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FRAMEWORKS AND ANALYSIS

SERVITIZATION IN MANUFACTURING FIRMS: A BUSINESS MODEL PERSPECTIVE

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ABSTRACT

Although a manufacturer's business model and associated business logic may be sound enough to benefit from current product-based opportunities, they may not be sufficient to take advantage of opportunities for servitization. To do so, the firm must reconfigure key elements of its business model. The purpose is to discuss how manufacturers can design, adjust, and align its different business model elements to successfully develop, sell, and deliver services. The firms analysed come from a pool of manufacturers taking part in three research projects on servitization. Successful servitization implies that firms address all elements of their business model. In general, too much emphasis is placed on service development initiatives. Firms and business units tend to have inadequate understanding of, and focus on, innovation in the other business model elements. However, inadequate alignment between elements inhibits servitization. These shortcomings can help explaining why servitization fail to gain traction.

Keywords: Servitization, business model, manufacturing.

1 INTRODUCTION

Manufacturing firms have always delivered services, by supplying spare parts, installing equipment, training employees, or providing customer support. In competitive markets though, firms seek new ways to differentiate their business, including an increased focus on services and product-service systems, often referred to as servitization. Despite the focus, studies show that manufacturers frequently struggle to servitize; many new service and PSS concepts are developed but fail once they are taken to the market, and even manufacturers that manage to launch new offerings fail to achieve their strategic objectives of servitization. Although a manufacturer's business model and associated business logic may be sound enough to benefit from product-based opportunities, they may not be sufficient to take advantage of opportunities for servitization, even if those are evident. To do so, the firm must reconfigure elements of its business model, which includes, but goes beyond, conventional business development. Hence, the our proposition is that servitization is a multi-dimensional, organization-wide challenge to the managers charged with its design and implementation, and that a comprehensive conception of it is therefore essential; that is, a business model perspective. The purpose is to discuss how manufacturers can design, adjust, and align its different business model elements to successfully develop, sell, and deliver services. In other words, how to successfully create and capture value through servitization. To address this issue, we investigate two main research questions:

1. What service business model elements must manufacturers adjust and align to achieve successful servitization?
2. What are the critical issues that manufacturers must address concerning each business model element to enable successful manufacturers initiatives?

We find that a strategic realignment to services must be mirrored in changes throughout the business model. This research identifies eight common business model parameters that can be used as a structuring and analytical framework: Offering; Revenue model; Processes (development, sales, delivery); Structure; Strategy; Customer relationship; Value network; and Resources and capabilities.

2 CONCEPTUAL BACKGROUND

In order to succeed with servitization it is not enough to only develop and sell new services. As discussed, service innovation is a multi-dimensional, organization-wide challenge that requires managers to take a holistic approach to their business and address all elements of the firm's business model. A business model is sometimes seen as a firm's "story" about how to make money, who the customers are, and what customer value is most important to address (e.g., Magretta, 2002). However, a business model should also include such things as the revenue model(s), structure, activities, processes, customer relationships, and the firm's position within the value network (sometimes referred to as an ecosystem) (Chesbrough, 2007; Osterwalder and Pigneur, 2010). Although it is possible to discuss generic business models, every firm has its own, unique business model that tells how the firm creates and captures value. If the firm works systematically with all elements of its business model and the linkages between them, it can become a difficult-to-copy competitive advantage. The reason for this is that it is generally much more challenging to imitate a well-functioning business model with alignment between its elements than to copy single elements. Thus, business model thinking can help create sustainable competitive advantage by reducing imitability; competitors find it more difficult to isolate and copy individual elements of an integrated business (Chesbrough, 2007; Kindström, 2010). We propose that a firm which systematically analyses and adjust its business model elements, based on both internal and external stimuli, is better positioned to succeed with servitization. There are two reasons for this. First, a coherent business model has higher potential to create long-term competitive advantage (Chesbrough, 2007). Second, successful servitization implies that firms address all elements of their business model and understand how they are connected (Galbraith, 2002; Neu and Brown, 2008).

3 METHODOLOGY

The firms analysed come from a pool of manufacturers taking part in three research projects on servitization; 2004-2006; 2006-2009; and 2010-2013. We selected firms that 1) allowed extensive access to key respondents at different hierarchical levels, and 2) to an extensive degree pursued service innovation activities. In addition, we aimed for firms that would yield qualitative richness and diversity of data. As a consequence, we selected a number of firms that we collaborated extensively with throughout the research projects. Some firms participated in one project only whereas others took part in two. The firms were AGA/Linde Gas, Metso, Saab Group, SKF, Toyota Material Handling, Volvo Group, and Xylem.

4 DISCUSSION

Guided by our analysed data and influenced by business model frameworks such as Chesbrough (2007) and Osterwalder and Pigneur (2010), we find eight distinct business model elements, all essential for service innovation in manufacturing firms. The business model elements are: Offering; Revenue model; Processes (development, sales, delivery); Structure; Strategy; Customer relationship; Value network; and Resources and capabilities. Figure 1 illustrates the distinct business model elements identified in our research in a structuring and analytical framework.

4.1 The service offering

The first business model element—the service offering—is what traditionally is associated with servitization. Services can show great diversity, from basic field service and inspection to extensive PSS that include a wide range of services and products. In order better understand key similarities and differences, services can be classified according to service focus—product or process orientated—and nature of the value proposition—input or output based (Ulaga and Reinartz, 2011). Services sold with availability or result as their starting point are output based; focus is on the achieved outcome of the service. What is needed in order to achieve this outcome (i.e., the input needed) is of secondary

importance. Through bundling and integration of service components and products, various PSS can be developed. The most advanced PSS are generally referred to as integrated solutions, in which the firm integrates different competences into tailored offerings which solve customer specific, strategic problems and the revenue mechanism is based on the customer's value-in-use (Storbacka, 2011). The more a firm provides solutions and other process oriented, output based services, the higher the value potential but also the complexity and risks (Nordin *et al.*, 2011). This is because more resources, capabilities, and actors need to be integrated and coordinated and because focus shifts from the supplier's delivery processes to the customer's value creation processes. Since the requirements on different services in the firms portfolio vary greatly, the firms needs to understand what services to offer and how extensive its service portfolio should be.

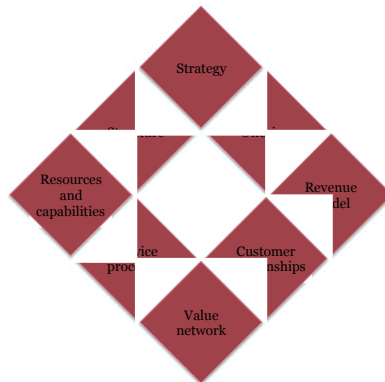


Figure 1: Business model framework

4.2 Revenue mechanisms

New technologies and innovative offerings enable new revenue mechanisms that are better aligned with the customer's value creation processes, such as availability based and performance based contracts. In practice, this means that firms that infuse services need to be able to manage traditional pricing schemes and revenue mechanisms in parallel with new methods and models that provide higher value potential but also higher financial risk. In the case of traditional, input based revenue mechanisms, the firms is paid per service hours and units sold. These services are sold as deeds without any direct link to, or feedback from, the customer's value creation process. On the other hand, output based revenue mechanisms are either based on fixed price (e.g., availability and usage) or dynamic price (performance and result, gain sharing, etc.). Such revenue mechanisms provide a clear incentive for the supplier to improve service productivity.

4.3 Service processes

Service development, sales and delivery are three processes that all are critical for the success of service innovation initiatives (Kindström and Kowalkowski, 2009). To the extent (if any) that manufacturing firms work systematically with service innovation this generally concerns concept development. Many firms frequently fail to commercialise interesting services due to insufficient knowledge and skills, resources, and commitment in the sales and delivery phases of the innovation process. The risk for failure is particularly high if the firm only blueprints complex NPD models and does not recognise central differences between product and service development. Whereas product development tends to be managed centrally and driven by technology, service development more often takes place locally in

interaction with key customers. Many times, service innovation is not a planned process; rather, services are developed on an ad hoc basis (Kowalkowski *et al.*, 2012). Compared to NPD, NSD models need a more flexible and iterative process with more extensive customer involvement, ensuring resources and competences for sales and delivery, and more cross-functional and local-central involvement.

Selling services generally require new competences, customer touch points, resources and processes. The sales function needs to obtain a more strategic role when managing customer relationships. A key issue is the coordination between the sales function and the service organisation. When services become more important, the salesperson gets a clearer role as a customer resource, working closely with the customer as a problem solver. Furthermore, the salesperson not only sells product features but, increasingly, the corporate brand and value. Regarding the sales process, it is not necessarily more complex but it requires contacts with more employees in the customer organisation; that is, more touch points and contacts at more strategic levels. Not only are most salespeople unfamiliar and uncomfortable communicating such values, customers also find these values more difficult to grasp and evaluate beforehand than traditional product values Kindström *et al.*, 2012).

The service delivery process is the third central service process. Services can be delivered through an internal arrangement, an external arrangement, or a hybrid approach which combine the other two. For example, a firm can provide services in-house in one market and work with partners on another. The firm can also choose to provide some services in-house, particularly the strategically most important ones, and let partners provide services that are less important or that the firm lacks resources to provide. The factors that determine the organisational arrangement can be classified as firm, market and offering specific ones (Kowalkowski *et al.*, 2011). If the firm understands the pros and cons with each arrangement, it can better design an arrangement and delivery process that fits the particular firm.

4.4 Structure

At certain points, servitization requires firms to change their organisational structure in order to, among other things, work closer with their customers. For product centric firms, the establishment of a separate service unit within existing product units is generally a first step to take. However, this is seldom a stable, long-term solution; despite equal formal authority it is often difficult to achieve the same attention and commitment within a product centric unit. The establishment of an independent business unit with profit-and-loss account and responsibility for strategic service development is therefore a logical second step for many firms. In order to become more customer centric many firms move further and establish specific, customer focused units such as key account management units (Gebauer and Kowalkowski, 2012).

4.5 Service strategies

Servitization processes, in particular in large firms, tend to take long time. The ability to create internal awareness and “sense of urgency” are strategic issues to manage. Since change management processes might take time and the servitization initiative can take several years before being profitable (Fang *et al.*, 2008), stamina and long-term commitment is required. The long-term time horizon makes it difficult for decision makers to get a comprehensive understanding of all strategic challenges ahead. A central strategic issue is whether servitization implies a transition from products to services and solutions or if it is a matter of expanding the offering and broadening the range of products and services offered. Another issue is if the purpose of services is to primarily support and strengthen the traditional product business or if the aim is to develop a competitive service business on its own. An effect of innovative services, in particular output based ones, is that they can lead to reduced product sales. If the strategy is to strengthen the traditional product business, a potential conflict will arise between the product and service units since their goals are partially incompatible. Changing strategies and business logic is a major change for product centric firms and, as discussed, it affects all parts of the firm’s business model.

