and activities, linkages between them, respective processes etc. on operational level (e.g. Klang, Wallnöfer, & Hacklin 2014; Richardson 2008).

In turn, BMI is the process of changing company's business model (Frankenberger et al. 2013) to create and deliver new value proposition and find new ways to capture value so as to address new opportunities as a result of external and\or internal to the firm changes (Johnson 2010). Below we provide the overview of the different phases in BMI process and give particular attention to the early phases. After that, we outline the key goals in BMI for servitization.

2.1 Business model innovation: early phases

Even though BMI process is iterative and cyclical (Hoveskog et al. forthcoming), Frankenberger et al. (2013) structure it along four iterative phases, i.e. (i) initiation, (ii) ideation, (iii) integration, and (iv) implementation.

In initiation phase, customer value and change drivers should be identified. Ideation phase is the start for generating tentative business model ideas including new value proposition(s) and how they can be created and delivered to the customer. These two phases are considered to be the early ones, and Frankenberger et al. (2013) emphasize existence of a feedback loop between initiation and ideation phases, when external fit of customer value, change drivers (e.g. policy or technology changes) and early experimentation with business models should be ensured. Integration phase supposes detailed business model elements design in order to create structures that support the processes of value creation, delivery and capturing around the newly designed value proposition (Euchner & Ganguly 2014). Finally, Implementation phase means realization in practice of the

previously designed processes and structures in a "trial-and-error" experimentation mode (Frankenberger et al. 2013).

All the detailed design and experimentation in integration and implementation phases requires clarity about (i) what customer value is and (ii) by means of which value proposition(s) it is to be delivered to the customer (Euchner & Ganguly 2014). This puts requirement on the early phases of BMI to generate some kind of a value proposition prototype as an output that is already aligned to fit the specific customer needs and so-called "jobs-to-be done" to create value-in-use for respective customer (e.g. Johnson 2010). To realize that, the processes of (i) customer value identification (Teece 2010) and (ii) value proposition design (Frankenberger et al. 2013; Eucher & Ganguly 2014) become key in the early phases of BMI, and thus, are in focus in this study.

Some of the currently available models and tools found in BMI include Service-Profit chain, Strategic System Auditing, Strategy Map and Balanced Scorecard, Intellectual Capital, Open Business model Framework, Business Model Canvas (Nielsen & Roslender 2013). Most of these tools rely strongly on the developments within strategic, supply and value chain and operations management. The notable exception is Business Model Canvas (Osterwalder 2004), which is widely used by practitioners (Klang et al. 2014) and partially uses design logic. All of the above-mentioned models offer general frameworks for describing interconnections between different building blocks of business model where customer is one of them, and it is almost taken for granted that customer value is known. None of the mentioned models focuses on how to identify customer value and connect it to value proposition design. The recently presented and practitioner-oriented Value Proposition Canvas (Osterwalder, Pigneur, Bernarda, & Smith 2014) is a notable advancement, as it integrates Empathy maps for mapping "pains" and "gains" as parts of customer profile and offers a canvas for matching them with corresponding value attributes in value proposition. However, such mapping is happening on rather emotional level and has limitations for application in complex B2B context, especially in case of designing product-service systems where understanding of operational processes is crucial. Overall, BMI models and tools do not provide manufacturer with the detailed "how to do" guidance for the early phase of BMI, but rather put emphasis on what needs to be done and offer frameworks rather than tool kits.

2.2 Servitization

Servitization is "*the strategy employed by product providers to add accompanying services to their product range*" (Visnjic, Wiengarten, & Neely 2014). During the early phases of BMI for servitization, the key processes of (i) customer value identification and (ii) value proposition design have specific focus. Customer value identification is related to understanding value attributes of product and service from customer's perspective (Raja et al. 2013) and the elements and processes (Nordin & Kowalkowski 2010) that are capable of transferring these value attributes to customer. Value proposition design is aimed at developing bundles of products, services, support, self-service, knowledge etc. (Vandermerwe & Rada 1989), i.e. integrating a number of elements into one new value proposition in form of product-service system to solve the identified and customer specific needs (Baines et al. 2009).

While adding services to manufacturer's value proposition it is important to take into account that there are different types of customers requiring not only different value attributes of service, but also the ways in which they are delivered. For instance, Baines and Lightfoot (2013) point out that there are three potential types of service value propositions: (i) "base" services; (ii) "intermediate" services; (iii) "advanced" services. These types of value propositions require different structure of value creation processes because levels of customer involvement into services differ correspondingly from doing services in-house to fully outsourcing services to manufacturer (Baines & Lightfoot 2013).

In addition to designing new product-service system, during servitization transition new organisational structure needs to be developed which is capable of creating and delivering the newly designed product-service system (Baines et al. 2009). The need for such interconnection between the changes in value proposition and organisational structure is evident in the work of Baines and Lightfoot (2013), where the authors identify among others that the characteristics of product, service and even customer impact the new organizational structure.

3. SERVICE DESIGN

Service design contributes to the design of complex product-service systems through two intervention levels. The first intervention level is related to customer value understanding (Moritz 2005). The second intervention level is related to the production process of the value proposition (Viladàs 2011), i.e. how the product-service system is conceived, developed and delivered.

To manage these two intervention levels, service design has developed specific visual representation tools, which assist in representing service systems and activities (Morelli 2006). These visualizations permit to understand and share the insights about customer behaviour through using maps, diagrams and images, which can lead to new customer insights identification (Segelström 2013), and ultimately serve to design or re-design integrated product-service value propositions. Overall, service design visualization tools (i) help to acquire the holistic view to consider the whole context where the value proposition is delivered (Stickdorn & Schneider 2010), (ii) provide systemic visualization of the dynamics in product-service systems (Morelli 2006; Segelström 2013), (iii) facilitate the testing of ideas and concepts and takes to a higher level the understanding of future situations in service delivery (Blomkvist 2014) as well as (iv) permit information to be shared quickly and efficiently inside and outside the organization (Viladàs 2011).

In order to gather data and fill in visual representation tools with context-specific content (i.e. quantitative and qualitative insights about customer behaviour and a contextual understanding of service use situations), service design uses user-research techniques (Edman 2010). Further, both visual representation tools and user-research techniques are presented.

3.1 Visual representation tools

Table 1 presents a selection of service design tools used for visualizing, communicating and designing complex product-service systems. The tools were selected according to their citations (Segelström 2013) in service design literature (Curedale 2013; Martin & Hanington 2012; Segelström 2013; Stickdorn & Schneider 2010; Tassi 2008) and based on previous empirical experiences in new service design in B2B contexts (Val, Iriarte, & Ollo 2013a; Val, Iriarte, Perez de Arenaza, Alzaga, & Arrieta 2013b). Diana, Pacenti, and Tassi (2009) propose to classify service design visualization tools in terms of their level of iconicity (abstract vs. realistic) and their relation of time (synchronic vs. diachronic), which we adopt in Table 1 below. As a result of such classification four tool categories emerge: maps, flows, images, and narratives [as shown in table 1].

Tool category	Level of iconicity	Relation of time	Examples of relevant service design visualization tools
Maps and Matrixes	Abstract	Synchronic	Service Ecologies (Manzini, Collina, & Evans 2004; Morelli 2006; Polaine, Løvlie, & Reason 2013) Stakeholder Motivation Matrixes (Manzini et al. 2004) Activity Maps (Sangiorgi 2004) Behavioral Mappings (Larson, Bradlow, & Fader 2005) Desktop Walkthroughs (Stickdorn & Schneider 2010)
Service Flows		Diachronic	Blueprints (Bitner, Ostrom, & Morgan 2008; Shostack 1982; 1984)

Tool category	Level of iconicity	Relation of time	Examples of relevant service design visualization tools
			Customer Journey Maps (Koivisto 2009; Parker & Heapy 2006)
Images	Realistic	Synchronic	Empathy Maps (Gray, Brown, & Macanufo 2010) Personas (Cooper 1999; Pruitt & Adlin 2006) Mood-boards (Baxter 1995) Evidencing-Tomorrow Headlines (IDEO 2003)
Visual Narratives		Diachronic	Storyboards (Goodwin 2009) Experience prototypes (Buchenau & Suri 2000) Service Walkthoughs (Blomkvist 2014)

Table 1: Major visual representation tools in service design

The level of iconicity (abstract or realistic) refers to the coherence of the visualization with respect to the product-service system. Abstract forms of representation are visual synthesis of the product-service system, based on a symbolic language and a codified set of signs and diagrams. At the same time, realistic representations aim to accurately replicate the product-service offering with photographic and cinematographic techniques (e.g. physical prototyping of service evidences; action simulations of use experiences through role playing).

Regarding the relation of the time, service design visualization tools give an instantaneous and static representation of the service (synchronic), or visualize via a sequence of actions and stages how customers and other participants walk through the product-service offering (diachronic). While in synchronic representations the meaning emerge from the link of the elements represented, in diachronic representations the attention is on the narration presented by the sequence (Diana et al. 2009). Further the resulting tool categories are described.

Maps and Matrixes are abstract-synchronic representations that give a systemic overall representation of the product-service system. Such tools as *Service Ecologies* put together all the stakeholders and elements participating in the service delivery, showing in an iconic manner how all these actors/elements are connected. Several variations (interaction, actor and stakeholder maps) could be also found more focused in representing people interactions, motivations and relationships between actors. These maps are useful to analyse the relationships between the different actors within the product-service offering and to bring out the motivations of each actor. Ultimately, according to Polaine et al. (2013) service design maps also contribute to generate new service concepts by reorganizing how actors work together.

Service Flows are abstract/diachronic visualization tools that serve to represent how customers interact with value propositions. In particular, *Customer Journey Maps* represent the customer journey throughout as well as before and after the service; this tool is focused on what the customer sees and experiences. Thus, *Customer Journey Maps* unhide the evidences that the customer interacts with during the service delivery, and they are especially useful to understand how the service value is “made tangible” to the customer by means of service (i.e. the so-called *Touchpoints).* However, *Customer Journey Maps* do not provide a structure of how the service works, their focus is emotional rather than operational. For the operational purpose, the most extended tool is the *Blueprint.* Originally introduced by Shostack (1982; 1984), it has several upgrades towards the five sections model (Bitner et al. 2008). Further, modified *Blueprint* models have been proposed for product oriented companies with the aim to assist the design of product-service systems (Geng & Chu 2011; Geum & Park 2011; Lee & Kim 2010; Lelah et al. 2011; Shimomura, Hara, & Arai 2009).

Images are realistic-synchronic representations of concepts related to material or immaterial aspects of the service. Images play a double role in service design. On the one hand, Images represent customer profiles or requirements like in *Personas* or *Empathy Maps*, and they both serve to resume customer viewpoints and requirements. On the other hand, Images are also useful to illustrate and to prototype services' *Touchpoints*. The creation of such "fictional" or "rough" evidences by *Tomorrow Headlines* (IDEO 2003) as e.g. presentations, catalogues, advertisements, apps & web-pages screenshots, reports etc. through realistic images, serves to pre-visualize and to prototype the service interaction with the customers, and helps to foresee how the value of the service is "made tangible" to the customer.

Finally, visual narratives, which are realistic-diachronic representations of services, represent the value-in-use of the service by a sequence of realistic service moments. Narratives aim to represent customer experiences, and hence, require realism in the representation. Storyboards in different forms and levels of detail are useful to get a better understanding of how the intended user's experience is. In addition, specific service prototyping techniques like *Experience Prototypes* and *Service Walkthroughs,* covering a range from early roleplaying to full-scale recreations where participants walk through representing service situations, serve as an ongoing representation of the whole service journeys and are used to foresee service future situations (Blomkvist 2014). Due to the complexity of industrial services and the immature condition of service design prototyping tools, the potential contributions of role playing prototyping techniques for the design and test of industrial services is still an open research question.

3.2 User-research techniques

Service design has developed own user-research techniques as well as adapts and uses techniques appertaining to ethnography, information and management sciences, service and operational marketing and product design and engineering among others. Based on Hanington (2003), Segelström (2013) indicates three types of user research techniques commonly used by service designers: (i) traditional methods, (ii) adapted methods, and (iii) innovative methods.

Traditional methods include techniques inherited from such fields as marketing, which are frequently focused on researching large numbers of users/customers (e.g. surveys, questionnaires, focus groups, interviews etc.). They represent the fundamental quantitative and qualitative design research methods in order to collect data regarding customer or other service participants' thoughts, feelings, perceptions, behaviors and attitudes. Adapted methods include techniques originating from such human behavior focused disciplines as e.g. social or computer sciences, which have been modified for specific service design purposes (e.g. observation methods, ethnography techniques, cognitive walkthroughs, etc.). Finally, Innovative methods include techniques developed within design discipline, particularly linked to participatory design and to co-design approaches. They tend to require a strong participation and active documenting of research subjects. Participants are equipped with inspiring instruments to discover new forms of understanding about environments and people/machine interactions (e.g. cultural proves/diaries, camera studies, a day in a life, etc.). This last type of user-research techniques has limited applicability in B2B context, due to their intrusiveness in customers' daily activities and the asymmetric relationships between customers and suppliers in some industrial sectors (Iriarte et al. 2014).

4. DISCUSSION AND CONCLUSIONS

Early phases of BMI for servitization include key processes of (i) customer value identification (Teece 2010) and (ii) value proposition design (Frankenberger et al. 2013; Eucher & Ganguly 2014), which need to deliver a value proposition prototype of product-service system as an outcome. In order to be able to design corresponding organizational structure in the further phases of BMI for servitization, such value proposition prototype needs to (i) be explicit about product-service system value attributes, which create benefits for customer and provide with added value-in-use; (ii) include

both elements and processes of product-service system (Nordin & Kowalkowski 2010) that are capable of delivering the intended value attributes to the customer.

Service design impact is on two intervention levels: (i) customer value understanding and (ii) production process of the value proposition. The goals of these intervention levels coincide with the ones that are set in the early phases of BMI. Moreover, service design is based on human-centred and co-creative processes and has both emotional and operational focus. Thus, another contribution of service design's approach to BMI for servitization lies in interconnecting subjective customer perceptions with how they experience performed service activities. This opens the possibilities for reapplying service design tools in BMI in general and for servitization specifically where understanding and visualization of how to create value-in-use for customers through intangible & experiential services is one of the central challenges. The potential value of the service design tools presented in the previous section [see table 1] for early phases of BMI for servitization in B2B context is discussed further.