4.6 Customer relationships

Stronger customer relationships are a key driver for servitization. Furthermore, solutions and other PSS in particular require new customer touch point and mutual adaptation in order sell and deliver the offerings. However, even if the supplier firm has the ability to offer a competitive service with potentially high value-in-use, the customer's purchasing strategy and processes, business logic, and organisational structure can hinder, or at least obstruct a deal. In-depth understanding of the buying centre, the relationships between its members, and the internal political landscape is therefore needed.

4.7 Value network

To various degrees, most firms are dependent on actors in their business network. Though its value network, the firm has access to an extended resource base that it can utilise, for example, when entering new service markets. A critical issue when collaborating is that all actors perceive the exchange to be equitable; that is, that costs and revenues are equitably divided when new services are launched. Management of risk, responsibilities, and customer relationships are other critical issues. Partially to our surprise, many firms lack fundamental knowledge about how their dealers view their servitization initiatives. While firms know their dealers' strengths and weaknesses regarding the product business, they often lack fundamental of their competence and commitment regarding new local service innovation initiatives. In order to succeed, competence and commitment is required not only internally in the local sales companies but also among the partners in the value network.

4.8 Resources and capabilities

Servitization is a dynamic process that requires continuous adaptation to new customer requirements and an accelerating ICT development. In order to understand what is required, the firm needs to manage three types of capabilities – sensing, seizing and reconfiguring – and a flexible resource base which supports the capabilities. Sensing capabilities concern collecting relevant market information about customer needs and the value of new services. Seizing capabilities are needed in order to capture and realise service innovation opportunities. Decision processes for products are seldom suitable for service-based innovation opportunities. In order to create long-term competitive advantage, the firms also needs reconfiguring capabilities to, when required, transform resources, processes, and operational skills. Incumbent firms in particular tend to become less flexible and agile, and have difficulties shifting from previously successful, product based trajectories..

5 IMPLICATIONS

A strategic realignment to services must be mirrored in changes throughout the business model. Successful change in one element depends on corresponding changes in and/or realignment of other elements. For example, in order to provide new a specialist service, a firm might have to create a distinct specialist unit responsible for delivery and develop a new revenue mechanism. In addition, new customer touch-points and a new sales approach might be required. Increased customer understanding is also needed, as is the ability to develop relationships with new members of the buying centre. In general, too much emphasis is placed on new service development. Firms and business units tend to have inadequate understanding of, and focus on, innovation in the other business model elements. Since inadequate alignment between elements inhibits servitization, these shortcomings can explain why many new initiatives fail. Since servitization processes differ between firms and over time, these differences are also reflected in the magnitude of change in the business model elements. A radical change most likely include all elements of the business model whereas a more incremental change might imply a shorter and more focused change, limited to some elements. The starting point also differs. A firm with an already established in-house service organisation can utilise this resource and focus on elements other than the structure and delivery process. Another firm might have a strong service concept but lacks the necessary

service processes, capabilities, and structure to sell and deliver it. Yet another firm might have strong customer relationships that it can harness to develop customised services which can be launched based on its unique customer insights.

Managers can use the business model as a tool to visualise internally how and when changes will occur. This should increase the internal transparency, understanding, and awareness about service opportunities and the changes needed. It is important to understand the dependencies that might exist between the elements; a change in one element will most likely affect also other elements. A first step in the business modelling process is to present the current situation and identify the future target position. Through an identification of the current position and situation in each business model element and the “big picture”, it is possible to next discuss what the business model should look like once the target position is reached. These insights should give managers an understanding of what major changes need to take place, in which elements, and in what sequence. Such insights should facilitate future servitization initiatives and strengthen the firm’s service innovation capabilities.

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EIGHT CHALLENGES OF THE SERVITIZATION

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ABSTRACT

There is an extensive research on servitization emerging independently from a number of different fields. However majority of the research is conceptual with few empirical studies based on single case studies limiting the wider applicability of the findings. The purpose of this paper is to conduct a structured literature review in exploring, identifying and synthesising the multidisciplinary research challenges in the journey towards servitization. A holistic framework of eight themes of challenges is presented that needs attention from academic researchers for developing a more complete picture of servitization.

Keywords: Servitization, Product Service System, Value-in-use

1 INTRODUCTION

Services are currently experiencing considerable attention by academics and practitioners because they hold an increasingly pivotal role in today's knowledge-based economies (Gronroos, 2000). Whether the value to the customer is delivered through products or services, the value chain should be viewed from the customer's perspective (Wise and Baumgartner 1999) and how the customer uses the product and/or service throughout its life cycle (Vargo and Lusch 2008). The combined product/service offering creates pressure on organisations to fulfil contractual obligations to customers who have extremely diverse and unpredictable requirements, coupled with an internal pressure to deliver the offering as economically as possible (Baines et al 2009). As articulated by Reinartz and Ulaga (2008) servitization requires organisations to build new people skills, technologies and capabilities. However, despite the growing volume of academic papers on the subject, our knowledge of the practicalities of implementing product-service systems is still fairly meagre (Johnstone, et al 2009). The aim of our paper is to review the literature from these studies, identify the issues and broadly classify the research challenges into different themes. A review of the related literature was conducted using a systematic approach (Denyer and Tranfield 2008). Keyword searches were employed using predefined search strings to identify articles published in specific management databases. A number of journals were chosen because they attract a large number of papers in the field of service research, exploring a broad range of research challenges from a product based organisation perspective (see Bititci et al, 2011). The initial key word in these databases yielded around 300 articles. By reading the title and abstracts, these articles are further filtered to obtain about 40 papers, which were supplemented by an additional 15 papers obtained through citation tracking as well as the authors' own expertise.

2 LITERATURE REVIEW

Over the past 25 years, a plethora of literature has emerged on how enterprises may innovatively integrate services with their products to deliver value-adding customer benefits to enhance competitive advantage (Wise and Baumgartner 1999; Neely 2007; Spring and Araujo 2009; Baines et al, 2009). Vandermerwe and Rada (1988), termed this movement as servitisation, where a “firm offers bundles of customer-focussed combinations of products, services, support, self-service and knowledge”. The integration of manufacturing and services is seen as an effective means for growing and/or maintaining profits, plus potentially significantly increased control over the downstream elements of the supply chain by erecting barriers to rivals or new entrants (Schmenner 2009). Whilst there are numerous ways of configuring the resources of an enterprise to create competitive advantage, enterprises tend to not invest in developing an understanding of the complementary services needed to leverage the competitiveness of their products (Anderson and Narus 1995). Spring and Araujo (2009) suggest various forms of product-service combinations, which often involve a shift from selling a product to customers to other transactional forms such as leasing, hiring, pooling and pay for the use, availability or performance. An additional challenge for the enterprise is to understand the changing nature of its collaboration with customers. The distinctive transition is retaining the ownership of the product with the organisation, which results in changes to cost structures as well as a re-distribution of risks and incentives between the parties involved. This situation is prevalent in complex engineering service systems; the defence industry is prime example (see Ng and Nudurupati 2010).

It is important to consider both aspects when designing the combined offering. White et al (1999) argue that there is a need for organisations to re-think the way in which they produce. They propose that the idea of a functional economy, “where the focus of consumption is not goods per se but the services which those goods deliver” should be closely associated with the concept of eco-efficiency. The central issue addressed in the design of PSS is the belief that both the analysis of technological potential and the investigation of users’ behaviour and attitudes are essential in the success of the PSS (Morelli 2002). Sakao et al, (2009) argue that successful PSS design depends on a thorough understanding of the interactions or touch-points occurring over the life cycle of the offering. These interactions encapsulate different human, behavioural, cultural, mechanical and institutional factors (See Morelli 2009). Organisations engaging in the transition to these “combined offers” must look beyond the immediate transactions with its customers in order to provide the appropriate offering (Johnstone, et al 2009). Hence they need intimate knowledge on the customer operations in designing its value proposition (Gummesson & Polese 2009). Integrating diverse knowledge areas throughout the lifecycle of the offering, requires integrated teams encompassing several areas of skills and expertise (Edvardsson et al, 2000). Therefore, knowledge area linkage in a service system will be a networked activity across firewalls.

Ulaga and Reinartz (2011) identified five distinctive capabilities that organisations must develop by deploying four unique resources for a competitive advantage. Although the findings are logical and coherent, they are derived only from the organisation perspective of the dyad and also needs further validation for general applicability. According to Spring and Araujo (2009), one limiting factor is that many academic policy makers still treat manufacturing and services as separate academic streams. There is a need to develop graduates with multidisciplinary skills with specialist knowledge in one field. A lot of contemporary management textbooks place insufficient attention to the detailed integration of manufacturing and services at the level of configuration of internal resources to deliver the combined offering (Heineke and Davis 2007).

Spring and Araujo (2009) argue that the goal of organisation is to develop on-going relationships with customers, suppliers and complementors to jointly develop and deliver the offering. The key challenge for the organisation is to design the right combination of risk-pooling capacity and contracts with customers. There is a need to develop methods and models for distributing the risks across the various actors in the organisation’s network. The contextual needs of the individual customers evolve constantly over time and it is crucial for the organisation to track their perceptions to new offerings to detect risks. Major

organisational changes are needed (Brady et al, 2005) for creating flexible modes of delivery to enable the customer in realizing the maximum value from their offering. According to Vargo and Lusch (2008) the key issue for the organisation is to deploy the necessary capabilities to enable the customer to co-create value with them to deliver value-in-use. Since the customer plays an active part in delivering value-in-use, it is necessary to understand and capture knowledge on their individual behaviour (Aurich et al, 2010). Ng and Nudurupati (2010) identified seven attributes to enable value co-creation with customer and their impact on the organisational capability to deliver complex combined offerings. Similarly Martinez et al (2010) identified five challenges that organisations should address in their journey towards servitization. Both these studies emphasized the importance of transforming organisation's service culture and aligning them to customer's values and perceptions to maximise value-in-use. Baines et al (2009) argue that the operations strategy for servitized offering should be a subtle blend of the two extremes (of pure product and pure service associated operation strategies). Based on this belief they identified how an organisation should develop and build their structural as well as infrastructural characteristics. Baines et al (2011) argue that organisations that are "vertically integrated" would ensure speed and effectiveness of their response to customer needs while minimising their costs. They argue that several areas are affected within the organisation in this transition journey, which include facilities, information and communication technologies, performance measurement systems, organisational processes and human resources. Bastl et al (2012) explored the five exhibited relationship behaviours in the servitized context.

3 FINDINGS AND DISCUSSION

Our review of servitization research shows that a considerable body of literature on the subject has developed over the past twenty-five years. Yet, these have emerged independently from a number of different fields such as engineering, marketing, management, environmental and design studies. As a consequence, its literature does at times appear to resemble a patchwork quilt of silo thinking, resulting in a somewhat fragmented picture. Underlining our findings, the authors' believe that extant literature on servitization suffers from three fundamental weaknesses. First, numerous studies are conceptual in nature with limited practicality. Second, there are relatively few empirical studies, and often the findings relate to a single case study based on the insights of a limited number of senior managers. This again limits the applicability of the findings across organisations. Third, often the dynamics are insufficiently studied in these organisations as data for most cases are collected post event. The authors believe that a pragmatic approach might be to develop a multi-disciplinary research framework based on the challenges that product-based enterprises must overcome in order to implement effective strategies. Whilst the research challenges are discussed from the full appraisal of 55 papers, few papers were picked for thorough investigation where their findings/contributions are strongly supported by empirical studies, to develop multi-disciplinary research framework, which are listed in Table 1.