Maps and Matrixes can be used in early phases of BMI for servitization to visualize the networked nature of current or future product-service systems. They help to construct an overall initial "big picture" of the product-service system. The value of these tools for early phases of BMI includes ability to put actors and relationships in one system (*Service ecologies and Stakeholder matrixes*) as well as place actors and actions in specific scenarios (*Behavioral mappings and Desktop walkthroughs*).

Service flows allow understanding and sharing in a quick and in a reliable way how service delivery processes operate by presenting the service journeys performed by each actor during the service provision. These are useful tools to define when and what kind of service evidences are the most appropriate ones for customers throughout the service delivery process, and hence, are valuable in the process of value proposition design. As *Customer Journey Maps* are relatively easy to apply in comparison with *Blueprints*, they are especially useful at the very beginning of value proposition design process, in order to have a preliminary understanding of the interaction of the customer with manufacturers' current value proposition. *Customer Journey Maps* lead the way for further more realistic tools implementation (both synchronic and diachronic), which result further in generating realistic value proposition prototype at the end of early phases of BMI for servitization.

Images help to understand the potential impact that the service could have in customers and are relevant for customer value identification. This becomes essential as a practice to foresee how value will be demonstrated to customers (Baines & Lightfoot 2013) in further value proposition design. However, the use of this category of service design tools has been criticized by some authors. For example, Shimomura et al. (2011) argue that *Personas* are effective to extract the customer requirements in a B2C service, but they present difficulties in B2B services due to the multi-stakeholder nature of organizations. Evidencing tools like *Tomorrow Headlines*, on the other hand, are valuable for making preview how value is made tangible to the customer (through service Touchpoints) , and hence, it makes it useful for the process of value proposition design in early phases of BMI for servitization. However, this tool needs insights into customer value, and hence, the use of evidencing techniques like *Tomorrow Headlines* is reasonable only after customer value is identified, at least preliminarily.

As Visual Narratives help to represent the value-in-use and understand future situation, they are valuable for creating detailed prototype in the process of value proposition design. Currently available BMI tools have limitations in providing such functionality. However, this service design tool category is still immature and needs further empirical experimentation, in particular for representing and prototyping product-service systems in complex B2B scenarios.

From preliminary practical experience the choice of specific tool kit (both visual representation tools and user-research techniques) is highly situation-dependent; e.g. level of access to customer's organization, level of initial insight, time limitations and the needed level of detail etc. can be mentioned among the choice-influencing factors. For instance, initial experimentation in one of the ongoing projects in the tool machinery industry (Val et al. 2013a) included implementation of service design tools in such sequence (i) *Empathy maps*, (ii) *Customer Journey Maps*, (iii) *Service ecologies,* (iv) *Blueprints*, (v) *Evidencing-Tomorrow headlines*. The choice of specific user research techniques also allows adjusting the level of detail and should be done according to the situational context, too. Overall, further research could focus on investigating certain combinations of tools into tool kits depending on the needed functionality within specific phases of BMI for servitization. This would provide practitioners with situation specific guidance.

Overall, the diversity of service design tools can bring value to BMI for servitization, however further systematic conceptual integration and empirical testing is needed. Summarizing the applicability of service design tools in the early phases of BMI for servitization in B2B context, service design tools are relevant for both (i) customer value identification and (ii) value proposition design in early phases of BMI for servitization. In more detail, in (i) customer value identification, service design can help to explore the sum of the use situations building the whole service experience, which is in the basis for assessments of value-in-use by beneficiaries (Ballantyne et al. 2011). This is crucial for a manufacturers moving towards service offerings, because it means that potentially service design human-centred perspectives permit to have a better comprehension of customers and other stakeholders' use experiences during the service provision, and therefore to better understand what is valuable (and what is not) for customers in intangible service offerings. For (ii) value proposition design in BMI for servitization, service design can provide specific instruments for experimentation and prototyping, understanding and sharing quickly how the value proposition is or can be delivered.

The main implications of this conceptual paper are as follows. For the managers at manufacturer's side we summarize service design tools, which can be used in the early phases of BMI for servitization to make explicit how the value of the product-service system is made tangible to the customer. Choosing the right tools and using them effectively to reach the specific goals in the process will make it easier for practitioners to overcome the initial challenges of servitization, e.g. not seeing service potential in the initial product offering. While the potential and usefulness of bridging service design and BMI for servitization is evident, empirical testing is needed for further systematic theoretical integration. Specific empirical cases where service design is employed jointly with BMI to support servitization transitions must be carried out and subsequently analysed, which will also contribute to better understanding of BMI in general and for servitization in particular.

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A BUSINESS MODEL APPROACH TO SERVITIZATION: DEVELOPMENT OF A NEW TYPOLOGY

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ABSTRACT

Purpose: the paper develops a new business model typology that analyse the transition towards servitization through a business model approach. Therefore, the proposed typology aims to support companies in the transition from ownership-oriented to service-oriented business models.

Design/methodology/approach: conceptual development of a typology starting from the existing literature on PSS and from empirical results carried out in previous studies.

Findings: the paper describes five PSS business models types and the different configurations of relevant business model elements in each type.

Originality/value: The paper contributes to a deeper and holistic understanding of the servitization phenomenon, describing the configuration of key elements of the business models of companies that "from products to solutions" according to different business model types identified.

Key words: Servitization; PSS; Business model; Typology;

1. INTRODUCTION

In the current competitive environment, manufacturing companies move from product-centric offerings to services and solutions in order to increase revenues and to build sustainable competitive advantage (Neely, 2008; Copani 2014). Notable industrial cases such as IBM, Xerox or Rolls Royce show the rationale and effects of successful shifts from products to solutions. However, research and anecdotal evidences suggest that manufacturers undertaking such a shift face several challenges (Brax 2005; Alghisi & Saccani, 2014). Some works suggest that a company in order to be successful in this transformation should not only adapt its proposition from product-centric to a product-service system (PSS), but also needs to redesign its business model (BM) (Baines et al., 2009; Slepniov et al., 2010; Kindstrom & Kowalkowski, 2014): in fact, literature has highlighted the fact that PSS can be explicitly associate to new business models and that BM concept is central to implementing a PSS successfully (Mont, 2002; Kindstrom, 2010; Reim et al. 2014). Despite that, little attention has been devoted to the understanding, describing and formalizing the BM of companies that move into services (Dimache and Roche, 2012; Reim et al., 2014). Business models for service-oriented product-centric companies seem to be still under-investigated in the literature (Reim et al., 2014). Therefore, to provide a first step into closing this gap, this study, that is a part of T-REX project funded by the European Community's Seventh Framework Programme, aims to propose a review of the general PSS BM typology (product-oriented, use-oriented, and result-oriented) for manufacturing companies, defining a new structured classification that analyse the transition towards servitization, using the key dimensions of the business model Canvas (Osterwalder and Pigneur, 2010). The research question addressed in this paper can therefore states as follow: how PSS business models of product-centric firms moving toward servitization can be characterized?

2. BACKGROUND

In the current global economy, manufacturers can no longer rely on the traditional product-focused business models with competitive dimensions such as time, cost, quality, flexibility or environment (Dimache and Roche, 2012; Copani, 2014). Especially in the capital goods sector, the increasingly competitive intensity made product-based competitive advantage difficult to maintain. To continue maintaining the leadership, it is necessary that leading manufacturers embrace new strategies based on other additional competitive sources of advantage: It is common agreement in literature that services represent one of the main pillars around which these new strategies should be designed (Gebauer et al., 2010; Copani, 2014). Most service literature underlines the potential of services to

improve profitability through higher differentiation and thus satisfaction, loyalty, and willingness to pay and due to these reasons the capital goods sector was targeted in the past by researchers as a significant sector for investigating service innovation (Oliva and Kallenberg 2003; Brax 2005; Azarenko et al. 2009; Neely, 2008; Baines et al., 2009; Copani 2014). Extending the service business through what has been defined as servitization can lead to generate new, less imitable, competitive advantages and new additional revenues and profits (Oliva and Kallenberg, 2003; Brax, 2005, Neely, 2008; Baines et al., 2009). For these reasons, similarly to what happened in other sectors, manufacturers of capital goods are reorienting their value propositions from selling products to provide solutions (Gebauer et al., 2013). Evidences show that to be successful in this transformation, a company should not only adapt its proposition from product-centric to a product-service system, but also needs to redesign its business model (Baines et al., 2009; Slepniov et al., 2010). Therefore, the required strategic realignment toward services should be mirrored in changes throughout the business model in what might be termed a service-based business model (Kindström, 2010). This perspective integrates not only the uniqueness or newness of the service but also innovations in other elements of the business model (Toivonen and Touminen, 2009). The moving towards a more servitized offerings is therefore leading to a fundamental change in business models of companies also in the capital goods businesses (Kujala et al., 2010) and is therefore a complex concept that seems to be still poorly understood (Martinez et al., 2009). For this reason, even though many manufacturers are considering the adoption of a business model in which the use or the function of a product is sold instead of the product itself (Van Ostaeyen et al., 2011), a limited application of these new business models, especially in the capital good sectors has been observed.

To draw a sector-specific picture of servitization, a research combining quantitative and qualitative methods was conducted between 2008 and 2011 at European level (Copani, 2013) among 77 companies. The research shows that service offerings are very spread among these surveyed companies. In fact, 78% of the companies offer on average more than six services and only traditional product-oriented post-sales services (such as technical documentation, ramp-up assistance, product training and maintenance) are common to almost all service providers (Copani, 2014). Moreover this research show, in accordance with Lay et al. (2010), that only 27% of companies declared to offer operational services and the percentage of total turnover generated by services was 18%, of which the 9% was invoiced together with products sale. This results are consistent also with Adrodegari et al. (2014): in this study, a survey carried out among 95 European companies operating in the machinery, automation and forklift sectors shows that product sales still represent the main source of companies' turnover with an average contribution of 74% (76% for machinery, 82% for automation, 52% for transportation) and that service revenue are still anchored to spare parts sales and traditional services (documentation, repair, basic training) that are extensively offered. Advanced services and new usage-oriented business models, such as leasing, renting or product-usage-fee, are instead only sometimes offered and generates revenue each for less than 6% of the turnover. Therefore, empirical research indicates and confirms that servitization in the capital goods sector (especially in machine tools industry and automation) is an on-going process which is not mature yet: successful advanced service innovators seem to be rare exceptions and are generally medium and large sized companies, while the adoption of service-oriented business models is still low. This is paralleled by the paucity of literature that addresses the implementation of PSS business models: little attention has been devoted to the understanding, description and formalization of the underlying business model of companies that move into services (Kindstrom and Kowalkowski, 2014).

3. A NEW TYPOLOGY FOR PSS BUSINESS MODELS

3.1 An overview of PSS BM typologies in literature

The usefulness of a typology in particular depends on its ability to explain the essence of the PSS business model concept and many academic papers on PSS use the agreed Tukker's (2004)

classification for this purpose (Reim et al. 2014). Anyway, existing literature reveals various typologies that could identify the different types of PSS business models. For example, Wise identifies four types of PSSs (Wise and Baumgartner, 1999): embedded services, comprehensive services, integrated solutions and distribution control. This classification is based on service content but product ownership is not considered. The concept of product ownership is instead presented in Michelini and Razzoli (2004) that distinguish between: provision of tangibles with included life cycle services, provision of tangibles under leasing arrangements, provision of shared products and function delivery. As mentioned before, Tukker (2004) proposes a classification making a distinction between three categories, namely: product-oriented, service-oriented and result-oriented. This classification of PSSs is agreed by several authors, which themselves refined it and added further elements (Azarenko et al., 2009; Barquet et al., 2013). Other authors proposed different classifications based on specific PSS elements (see for example Kujala et al., 2010; Storbacka et al., 2013) but Tukker's classification remains the most widely accepted classification of PSS business models, and it is used extensively in the literature (Barquet et al., 2013). Nevertheless, the classical typology is affected by some problems that prevent it to capture the complexity of PSS business models examples found in practice (Van Ostaeyen, et. al, 2013): these categories therefore, may be explored further to facilitate the most appropriate categorization of companies (Beuren et al., 2013).

3.2 The five PSS business model types

Because the PSS literature has not discussed business models extensively (Kindstrom, 2010; Meier et al., 2010), a research gap exists that supports the need to develop a better understanding of how service-oriented business models are configured (Reim et al., 2014): in order to provide a first step towards a deeper understanding of PSS business models characteristics, starting from the analysis of the literature and empirical evidence of previous research (Adrodegari et al., 2014), we combine different revenue mechanisms and value propositions, to come out with different types that we configure using specific business model element as a landmark. In fact, differently from other PSS typologies proposed in literature (Wise and Baumgartner, 1999; Michelini and Razzoli, 2004; Tukker; 2004), the types presented in our work are described through the a well-known business model Canvas and can represent archetypal business models that manufacturing companies can take for moving towards a new (more) service oriented configuration.

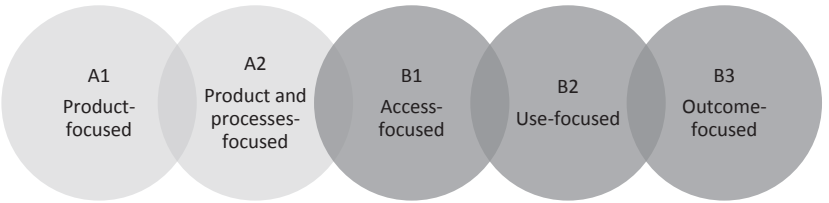

Figure 1: The proposed PSS BM Typology

As presented in Figure 1, we first identified two main categories that can group PSS business models:

(A) *Ownership-oriented business models*, in which the product sales are the main source of revenue and services are sold as an add-on of the product, both transitionally and relationally;

(B) *Service-oriented business models*, in which services strictly linked to the usage of a product are the main source of revenue. The ownership of the product is not transferred to the customers. Services are sold through relational contracts with generally medium-long term duration. Add-on services can also be sold on a transactional base outside the contractual agreement.

In the remainder of the paper, the identified five BM types are presented.