In the interests of simplicity, the literature on the various challenges of product-based organisations in their journey towards servitization is synthesized into eight themes as presented in Figure 1. *The first theme* is to explore the customer perspective, where understanding value-in-use plays a significant role in contrast to customer requirements (in terms of product features). Although few authors have conducted their research and developed tools and techniques (Ulaga and Reinartz 2011; Morelli 2009) for understanding value-in-use, it is not yet completely clear in how to develop such a capability and their associated resources to explore the contextual variety of customer needs. Based on the understanding of these contextual needs, an organisation has to explore different ways of addressing them, which leads to *the second theme* of redesigning the interface with the customer. In other words, an organisation has to decide whether to gain competitive advantage in transferring or retaining the ownership of product to/from the customer and perform the associated services. This leads to an exploration of different contracting approaches, such as leasing, renting, availability or performance based contracts. However, the challenge here is to find which contracting mechanism is economical and beneficial to both parties. Despite Ng and Nudurupati (2010) having identified various risks involved in outcome based contracts

for complex engineering services, the findings are limited to a specific industry. Hence, we need more research to explore the different risks and incentives involved in these approaches and how to re-distribute them.

Research Challenge/Theme	Spring & Araujo (2009)	Morelli (2009)	Sakao et al (2009)	Ulaga & Reinartz (2011)	Martinez et al (2010)	Johnstone et al (2009)	Baines et al (2009) & (2011)	Bastl et al (2012)	Ng et al (2010) & (2011)
Theme 1: Customer Perspective		✓		✓		✓	✓		✓
Theme 2: Redefining the Interface	✓			✓					✓
Theme 3: Revenue, Pricing & Selling									
Theme 4: Product/Service System Design		✓	✓	✓	✓	✓	✓		✓
Theme 5: Supply Network	✓	✓			✓		✓	✓	
Theme 6: Organisational Architecture			✓			✓	✓		✓
Theme 7: Performance Measurement							✓		
Theme 8: Cultural Transition					✓	✓	✓		

Table 1: Research Challenges/Themes Matrix with Supported Literature

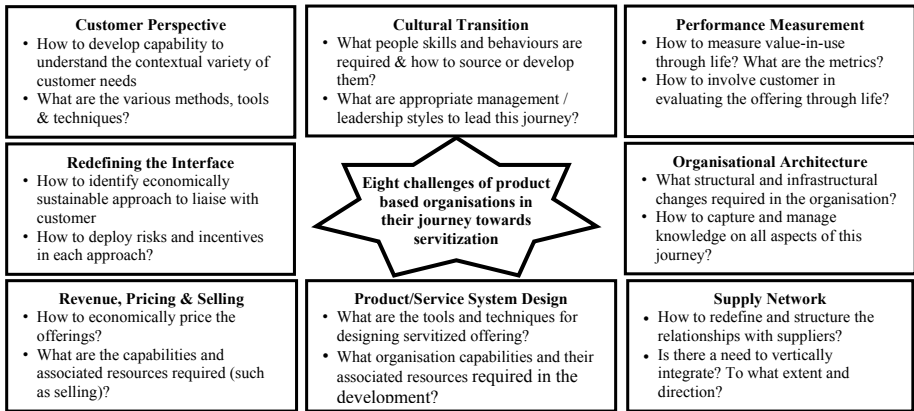


Figure 1: A holistic framework for research challenges of product based organisations

A further challenge here is in defining the use, availability and performance of the product, how to measure them and allocate the necessary resources. Due to the uncertainty in the nature of services consumed, which are often state-dependent and contextual in nature, it is difficult to establish the necessary resources required to provide that service, making the pricing of the service complex (Bakos and Brynjolfsson 1999). If the services are overpriced, the organisation will be less competitive and lose revenue, and if the services are under-priced, the organisation will suffer a loss of income. This leads to the *third theme* of revenue, pricing and selling. Organisations need to know how to price their offerings and assess whether the additional services result in expected revenue generation. Organisations need to explore whether they need additional capabilities in selling the servitized offering. Further research needs focus in identifying the additional selling capability and the associated resources.

A lot of literature was already reported on designing product/service systems predominantly from a sustainability point of view delivering environmental benefits with limited research focussing on economic benefits from sustaining competitive advantage. However as argued earlier most of the findings are either conceptual or limited for general application. Hence, *the fourth theme* of designing the product/service system has emerged. It is necessary to develop a new generic approach for this design and what are the various methods, tools and techniques available to support the design. It is necessary to explore the necessary organisational capabilities and their associated resources in designing the servitized offering. In today's economic world, a lot of businesses are concentrating on their core competencies and outsourcing the less important activities and this is one of the rationalization for servitization. However the organisation who is providing the servitized offerings to its customer in turn could outsource some of the elements of the offerings to its suppliers. This leads to the fifth theme of supplying network. It is necessary to explore how the organisation can renew its relationship with its suppliers in their journey towards servitization and the literature on this aspect is scarce. How should the organisations vertically integrate with its suppliers and to what extent does it prove beneficial.

The sixth theme is exploring the organisational architecture. Baines et al (2009) identified two lines of enquiry namely structural changes as well as infrastructural changes. In line with this study, further research is needed to explore, validate and generalise the findings. One of the key elements within this architecture is knowledge management. The key challenge is to explore the ways of capturing and managing the knowledge throughout the journey of servitized offering. According to Ostrom *et al.* (2010), performance measurement should transform the business strategy and service design to deliver value-in-use. Today, the majority of customer-facing measures, such as on-time delivery, flexibility, responsiveness, accuracy of documentation and even customer satisfaction, tend to focus on value-in-exchange rather than value-in-use-through life (Bititci et al 2012). This leads to *the seventh theme* of performance measurement, which puts emphasizes in identifying the metrics to measure value-in-use through-life. It will also be an interesting aspect to explore whether it will be beneficial for the organisation to measure or involve customer to evaluate value-in-use through-life. *The eighth theme* is the cultural transition from product to service oriented thinking. For instance, it is not just sufficient for service engineers to demonstrate technical skills (such as repairing a machine/part) but also need to demonstrate people skills (able to communicate with user and train if necessary). Although few researchers explored this issue to some extent, further research needs to be done exploring the necessary people skills required in the servitized journey. It will be necessary for the organisations to find the appropriate behaviours necessary and the ways of developing and transforming them. It is also necessary to explore different kinds of management styles that are suitable in this journey.

In conclusion, it is therefore imperative to pull the various research streams together in a holistic approach with a wider participation from industry. Furthermore, the frame of reference needs to be widened to focus on the value perceptions and operational interactions throughout the complete product service system, and lengthened to capture the dynamics of the system across multiple time periods (i.e. there is a need for longitudinal studies). If the academic research community is to develop a more complete picture of servitization it needs to move from a disciplinary (silo-like) focus to a more holistic mindset incorporating layers of complementary research outputs.

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SERVICE TYPES AND THEIR DIFFERENTIAL RISK EFFECTS FOR MANUFACTURING FIRMS: AN EMPIRICAL ANALYSIS

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ABSTRACT

This paper investigates the impact for manufacturing companies that servitize of offering different types of services. While conceptual literature suggests that heterogeneous service types possibly lead to different consequences for the supplying firm, empirical research in this area is still at an early stage. Making use of bankruptcy data, this paper examines the risk implications of two empirically developed categories of manufacturers' services ('demand chain' and 'product support' services). The study formulates two propositions, respectively asserting that (i) the level of correlation between product and service demands, and (ii) the opportunity of economies of scope between the product and the service business are important aspects affecting the outcome of different service types. The study is based on quantitative evidence from 75 servitized and 54-non servitized bankrupted firms.

Keywords: manufacturing, services, risk.

1 INTRODUCTION

Managers and scholars generally agree about the fundamental benefits for manufacturing companies of expanding the service portion of their business (i.e. servitizing). Yet increasing anecdotal evidence indicates that not in all instances do service additions have a positive effect on the performance of the firm (e.g. Fang *et al.* 2008, Eggert *et al.* 2011).

To shed light on this issue, the managerial literature has started to investigate the variables that affect the link between service growth strategies and overall manufacturers' outcomes. Here, several scholars have suggested that service types possibly lead to different consequences for the supplying firm. However, research on the classification of services in manufacturing industries is still at an early stage,

and it is not clear what types of services firms should offer in order to achieve the greatest benefits from the service expansion.

Furthermore, prior investigations on the differing effects of various types of manufacturers' services have been built upon theoretically developed service categorisations. In particular, the few studies taking a heterogeneous view of services have used Mathieu's (2001) distinction between 'services supporting the product' (SSPs) and 'services supporting the client's actions' (SSCs). Yet, the service literature (wherein service classification has been formally investigated since the 1960s (Cook *et al.* 1999, Liu *et al.* 2008)) emphasises that the definition of the real-world implications of service types is facilitated by the use of empirically developed service classifications (Shafti *et al.* 2007). Thus, in this study, we explore the adoption of an evidence-based approach to investigate the differential effects of heterogeneous service types on firm performance.

Finally, extant literature largely focuses on the positive outcomes of offering services. In general, scholars identify profitability and quality of customer relationship as the relevant service-related outcomes. Homburg *et al.* (2003) and Gebauer and Fleisch (2007) propose these as respectively the financial and non-financial outcomes of service growth strategies. Yet prior research neglects the influence of emerging service initiatives on the risks faced by the firm. Indeed, the infusion of added services to the traditional product offerings of manufacturing companies poses a unique challenge: manufacturers must enter a new field, namely the service-providing field. This often implies substantial investments in service-related capabilities, the implementation of the necessary organizational structures and processes, as well as different interactions with customers and business partners. All these demands have the potential to increase risks for a firm that is proposing to exploit service opportunities. Nevertheless, it can be contended that the extension into services may reduce several traditional risks affecting manufacturing firms. We assume that the extent to which particular risks increase or decrease reflects the service offering of the firm. Hence, we analyze the various risks affecting firms in order to derive insights regarding the impact of service types on organization performance.

The paper starts with a literature review. We then report on the results of an empirical study, which are used to develop a set of research propositions. Finally, we discuss academic and managerial implications.