A1: Product-focused business model
In this BM, the main purpose is to deliver tangible value to the customer. For both customers and suppliers this model appears as the most familiar one as it uses, basically, knowledge and experience that has been gained for many years. Therefore, the supplier can use the traditional business model (product/price) and add value by additional actions. The company can sell a combination of single standard products and industrial services, which are usually not customized, with the aims of improving or restoring the functionality of the product, such as through maintenance and repair (basic field services and inspection). In this BM, the project has no (or lower) responsibility for product lifecycle and transactions are often single and independent from each other. The product business is a core activity for product-centric firms such that a product-oriented core of resources and capabilities: these companies typically invest significantly less in R&D for services than they do for products and IT system are not usually used proactively but only to manage company data. Companies have traditional "tangible" production costs (e.g. resources, time input and cost of capital used) and the revenue is mainly generated from the product sale ("one-off payments"). Sales and after-sales channels are usually separated and services are sold as a deed, such as repair of a broken machine or a training session for operators. Moreover, relationship is sometimes characterized by informality and business agreements are signed directly with the client's top management. This makes it difficult to formalize the customer relationship through contracts, which are essential for the proper operation of service-oriented business models.

A2: Product and processes focused business model
This business model is similar to the product-focused one: the main difference here is that the company offers services, both in the pre and after-sale phases that aim to optimize customer processes. In this BM, the company might suggest all kinds of optimization for using the product, which in the end can lead to increase processes efficiency and effectiveness. Usually here, service is established as a separate unit in which service are also developed based on specific customer needs, and it is configured as a profit centre. Therefore, employee training is important in order to improve the advice and consultancy capabilities: also marketing/customer segmentation and customer knowledge management activities acquire importance. Generally customer relationships are characterized by informality: business agreements are signed directly with the client's top management and this makes difficult to formalize the customer relationship through contracts. In product and process focused business model, it is also important for the company to develop IT systems on product that can assess the impact of the process optimization, collecting information about performance and usage of the product. After-sales channel may be involved by the sales channel in the provision of consultancy services related with customer maintenance activities. Similarly to the product-focused model, sales and service are both transitional and generate two different revenue streams. In particular the main revenue stream is represented by product sales in which here is also included a pre-sales service related component.

B1: Access-focused business model
The main difference of this kind of business model compared to the ownership-oriented models is that the customer does not buy the product but pays a fixed regular fee to gain access to it. The company usually keeps the property rights of the product and has the responsibility for its utilization conditions (timely install, maintain, upgrade, etc.) during a given period of time. Thus the provider here also takes responsibility for maintenance, repair and control: for this reason, in this kind of model, the company may perceive an incentive to prolong the product-life and may design the product accordingly. Therefore, services that guarantee the functionality and extend the product lifecycle are offered, such as preventive maintenance, product upgrade, retrofit and revamping. Interaction and collaboration between service and technical office personnel is consequently important in order to guarantee continuous improvement of the product aimed to extend product lifecycle. Product lease/renting has low tangible value for the user, since various costs and activities are shifted to the provider: compensation for the customer can come from the fact that the user no

longer needs to bear the capital costs of the product. For these reason, in this BM (likewise B2 and B3) could be used also to reach small companies or companies that are entering the market, which do not have enough capital to purchase new product and will find it difficult to make heavy investments. In access-focused business model changes also the business relation that shift towards a relation-oriented model: thus for provider it is crucial to establish long-term relationships through formal agreements, seeking close relationships with its customers. Human resources acquire importance as a key resource to deliver the new value proposition to the customer: in this kind of business model qualified staff to service the product during its use is needed but, in addition, company has to invest in training also for sales and retail personnel that should promote the new offer, making it more attractive than a product-based option. Fleet management systems become essential and advanced and integrated IT systems can also allow to identify when maintenance should be done, prolonging the product life. Generally, payment may be based on a monthly payment of a fixed rate, which would cover both the product and services that would be made available throughout the product's lifecycle. Thus, all service-oriented business models (namely B1, B2 and B3) implicate a new revenue model, where the focus is on the definition of new selling parameters primarily driven by customer perceived value creation instead of internal cost. Internal costs have to been understood better than in past: leasing/renting product instead of selling them would increase the company's costs since it would require high initial capital investments and financial resources become critical.

B2: Use-focused business model

The main characteristic of this business model is that the customer does not buy the product or system but pays a variable fee that depends on its actual usage of the product. Despite this, there still remains a clear tangible value for the customer since various activities (e.g. maintenance) are outsourced to the provider. Therefore, the company is responsible for all life cycle costs, which provide a powerful incentive to design a product that in terms of costs is optimized over the life cycle, of which elements can be re-used after the products' useful life.

A very important incentive for the customer in B2 and B3 business models is that the provider feels an incentive to continually improve the product with lifecycle performance. Moreover, here customers focus on the value as a value-in-use that is created (and determined) at the moment of consumption, not value-in-exchange that is added to goods during the production process. Therefore, in this business model, is necessary to design a new value propositions based on the customers business and processes including interactive parameters for assess the value-in-use. Having the customer as co-producer makes the company dependents on the participation of the customer and customer a resource in the marketing process: the value of the relationship with customers during the whole lifecycle of products is therefore critical and the company's ability to develop close, long-term relationships becomes a prerequisite in this BM (customer embeddedness capability). At the same time, the company has to know in details the customers and partners context that can determine the service-related experience, being up-to-date with our customers' preferences, needs, problems, worries, interests, usage pattern. In fact, in order to made a clear cost calculation, company has to be able to analyse the behaviour of the user and to collect the product usage and process data: an extensive knowledge over the installed based is a prerequisite in this kind of BM. Therefore, advanced and integrated ICT system (e.g. CRM, PLM, Fleet Management systems, ...) are fundamental in this business model. In particular, health management systems are required to monitor performance and usage condition of the installed base. The development of the Product/Service System and supporting services activities throughout the product life cycle become crucial: in particular, the integration of the development processes of the product and the service will create key process that is crucial to the companies. The company usually has to redesign a new structured business unit and establish organizational roles dedicated to service development, realigning also rewards systems to promote service sales and revenue. A radical change is therefore required also in the organization mind-set: in the transition towards service-oriented business models, a fundamental shift is also required in the organizational culture and market engagement,

which necessitates time and resources. For example, customer service have to be trained to assist new client segment, as well as a new sales channel qualified to demonstrate to clients the benefits of new offer. As mentioned also in B1 model, the payback period is often longer than for physical product sales. Therefore, provider must have the financial resources or receive support from its financing partners to bridge this period. Often a risk premium has to be included for this models and company should develop approaches, which can reduce the liability risks and enhance control over 'production' uncertainties. In fact, the more the firm provides solutions and other customized services, the greater its value potential, but also the greater its complexity and risk. For these reasons also pricing capability is needed to change the revenue model and define the correct fee.

B3: Outcome-focused business model

In this BM, the customer pays a fee that depends on the achievement of a contractually set result in terms of product/system performance or outcome of its usage. This BM is similar to the B2 but here the value for the customer is generated by the reduction of initial investment, the minimization of operational costs and risks to achieve an expected outcome with the product usage. Therefore the value-in-use becomes the value-in-results such as availability of the product. Selling the result of a usage means that the provider operates the product himself: here the user will make a more conscious use of the service, though in other cases in order to use it correctly and realize the expected outcome. In this BM (also in B2), the proposition of value through products and services embraces a complex network of suppliers and competencies: when designing partnerships, it is therefore important to specify each partner's value throughout the product lifecycle. For example, a field service network is a prerequisite for successful service delivery, includes both the internal service organization and external service partners. Architecture for product monitoring is crucial: aspects of both hardware and software must be considered. Within the company, an adaptable back-office infrastructure with clever ICT systems can enable not only more cost-efficient operations but also higher service quality, through better resource allocation and more accurate information sharing among field technician. In fact, provider has to collect and manage product usage and process data creating suitable performance indicators to measure the results of this new offer. Usually this BM requires a "case-by-case design": defining the ''right'' outcome, the "right" services and the "right" cost is crucial. For these reasons, cost structure management and price definitions are challenges to the success of the new offering. Payments may be based on the availability of the product and/or service, on the end result of the use of products and/ or services. The type of pricing mechanism chosen can make a big difference in terms of revenues generated: output-based revenue mechanisms rely on either fixed (e.g. availability, usage) or dynamic (e.g. performance, results, gain sharing) prices. As for B1 and B2 models, high financial capabilities are a prerequisite of this kind of model. Moreover here, change the provider's risk assumption, which now implies result of the use of the product. In fact, non-conformity costs of product output are borne by the provider.

4. CONCLUSION

In literature different typologies have been presented over the year, to describe different options of PSS business models. In particular, form previous works that use/propose PSS business model typologies, emerges that recurring dimensions of the business model (for example the revenue model or the value proposition) could be very differentiated among different options of BM (see for example Tukker, 2004; Dimache and Roche, 2013). Therefore, according to our view, the definition of a new structured PSS typology could be very useful to describe the transition towards servitization: in fact, the identification of PSS characteristics according to different BM dimensions, could allow to observe some distinctions comparing the characteristics of traditional business model giving in addition a deeper understanding of the preconditions to success (for practitioners (see also Storbacka et al. 2013). Starting from the existing gap in the adoption of a structured approach to PSS typologies, this paper develops a new typology for PSS business models, grounded on existing literature and on element and dimensions of the business model Canvas that reached nowadays the consensus of a large group of experts from academy and industry. Thus, practitioners could benefit

of this work because can help them the to develop a deeper understanding of PSS business models characteristics through the configuration of five hypothetical PSS types, which represent the extremes in the range of options available to firms as they set their strategies and structure their business models. In this sense, the new PSS BM typology can be also seen as a practical guideline to help companies in the journey towards new service oriented business models: using the different PSS types, companies would be able to assess where their current business model stands and then define the desired future configuration and possible actions. In this sense, the new typology is used as a landmark in the next steps of the T-REX project: in fact, in order to implement a new (more) service oriented configuration, a specific methodology and toolkit that uses the different BM types as a reference, has been developed to support companies in this transition. Although this paper contributes to the development of typological classification of BM advocated by the general BM literature (Baden-Fuller & Mangematin, 2013), the study conducted is based on the analysis of specific industry sectors and this could limit the generalizability of the findings and the proposed typology. In spite of the proposed targets, the defined five BM types, although comprehensive and detailed, are still merely static representation of a business models and further research is needed to refine and test this typology: identifying the complete configuration of all the identified relevant variables of the business model framework is the objective of the next steps of this research.

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Redesigning the Manufacturing Business Model for Services: Lessons The Office Products Industry

Edward Crowley, Dr. Jamie Burton & Dr. Judy Zokiewski

ABSTRACT

Purpose: Identify how business model transformation, and the intentionality of this transformation impacts servitization efforts.

Design/methodology/approach: The study uses a mixed methods design incorporating both quantitative grounded theory analysis and elite interviews.

Findings: There is a difference between firms in terms of their intentionality for business model transformation. This difference does appear to be, to at least some extent, dependent upon the firm's headquarters location. The intentionality of a firm's business model transformation efforts does appear to impact the success rate of Office Products Industry servitization efforts.

Originality/value: This study addresses a unique question – is intentionality in business model design important for servitization? This question is significant for planning and managing servitization efforts for manufacturers.

Key words: Servitization, Business Model (BM), Transformation, Japan vs. North America

1. INTRODUCTION

Business models (BM) define how firms deliver value to customers (Teece 2010), and servitization involves shifting the firm's approach from providing value through products to providing value through service-product bundles (Vargo et al. 2008); thus, servitization requires a shift in how firms deliver value and hence a shift in BM. This is true regardless of whether you define value as coming from delivery to the customer (Corrêa et al. 2007), or through providing the customer the opportunity to create value themselves through product and/or service use (Vargo and Lusch 2004). However, the question arises: is BM transformation a conscious effort (Chesbrough 2010), actively planned and managed to avoid potential pitfalls (Van Looy and Visnijc 2012), or is it a byproduct (Visnjic and Van Looy 2013)? This question is relevant as firms expand their range of IOT enabled products (with intelligence sensing/reporting capabilities) and which provide significant perceived opportunities for incremental service revenue (Ono and Ono 2014; Laya et al. 2013).

This paper leverages the position of the lead researcher as practitioner and academic, to utilize data and elite interviews from the Office Products Industry (manufacturers of copiers, printers, multifunction devices) to understand the transformation of business models. It explores whether there is a difference in the approach to business model transformation between Office Product firms headquartered in Japan, versus those in North America, given their different levels of servitization (Crowley et al. 2014). The office products industry is appropriate for this study given its history in leading servitization (Visintin 2014), and the relatively high level of IOT enablement and servitization (in excess of 20%) observed (Crowley et al. 2014). The theoretical basis for servitization is examined and business models and evidence regarding the transformation of the OP Industry business model is explored, indicating whether this business model transformation is intentional, or reactive.

2. THEORETICAL FOUNDATIONS FOR SERVITIZATION AS A FORM OF BUSINESS MODEL CHANGE

2.1 The Business Model and Servitization

The BM provides the conceptual foundation for a business and can be described simply as the process of creating value for customers, enticing payments from customers, and converting these payments into profits (Teece 2010). Leitao (2013) identifies four essential components of the BM: customers, offers, infrastructures and financial feasibility. In addition the BM answers key questions about the business including what product or service will be offered, who will pay for it, how will it generate profits, and how will a competitive advantage be generated. There are a number of factors that impact the development of the BM. These include: the concept of accountability in terms of obtaining alignment with what they are accountable for providing versus what they actually deliver; the ecosystem in which the service is developed and within which the firm that operates has a significant effect, both enabling and moderating the firms innovation of the service business model; and, the delicate balance of risk versus reward since innovation in both the value proposition and value deliver create risk, but also potential reward (Visnijc and Neely 2012).

The transition of a manufacturer from providing products to offering services (servitization) has significant impact on the BM (Van Looy and Visnijc 2012; Viitamo 2013; Visnjic and Van Looy 2013). Research into the innovation process for manufacturers building service offerings in Germany identified multiple innovation typologies based upon whether the services are knowledge intensive, network based, scale intensive, or supplier dominated (Hipp et al. 2005). Reinartz (2008) describes four steps in the transformation to a profitable industrial service business including: recognizing you are already a service company, industrializing your back office, creating a services-savvy sales force, and focusing on customers' processes. While these are not described specifically in the context of BM transformation, they all impact the core aspects of the BM described by (Leitão et al. 2013) (customers, offers, infrastructure, and financial feasibility).