2 LITERATURE REVIEW

Much of the existing literature treats the services offered by manufacturing companies as a homogeneous entity. However, classification schemes for these services have appeared in a number of academic papers. Manufacturers' services have been differentiated according to the phase of the purchasing process when they are provided (i.e. pre-sale, post-sale, and at-sale services) (e.g. Frambach *et al.* 1997). Two categories of services - maintenance and support services and business advisory services - have been proposed based on the nature of the revenue model: usually involving a contract in the former case and single transactions in the latter case (Kotler 1994). Intangibility, frequency of purchase and customization have been used to distinguish complex services (like provision of integrated solutions, research and development, management consulting) from simple ones (Lindberg and Nordin, 2008). Looking at the orientation of the services, a distinction has been suggested between services that focus exclusively on the company's products and services that include other vendors' products as well (Raddats and Easingwood 2010). Proposed service categorizations also focus on services that are / are not linked to a specific product (e.g. Cova *et al.* 2000). Nature of product-service integration, ownership of the product and role of technology define the taxonomy proposed by Park *et al.* (2012). Finally, services have been classified reflecting the service strategy. For example, Santamaria *et al.* (2012) outline three possible strategies: services aimed at supporting the sale of the product, services aimed at providing the functionality of the product without need for the customer to purchase the product, services aimed at overcoming obstacles to adoption or use of the product. These classifications provide valuable insights

into the characteristics of services within the context of manufacturing firms' offerings. However, they fail to explicitly address the relationship between service types and firm performance.

An exception is given by Mathieu's (2001) distinction between services supporting the product (SSPs) and services supporting the customer actions (SSCs). The main goal of SSPs is to ensure the proper functioning of the product or customer access to it (e.g. installation, help desk, repair). In contrast, SSCs support particular customer actions and advance the mission of the customer organization (e.g. business consulting, financing, management of the customer maintenance function). Antioico *et al.* (2008) found that a SSC business orientation leverages the relative product sales, while SSP generate service volume. Eggert *et al.* (2011) observed differential effects of SSPs and SSCs on firm profitability, with the level of product innovation activities acting as moderator variable. However, it must be noted that Mathieu's (2001) classification was developed based on conceptual arguments relating to the implementation issues associated with each service type. Use of empirically derived categorizations has been largely neglected in the literature on extended service strategies. In addition, service classification schemes have rarely been applied taking into account the purpose for which they were initially developed.

Several studies have suggested that adopting a strategy of enlarged service provision may be risky. For example, Gebauer and Fleisch (2007) have contended that service expansions harbor internal and external risks. Internal risks refer to the need of adopting service related values and norms, and to manage the relationship with the dominant product-oriented organizational culture; external risks are due to the customers, who may not be willing to share with the supplier intimate knowledge about their operations as required by especially the more advanced services. Fang *et al.* (2008) have argued that extended service strategies bring about increased risks because they may involve sacrificing resource inputs to the core manufacturing competences; in addition, they can create internal conflicts which, in turn, undermine the firm's ability to create value. Penttinen and Palmer (2007) have submitted that, because services increase the completeness of manufacturing firms' offerings, transaction risks may originate, i.e. the customers may be reluctant to accept these enhanced offerings as they feel the possibility of opportunistic behavior on the supplier part. Scholars have asserted that services may also reduce some risks for the provider. For example, sales of services are to some extent counter-cyclical to product sales, thus reducing the risks for the company in times of economic downturns (Raddats and Easingwood 2010, Eggert *et al.* 2011). Although it is true that various aspects of risk have been linked to manufacturers' services, the academic literature lacks of systematic analyses investigating the risk implications of service transition strategies. To our knowledge, the most directly relevant contribution is the paper by Nordin *et al.* (2009), which has used input from managers at 9 European multinational firms to develop a set of propositions regarding the impact of customization, bundling and range of solution offerings on operational, strategic and financial risks. Prior research on the repositioning of manufacturing companies into services has clearly neglected the topic of risk, and thus this represents a fruitful area for further investigation.

3 EMPIRICAL STUDY

This paper builds upon previous research work by the authors (Benedettini *et al.* 2013), which has evaluated evidence from 212 bankrupted firms (113 servitized and 99 non-servitized) included in the overall sample described by Neely (2008). Specifically, this work collected data from multiple secondary sources (Factiva database, answer and company databases, news archives, company websites, annual reports) in order to identify the cause(s) for the bankruptcies. For each firm, selected information – namely products and services offered, location, history, date of the bankruptcy filing and causes of the bankruptcy – was summarised in a case study document.

As the data were collected, the sample was reviewed and 83 firms were excluded. These included firms that were determined irrelevant to the study, as well as firms for which no sufficient information about the bankruptcy was found. At this stage, cases of miscoding were also corrected regarding the classification of firms as either servitized or non-servitized (these originated from the use of an automated

coding procedure in the initial Neely's (2008) paper). In particular, one firm was classified as servitized if evidence was found in the firm's annual report and/or OSIRIS business description that the firm offered one or more of the 12 types of services that Neely (2008) identified as typical services offered by manufacturers (Table 1). After these corrections, the final sample was composed by 75 servitized firms and 54 non-servitized firms.

We used cluster analysis to establish service types for the servitized firms. We used the 12 types of services proposed by Neely (2008) as coding criteria. The analysis yielded two groups of firms. Firms in group 1 (38 firms) were more likely to offer retail and distribution services, as well as financial services. We named these 'demand chain services'. Firms in group 2 (37 firms), which we named 'product support services', were more likely to offer systems and solutions, installation and implementation, and maintenance and support services.

Design and Development services	Installation and Implementation services	Outsourcing and Operating services
Systems and solutions	Financial services	Procurement services
Retail and Distribution services	Property and Real Estate	Leasing services
Maintenance and Support services	Consulting services	Transportation and Trucking services

Table 1: The 12 types of manufacturers' services identified by Neely (2008)

The next step was to frame the coding of the data. A review was conducted of the classifications of bankruptcy causes proposed by the literature, and the Ooghe and Waeyaert (2004) framework was selected as a suitable model. This framework structures bankruptcy causes under the headings of environmental and internal causes. While environmental causes consist of factors from outside the firm that have an impact on the firm, internal causes are factors that arise from within the firm. According to the Ooghe and Waeyaert (2004) framework, environmental causes include: (i) factors in the general environment (i.e. factors that affect a business environment or an industry as a whole); and (ii) factors in the immediate environment (i.e. issues that are particular to the specific firm). Internal causes are instead related to three possible aspects: (i) management abilities; (ii) corporate policy; and (iii) company characteristics. The Ooghe and Waeyaert (2004) framework does not provide an explicit list of the causes in each category. Therefore, the data coding instrument was developed by extracting from the firms' case study documents a list of empirically developed causes and organizing these causes according to the categories proposed by the Ooghe and Waeyaert (2004) framework. Our final coding instruments – an operationalized framework of the causes of bankruptcy – consisted of 35 fundamental causes, i.e. 35 potential bankruptcy risks.

The coding of the data followed the content analysis technique and was performed by two independent coders (in order to validate the coding reliability). The coding process led to capture the risk factors – from the list of 35 - that were relevant to the bankruptcies of each of the 129 sample firms.

Evidence regarding differences between service types was extracted through an ANOVA for number of risks, with post hoc comparisons across three groups: demand chain servitized firms, product support servitized firms and non-servitized firms. Results (not reported here for space reasons) indicated:

- a significant difference between number of environmental bankruptcy risks for demand chain and product support servitized firms;
- that demand chain servitized firms encountered: (i) more general environment risks than product support firms did; (ii) more total environmental risks than non-servitized firms did.

4 ANALYSIS AND INTERPRETATION

The analysis of the foregoing results led us to formulate two broad propositions regarding the impact of the move of manufacturing companies into different types of services. These are described below.

Our first proposition concerns demand patterns. While, on the one hand, demand chain services (i.e. retail and distribution, financial services) are easy to offer because they require limited technical knowhow, on the other hand it should be noted that these services involve substantial investments – for

example to acquire distribution facilities or stores - and are typically sold with new product units. Thus, if environmental conditions become unfavorable to the product business (e.g. during economic downturns or because the customers loose interest in the company's products), two negative effects originate from the service business: the additional investments weaken the firm; and service losses are tied to reductions in product sales. It should therefore not be surprising that firms that servitized into demand chain services incurred into higher environmental risks.

On the contrary, revenues from product support services (especially maintenance and support) are likely to increase during times of negative economic conditions as the customers may be willing to keep their assets in operation for longer. And indeed, we observed that product support firms were, not only not exposed to higher total environmental risks than non-servitized firms, but also exposed to less general environment risks than demand chain firms. Here it may useful to stress that the general environment category in the operationalized framework included such factors as economic downturns, industry overcapacity and competition from foreign countries. Taken together, these considerations suggest the following:

Proposition 1: Important variables affecting differences between service types include the level of correlation between product and service demands.

Our second proposition pertains to diversification arguments. Product support services (installation and implementation, maintenance and support, systems and solutions) realize a diversification which is related to the product business. This means that a number of synergies between products and services are possible or, in other terms, economies of scope originate. For example, the provision of the services can leverage on product related knowhow while, at the same time, generate learning effects in the product field. The company can also build on existing customer knowledge. In addition, the product-service bundle gives to the customer a more desirable outcome than would the product and services separately. Hence, the services contribute to strengthen the market position of the firm.

On the contrary, demand chain services are generally unrelated, or however more loosely related, to products. As a consequence, economies of scope will no longer act as a source of resource savings and value creation. It can be foreseen, therefore, that it will be more difficult for the firm to face the competition associated with the new business environment. This view is fully consistent with our results. Thus, we propose:

Proposition 2: Important variables affecting differences between service types include the opportunity of economies of scope between products and services.

5 CONCLUSIONS AND IMPLICATIONS

Our paper addresses the relative gap in the literature regarding the causality between service types and servitization performance. From a methodological perspective, it proposes the use of an empirical approach to the classification of manufacturers' services. From a managerial perspective, it identifies two general-level moderator variables (the level of correlation between product and service demands, the opportunity of economies of scope between products and services) that affect the performance outcomes of different types of services. From a theoretical perspective, it suggests that analyses of the risk implications of services can effectively support the development of a formal theory of servitization.

We acknowledge as a limitation of the paper that we examined firm performance as the outcome of a limited range of risks (i.e. bankruptcy risks). We are also aware that our findings assumed the servitization strategy as the only relevant difference within the sample firms, while there are several other factors (e.g. firm age, location, market reach) that may affect bankruptcy. Further research should clearly take a broader view of enterprise risks and consider interactions between multiple variables. We hope that

our study stimulates more work in this important area, helping us better understand how the shortcomings of services can be avoided.

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TOWARDS A TYPOLOGY FOR SERVICE MARKETS IN MANUFACTURING INDUSTRIES – AN EMPIRICAL ANALYSIS WITH MANAGERIAL IMPLICATIONS

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ABSTRACT

In the research field of servitization the transition of manufacturers becoming service providers is widely accepted, but little is known about the transition of companies with respect to their industry sector. Therefore, this paper identifies sector specific characteristics of service markets in five different manufacturing industries and develops a first typology for industrial service markets. Through this typology, practical managerial implications for supporting a sector specific transition of industrial companies can be developed.

Keywords: servitization, typology, manufacturing industry, service markets

1 INTRODUCTION

Although the industrial sector has traditionally offered and consumed services – for instance the repair of delivered products or the training of customers’ personnel – those activities strategically played a minor role in the past, at least for manufacturing industries. Services were seen as a necessary evil, which had to be offered, however, not as a strategic asset. But in the view of a service-dominant logic (see Vargo and Lusch 2004), they become increasingly more important in manufacturing industries in the last decade (e.g. Lay et al. 2010; Baines et al. 2009; Neely 2008).

One of the most considered topics in the research field of the so called “servitization” (see e.g. Vandermerve and Rada 1988) is the transition of manufacturers becoming service providers (compare e.g. Gebauer et al. 2005; Matthyssens and Vandenbempt 2010; Penttinen and Palmer 2007; Oliva and Kallenberg 2003). While most contributions analyse success factors or develop step models for this managerial challenge, little is known about the transition of companies with respect to their industry sector. Therefore, the aim of the paper is (1) to identify sector specific characteristics of service markets in manufacturing industries and to develop a first typology for industrial service markets, and (2) by means of this typology, to work out practical managerial implications for supporting a sector specific transition of industrial companies.

Therefore, the procedure of the paper is as follows. In section 2, the impact of services in manufacturing industries is presented to explain the importance and advantages of industrial services and service innovation. In section 3, five industrial sectors – namely manufacture of machinery and equipment, metal products, optoelectronics, automotive and supplier to automotive – were identified that play an important role in Germany and that should receive further attention in the future. The service markets of those five industry sectors were then analyzed in detail by means of the representative German manufacturing survey 2009 (see survey documentation in Jäger and Maloca 2009). This empirical analysis gives, amongst other things, insights into the service turnover and distribution of service innovators. Based on the generated findings, we specify and cluster the individual characteristics of the

five markets and develop a first typology of service markets in manufacturing industries in section 4. By means of this typology we deflect managerial implications for supporting the transition of companies with respect to their industry sector. The paper closes in chapter 5 with some cross-analysis and conclusions.

2 MANUFACTURING INDUSTRIES AND SERVICES

In literature there exist numerous classifications or typologies differentiating industrial services by various aspects. In general, two different classification types can be distinguished: (1) Conceptual typologies for getting a clearer understanding about the nature of services in manufacturing industries, (2) Servitization models describing various stages and levels of manufacturers basing on generic and theoretical approaches. For our analysis we considered particularly the second type of classification. A widespread concept focuses on the needs of the customers' company and deflects an adequate service portfolio for each customer type. Therefore authors suggest three different service types, each supporting the client in a different way: (1) Services supporting the product, (2) Services supporting the processes, (3) Services supporting the client (compare e.g. Velamuri et al. 2011; Mathieu 2001).

2.1 Typology of Industrial Services

With regard to this typology it is possible to develop a new service typology. This typology uses classical servitization step models and combines it with the service portfolio model. First we merge the services closely linked to the product as e.g. maintenance, repair or installation. These services may be provided by the equipment manufacturer and support the product and its functions. To emphasize the link to the material product we call them "product-related services" (type I). The next two types are highly knowledge intensive services. These services can also be delivered by external professional service providers. Both types are linked to technologies, one to information and communication technologies (ICT) and the other one to engineering technologies. Hence, we call them ICT-based services (type II) and advanced engineering services (type III). Type II and III can support both, processes and the client. The last type also belongs to knowledge intensive services, but isn't linked to any technology. In fact it targets on business management and consultancy services, which support the client.

Summing up we suggest a typology basing on four service types. In detail these four types are:

Product-related services: This type contains classical industrial services that are closely linked to the material product as e.g. maintenance, repair, installation or spare part services. Product-related services can be offered by the equipment manufacturer and hence, technical basic know-how is necessary. But this service type can also be delivered by service factories or repair shops.

ICT-based services: The second type concerns all services that are connected to information and communication technologies (ICT). Possible examples are monitoring, digital libraries, hotlines or online support. Providers of ICT-based services don't need experiences in production technologies of manufacturing industries. Their core business is the supply of information platforms, web pages and ICT-infrastructure. Consequently, ICT-oriented companies should deliver these services.

Advanced engineering services: Engineering, Research and Development, process optimization or upgrades belong to this service type. They are linked to material technologies. Companies offering those services need high qualified staff like engineers or informatics. Hence, for offering those services engineering companies are needed.

Management and consultancy services: The last service type includes marketing support, project management and consultancy or business management. This service type is highly complex, knowledge intensive, and needs high qualified employees but isn't linked to any technologies. Consultancies or research institutes should offer those services.

2.2 Impact of Industrial Services

In order to show the dissemination of the four identified service types in Germany, data from the German manufacturing survey is used. The German manufacturing survey is conducted every three years and is the broadest survey on modernization trends in production and technology-oriented companies in Europe. The survey covers a representative sample of approximately 1500 companies of the manufacturing sector in Germany. Table 1 shows the dissemination of the four major industrial service types in the entire manufacturing industry in Germany. More than three quarters of all industrial companies offer services in “design/consulting/project planning”. Hence, the *Advanced engineering services*, which also includes “technical documentation”, is the most represented service type. Nearly 50 percent of the firms offer the service “installation/start-up procedure” as well as “maintenance/repair” (both belonging to *Product-related services*). Although, only 14 percent offer “leasing/renting/finance” a lot of companies operate in *Management and consultancy services* which also enfold “trainings”. Additionally, only one fifth of all companies offer services in “software development” which corresponds to *ICT-based services*. This distribution goes along with other current studies (e.g. Tether/ Bascavusoglu-Moreau 2012; Dachts et al. 2013; Bikfalvi et al. 2013) and reflects the relevance of different services in manufacturing industries.

Product-related services		ICT-based services	Advanced engineering services		Management & consultancy services	
Installation/ Start-up procedure	Maintenance/ Repair	Software development	Design/ Consulting/ Project planning	Technical documentation	Leasing/ Renting/ Finance	Training
n=688 (48,1%)	n=632 (44,5%)	n=318 (21,9%)	n=1109 (76,0%)	n=825 (56,5%)	n=209 (14,4%)	n=790 (55,3%)

Table 1: Dissemination of the service types in German manufacturing industries

3 SELECTED INDUSTRIAL SECTORS AND THEIR SERVICE ORIENTATION

This third part takes as a starting point the assumption that recommendations for industrial services have to take into account the heterogeneity of the manufacturing sector and the capabilities of the consumers. Therefore, we will concentrate on five sectors: Manufacture of machinery and equipment, metal products, optoelectronics, automotive and supplier to automotive.

3.1 Insights into service turnover

In general, there is a distinction between directly invoiced and indirectly invoiced turnover. The sum of directly and indirectly share is the total share of turnover generated by services. This differentiation is necessary because of the widely spread reluctance of clients to pay for services. Consequently, direct invoice describes the share of paid services while indirect invoice specifies the share of services cross-financed by the price of the core product. In this context it should be noted that every industry sector in Germany holds a higher indirectly share than directly share of service turnover.

We observe the average value of direct and indirect share of turnover with services corresponding to the selected industry sectors. Regarding the total share of turnover the assumption rises that the degree of dissemination of services and the service turnover are linked to each other. Service offers are widely spread in the sectors optoelectronics and machinery and equipment. This is also reflected in an above-average turnover for both sectors. For the manufacturer of machinery and equipment the industry account for 16.6 percent the total turnover with all services and 15.9 percent for the optoelectronic industry. In contrast to this, the lowest share of total turnover with services has the automotive industry (10.0%) followed by metal products (12.2%) and suppliers to automotive (12.9%).

3.2 Insights into distribution of service innovators

We observe the share of service innovators of the industry sectors compared to the entire manufacturing industry of Germany. A service innovator is defined as a company which introduced new services during the last three years. The share of service innovators for the five selected industries differs widely. While the proportion of service innovators of machinery and equipment is higher than the average, the sectors automotive and supplier to automotive have an underdeveloped quote of innovators. A deviation from the average of 18 percent is not observable for metal goods and optoelectronics. However, every industrial sector shows obviously a relevant share of service innovators and hence, a relevant implementation rate of new services within the last three years. Even in the sectors with the lowest innovation activities every seventh company introduced new services. Again, there seems a linkage between innovation activity and service dissemination. For example, the machinery and equipment industry offers various services and has also introduced a lot of new services during the last three years. In contrast, the increase of new services for supplier to automotive was at lowest in comparison with all other industry sectors.

4 A TYPOLOGY OF SERVICE MARKETS IN MANUFACTURING INDUSTRIES

For classifying service markets in manufacturing industries we use Figure 1, which shows a diagram with two axes. The x-axis demonstrates the general degree of servitization of a sector. The degree of servitization gets measured by the total share of service turnover of a sector (see section 3.1). The y-axis shows the degree of innovation of a sector. The degree of innovation is measured by the share of service innovators of a sector (see section 3.2).

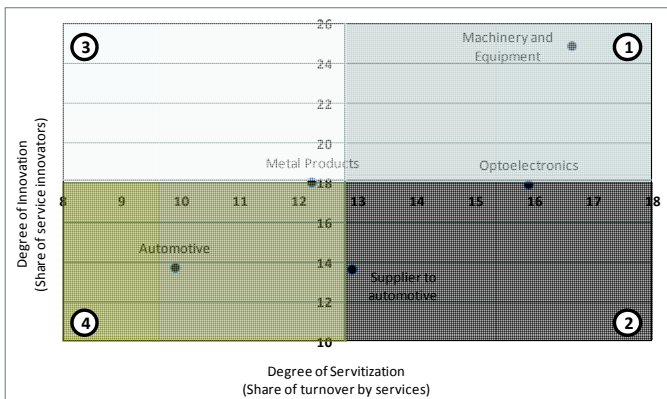


Figure 1: Classification of service markets for five industrial sectors

The two axes demonstrate the average value of each dimension for the entire manufacturing industry in Germany. Consequently, a matrix with the following four fields arises:

Field 1: *Markets with superior service orientation and superior service innovation activities:* Industrial sectors belonging to this field generate a higher share of turnover by services than other sectors. Moreover, these industries hold a higher share of service innovators than other branches. Consequently these branches tend to a professionalized service market with highly dynamic and innovative service offers. Machinery and equipment belongs to this category.

Field 2: *Markets with superior service orientation but low service innovation activities:* The branches of field 2 have higher shares of turnover with services than ordinary branches. But their share of service

innovators is lower than the average of German manufacturing industries. Hence, these sectors have a superior service oriented market with robust service offers and long-lasting service life cycles. Optoelectronics as well as suppliers to automotive belong to this type.

Field 3: Markets with underdeveloped service orientation but superior service innovation activities: The branches placed in the third field have a lower share of turnover by services than other German manufacturing industries. However, the share of service innovators is higher than the average. As a consequence, sectors in this field tend to have an underdeveloped service market, but with a drift to a higher service orientation. None of the analyzed branches are part of this field.

Field 4: Markets with underdeveloped service orientation and low service innovation activities: This field shows the branches which have both: a lower share of turnover by services and a lower share of service innovators compared to other German manufacturing industry. Accordingly these branches tend to have an underdeveloped service market. In addition, there also seems no drift to a higher service orientation. Automotive as well as metal products belong to this category.

The diagram in Figure 1 has given a first overview about the characteristics of service markets in five selected industrial sectors. By means of this diagram and the findings of the previous chapters we give now a summary about the features of the observed industrial sectors.