Keen and Qureshi (2006) draw a very clear distinction between BM and business strategy by saying the BM is the "what" of the business versus strategy which is the "how" of the business. This distinction is important in that when we speak of servitization, we are describing the shift from one BM (manufacturing) to another BM (services) (Kindström 2010). Again, Keen and Qureshi (2006) argue that the distinction of BM from business strategy has important applications since it implies that BMs do not 'just happen' but rather, they require well thought out strategy and execution. In fact, they argue this is one of the reasons for many dot.com failures. They had a unique and innovative BM, but the strategy and execution were lacking.

2.2. Drivers of Business Model Transformation

The drivers of BM transformation are complex. A cognitive recognition by the top executives of the organization that there is a need to change the BM appears to be one key driver of BM transformation (Aspara et al. 2013). Chesbrough (2010) argues that a willingness to experiment with new BMs, an ability to take action that creates new information which reveals the existing possibilities of a new environment (effectuation), and having a strong leader for change within the organization are all critical elements to enacting BM change. BM transformations are often accelerated after the firm enters a crisis point (Qureshi 2006; Davidson 1999). This crisis point facilitates the formation of a political coalition among the top executives, based upon a consensus that a new BM is feasible (Aspara et al. 2013). Business process re-engineering is one aspect of BM transformation which provides a formal method for redesigning specific aspects of the BM by identifying automating processes, enhancing them, and then redefining these processes (Davidson 1999). We contend that intentionality of BM change is a key factor in BM transformation.

2.3 Barriers to Business Model Transformation in Servitization

The evolution of the BM from a product centric focus to a services focus is not a linear process both in terms direction or scale. Recent research indicates that directionally firms may move towards services and then away from services multiple times before moving to a servitized state, resulting in a very non-linear path to servitization (Finne et al. 2013). In relation to scale, further research indicates an early highly profitable stage, followed by a mid-state with less profitability until the firm reaches a stage where profitability growth and scale become realigned (Van Looy and Visnijc 2012). In addition, firms may go through a reverse servitization process whereby the firm moves away from servitization back to a product centric BM due to the challenges in servitization, essentially failing in their servitization efforts (Finne et al. 2013). The barriers to BM transformation within the context of servitization are potentially numerous, however, they can be grouped into several major categories including: the firms' existing dominant logic (Bettis and Prahalad 2015), the organizational structure for the services business (Gebauer et al. 2006), and the ability to shift from producing and delivery products to effectively producing and delivering services (Neely 2009).

If a firm views itself as a manufacturer, or sees its existing BM of manufacturing as the 'profitable' BM for the firm, this existing dominant logic (Bettis and Prahalad 2015) can become a filter for information and limit the firm's ability to change its BM, as in the case of Xerox in the early 1990's and its inability to capitalize on many new innovations such as developing Ethernet, the mouse, or other core technology innovations which became significant successes outside of Xerox (Chesbrough 2010). This dominant logic becomes a filter and barrier to considering new opportunities or even creating successful new BMs for innovations that do not fit the firm's existing BM. The firms' organization structure can be a barrier to the development of a successful service BM when the service business is not provided a level of autonomy which will allow it to create the unique organizational characteristics such as metrics, culture, and leadership offerings that can be different to, and even conflict with, the original manufacturing BM (Gebauer et al. 2005). In essence, the existing BM can 'smother' the new BM limiting its successful growth.

Another significant barrier is the shift from a product centric delivery model to a services centric delivery model. This is a fundamental BM shift (Neely 2009) consisting of both the operational requirements associated with shifting from products to services (Baines 2013) and shifting from a manufacturer view of value derived from product use, to the customer focused concept of value being generated from combined services and products (Vargo and Lusch 2004). A final, potential barrier that has been identified is that the location of a firm's headquarter location can be important by creating business culture, organizational decision dynamics, and leadership dynamics that either encourage or discourage servitization (Crowley et al. 2014).

3. RESEARCH METHOD

The research methodology was a mixed methods design which included an initial phase which utilized quantitative grounded theory to examine global data from a longitudinal survey of service contracts to understand the servitization dynamics of the OP industry. Based upon this analysis a theory was developed which posits that the location of a firms can be a deciding factor in the cultural, BM, and/or accelerators factors which impact a firm's level of servitization. The second phase of research utilizes elite interviews with executives in OP industry manufacturers to further understand and develop this aspect of servitization. This article addresses one aspect of this– the intentionality of the BM transformation – this is done using results from elite interviews carried out with respect to this topic. Elite interviews were conducted with thirteen executives from six OP industry manufacturers located in Japan, Europe, and North America with nine interviews from firms with headquarters in Japan, and three with firms that have headquarters in North America.

4. TRANSFORMATION OF THE OFFICE PRODUCTS INDUSTRY'S BUSINESS MODEL

4.1 Drivers of Business Model Transformation in the Office Products Industry

Historically, manufacturing firms within the OP Industry shared a common aspect to their BM that was fundamentally driven by putting marks on paper, whether it be for printing an original document or making a copy of a document which in turn generated strong recurring revenue streams from the supplies (ink and toner) that are used in printers and copiers (Xerox 2011; Rooke 2012). There are a number of forces which are fundamentally impacting this traditional BM including tablet PCs, replacing paper based documents (Huberty et al. 2011) and mature markets with declining shipment volumes (Lecompte 2013) which are resulting in declines in pages and subsequently the demand for supplies (Photizo 2012). As the traditional BM comes under pressure, OP Industry firms are increasingly being forced to consider a new BM based upon services as a way to retain revenue and profitability growth.

4.2 Evidence of Business Model Transformation in the Office Products Industry

The shift to a services model, or servitization, can be articulated by measuring the portion of the firm's total revenue which is derived from services (Fang et al. 2008). The growing level of servitization in the office products industry is shown in Table 1.

	2008	2009	2010	2011	2012
Servitization %	10%	14%	18%	20%	23%

Table 1: Office Products Industry Servitization (Crowley et al. 2014)

However, this BM transformation is not uniform across the industry as evidenced by the rate of servitization. As a group, North American firms are seeing the rate of servitization grow much faster than Japanese firms. In fact, the North American firms, as a group, have surpassed the point of critical mass as defined by (Fang et al. 2008)where servitization has an impact on the firm's financial valuation. Specifically, North American OP firms have grown from 16% of their revenues being derived from services in 2008 to 39% being derived from services in 2013, whereas Japanese OP firms have only seen services grow from 5% of revenues to 11% of revenues during that same time period (Crowley et al. 2014). The fact that servitization has different adoption and acceptance rates by individual firms is not unique to the OP Industry and has been identified by multiple researchers (Eggert et al. 2011; Mathieu 2001; Bandinelli and Gamberi 2012; Neely 2013). So this leads to the question as to why there is such a disparity, this will be discussed in the next section.

5. INTENTIONALITY OF THE SHIFT TO A SERVICES BUSINESS MODEL

Some manufacturers in the OP industry are making the change to a services based BM in a very proactive manner due to anticipated or current pressure on the current BM. This is identified in this quote from the CEO of Xerox, Ursula Burns, "*This technology explosion, this information explosion forces us to look at our BM and change it because we would be less relevant every single day if we didn't do something*" (Zajas et al. 1995). But is this change intentional across the entire range of companies, or is the BM change a passive result of a strategic focus. In other words, is there an active focus on BM transformation, or is the BM transformation a by-product of the focus on building service revenue streams?

The elite interviews utilized a semi-structured approach as a mechanism to understand the dynamics which drove the firm's focus on, and process of, servitization. The BM aspect of servitization was

identified by multiple respondents. The interviews resulted in several major themes in relation to servitization including passive versus active focus on changing the BM, the existing BM being a barrier to adopting servitization, and adjacencies to the BM can be beneficial to servitization.

5.1 Passive versus Active Business Model Focus

For all three of the North American interviews, and one of the Japanese interviews, the BM was identified as an active focus of the transformation process. In these interviews, the executives explicitly highlighted a focus on shifting from a manufacturing based BM to a services-led BM and activities which were undertaken to drive the shift in the BM. Their BM innovation activities are consistent with activities identified by Amit (2015) including adding novel activities (developing consulting based professional service offerings such as document and workflow optimization), linking activities in novel ways (creating new revenue streams from services by providing integration activities for both hardware, software, and consulting offerings), or by changing the parties that perform activities for the firm (forming alliances with software vendors to enable new service activities and changing channel partner strategies to attract 'service capable' partners).

Interestingly, three of the four Japanese firms did not identify the BM as a focus of transformation activities. When mentioning the BM, they either did not address the BM or addressed the existing BM (manufacturing or product value creation focus) as being a barrier, or something that may eventually shift as a result of efforts to create a service revenue stream.

5.2 The Business Model As A Barrier

The majority of the firms identified the existing BM as an active barrier to the development of a new services based BM. While the OP Industry is under significant business pressure, it is still very profitable with the supplies (toner and ink) revenue streams having margins in excess of 80%. Several respondents identified this profitability as a barrier to the firm being willing to invest in new service driven BMs. They also cited the difficulty in obtaining support for a new BM due to the strong manufacturing culture associated with the existing BM as being a barrier to BM innovation. One firm, which is currently going through the process of shifting its focus back to products, or reverse servitization (Finne et al. 2013), actually cited the firm's current BM and an inability to think beyond this BM as a reason for the firm's failure to servitize and its shift back to products.

5.3 Business Model Adjacencies as a Driver

While the existing BM can be a barrier, in one North American firm, proximity to the firm's existing product and transactional based BM was identified as a platform for creating a new, complimentary BM. Skills, abilities, and alliances developed to support the existing model are being leveraged as means of expanding capabilities and building new service based offerings which have a different model for delivering value to the customers and a new financial structure for receiving compensation for these offerings. Additional North American firms identified proximity as a way to incrementally evolve the new services BM, without creating a new BM from scratch or going through an abrupt transition from the existing BM to the new BM.

6. CONCLUSIONS, APPLICATION, AND LIMITATIONS

6.1 Discussion of Conclusions

Based upon this research, the intentional focus on BM evolution or transformation appears to be one contributor to the successful development of new service-based BMs for OP Industry manufacturers. The recognition of the BM as a method for articulating how the business operates becomes a framework for transformation activities related to the new BM and appears to create within these firms a means of identifying potential barriers and drivers for the new business (and associated BM) (Teece 2010). Armed with this awareness, the firms appear to be better equipped to deal with the challenges associated with building service businesses in a manufacturing firm.

There did appear to be a very different level of cognitive recognition or value of proactively addressing the BM for the majority of the Japanese firms. While the American firms appeared to treat the BM as something that had to be analysed and managed, for the Japanese firms the BM appeared to be more of a result of specific activities versus an actively managed cognitive paradigm. This finding appears to provide further insight into the notion that the location of a firm's headquarters location can be important in creating business culture, organizational decision dynamics, and leadership dynamics that either encourage or discourage servitization.

The intentionality of focus is a new contribution to research that expands upon existing research which identifies executive recognition (Aspara et al 2013b), an ability to take action (Chesbrough 2010), and a defining crisis point event (Qureshi 2006b, Davidson 1999b) as enablers of business model transformation in support of servitization.

6.2 Management Implications and Application

This research indicates that a conscious focus on BM innovation is an important aspect of a successful servitization process. By applying this focus, firms have a higher potential for proactively addressing potential barriers to servitization such as creating an organization structure which avoids the existing management metrics (which are tuned for the existing BM) 'smothering' the new BM which requires different management metrics. Without a proactive view on the BM, these issues may not arise until they present significant barriers.

This research indicates a need for executives to actively plan for BM transformation and innovation as part of their servitization efforts. This also implies that there is a good understanding of the firm's existing BM and a conceptual framework for the future or planned BM. Based upon this, developing a clear planning process for defining the new BM, measuring and managing the transition, and identifying key barriers or enablers should become a critical part of servitization development process.

By providing a focus on the need for executives to have a cognitive recognition and focus on the transformation of the business model, this research expands upon the existing body of literature which identifies specific barriers and drivers to business model transformation in the support of servitization (Gebauer et al. 2005; Kindström 2010). This has a very significant practical implication in terms of identifying a need for additional executive management education and dialogue regarding best practices and approaches to business model transformation.

6.3 Limitations and Recommendations for Further Research

It was clear from the interviews that the intentionality of the BM design is only one aspect of the firm's success in servitization. There are a number of additional factors which are arising from the elite interviews which have a clear impact on the firm's servitization efforts including executive leadership, corporate culture, perceptions regarding threats to the industry, and customer intimacy and focus. A singular focus on the BM would overlook these critical factors.

It is important to acknowledge that while this article discusses BMs as a well-defined concept, there is still significant discussion about the definition of the BM within academic literature, although there is increasing recognition that it is a unit analysis distinct from product, the firm, the industry, or network units of analysis (Zott et al. 2011). While this article recognizes that there is still discussion and perhaps debate about what the BM is, it proposes that there is enough of a conceptual basis existing to use the BM as a unit of analysis.

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Applications of servitization in smaller companies

AN ECOSYSTEM DEVELOPMENT MODEL FOR SME'S WITH BIG IDEAS

John Pritchard & Nick Frank

ABSTRACT

Purpose: Our goal is to encourage other SME's not to shy away from innovative business models such as servitization that can offer new solutions in todays rapidly changing world.

Design/methodology/approach: It was found that current research on ecosystem development did not provide a holistic framework from idea to execution for smaller businesses. As MAC Solutions began the development of their own ecosystem, they realised that due to the complex nature of the thinking process, it would save time to develop a framework.

Findings: The framework developed was the result of moving through this process. It was found that in the reality of the SME world, not all activities within the framework have to be completed, but it helps managers understand and assess the risks they are taking. In this sense the value of the tool was to support managers intuition and encourage debate based on analysis, in what can be a very complex decision making environment.

Originality/value: To our knowledge research exists for building ecosystems in relatively complex and large business environments. No evidence was found of a pragmatic holistic framework that supports smaller businesses delivering innovation through an ecosystem approach.