Machinery and equipment: This industrial sector seems to have the most sophisticated service market of the five analyzed branches. All four service types are more diffused than in other German manufacturing industries. Moreover the service business in this sector generates the highest share of turnover compared to the other branches (directly share of 8.2%). The high indirectly share of turnover with services (8.4%) also verifies the high service orientation. 25 percent of the companies in this branch offer new services. Due to the existing economic potential, companies in this sector should offer a broad range of different services. However, these firms should innovate quickly or otherwise their service offer is aging rapidly and loses its exclusiveness after a few years.

Optoelectronics: The sector optoelectronics also seems to have an advanced service market. According to machinery and equipment all four service types are diffused over average compared to other manufacturing industries in Germany. The service business generates a light superior directly share of turnover (6.4%) compared to the remaining industries (5.4%). But most of the turnover is generated by indirectly share (9.4%). 18 percent of the companies are service innovators which leads to the assumption of ordinary innovation activities in this sector. Companies belonging to this sector may acquire competitive advantages by developing new or innovative services. Moreover, the service offer should contain a broad range of services. But as the analysis shows, clients are unaccustomed to pay for services and hence it seems necessary to hide service costs at the sales price of the product.

Metal Products: This industrial sector tends to an ordinary service orientation compared to other sectors in German manufacturing industries. The diffusion of product-related services and advanced engineering services are almost similar than in other manufacturing industries in Germany. But there seems to be a lack of the prevalence of ICT-based services and management and consultancy services. However the analysis does not give an advice for this situation. The manufacturers of metal goods generate almost the same share of turnover with services than the remaining industries. The same conclusion is true for the share of service innovators. Consequently, firms producing metal goods should focus on services that are closely linked to the product. The need for consultancy services seems to be underdeveloped. Moreover, the offering of new services may hold high potentials for competitive advantages, too.

Automotive and suppliers to automotive: These two sectors hold comparable innovation activities but different degrees of servitization. Both branches have a share of 14 percent of service innovators which is, compared to other sectors, underdeveloped. This leads to the conclusion of robust service offers with long-lasting life cycles and hence lower innovation activities. Suppliers to automotive tend to have an underdeveloped service orientation in product-related services and in management and consultancy services while the automotive sector has ordinary orientations for these service types. ICT-based services are underdeveloped in automotive and ordinary developed for automotive suppliers. In both branches

advanced engineering services hold an average development. The biggest difference between both sectors is the share of turnover generated by services. While suppliers to automotive generate an average value compared to other manufacturing industries, the automotive sector holds a substandard. Companies in this sector should offer engineering and technical services. Innovation activities are very low, which leads to the assumption that new services are able to generate competitive advantages for their providers.

5 CROSS-ANALYSIS AND CONCLUSIONS

Beside the characterization of service markets we conducted some cross-analysis. Basing on this cross-analysis we can formulate the following findings as hypotheses: Branches, which hold a high indirectly share of turnover by services tend to lower innovation activities. Overall there is a linkage between the degree of dissemination of services, the turnover with services and the share of service innovators in industrial sectors. These factors seem to influence each other in a positive direction. The service orientation in industrial sectors increases the competitiveness of companies in terms of turnover and growth of employment and moreover may trigger the innovation activities of the core product. Finally, we can conclude that service markets of manufacturing industries are observable heterogeneous and that their characteristics differ between single industrial sectors. Consequently, this paper gave first insights into this topic and identified the characteristics of service markets in manufacturing industries.

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ORGANISATIONAL CAPABILITIES

MANUFACTURING SERVITIZATION PROGRESS IDENTIFICATION AND EVALUATION FOR CAPABILITY AND MATURITY

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ABSTRACT

Market globalization has brought us not only new opportunities, but also new challenges. The theme of innovation has become a mandatory topic for all industries – it has become a focal point for the enterprise, society and the world. The goal of innovation is to create business value by developing worthwhile ideas into a customer-centric marketable reality. This, for most companies, is difficult to achieve due to the lack of a methodology and tools for systematic innovative thinking.

This paper introduces the concept and strategies for evaluation of manufacturing servitization maturity based on five stages, which are ‘Product’, ‘Product Fundamental Service’, ‘IT-enabled Product Service’, ‘Customer-royalty-centric Product Service’, and ‘Service Ecosystem’. A process of capability identification and clustering approach are explained. To validate the proposed evaluation model, 166 manufacturing companies are included in this survey.

Keywords: Manufacturing Servitization, IT-enabled Service, product service system, customer service.

1 INTRODUCTION

Many advanced countries, whose economic base is manufacturing industry, made efforts to transform their economy and reinvigorate manufacturing industry because they suffer threats from emerging markets and global manufacturing supply chain. Therefore, manufacturing firms not only seek manufacturing technique innovation but also began to focus on induction and impetus of service. Due to this trend, servitization of manufacturing has become a focal point for the manufacturing industries all over the world.

A lot of research has been done to provide evidence that manufacturing industries are making effort to transform. Some also use the profit or company description as the indicator of the progress of

servitization. However, lack of identifying different capability level of manufacturing servitization causes manufacturers not knowing the best strategy to improve themselves.

Hence, this paper proposes a general servitization transformation progress for manufacturing industries. The progress includes 5 levels, including 'Product', 'Product Fundamental Service', 'IT-enabled Product Service', 'Customer-royalty-centric Product Service', and 'Service Ecosystem'. The description of each level is as follows:

In each level, stage definitions and corresponding feature set are given. According to the definition, an evaluation model is proposed to identify which level a company is in according to its current condition. Once a company is identified to be in a certain level, a set of existing methodologies, strategies, and technologies can then be applied to aid this company in further improvement.

To validate the proposed evaluation model, 166 manufacturing companies are included in this survey. The servitization progress and maturity of each company is analyzed and evaluated using the proposed methodology. The result shows that the model is able to measure how mature each manufacturing company is in servitization transformation.

2 MANUFACTURING SERVITIZATION

Many advanced countries, whose economic base is manufacturing industry, made efforts to transform their economy and reinvigorate manufacturing industry because they suffer threats from emerging markets and global manufacturing supply chain. Therefore, manufacturing firms not only seek manufacturing technique innovation but also began to focus on induction and impetus of service. This way, the fuzzy boundary of manufacturing industry and service industry drive and stimulate the development of manufacturing servitization.

Servitization was proposed by Vandermerwe and Rada in 1988. They emphasized the concept of customer-focus, combining product, service, support, and knowledge is the most important element. Furthermore, the authors also asserted that not only service industries but also manufacturing industries should focus on innovative value-added service development in order to quickly enhance their core competencies. Baines defined manufacturing servitization as innovation of organizational capabilities and process, from product sales to integrated product-service.

Servitization is defined as the strategic innovation of an organization's capabilities and processes to shift from selling products to selling an integrated product and service offering that delivers value in use, i.e. a Product-Service System. The concept of a Product Service-System (PSS) is a special case of servitization. Mont defines PSS as a system of products, services, supporting networks, and infrastructure that is designed to be competitive, satisfy customers' needs, and have a lower environmental impact than traditional business models. In PSS business model, industries develop product with value-added service instead of single product itself, and provide their customers services that are needed. In this relationship, the market goal of manufacturers is not one-time product selling, but continuous profit from customers by total service solution which can satisfy unmet customers' need (gap).

3 RESEARCH METHODOLOGY

The purpose of this study is through III experience and discusses Servitization capacity literature to explore general servitization transformation process for manufacturing industries in Taiwan. This research examined the top one thousand manufacturers of Taiwan. 1000 questionnaires were sent to firms and sample according to the proportion of manufacturing categories, finally through the SPSS statistical software as the primary analysis tool. This study were collected 166 valid questionnaires, grouping by cluster analysis in order to discuss the general servitization transformation process for manufacturing industries in Taiwan.

3.1 Manufacturing Servitization Capability

According to the definitions of manufacturing servitization previously mentioned, this research developed a company capability evaluation for manufacturing servitization and defined five perspectives, including company core competence, service investment degree (SI), customer affinity (CA), and information technology capability (IT). Among 4 perspectives, we further elaborate company core competence into 3 perspectives. According to the categorization proposed by Prahalad & Hamel(1990), company core competence can be defined as follows:

1. Product development capability (PD): A outstanding product design and development will enable the company to provide unique product functionalities and further create unique customer values. For instance, key technologies or patents to provide service based on its products.
2. Overall manufacturing capability (OM): The company integrates all of its manufacturing value activities and makes them smooth and controllable. For instance, supply chain management strategy, quality control technology, throughput flexibility, real time warehouse management, etc.
3. Marketing capability (MK): The company equips knowledge of market trend and can plan its marketing activities based on these inputs. For instance, Market control ability, brand development capabilities, distribution channels, market response ability.

With respect to each perspective, corresponding five-point Likert items are designed and integrated in order to evaluate companies' capability in manufacturing servitization.

3.2 Manufacturing Servitization Maturity

This study combines the experience of Institute for Information Industry on manufacturing services counseling with the achievements of the past academic research and define the process as a set of growth stages. Through an overall performance evaluation on different perspectives, a company can be placed to a certain stage. Robert S., (2009) have shown how to examine the service transformation process which the manufacturing industry is going through a percentage of service revenue. In this research, service maturity is divided into four stages. However, lack of identifying different capability level of manufacturing servitization causes manufacturers not knowing the best strategy to improve themselves.

Hence, this paper proposes a general servitization transformation progress for manufacturing industries. The progress includes 5 stages, including 'Product', 'Product Fundamental Service', 'IT-enabled Product Service', 'Customer-royalty-centric Product Service', and 'Service Ecosystem'. The description of each stage is as follows:

	Stage	Definition
Stage 1	Product	Simply gain profits by manufacturing and selling products.
Stage 2	Product Fundamental Service	Still focus on manufacturing products. To improve product selling, corresponding 'must-to-have' services are provided, like after-sale services, delivery and installation services.
Stage 3	IT-enabled Product Service	Strengthen services described in Stage 2 through information technology systems, and further reduce operation costs and increase production efficiency.
Stage 4	Customer-royalty-centric Product Service	Provide customer-royalty-centric product service based on information technologies developed in Stage 3.
Stage 5	Service Ecosystem	Develop or operate a service with collaborations from partners inside current value chain or from different industries. New business model for continuous service ecosystem.

Table 1: Five stages in manufacturing servitization progress

As previously mentioned, the capabilities of manufacturing servitization with respect to different perspectives can reveal the maturity of manufacturing servitization for a company. Analyzing a company's performance in different capability perspective can not only understand which stage it is located in but also evaluate which perspective it can improve. Eventually, suitable strategies and

information technologies can be suggested according to its stage identification.

4 DATA ANALYSIS

4.1 Reliability and Validity Analysis

In this study, the questionnaire was designed to obtain a real dataset to validate our proposed model. To ensure the reliability and validity of the questionnaire, the items and perspectives are defined through discussions with experts from both industrial and academic area and followed by a pre-measurement of reliability and validity for investigation scales. The goal of reliability measure is to ensure the correctness and precision of the procedures. The validity is constitute of convergent validity and discriminant validity. The threshold value of the factor loadings and the average variance is then extracted in order to ensure that the questions with convergence validity are correctly measured. Besides, potential reactions belong to construct variables to ensure that the research questionnaire with discriminant validity through the comparison of the correlation coefficient and AVE, potential construct variables have the value of existence.

After SPSS, the factor loadings of the measured variables data show that all of the measured variables are greater than the threshold value of 0.5. The results are shown in Table 2.

	PD		CA		SI
a1	0.810117	c1	0.802591	b1	0.707734
a2	0.742349	c2	0.830669	b2	0.748328
a3	0.660748	c3	0.780975	b3	0.80101
a4	0.788859	c4	0.785869	b4	0.832482
a5	0.854677	c5	0.729594	b5	0.736717
a6	0.757244	c6	0.782766	IT	
	OM	c7	0.797885	d1	0.783299
a7	0.747732	c8	0.788191	d2	0.872488
a8	0.819501	c9	0.789241	d3	0.873176
a9	0.809893	c10	0.807355	d4	0.870724
a10	0.777743	c11	0.812715	d5	0.799396
a11	0.799434	c12	0.852169	d6	0.853102
a12	0.809893	b13	0.800027	d7	0.843871
a13	0.731427			d8	0.772155
a14	0.788215			d9	0.782095
	MK			d10	0.770599
a15	0.766646			d11	0.79525
a16	0.759557			d12	0.871007
a17	0.733537				
a18	0.718561				
a19	0.813877				
a20	0.84881				

Table 2: Factor loadings of measured variables

We use cronbach's alpha and composite reliability to confirm whether the investigation scale is reliable. From Table 3, it shows that potential construct variables of cronbach's alpha are greater than the threshold value of 0.7. It can also be observed that the composite reliability is greater than a threshold value of 0.8. The results show the reliability of the scale is acceptable.

Cronbach's α	Potential construct variable	Composite reliability
0.95726	PD	0.962271
0.866668	OM	0.899818
0.874246	MK	0.914742
0.863253	SI	0.897556
0.901764	CA	0.920997
0.952157	IT	0.957757

Table 3: Cronbach's alpha and Composite reliability

Convergent validity through factor loadings and average variance is extracted for testing. Higher average variance extracted means that the construct result is higher reliability and convergent validity. In our results, all construct variable's average variance extracted are higher than the threshold value of 0.5. If the square root of the average variance extracted is greater than the potential construct variables and other correlation coefficients of the variables, the construct variable has discriminant validity. Table 4 shows the result which the scale has discriminant validity.

	IT	MK	SI	PD	OM	CA	AVE
IT	0.8252						0.681
MK	0.6620	0.7748					0.600
SI	0.7147	0.6201	0.7666				0.588
PD	0.6271	0.7593	0.5780	0.7714			0.595
OM	0.5554	0.7730	0.5048	0.6120	0.7706		0.594
CA	0.7734	0.7265	0.7118	0.6109	0.6630	0.7975	0.636

Table 4: Discriminant validity

4.2 Cluster Analysis

We use Two-stage clustering through the dataset previously mentioned. Firstly, Ward's hierarchical cluster method is used to find a better cluster number. Then, a non-hierarchical K-means method is applied for Two-stage clustering.

4.2.1 Hierarchical Cluster Analysis

According to the difference from cohesion coefficient, the results of dividing data into four groups are much better. Table 5 shows the difference from cohesion coefficient.

Cluster id	Coefficient	Coefficient increment	Coefficient increment
1	27.305		
2	65.730	38.425	
3	116.907	51.176	12.751
4	174.386	57.479	6.303
5	244.763	70.377	12.898
6	353.958	109.195	38.818

Table 5: Cohesion coefficient

4.2.2 Non-hierarchical cluster analysis

According to the relationship between each variable center point and definition of servitization transformation process, clusters can be reasonably corresponding to the servitization transformation process we defined, which proves the feasibility of this research for the evaluation goal. Since there are few companies reach Stage 5 in Taiwan, the cluster analysis cannot reveal a corresponding cluster to represent it.

	Initial cluster centroid (4)			
	Cluster			
	1	2	3	4
PD	2.50	4.67	4.00	1.67
OM	1.75	5.00	3.13	4.25
MK	1.50	5.00	3.50	3.17
SI	1.40	4.80	3.20	3.00
CA	1.46	5.00	3.54	4.31
IT	1.33	5.00	4.00	2.42
Sample number	3	66	76	20
Stage	1	4	3	2

Table 6: Relationship between each variables center point

Group 1: This cluster contains 3 samples. In this group, enterprises focus more on product development and can be summarized to the first phase of servitization transformation process, which is the stage of pure product manufacturing.

Group 2 : This cluster contains 66 samples. For the companies being categorized into this group, the service investment degree and customer affinity performances are better than the other groups. The group can be summarized to the fourth phase of servitization transformation process.

Group 3: This cluster contains 76 samples. The variables from this group are the second highest among different perspectives. It can explain the enterprise through information technology to enhance the efficiency of customer service. Hence, the group can be summarized to the third phase of servitization transformation process.

Group 4: This cluster contains 20 samples. Group 4 has good integrate capacity and customer affinity, but service investment degree is less than group 2 and group 3, it can explained the enterprise basic services to enhance customer affinity. The group can be summarized to the second phase of servitization transformation process.

5 CONCLUSIONS

This paper has introduced a methodology and a set of definitions that are used to evaluate manufacturing servitization capability and maturity for different manufacturing industries. There are four major perspectives for identifying capabilities, which are company core competence, service investment degree, customer affinity, and information technology capability. In each level of manufacturing progress, stage definitions and corresponding perspectives are given. Then, an evaluation model is proposed to identify which level a company is in according to its current condition. Finally, 166 manufacturers are included in this research in order to validate the proposed methodology.

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**PRODUCT SERVICE SYSTEMS, PERFORMANCE MANAGEMENT,
DEPENDENCE AND INTERDEPENDENCE**

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ABSTRACT

Product Service Systems (PSS) deliver complex service through outcome focused interactive activity that transcends disciplines, functions and organisational boundaries of the customer and firm. The performance management challenge increases where value emerges from the complex combination of roles. A qualitative case study is undertaken to understand how a PSS may benefit from the provider firm changing its management perspective such that they assume the performance management role of the customer. This includes implementation of common service enterprise performance objectives and output KPI's. The research identifies dependent and interdependent activity within the case study PSS where benefit exists by managing the activities in different ways. Definitions for independent, dependent and interdependent activities in the context of a complex engineering service are provided. The definitions improve the understanding of each type of dependence and how they may manifest in practice.

Key words: Servitization, Performance and Interdependence.

1. SERVITIZATION

Servitization refers to the transformation of manufacturers from gaining revenue through providing products to revenues gained from service provision (Baines et al., 2009). Value in manufacture arises from transforming materials and equipment, but complex service value arises from the simultaneous transformation of materials and equipment, people and information in a consistent stable manner (Ng et al., 2011). The term service enterprise describes the lens to study such activity (Purchase et al., 2011) where enterprise is defined as the complex system of interconnected and interdependent activities undertaken by a diverse network of stakeholders for the achievement of a common significant purpose. As manufacturing firm's value proposition change new business models are required to ensure appropriate and efficient service delivery and value capture (Zott and Amit 2010). In the complex service enterprise the customer, provider and key suppliers work together to co-create value (Prahalad and Ramaswamy 2000). The actual value realised is often an emergent property of the system resulting from the interactions between parties (Ng et al., 2011). Enterprise managers switch their focus from task specialisation and resource exchange to resource integration with the aim of achieving a service level outcome (Penrose 1959). Competence is embodied by the collective knowledge and skills of the extended enterprise. Increasingly the provider firm takes on the operational role of the customer through forward integration (Baines and Lightfoot 2012). Taking the customer perspective helps the providers fulfil contractual obligations in support of the customer, and thus avoid penalties, and economically deliver outcome (Baines and Lightfoot 2012).

2. PERFORMANCE MEASUREMENT

Performance measurement for manufacture is well established (Kaplan and Norton 1993 and 1996; Neely et al., 1995; Slack et al., 2007). A performance measure can be defined as a metric used to quantify the efficiency and effectiveness of action and the performance measurement system refers to the framework of measurement employed (Neely et al., 1995). A performance measure is a prerequisite for judging whether an operation is good bad or indifferent (Slack 2007). In services, measurement of individual operational input and output is problematic (Kingman-Brundage 1995) especially where interdependent activities exist. Careful selection of measures is required, coupled with consideration of their use, how much they cost and what benefit they ultimately provide to the enterprise (Neely et al., 1995). The performance measurement system has dimensions that focus on results i.e. competitiveness and financial performance and on the determinants of the results i.e. quality, flexibility, resource utilisation and innovation (Neely et al., 1995). As an example the balanced scorecard (Kaplan and Norton 1993) was initially structured to provide four perspectives, a financial perspective, a customer perspective, an internal business processes perspective and a learning and growth perspective. Kaplan and Norton (1996) further developed the scorecard as a strategic management system providing four new management processes that separately and in combination contribute to linking long-term strategic objectives with short-term actions. These included; translating the vision; communicating the strategy; business planning and allocating resource and feedback and learning to modify strategies to reflect real time learning.

3. DEPENDENCE AND INTERDEPENDENCE

An enterprise which delivers a complex engineering service may be described as one made of a number of dynamic interdependent parts (Anderson 1999). It is therefore necessary to understand the characteristics of interdependence to be able to establish effective performance management of the service activity. Literature explicitly defining dependence and interdependence in business operations is limited however sufficient exists to enable an improved understanding of the nature and difference of independent, dependent and interdependent activities. Donaldson (2001) proposes that task dependency describes the way activities or products in an organisation are connected and how they relate to one another. Connectivity can be pooled (indirect connection), sequential (direct one-way connection) or reciprocal (two-way connection). Barrick et al., (2007) describes a dependence relationship in the context of a management team as a situation where some team members are dependent and some are not and the dependent is identified where their activity is contingent on another. Barrick et al., (2007) also describe interdependence as the relationship or link between activities where each member is mutually dependent on the others. There is also a difference in the time frame. The interdependent activities unfold simultaneously and interact with each other in real time. Thus they are not planned in detail, do not have specific lead-times and are not necessarily sequential. When activities support one another to complete the task value emerges (Ng et al., 2011). Interdependence changes the traditional view that maximizing individual performance will lead to organisational success and is replaced by a focus on group performance. This refines the control process including the performance and accounting practices. The plan, do, review loop is redefined. The one to one mapping of individual actions to clearly identified outcomes is replaced by a focus on the effectiveness of a group of individuals engaged in interdependent activities (McNair 1990). In an interdependent relationship, participants may be emotionally, economically, ecologically and or morally reliant on and responsible to each other. An interdependent relationship can arise between two or more cooperative autonomous participants. To achieve the best performance there is a need to match the degree of coherence and communication with the level of interdependence (Barrick et al., 2007). The characteristics of independent and interdependent activities differ. An independent activity reflecting an individual approach requires low communication and coherence between players, and low innovation and flexibility from players. The interdependent activity however, reflecting a common objective or team approach, requires communication and coherence and high flexibility and innovation due to emergent low

predictability of task (Barrick et al., 2007, Callahan et al., 2008). Business model literature also refers to interdependence (Zott and Amit 2010). Here dynamic interdependent activities are central to the concept of an activity system, and provide insights into the processes that enable the evolution of a focal firm's activity system over time as its competitive environment changes. Managers who shape and design both the organizational activities and the links that weave activities together into a system create these interdependencies. Such purposeful design within and across firm boundaries is the essence of the business model. The firm will perform some business model activities with others performed by suppliers, partners or customers (Zott and Amit 2010).