Key words: Ecosystem, Product Service Innovation, Business model, IoT

1. INTRODUCTION

In todays connected world, we think less about products and more about solutions and outcomes. Relationship, network and ecosystems are increasingly replacing traditional transaction and supplier thinking.

SME's who see the opportunity to develop the Intermediate and Advanced services that support the Servitization business models (Baines, Lightfoot 2013), must integrate their value proposition more deeply into their customer's processes. This often means developing new capabilities, technologies and relationships, which can be a daunting prospect for a small and focussed business.

One such SME, MAC Solutions (www.mac-solutions.co.uk) has decided to embark on such a path. Their ambition was to develop solutions aimed at supporting SME businesess turn *data-to-intelligence-to-profit*. Their goal was to provide Asset manufacturers and Asset User's with 'off the shelf' and 'compatible tools', that allows the creation of remote monitoring solutions infrastructure at a fraction of the cost of developing it themselves.

Their challenge has been to go beyond their core competency of being a reseller of the leading supplier of industrial routers for equipment. It has meant the integration of a number of new technologies to create an end-to-end solution. They have had to work with a number of new stakeholders to combine their knowledge into an integrated system, which is flexible enough to be applied in different use cases.

To help them develop the concept to a successful implementation, they created an Ecosystem Development Model. This model has been very useful in breaking down the complexity of ecosystem development into smaller sub-components that smaller business can follow for themselves. Similar

to breaking an elephant into smaller bite size chunks. Within the model there are 4 key activities:

1. Analysis
2. Building Blocks
3. Execution
4. Resilience

This paper will expand on the model, providing insights into it's use. Our goal is to encourage other SME's not to shy away from innovative business models, such as servitization, that can offer new solutions in today's rapidly changing world.

2. OUR MOTIVATION

The motivation for this paper came from the intersection of two events;

1. MAC Solutions is a £2M+ UK supplier of industrial router solutions. Together with one of its key supplier eWON (www.ewon.biz), the company identified an opportunity to supply a remote service solution to SME equipment manufacturers. This went beyond the router hardware / cloud technologies currently supplied, and would involve the integration of historians, alarm management, analytics, and data management. MAC Solutions realised that they did not have all the expertise within these businesses and that they would need to develop an ecosystem of expert partners to deliver their vision.

2. In the same time period they saw Ivanka Visnijc present her paper 'Collaborate to Innovate' (Visnijc, Neely 2013). Although focused on Ecosystems for building Smarter Cities, it was felt this could be applied to the SME environment. This was the beginning of the journey.

But how does one go about developing an ecosystem?

'Collaborate to Innovate' provided an overview of how to articulate an ecosystem, the roles of each of the actors and how they might work together. Useful insight was gained into business model design (Weiler, Neely 2013) as well as a second paper by (Visnijc, Neely 2011) on how service solution providers have used ecosystems. Irene Ng's book 'Creating New Markets in the Digital Economy' (Ng 2014) gave insights into 'value' within a 'constellation' of partners. An IBM published paper (TIAN et Al 2008) highlighted some of the key stages in developing an ecosystem and the importance of resilience testing, but was not pragmatic enough for the needs of an SME. A useful HBR article was identified 'The New Patterns of Innovation' (Parmar et al 2014) that gave great insight into the use of data to drive new business models. MAC's perspective was broadened by attending a master class on Open Innovation by Prof Wim Vanhaverbeke (co-author, with Henry Chesbrough New Frontiers in Open Innovation), as well as attending a lecture by Henry Chesbrough on Open Innovation. Whilst this provided the knowledge that other companies have successfully developed ecosystems, and gave insights into successful business models, it did not provide the roadmap that MAC was looking for.

Within this context MAC found itself developing it's own framework to solve, what is a complex management problem for any company big or small.

3. PROPOSED ECOSYSTEM

The complex problem MAC were trying to solve was how could OEM equipment manufacturers and Asset Users turn data generated by machines into profit.

This business problem has many buzzwords associated with it such as Internet of Things(IoT), Smarter Connected Products and Machine to Machine (M2M) technologies. The goal of MAC solutions was to create a solution for SME manufacturers that cuts through the hyperbole and

provide them with the capability to enable 'Remote Services'. Critical to this is understanding how to turn data into profits through increasing revenues and customer loyalty, or reducing costs.

The different actors required in delivering this goal are shown in figure 1. They cover both the key technology aspect of the ecosystem such as the hardware, software and Telco providers. It includes the role of the Integrator who interfaces with the customer to pull together the technologies. In addition a consulting partner is included, as the successful adoption of the solution requires a change in mind-set. This change in mind-set is called 'Service thinking' and is well described in the book 'Service Thinking' (Hastings, Saperstein 2014)

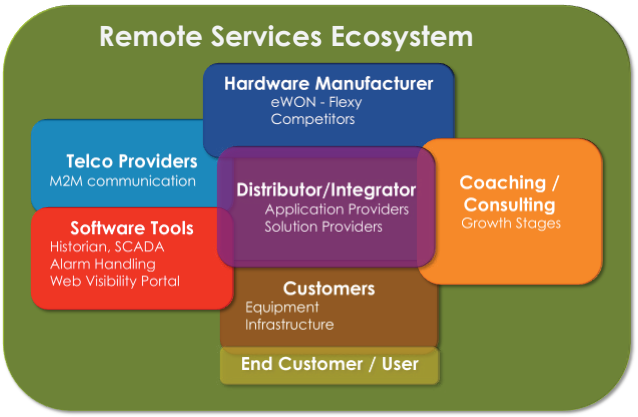

Figure 1: Overview of the Remote Services Ecosystem

4. ECOSYSTEM DEVELOPMENT MODEL

In the overview of the Ecosystem Development model shown in figure 2, it can be seen that many of the building blocks and activities are inter-dependent. This is because developing an ecosystem is not a sequential process. Insights from a later activity will drive a review of initial assumptions. An activity might be missed because it is not thought to be a priority, or simply because expertise is not available. In his research (Adner 2006) highlighted how it is this **interdependence** between partners, which creates an uncertain risk profile for such projects. Understanding and managing this risk is one of the key challenges to be overcome. Adner observed that 'When they work, ecosystems allow firms to create value that a single firm could not create alone'. But most examples involve larger enterprises that have access to significant resources. What about small resource constrained business that set themselves the challenge of solving a complex business problem using an ecosystem methodology.

At the start of it's ecosystems development, MAC's managers acted as most managers would. They used their intuition and management experience to understand the priorities and actions through which they would need to move. However, it quickly became clear that the dynamic nature of the ecosystem design, made it difficult to navigate based on intuition alone. There are simply too many interdependent parameters that impact the business relationships. This is a key point for an SME to appreciate. The traditional customer/supplier relationships cannot deliver an Advanced Service solution, where customer's and partners are much more interdependent. Indeed in an analysis of 'Factors affecting the readiness of an individual company for Servitization' (Baines, Lightfoot 2013), three of the nine readiness factors (Culture, Relationship & Contracts), directly influence how a company manages the interdependence between internal and external partners. It was the realisation that a new way of thinking is required, which led to the emergence of this development model as a thinking framework.

The second aspect of the development model is that the content does not represent new business thinking. Instead it organises traditional management tools into a logical framework and helps business leaders see where their gaps exist. Its value is to ground their thinking when dealing with the reality of conflicting priorities found in business life.

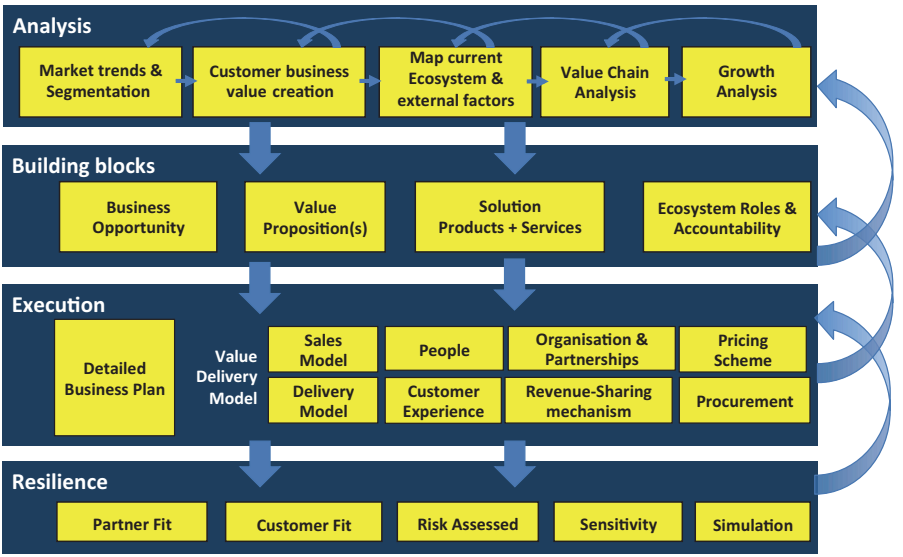

Figure 2 Ecosystem Development Model

As the ecosystem design developed, four key activities emerged:

1. **Analysis**: The basic business analysis that should be completed to gain a deep insight into the markets, customer value and the current business context.
2. **Building Blocks:** Define the basic elements of the business, so that a clear vision, mission and strategy can start to evolve.
3. **Execution:** The key components for executing and implementing the ecosystem. In other words developing the Value Delivery Model and the detailed Business Plan to drive the allocation of resources and actions.
4. **Resilience:** Develop mechanisms for ensuring that the business plan is resilient in terms of business risk and partner/customer fit.

5. ANALYSIS

The objective is to undertake research and analysis that turns ideas into real value propositions. In the case of MAC solutions, the ecosystem concept originated with its hardware supplier eWON, who is market leader with over 120,000 assets connected through its router/M2M solution. The question for MAC was how to participate in this concept, and its own role within the ecosystem as a reseller and integrator of the technology. (Refer to figure 1). Clearly they had to understand the market and the opportunity. To do this MAC undertook five distinct pieces of analysis:

1. **Market Trends & Segmentation:** They gained insight into the impact M2M technology could have on the growth strategy of equipment OEM's through Remote Services and Asset Users. This allowed some very clear target segments to be defined.

2. **Customer Business Value Creation Chain**: They aimed to understand the chain of activities and value in moving from the technology to the different use cases. For example from Internet technology to Security to Storage to Analytics to Value Use case such as 'Warranty

reduction'. Immediately one can see the interactive nature between this piece of thinking and identifying target segments based on the value the ecosystem can deliver.

3. **Map the Current Ecosystem and External factors**: They mapped out the current ecosystem of supply partners, and in particular the relationship between them. Combining this with the external factors that influenced the current ecosystem, MAC could understand the gaps in any future constellation of partners.

4. **Value Chain Analysis**: They mapped out the current value chain, identifying the value added activities. MAC assessed the percentage of the total solution cost of each activity and the power of each partner in terms of their ability to be substituted. This exercise brought significant insight into MAC's relationship vis a vis other partners, thus creating a vision of MAC's role in the ecosystem.

5. **Growth Analysis:** They started the process of evaluating the potential for customers to innovate their business model based on remote services and data. However minimal time was spent on a detailed growth analysis, as there was every indication that this is a significant revenue opportunity, and time was better spent in determining the segmentation and potential solutions.

6. BUILDING BLOCKS

The objective of the Building Block Activity was to take a growing understanding of the market potential, and develop some tangible ideas regarding the value proposition of the ecosystem and the solutions. One can appreciate that as solutions began to be defined, this had an impact on the Analysis activity. Four basic areas of understanding were built up:

1. **Business Opportunity**: Essentially this was the problem to be defined, and whether there would be a demand for the solution. For example the MAC problem to be defined was 'How to turn data into Intelligence and then into profit?'

2. **Value Proposition**: A high level proposition for the Ecosystem itself was defined.

> *Provides Asset manufacturers and Asset User's with 'off the shelf' and 'compatible tools' that allows them to create a remote monitoring solutions infrastructure for their equipment/assets, at a fraction of the* cost of developing themselves

Figure 3: Ecosystem Value Proposition

In addition a detailed value proposition for each target segment was defined, because they had quite different needs.

3. **Product Service Solution**: Based on the value discussion, a potential product service solution was developed. At this stage, the focus was mainly around technology and finding partners who were interested and compatible.

4. **Ecosystem Roles and Accountability**: It was found that the research of (Visnijc, Neely 2013) very useful in providing a framework for the different potential roles within an ecosystem. MAC mapped these roles & responsibilities against the potential partners defining roles and responsibilities using a RACI model (i.e. Responsibility, Accountability, Consulted and Informed) in effect creating a Statement of Works for each member. In total including the client, there are currently eight partners in this ecosystem.

7. EXECUTION

The goal was to develop a detailed Business Plan and Value Delivery model, which would be used to drive the deployment of the ecosystem.

1. **Detailed business plan**: The detailed business plan is the mechanism by which a company makes decisions on resources allocation. It normally lays out the business arguments for the proposal, including forecast revenues, profitability, resource needs and timing. Decision makers discuss this plan and allocate resources.

2. **Value Delivery Model**: The value delivery model enables the business plan to be developed as it details how the value proposition is delivered to the customer. This is particularly important for an Ecosystem where one works with 3rd parties. Essentially it involves having a good grasp of the following elements:

    a. Sales Model: How will the proposition be sold and marketed?
    b. Delivery Model: What are the process flow, management practices, KPI's, people competencies and Tools?
    c. People: How will you develop the competencies you need?
    d. Customer Experience: What is the customer experience you want to deliver?
    e. Organisation & Partnerships: How do you organise for the service and how do you manage partnerships?
    f. Revenue-Sharing mechanisms: How is value shared between each of the members of the ecosystem?
    g. Pricing Scheme: What is the pricing strategy for the end service?
    h. Procurement: What is the procurement strategy for the different elements needed to deliver the product service system?

As highlighted in figure 4, the reality of this project is that not all aspects of this building block have been completed. In particular a detailed business plan was not developed and neither has much time been spend on defining customer experience or on procurement.

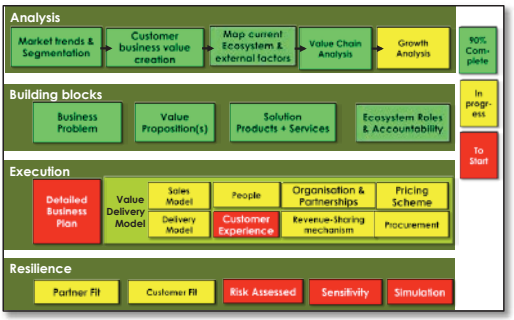

Figure 4: Status of Ecosystem Development Model for first customer project

Instead a very pragmatic approach has been taken in using a pilot sales project to drive the commercial and organisational detail. Piloting was felt to be important because this is a very fast moving space with new data delivery mechanisms being created such as the cloud and collaborative platforms.

This pilot project is being implemented in February 2015.

8. RESILIENCE

As with any partnership, an ecosystem has to have a natural built in resilience if it is to survive and prosper. A methodology identified in a Cambridge Service Alliance paper by Weiler, & Neely (2013) was used, in which a comparison between the Business Model of the Ecosystem and a key supplier within it was developed. We asked ourselves a number of questions regarding the business model, and as shown in figure 5, looked for divergence between the ecosystems business model and the partner.

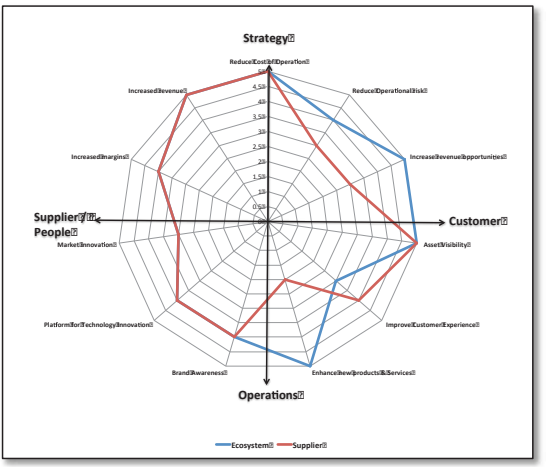

Figure 5: Partner Fit

This has been the only real analysis done as part of this building block. The key methodology being to pilot the programme and test the resilience on a live customer project.

9. CONCLUSION

Whist the Ecosystem Development Model has proved to be a valuable framework, not all the elements have been used at the time of the first customer pilot. The majority of the analysis has been done in the upfront market and business research phase. However at the mid and back end of business planning and execution, there was much less reliance on formal analysis, and much more on intuition, market experience and practical testing. This is not uncommon amongst SME's, who are time and resource constrained. The value of the framework has been to provide a pragmatic roadmap that an SME can follow to test validate their intuition with relevant, but not necessarily complete business analysis. It is this practical and pragmatic approach, where there is an absence of research and thinking applicable to SME's.

Perhaps it is the fear of complexity and a lack of practical tools that holds many SME's back from implementing servitization. Certainly from the MAC experience, there are two key messages, which might be subject to further research for SME organisations:

1. SME's need to appreciate that when they build partnerships that are more interdependent, they requires a more intimate understanding of the customer value chain. It requires them to 'consider traditional questions in a somewhat non traditional way' (Adner 2006)

2. The use of Pilot programmes is a very pragmatic and easy to understand approach that an SME can take to test and understand some key questions. When done in the context of the developed framework, risk can be reduced.

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SERVITIZATION AT A SMALL ELECTRICAL COMPANY THROUGH A KNOWLEDGE TRANSFER PROJECT

Ebi Marandi, Francine Turner-Gross, Judy Zolkiewski & Carl Eastham

ABSTRACT

Purpose: to highlight the challenges faced in both servitization and in the implementation of KTP projects.

Design/methodology/approach: This is a case study based on a small electrical company's experience of implementing servitization through a Knowledge Transfer Project (KTP) in partnership with a university

Findings: The key challenge identified was how to change the mind-set of the company from a technical sales-led manufacturer to a service provider. This involved introducing relational selling models and formal procedures for including distributors in the process. A key feature identified was the role of the incumbent workforce in the success of the servitization efforts. This appeared to be dependent on the willingness of the workforce to develop new capabilities and develop a service orientation philosophy.

Originality/value: This paper is intended to make a contribution towards gaining an understanding of the practical issues involved in implementing servitization at a company which has historically regarded itself as a manufacturer. It also offers an insight into how a successful KTP partnership can be developed.

Key words: Servitization, electrical company, marketing, distributorship

1. INTRODUCTION

This paper discusses the process of implementing servitization at a small electrical engineering firm through a two year Knowledge Transfer Project (KTP) in the North West of England. The project began in November 2013 and is now in its second year of implementation. As such it addresses the challenges identified by Oliva & Kallenberg (2003) of moving from a product to a services focus and, as such the objectives of the paper are twofold:

- Firstly, to outline the challenges faced as a SME begins to implement a servitization business model and to identify the barriers to this transformation, e.g. barriers relating to lack of marketing and service culture, as well as not having appropriate distributorship and communication models in place.
- Secondly, to outline key learning points for manufacturing SMEs that wish to implement servitization as part of their business model.

The paper is structured as follows. It begins with a brief overview of relevant servitization literature. This is followed by a brief outline of the methodology adapted- that of a case study which is being developed using action research. The case background is then presented and the steps taken prior to implementation of servitization, including the re-designing of models that are key to the successful implementation of servitization, are outlined. The results at the half way point of the project are presented along with a discussion of the lessons that managers need to be cognisant of in relation to the operationalization of the case.

2. LITERATURE REVIEW

Vandermerwe and Rada (1988) described how, increasingly, companies around the world were attempting to add value to their core offerings through services. The trend spreading to almost all industries, was customer demand-driven, and aimed to sharpen competitiveness. According to Baines, Lightfoot and Kay (2009) this trend has continued to attract increasing interest in the topic from academia, business, and government. One reason for this is the belief that a move towards

servitized manufacture is a means to create additional value-adding capabilities for traditional manufacturers (Brax, 2005). Furthermore, such services are distinctive, long-lived, and easier to defend from competition based in lower-cost economies (Baines, Lightfoot and Kay 2009; Baines and Lightfoot 2013). The debate about services-led competitive strategies centres around the differing practices between production and servitized operations (Baines, Lightfoot and Smart 2011). The generic research concerns being addressed within different communities are associated with the concepts of product-service differentiation, competitive strategy, customer value, customer relationships and product-service configuration (Lightfoot, Baines and Smart 2013). Additionally, for many leading engineering companies, the integration of services into product offerings is seen to comprise an important shift in the underlying business model (Raja, Green and Leiringer 2010). There are also warnings of generic, implementation issues - new marketing and commercial capabilities to be acquired; fresh perspectives on appropriate performance measures; new relationships with customers; and adopting and nurturing a service culture and supporting processes (Mills, Neaga, Parry and Crute 2008). This may require manufacturers to develop new internal and external capabilities (Paiola *et al.* 2012).

3. METHODOLOGY

This is a case study, focusing on collecting information on a specific event or activity in a particular firm, (Hair, et al. 2007). This type of research involves an empirical investigation of a contemporary phenomenon in a real life-context, from multiple sources (Saunders, Lewis and Thornhill 2012). This paper is based on an investigation of a live project as it has been happening and continues to be operationalized. It concerns the process of implementing servitization at a small company through a KTP project. All the authors have been involved in the project. The data has been gathered from meetings, discussions, interviews and company records. Arguably, the methodology involved is also a form of action research where a researcher and the client collaborate to seek a solution to a problem (Bryman and Bell 2011) In this case the client (the company) and the researchers (the Academic Advisors and the KTP Associate) have collaborated for the benefit of the company.

4. THE CASE BACKGROUND

A Knowledge Transfer Project (KTP) - is a three-way project involving academia, a business and a recently qualified person (known as the Associate). KTP works with over 140 universities, further education (FE) colleges, and research and technology organisations (RTO) across the UK, which translates into over 450 university departments. That includes all Research Excellence Framework (REF) rated departments, covering a wide range of academic disciplines – including engineering, computer sciences, physics and mathematics, management, social sciences and the arts (KTP.Innovateuk.org). Part-funded by 13 Government organisations, and led by the Technology Strategy Board, KTP projects apply knowledge and expertise of academics to business critical projects. An academic from a university links with a company that needs help and advice and writes a detailed proposal and makes an application for a grant to cover the costs of the academics' time and the salary of the Associate for the duration of the project, which can vary between a few months to three years. During this process and subsequent stages an experienced area KTP adviser is at hand to provide help and guidance as well as monitor the progress of the project and the welfare of the Associate. One person from the company (normally a manager) acting as the Work-Place advisor along with the Academic Advisor and the Associate are the main engines who push forward the aims of the project within the company. Regular meetings are held between these people and as well as regular periodic meetings with the area KTP Advisor, senior company managers/director and other involved academic to monitor the progress of the project and the performance of the company (KTP.Innovateuk.org).

The company was established in 1995 by four PhD students from the University of Manchester, three of whom currently occupy key roles within the company and are engaged in managerial or engineering innovation tasks. The company specialises in On-line Partial Discharge (PD) testing and

monitoring of high voltage assets. They develop world leading technology in the detection and location of PD in cables, switchgear and accessories. PD is essentially a series of small sparks that occur in aging or damaged high voltage insulation which can be a sign of imminent failure and therefore poses high health and safety risks as well as the risk of power outages. If the PD is not detected before failure repairs can be very costly.

In the past the company have been renowned for their permanent monitoring systems, however, they have also recently introduced smaller handheld instruments. In the past they have provided some services, including, site testing, data analysis and reporting; however, these have been mostly restricted to the UK market and on a very small scale.

The company's most profitable territories in 2013 were the Far East, notably Korea, and the Middle East; primarily Saudi Arabia and Qatar. They compete in these markets with two other UK, and several overseas, companies.

Since the company was founded they had experienced some periods of prosperity; however, turnover has been uneven. In the early 2000s they suffered from the outbreak of the foot and mouth disease in the UK, meaning engineers could not gain access to wooden electricity poles in rural areas, the testing of which was a large part of the business. This hit the UK business significantly. Once they recovered from the downturn in the early 2000s, it became apparent that the company were excelling in technical knowledge and expertise but lacked in the business and marketing skills to effectively respond to market opportunities needed for a steady growth.

In January 2013 senior management decided that they needed to stabilise profits and pursue grow by finding alternative sources of income through servitization; however, they did not have the knowledge or the expertise to implement a model themselves. As the company had previous links with the University of Manchester they decided that a KTP was a good path to take. So, an approach was made to Manchester Business School and the resident KTP Officer to find an interested academic and to explore the possibility of applying for KTP funding and enlisting government financial help and academic advice to turn the company's fortunes round. Initial discussions indicated that servitization could prove helpful to the company. A proposal was prepared between the company and the University of Manchester, then submitted to the KTP Board, which after a number of amendments was accepted and a grant of £132,000 was approved. Two rounds of interviews were held to find a suitable Associate and the implementation of the two year project began in November 2013. At the end of 2013, the company's annual turnover was £1.2 Million and the profit stood at £100k. The company employed a total of 12 people at the time.

The problems that the company felt they faced at that stage were:

- Reliance on unqualified and inexperienced third parties to sell, install and commission their highly technical and complex products in overseas markets
- Lack of standardised business model/service offerings within UK and overseas markets
- The unexploited potential for a service based model due to a lack of direct knowledge of the end user's needs
- Limited growth in the UK and overseas

The KTP partnership aimed to:

- Unlock the potential for a significant growth in overseas sales through servitization of existing products, offering of pure services, and implementation of a new marketing and servitization model that could be applied in the company's current and future markets.
- Increase efficiency and hence economic value in the dissemination of expertise and technical services

- Review and modify the existing business model/business strategy to support sustainable growth
- Establish brand/reputation globally – thereby assisting to gain entry onto preferred supplier lists, enabling the company to bid for new contracts in their own right rather than as part of a third party contract

One of the challenges of KTP projects lies in the fact that the proposal for action, in this case implementation of servitization, has to be written in advance and in detail based on a limited knowledge of the company and the numerous issues that exist within the company, or could arise, and which could affect the implementation of the project. Yet it is expected that the steps, stages and time lines written in the project have to be quite strictly adhered to. In the implementation of this KTP project, therefore, it was found necessary to run some project stages concurrently and also to engage in activities that were not envisaged in the proposal but were, soon after the project began, discovered to be necessary if the project were to be successful.

The approved proposal had a number of aims set for the project and specific actions were envisaged under each aim with a specific time allowed and the results had to be reported to the quarterly Local Management Committee (LMC) consisting of the Associate, the Academic Advisor, Work Place Advisor, second Academic Advisor who is there to step in if the main Academic Advisor is unavailable due to changing circumstances, a senior company director and the area KTP Advisor. The aims and different stages of the project were established as follows and related to the two major promising markets for the company: Korea and the Gulf states of UAE, Qatar and Saudi Arabia (The latter three treated as one market).

5. IMPLEMENTATION

5.1 Familiarisation

At this initial stage the Associate settled into the company and familiarised herself with the company's business and products. Then, with the guidance of the Academic Advisor, a marketing audit of the company was carried out highlighting the company's internal strengths and weaknesses as well as the environmental threats and opportunities faced by the company. The company's main competitors and their strengths and weaknesses were also identified. For this purpose both desk research and interviews with a sample of the company's distributors and company staff were carried out. As the company only had 12 employees at the time all the members of staff were interviewed.

An outcome of this stage of the project was the realisation that prior to servitization being implemented there was a need for marketing philosophy as well as an understanding of service as a competitive advantage to be explained to the management and employees. The company was one that had put much emphasis on technical excellence and had been engaged basically in making and selling (this is synonymous with the challenges identified by Neely, 2008). This was where the major hurdle for the project lay but as it turned out most of the staff, who are young and educated engineers, showed enthusiasm in learning about, and bought into the idea of the marketing philosophy as the basis of running of a firm, the nature of service and its potential for competitive advantage and growth illustrating the importance of mandating a change in philosophy and mind set (Neely, 2008). The Academic Advisor gave talks, on different occasions, on these topics as well as on branding and relationship marketing attended by most of the staff. The Associate upgraded the company website, started to produce monthly newsletters, set up an ideas board and learning lunches every other week where a different department would present a project or technical topic in order to transfer knowledge through the company and help everyone understands what others were doing at the company. This can be seen as the beginning of the implementation of a more relational marketing strategy, i.e. a transformation from a sales-led philosophy; another key stage in servitization identified by Neely, 2008).

5.2 Distributor Communications

The next stage of the project involved examining distributorship agreements of the company and it was realised that there was no standard distributorship agreement and that in some cases there was no distributorship agreement at all. So, the Work Place Advisor and the Associate wrote a new distributorship agreement that set goals for distributors and support responsibilities for the company and it was decided that by January 2015 all distribution would have to have signed this new agreement. All distributors were contacted and the new contract and the reasons for it and the benefits for them as well as for the company were explained. There has been much progress made with this part of the project and the company consider some of their recently increased sales due to these new agreements. This finding supports the points identified by Paiola *et al*., (2012) relating to the central importance of the distributors in the development of an SME's servitization strategy. The Associate has, in fact, put in place a distributorship management model which includes acquiring a new distributor to managing regular contacts with existing ones, enabling reinforced communications and improved relationship management to get the most out of the partnerships.

5.3 Evaluation of target overseas markets

For each of the target markets in the report a thorough environmental analysis including PEST, competitor analysis and market trends analysis were carried out. This was to highlight opportunities as threats (for the company's manufactured and service products). Both of the markets are politically stable and economically growing, yet (particularly the Gulf States) are close to areas of political turbulence. Hence, it was decided that these would be regarded as something between primary and secondary markets, i.e. no investment in office space and plants would be made in these areas but sustained marketing and sales activities would take place in order to maximise sales and profit. Also, the Associate conducts regular environmental analysis of these markets in case of changes in any factors that may affect the company's operations.

5.4 Business and Cultural Familiarisation

The senior managers, with experience of travelling for business to the Middle East and Korea, were interviewed and also desk research was carried out concerning the business culture of the target markets. A report was written and the findings were presented to all the staff at the company. A formal process was then established for future business and cultural familiarisation with overseas markets.

5.5 Servitization, growth & communications model development

At the beginning of the project a Steering Group was established which was made up of the Academic and Business Advisors, the Associate, Services Manager, Software Manager, and the Industrial Designer. This was done to report the progress being made by the Associate and to feed the knowledge gained into the company. Importantly, a major reason for having a Steering Group was that if the key people in the company were persuaded to agree with servitization got involved in idea generation and also in the implementation of the project it was more likely that they would be cooperative and help in the success of the project, that they would take part-ownership of the project rather than seeing it as the Associate's project. This is in fact what has happened. The Steering Group has met at every key stage of the project to learn and understand what progress has been made. After marketing related steps were taken a brainstorming session took place with the involvement of the Steering Group in order to come up with service product ideas. A handful of service ideas were picked from the 50 or so that were suggested and were agreed to be put through concept development and business analysis. Each person who had come up with one of the selected ideas was assigned to write a full description of the service, make an initial business analysis, assess capability within the organisation to provide that service, identify the target market, the size of the market, who would be responsible for the service, etc. Once this was completed an in-depth analysis was conducted by the Associate, looking into costs, breakeven analysis, pricing and

timescales for implementation. Then, these new service product ideas were discussed with a sample of the distributors and end-users. Finally, after positive feedback from the distributors, the services listed below were chosen for development and implementation (these are in-line with suggestions by Baines (2013):

- *Annual company conference* in Dubai to which all distributors would be invited. The conference would have the company staff giving talks about the latest innovations in the industry, be used as a platform for networking and relationship building. The first conference, 'Middle East Partial Discharge Conference 2014 - MEPD', was held in November 2014 and was met with great feedback. The participants were not charged a fee but the company is now considering expanding the conference and charging the participants from next year.
- *Training courses in the UK and abroad* are in the planning stage with costings and venues already worked out. Ways of accrediting these courses are currently being assessed. These will be day long courses on a variety of subjects, (Partial Discharge for beginners, Tools for asset Manager, etc.) available in the UK or abroad according to demand to both customers of the company's products and non-customers.
- *Leasing of monitoring systems* as a new profitable alternative to selling systems and equipment has been fully planned and the promotional material for this service is currently being prepared.
- *Remote monitoring* is a service which will be offered on a monthly basis, involving data analysis reports for a customer that has one of the company's monitors installed in their sub-station.

At the time of writing, the project is at just over the half way mark and on schedule. The above services will be implemented by the middle of the summer of 2015 and then monitoring and evaluation will be carried out up to November 2015 when the KTP project will end. There is a new buzz and vigour at the company and everyone is excited. Since the project began seven new employees have been taken on, with two of the positions directly linked to implementing servitization. These are IT Support Engineer and Software Engineer. The company's sales and profits are considerably up and stand at approximately double the figures for the previous year. While, this rise in revenue cannot yet be attributed to servitization it can certainly be, to a large extent, attributed to the new distributorship agreements and the greater emphasis on marketing and relationship building. The direct impact of servitization can be assessed in November 2015.

6. LESSONS LEARNED

At this half way stage of the servitization project at a small electrical engineering company, the following are the actions that were taught necessary in implementing servitization. These points may be of use to other small manufacturers.

- *First embed a marketing philosophy in the organisation*- Small manufacturing companies are often devoid of marketing philosophy; they make goods and sell them. While they may have a sales manager, or even sales director, marketing to them is no more than having a few brochures and some kind of web presence. When they refer to marketing, they really mean selling. To begin servitization a thorough marketing audit of the organisation needs to be carried out in order to identify the strengths and weaknesses of the company as well as the opportunities and threats it faces. Quite possibly, as in the case of this project, marketing as a business philosophy, i.e. achieving organisational objectives through anticipating, understanding and satisfying customer needs and wants and building long term mutually beneficial relationships, has to be explained to them and they need to accept this and invest in marketing personnel and activities (e.g. market research). There is now a danger that once

the Associate's time at the company is finished the company may go back to its old ways again, unless of course she or someone else continues in the role and nurtures the new culture that is developing within the company. Additionally, the company need to recognize that successfully selling services brings with it challenges relating to ensuring that the customer is actively engaged in co-production (Brax, 2005) and that this may be the cause of some of the servitization paradoxes encountered when servitization does not reveal as much additional profit as anticipated (Kastalli & Van Looy, 2013).

- *Put in place proper distributorship agreements* and relationship management processes. Here we can see the significance of developing new internal capabilities as suggested by Oliva, & Kallenberg, R. (2003) Paiola et al., (2012).
- *Explain servitization*, through meeting and talks, and involve all key people in idea development and then let each person take ownership of a service product, its development and implementation. Change the mind set of the organization (Neely, 2008)
- *Involve all your staff and main customers* in any service development. Encourage different staff to become the owners, or champions, of each new service product. Facilitate innovation of capabilities (Kastalli & Van Loo, 2013)
- *Use every opportunity to develop relationships* with customers and as you grow consider having key account managers (Neely, 2008).
- *Regularly evaluate and monitor* your plans, as well as the macro-environment, customers and competitors.

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EXPLORING THE ATTITUDE OF BERGAMO'S SMES TOWARDS SERVITIZATION

Alice Rondini, Fabiana Pirola, Paolo Gaiardelli & Marzia Morgantini

ABSTRACT

Purpose: The goal of this paper is to identify, through an empirical investigation, the relationship between product-service offering configuration, internal and contextual variables affecting the servitization of Small and Medium Enterprises' (SMEs).

Design/methodology/approach: The paper is based on a quantitative analysis approach. First, a research model linking product-service offering configuration, internal and contextual variables influencing servitization was developed. Then, a cluster analysis was performed to identify common behaviours of SMEs and to assess the relationship between the selected variables.

Findings: This research identifies a servitization level rather limited among manufacturing SMEs in the Bergamo area. Moreover, the analysis proves a significant influence of some internal determinants, which emerged to be much more influential than contextual variables.

Originality/value: This paper contributes to knowledge providing an overview of the attitude of SMEs in the adoption of the servitization process. Furthermore it analyses the reasons that lead small and medium manufacturers in embracing, or avoiding, a service strategy.

Key words: Product-service offering, servitization, SMEs, survey, cluster analysis

1. INTRODUCTION

The economic globalization, combined with an increasing products homogenisation, fleeting obsolescence and continuous reduction in sale profit margins, have been radically changing companies competitive environment. Slow-moving markets have progressively transformed themselves into dynamic contexts where new players emerged (Aurich et al. 2010). In particular, low cost countries competition has made cost reduction an unsuitable strategy for manufacturing companies located in the developed economies. This has forced many companies to think over their traditional business strategies to enhance their competitive position (Fähnrich & Meiren 2007). One possible path over the definition of articulated portfolios is the integration of existing products with additional services along their entire lifecycle (Neely 2008). This transformation, known as servitization of manufacturing (Vandermerwe & Rada 1988), has been demonstrated to enhance the strategic position of companies. Indeed, extending the business around services might allow manufacturers to achieve more sustainable economics returns, reduce costs, save time, increase knowledge and information and improve the image of the company. From a customer perspective, integrated product-service solutions are even more valuable than pure physical goods. In other words, servitization offers a route for increasing customers' loyalty, establishing long-lasting relationships and increasing the repurchase intent (Furrer 2010, Baines et al. 2009). Many companies all over the world are experiencing a shift in their core business, adding value by offering services. Nevertheless, it seems that the success related to servitization is restricted to big enterprises with strong organizational structures, grounded skills and top management commitment. On the contrary, how Small and Medium Enterprises (SMEs) approach this phenomenon and the reasons why they could adopt, or avoid, a servitization strategy has not been yet explored. These gaps are the main motivations that sparked off the present research, whose main goal is to understand if, and how, SMEs are facing the shift towards a service-oriented business model. In particular, this paper aims at assessing the servitization level achieved by small and medium manufacturers, identifying the relationships between their product-service offering, the context where their operate and their internal organizational and managerial orientation. In line with the analysis of literature, presented in section 2, a research model linking variables affecting servitization and product-service offerings configuration is described in section 3. Research findings achieved from a statistical analysis carried out on a sample of 266 questionnaires provided by SMEs

are described in section 4. Finally, section 5 reports the conclusions together with the identification of limitations and possible further developments.

2. THEORETICAL BACKGROUND

This literature review is composed of two main sections which cover i) product-service offerings classification and ii) contextual and internal variables (i.e. dedicated organization, company size, managerial commitment) affecting servitization.

2. 1 Product-service offerings classification

There is no one ideal servitization strategy. Rather, research confirms that companies proceed along a continuum through incremental stages, with each stage characterised by increasing number and types of product-service offerings (Lay et al. 2010). Many classifications models, adopting different combinations of descriptive drivers have been proposed in literature to illustrate how the change of product-service offering translates into differing levels of servitization (Mathieu 2001, Tukker 2004, Oliva & Kallenberg 2003, Gaiardelli et al. 2014, Frambach et al. 1997). However, since "adopters of servitization do not necessarily apply the product-service classification and instead distinguish on the basis of the value proposition with their customers"(Baines & Lightfoot 2013), the authors provide a different classification model that distinguishes product-services in three types of propositions: *base services* provided for customers "who want to do it themselves", *intermediate product-services* include solutions for customers "who want us (the provider) to do it with them" and finally *advanced product-services* that bundle together products and services in a sophisticated offering, for customers who want the manufacturer take care of everything.

2. 2 Variables affecting servitization

Despite the several theses asserting the importance of servitization, literature raises the issue of the so-called service paradox, stating that making incremental profit by adding services can appear more difficult than might be expected (Gebauer et al. 2005). Moreover, current literature claims that service infusion in the manufacturing industry is still limited, servitization processes are slow and companies are unable to exploit benefits from service strategies (Oliva & Kallenberg 2003). This issue is particularly relevant for SMEs that are characterized by weaker management foundation and lower availability of funds with respect to large companies. Because of this, they have to face greater challenges in the new market competition (Lihong 2014) and they have to be able to coordinate different part of their value chain to obtain a competitive advantage. Due to these aspects, there is evidence that large firms, with higher *organizational capabilities* and more funding opportunities, have a higher level of servitization with respect to SMEs (Neely 2008).

The *size of the company*, however, is not the only variable affecting company's success in implementing service strategies. Literature cites the *strategic commitment* as one of the most determinant variables influencing the success of the servitization process. The transition from product manufacturer into service provider constitutes a major managerial challenge and the top management is the springboard towards such a cultural change (Oliva & Kallenberg 2003). Even if for most of the companies the introduction of services is pulled by the context (i.e. *customers' requests, legislation, competition*) (Gebauer 2007), companies should not simply react to market changing conditions, but they should have a *proactive approach*, triggering a cultural shift within the whole organization towards a clear and strong service strategy (Oliva & Kallenberg 2003). In addition, another determinant of servitization is the *type of product offered.* In particular, current literature states that the more complex is the product, the easier is the approach to the servitization (Furrer 2010). Other product's characteristics that push customers toward additional services include technological innovation and customization (Windahl et al. 2004). These types of products refer to markets with a business-to-business (B2B) approach. Indeed, Baines et al. (2009) assert that the potential impact of services on sales is particularly remarkable in industrial, or B2B context, where there is a strong increase in demand for services from customers.

In conclusion, despite all the discussion about the several potential advantages coming from the service infusion, it is fundamental to consider that the firm's general economic context plays a decisive role in the success of the servitization process. Thus, considering the issues that SMEs have to face when servitizing and the impact that the general economic context can have during this evolution, this paper aims at exploring the main determinants influencing SMEs servitization journey and its success.

3. RESEARCH MODEL AND DESIGN

3.1 Research model

Although literature encourages companies to develop their servitization strategy along with different product-service offering sophistication, it offers little guidance as to what extent of internal and contextual variables would lead to improved service offerings. In order to answer this question, we propose a research model that highlights the relationship between product-service offerings and the context where their operate [as shown in Figure 1].

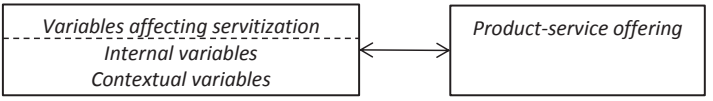

Figure 1: Research model

3.2 Research design

A quantitative deductive design was used and the hypotheses tested using a questionnaire survey. A first internal meeting held in the start of the research project, helped to design the initial sample, which was drawn from the lists of manufacturing companies operating in the Bergamo area: the initial sample consisted of 3800. A further kick-off meeting was held to define the questionnaire structure, wording and scaling (Forza, 2002). The final questionnaire was organized in three main sections concerning contextual variables, product-service offering configuration and internal variables. The questionnaire was submitted by email to about 1500 companies and the survey open from early April to late July 2014. The questionnaire can be provided by the authors upon request.

Internal variables

The main variables underlined by literature as the most relevant internal variables behind the servitization process were selected. They are: company size, strategic commitment, and organisational capabilities. In particular "top management commitment" and "strategic orientation" variables were considered related to the strategic commitment, while "dedicated service unit/personnel" was adopted to represent the organisational capabilities towards a servitization transformation.

Contextual variables

The product complexity, the type of market, the customer requirements, the competitors' strategies and the laws and regulations, identified in literature as the five main external factors influencing servitization transformation, were adopted to develop the questionnaire section devoted to explore contextual variables of servitization.

Product-service offering mapping

A map of product-service offering was defined using as main sources of information public available data from company websites and management and academic literature in the area of service for the manufacturing industry. Then services were classified on the basis of two dimensions, which are easy to be understood, are able to describe services in a unique and not misleading way and are suitable for practical applications: i) *Lifecycle*, distinguishing between pre-sales services (Pre), services for supporting the product-use (Support) and end-use services (End) (Frambach et al. 1997);

and ii) *Orientation*, distinguishing between Base, Intermediate, and Advanced services (Baines & Lightfoot 2013).
35 services were identified and classified according to the selected drivers [as shown in Table 1]. In particular, 12 over 35 can be defined as pre-sale services, 21 as support services and only 2 services as end-use services. Concerning the orientation, it emerges that the majority of product-service offerings is composed of Base and Intermediate solutions. However 11 over 35 are Advanced solutions.

Service	*Lifecycle*	*Orientation*	*Service*	*Lifecycle*	*Orientation*
Trial period	Pre	Base	*Help Desk*	Support	Intermediate
Commissioning	Pre	Intermediate	*Leasing*	Support	Advanced
Installation	Pre	Intermediate	*Refurbished spare parts*	Support	Base
Insurances	Pre	Advanced	*Green maintenance*	Support	Intermediate
Financial support to buy services	Pre	Intermediate	*Time based maintenance*	Support	Intermediate
Financial support to buy products	Pre	Base	*Condition based maintenance*	Support	Intermediate
Support during the product development	Pre	Intermediate	*Remote monitoring and diagnosis*	Support	Intermediate
Customer's activities optimization	Pre	Intermediate	*Maintenance contracts*	Support	Advanced
Product use training	Pre	Intermediate	*Help desk remote support*	Support	Intermediate
Sustainable use consulting	Pre	Intermediate	*Customer activities management*	Support	Advanced
Sustainable use training	Pre	Intermediate	*Short term rent*	Support	Advanced
Sustainable product develop. consulting	Pre	Intermediate	*Long term rent*	Support	Advanced
Extended warranty	Support	Base	*Pay-per-use*	Support	Advanced
Repair	Support	Intermediate	*Pay-per-result*	Support	Advanced
Spare parts	Support	Base	*Mobile App*	Support	Base
Product upgrade	Support	Advanced	*Take back management*	End	Intermediate
Software upgrade	Support	Advanced	*Retrofit*	End	Advanced
Help desk for intervention management	Support	Intermediate			

Table 1: Product-service offering map

4. RESEARCH FINDINGS

A statistical analysis was carried out to analyse the questionnaire results and to evaluate the main variables affecting the product-service offerings and the servitization process. In particular, a two-stage cluster analysis (Donicar 2003) was performed to identify homogeneous groups of companies from the point of view of the service offering:

1. First, a hierarchical cluster analysis using Ward's method and applying squared Euclidean Distance was chosen to determine the optimum number of clusters. The Ward's method was selected because the analysed dataset did not include any outlier (Ward 1963);
2. The hierarchical cluster analysis was re-run with the selected number of clusters. This second step allowed the allocation of each case to a specific cluster.

Then, the identified clusters were investigated to understand the relationships between internal and contextual variables and product-service offering. To this purpose, a one-way ANOVA test along with a Tukey's post hoc or Tamhane tests were considered to define to what extent a specific variable influences product-service offering.
The main research findings are reported as follows.

General results

A total of 303 complete questionnaires were returned, corresponding to a response rate of the 30%. Since SMEs are the focus of the research, respondents have been polished up from large companies resulting in a final sample of 266 micro, small and medium enterprises. The responding sample is almost heterogeneous. It counts 29,7% of Medium companies, 30,1% of Small and 40,2% of Micro.
A general analysis of data shows that interviewed companies mainly operate in a *Business to Business* context (82,0%) and do not belong to a group (78,6%). Moreover, their production plants

are located in Italy (95,1%) and they mainly operate in the Italian market; indeed, the 16,2% of the sample states that the domestic market accounts for over 50% of their business, while the 29,7% sell exclusively in Italy. Furthermore, the analysis highlights that companies of the sample basically belong to the production of machinery sector (21,8%), metal products production (12,8%) and wood manufacturing (12,8%), which are even the most relevant manufacturing realities in the Bergamo area. From an initial evaluation it also emerges a servitization level rather limited: on average, only 6,5 services are offered over 35.

Cluster analysis

From the analysis, it was possible to identify 3 clusters that differ according to the service orientation and the service portfolio: 117 respondents were included in cluster #1, 114 in cluster #2, 35 in cluster #3. The three clusters were categorized and defined as follows:

1. Cluster #1: *Uninvolved.* It is the largest group, consisting of micro, small and medium companies that offer few services, on average 3 out of 35. These companies, operating in the Italian market, belong to the textile sector (18%), metal products (14%) and the clothing manufacturing (11%).
2. Cluster #2: *Halfway.* It is a large group of mainly micro enterprises (51,7%) that provide on average 7 services out of 35. The majority of companies in this group operate in the Italian market and belong to the field of the machinery industry (23%), wood manufacturing (19%) and metal products (8%).
3. Cluster #3: *Disposed.* It is a small group of small-medium companies that offer on average 16 services out of 35. These companies primarily belong to the production of machinery industry (74%) and the higher part of their business is out of Italy.

Based on the statistical difference of variances, a Tukey's post hoc or Tamhane tests were performed to determine where the differences between the groups were lying (Keppel, 1973). The three groups emerged as statistically different ($\alpha<0.05$) in terms of the number of services offered and the structure of their product-service portfolio [as shown in Table 2].

Dependent variable		(I) Cluster	(J) Cluster	Mean Diff.	Sig.
Total n° of services	Tamhane	Uninvolved	Halfway	-3,378	0,000
		Uninvolved	Disposed	-13,012	0,000
		Halfway	Disposed	-9,635	0,000
Pre-sale services	Tukey	Uninvolved	Halfway	-0,069	0,000
		Uninvolved	Disposed	-0,267	0,000
		Halfway	Disposed	-0,198	0,000
Support product-use services	Tamhane	Uninvolved	Halfway	-0,099	0,000
		Uninvolved	Disposed	-0,367	0,000
		Halfway	Disposed	-0,268	0,000
End-use services	Tamhane	Uninvolved	Halfway	-0,062	0,271
		Uninvolved	Disposed	-0,411	0,000
		Halfway	Disposed	-0,349	0,000
Base services	Tamhane	Uninvolved	Halfway	-0,556	0,000
		Uninvolved	Disposed	-1,816	0,000
		Halfway	Disposed	-1,259	0,000
Intermediate services	Tamhane	Uninvolved	Halfway	-2,094	0,000
		Uninvolved	Disposed	-6,457	0,000
		Halfway	Disposed	-4,363	0,000
Advanced services	Tamhane	Uninvolved	Halfway	-0,590	0,000
		Uninvolved	Disposed	-4,430	0,000
		Halfway	Disposed	-3,840	0,000

Table 2: Multiple comparisons

Deepening the analysis on the clusters' product-service offering, it emerged that "Halfway" and "Disposed" focus on services that support the product use and functioning, while "Uninvolved" manufacturers mainly concentrate on pre-sales services, in particular providing information services and solutions to support the product development [as shown in Table 3].

Cluster	*Lifecycle*			*Orientation*		
	Pre	*Support*	*End*	*Base*	*Intermediate*	*Advanced*
Uninvolved	**53,70%**	35,90%	10,40%	16,72%	**68,09%**	15,20%
Halfway	41,10%	**51,80%**	7,00%	16,96%	**66,23%**	16,81%
Disposed	33,90%	**59,00%**	7,20%	14,73%	**53,96%**	31,31%

Table 3: Percentage of services offered by each cluster.

Regarding the product-service orientation, intermediate services are the most spread among all groups. However, in the "Disposed" group, advanced services start to diffuse, meaning that more servitized companies begin to offer solutions which focus more on product's performances rather than on the product itself.

Concerning the main internal variables underlined by literature as the most relevant factors behind the servitization process [as shown in Table 4], it emerged that "Top management commitment" and "strategic orientation" towards services are significantly different between "Uninvolved" and "Halfway", while there is not significant evidence with respect to "Disposed". On the contrary, "Company size" and "Dedicated service unit/personnel" are significantly different only between "Halfway" and "Disposed". This result suggests that a shift from a pure-product orientation towards a service-oriented perspective is sparked by a cultural change of the top management at first, but this strategic initiative is not enough to complete the shift. Organizational and structural issues are an integrated part of the servitization challenges and need to be solved in order to sustain the cultural movement. Indeed, bigger companies emerge as more servitized and better able to exploit servitization advantages, since they can rely upon higher investments capabilities. They allow dedicated and expert personnel as well as advanced performance measurement systems.

Dependent variable		(I) Cluster	(J) Cluster	Mean Diff. (I-J)	Sig.
Top management commitment	Tamhane	Uninvolved	Halfway	-0,530	0,003
		Uninvolved	Disposed	-0,850	0,000
		Halfway	Disposed	-0,319	0,195
Strategic orientation	Tamhane	Uninvolved	Halfway	-0,208	0,001
		Uninvolved	Disposed	-0,419	0,000
		Halfway	Disposed	-0,211	0,099
Company size	Tamhane	Uninvolved	Halfway	0,196	0,188
		Uninvolved	Disposed	-0,683	0,000
		Halfway	Disposed	-0,878	0,000
Dedicated service unit/personnel	Tamhane	Uninvolved	Halfway	-0,251	0,000
		Uninvolved	Disposed	-0,550	0,000
		Halfway	Disposed	-0,300	0,003

Table 4: Internal variables multiple comparison

Eventually, referring to contextual factors of servitization, none of the identified variables, except from customer requirements and product complexity, proves to be determinant in the servitization adoption among SMEs [as shown in Table 5]. In other words it seems that the competitive environment does not play a decisive role in going beyond a product-centric orientation towards a service perspective. However, customer requirements and product complexity seem to play a decisive role in an advanced stage of the servitization process, when the company has still begun to adopt proper arrangements for implementing a service strategy.

Dependent variable		(I) Cluster	(J) Cluster	Mean Diff. (I-J)	Sig.
Product complexity	Tamhane	Uninvolved	Halfway	0,196	0,188
		Uninvolved	Disposed	-0,683	0,000
		Halfway	Disposed	-0,878	0,000
Type of Market	Tamhane	Uninvolved	Halfway	0,249	0,375
		Uninvolved	Disposed	0,233	0,462
		Halfway	Disposed	-0,016	1,000
Customer requirements	Tamhane	Uninvolved	Halfway	-0,024	0,975
		Uninvolved	Disposed	-0,266	0,001

		Halfway	Disposed	-0,242	0,004
Competitors' strategies	Tamhane	Uninvolved	Halfway	-0,066	0,626
		Uninvolved	Disposed	-0,212	0,095
		Halfway	Disposed	-0,146	0,364
Laws and regulations	Tamhane	Uninvolved	Halfway	0,001	1,000
		Uninvolved	Disposed	-0,096	0,457
		Halfway	Disposed	-0,098	0,442

Table 5: Contextual variables multiple comparison

4. CONCLUSIONS AND FURTHER DEVELOPMENTS

To succeed in modern competitive environments, companies need to rethink their overall business strategies. Theories clearly praise evident advantages coming from the servitization adoption. However very few studies examined the approach of SMEs towards this phenomenon and the most determining variables that lead this kind of companies in adopting or avoiding a service strategy.
To fill, at least partially, these gaps this paper proposed an empirical investigation to assess whether there is a relationship between the firm's product-service offering and the main internal and contextual determinants underlying the servitization phenomenon.
A survey spread to local companies operating in Bergamo allowed the identification of common patterns among them. Three clusters ("Uninvolved", "Halfway" and "Disposed"), statistically different in terms of product-service offerings, emerged. In particular, moving from the former to the latter, it may be observed a progressive enlargement of the product-service offerings and a transformation of the nature of the portfolio from a traditional product-based to a service-based strategy.

The features of the three clusters seem that the servitization journey of the local SMEs has just started. They are mainly focused on the product, which is still considered the core of the business. Only a few number of enterprises is enlarging its offering with more advanced solutions. However, SMEs are facing considerable challenges in changing their business strategy towards a more service-oriented perspective.

The research findings indicate that a relationship between the internal variables and product-service offerings exists, while contextual variables do not seem fundamental for SMEs to embrace or avoid a servitization strategy. In particular, if the cultural inclination of the top management and the strategic orientation towards services is fundamental at the early stages of servitization, organizational capabilities appear as necessary to accomplish the process. External pressures, such as legislation, market pressure or competition do not emerge as influential.

This analysis specifically refers to a limited sample of companies, thus it cannot be generalized. In addition the companies interviewed all belong to the Bergamo area that is a specific ecosystem and could differ (completely or in part) from others. Moreover, the analysis carried out are specifically related to the issues tackled in the ad-hoc questionnaire. Other investigation areas could be taken into account. Thus the guidelines obtained with this research could be tested or observed in other contexts and companies or can be expanded with future research. Future analysis also foreseen would be related to the comparison of what obtained with what can be observed in large enterprises.

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