4. RESEARCH METHODOLOGY

The research adopts a qualitative case study approach to establish an in depth understanding of the challenges of servitization and the new performance management required by a PSS providing a complex engineering service. Three sets of semi-structured interviews are undertaken with senior managers at the provider (10 interviews), the customer (2 interviews) and a key supplier (5 interviews). The interviews deliver in depth discussion on enterprise structure, process and performance management. They are recorded and transcribed to ensure accurate capture of all discussion and avoidance of bias. A comprehensive understanding is delivered by constant comparison implicitly building an understanding during analysis (Glaser and Strauss 1967) and cross comparison of data from individuals, functions and companies (Yin 2009). The consistency of approach delivered by the semi structured interviews and accurate translation provides for reliability. The findings are allocated to six deductive categories of issues, servitisation, competence, value in use, co-creation, suppliers and enterprise. In this paper the interview responses relating to servitization, performance measurement and dependence are discussed

5. FINDINGS AND DISCUSSION

When offering a new complex engineering service the servitizing provider firm needs to shift focus from resource exchange to provision of service through leading the performance management of the service enterprise. This can be achieved by forward integration (Baines and Lightfoot 2012) where the provider assumes the role of the customer. This will include the management of value creating activities where interacting business parties transform people, information and materials and equipment simultaneously. Such value co-creation is a key activity for a complex engineering service provider (Pralhad and Ramaswamy 2000, Ng et al., 2011). The case study provider firm activities have changed accordingly and recognise their key activity is to manage the delivery of a service providing asset availability at lowest cost. This replaces the provider manager's previous focus on the process of manufacture of products for sale and the associated supply chain of independent firms producing and exchanging resource in support of that sale. The case study service organisation, dynamics and the timescales of their activities have all changed. Previously they were operating individually on planned activities with ample time allowed. Now they are working collectively in a responsive manner required to deliver an immediate solution. This has created a change from multiple dependent activities towards greater interdependence. To help manage in this new paradigm the service provider has taken over the position and performance management activity of the customer, shifting their performance management focus to the system outcome rather than individual inputs. The provider and customer propose this switch has been a breakthrough helping to increase levels of performance.

Complex service enterprise teams will benefit by establishing an enterprise wide strategy complete with supporting objectives (Purchase et al., 2011). The strategy and objectives help communication across the enterprise. The objectives can be further cascaded to activities and actions to be measured by key performance indicators (Kaplan and Norton 1996) providing the link between service enterprise strategy, asset availability and operational KPI's. Performance measurement of each activity needs to be established including the interaction between firms or functions where delays can occur and costs accrue. The case study interviews provided detail of enterprise structure, process and performance management and

confirmed the importance of establishing common objectives across the service enterprise. Discussions revealed that a joint service enterprise project team established between the customer and provider was used to manage delivery of the service. However interviewees stated that real boundary crossing management did not currently exist and sharing of objectives was unclear. The service project team's strategic direction was closely followed by those in front office activities but the back office and extended supply chain appear distant and subject to multiple business and project objectives. This slowed responsiveness and ultimately contributed to increased cost. Supplier interviewees had limited visibility of the combined provider-customer management team and suggested flowing communication and common objectives to the extended enterprise would be of benefit.

The case study enterprise has started to measure performance against four new top-level output measures, delivery, quality, cost and function. In support they review their inputs and consider impact on asset availability rather than achieving contractual requirements alone. All interviewees were aware of performance measures cascading down and rolling up to the main service deliverable engaging the extended organisation. Tangible and intangible measures exist and include measures on the customer performance. The provider agreed general terms and conditions with suppliers together with specific statements of work that capture the actual level of service desired for specific equipment. At the earliest opportunity the procurement team agree the most appropriate KPI's with the supplier(s). Selection of metrics depends on whether it is the development, production or support phase and the agreed contract goal. Specific measures are chosen from a broad range including; schedule agreement; lead time reduction; cost reduction; reliability improvements (improved mean time between failure); reduction in no fault found; guaranteed repair turnaround times, guaranteed replacement times; demand satisfaction rate; technical services; and throughput measures. When measures are chosen the provider's procurement team measure supplier's performance and KPI's are consolidated to the product level. The supplier interviewees stated that a number of tangible and intangible KPI's and specific turnaround times had been flowed down to them from the provider.

When supply chain activity is replaced by value co-creation where firms work together simultaneously transforming materials, equipment, people and information (Ng et al., 2011) interdependent activity exists. Interdependence changes the traditional view that maximizing individual performance will lead to organisational success and is replaced by a focus on group performance (McNair 1990). Detailed planning and mission control is difficult as an emergent outcome is achieved through co-creation and interactive collaboration (Ng 2011). The plan, do, review loop is redefined. The one to one mapping of individual actions to clearly identified individual outcomes which represent dependent activity is replaced by a focus on the effectiveness of a group of individuals engaged in interdependent activities (McNair 1990). Matching the level of coherence required and the level of communication will further improve performance (Barrick et al., 2007). The case study interviewees recognised their increased interdependency and the need for the enterprise to work together efficiently. Suppliers are co-located next to the asset in order to work with the provider and customer team to help provide an immediate diagnosis of the problem followed by a shortened lead-time to repair an asset on site. Interviewees recognised that the increased co location of provider, supplier and customer improved performance particularly when problems arose and where interdependent activity is required to repair expensive equipment. Focus on the output and co-location has increased the speed of interdependent activity providing evidence of the benefit of co-production (Ramirez 1999). Enterprise value is emergent as the stakeholders co-produce availability working together in a simultaneous interdependent way to ensure asset availability and service outcome. This new way of working delivers improved availability at lower cost as spares usage, stock and supply chain activity are minimised. Performance measurement is focused on the enterprise team delivering rapid asset availability and avoiding the need for costly additional spares utilisation. As evidence in support of the benefits, the supplier repair turnaround time has been reduced from 28 days to 5 elapsed days.

The case study findings identify that service enterprise management teams benefit from; recognising where interdependencies exist; establishing the optimal process to achieve the output; focusing on the time the team take to re-establish availability; managing all inputs in support; and utilising appropriate performance measures. The case study findings also highlight that acceptable alternative approaches can be established where problems arise with less expensive equipment where on base diagnosis and fix is not considered profitable. Here the reliance remains on the traditional extended supply chain repair activity. To achieve the agreed 28 day or best endeavours turnaround the suppliers hold specific stock and engage in special efforts. Interdependence exists between the provider and customer who through a focus upon co-production work together co-creating value at the level of aircraft use. However the extended suppliers remaining in traditional type contracts are effectively decoupled from the front line service activity. These suppliers continue to work to agreed turnaround measures operating in a mind-set where the product dominates and value is perceived as being realised during the exchange of equipment (Vargo and Lusch 2008). These suppliers represent an area of opportunity for further enterprise integration.

6. CONCLUSION

The research extends Baines and Lightfoot (2012) concept of forward integration by finding evidence that the provider of a complex service can benefit from assuming the performance management role of the customer through measuring outcome as the customer experiences it. The work shows that service enterprises may benefit from common objectives and a level of communication matching the required coherence of operations. The case study interviewees explained they had increased co-location and interdependence as part of a move towards co-production in part of their operations. They reported this had improved the speed of asset repair, reduced costs and thus increased the enterprise efficiency.

Taking into consideration the literature and case study findings and accepting that dependence is defined relative to a given or defined enterprise refined definitions of the three forms of dependence are proposed. Drawing upon literature (McNair 1990; Anderson 1999; Donaldson 2001; Barrick et al., 2007; Callahan et al., 2008; Zott and Amit 2010; Ng et al., 2011) definitions are provided for independent, dependent and interdependent activities and how they manifest in practice.

Independent activity starts and finishes without constraints from other activity, has its own quantified output where progress towards output can be monitored, and does not have a relationship with other activities endogenous to the defined enterprise.

Dependent activity requires an input from a prior activity, has its own output but interacts sequentially with other dependent activities within an enterprise. It can be measured and progress towards enterprise outcome can be monitored.

Interdependent activity exists where multiple activities interact simultaneously to deliver an enterprise output. Process flows may be non-linear and act in parallel making instantaneous progress towards enterprise output difficult to measure.

It is proposed that these definitions may provide understanding and consistency of articulation where different types of dependence exist within complex services. The definitions for dependence and interdependence identified in the case study attracted different and successful management approaches. This finding highlights that dependent and interdependent activities can exist within a PSS and benefit from different management and different performance measures.

The research case is from an aerospace enterprise and generalisability of findings may be possible where similar complex engineering service is provided.

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ERNST & YOUNG – SOCIAL MEDIA AS KEY DRIVER FOR FUTURE DEVELOPMENT

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1 INTRODUCTION

In today’s business environment, more and more advisory companies are starting up. Since the economic situation is confronting companies with more challenges than ever before, companies often are dependent on consultants in order to set-up their company more efficiently for the future. If one takes a look on the current advisory landscape there are lots of companies which offer services for all kinds of business divisions across industries. Names like “Roland Berger” or “McKinsey” are coming up in people’s minds if they are talking about management consulting. During the last few years, the profitable management consulting companies dominated the market but today they have to compete against companies that started business not with advisory – the Big 4. The name “Big 4” stands for the dominating audit companies, Ernst & Young (EY), KPMG, PriceWaterhouseCoopers and Deloitte. These companies have established an advisory department beside their auditing business in order to be competitive against companies outside the Big 4 group. The advisory business in each company grew quickly and compared to the strategic management consulting firms, the Big 4 are not only focusing on strategy development but furthermore on strategy implementation together with the client over a longer period of time. Today consulting companies are often confronted with the topic social media within their client projects. This topic is highly discussed since market conditions are constantly changing and companies must focus on the “voice of their customers” instead of developing products without taking customer needs into consideration. Within this paper, the company Ernst & Young will be briefly described in the first part. The second part will then look deeper into the topic of social media and the related services that Ernst & Young is offering regarding social media consulting.

2 ERNST & YOUNG

During the last 20 years, Ernst & Young has been developed into a highly recognizable global organization which is located in more than 700 offices in over 140 countries around the globe. Ernst & Young has its global headquarters in London and since 2001 Jim Turley is the Global Chairman and CEO. He will retire as of June 2013 and will be replaced by Mark Weinberger. With more than US\$ 24,4 billion in Fiscal Year 12, Ernst & Young is a global leader in assurance, advisory, tax and transactional services. (EY, 2013a)

The overall organization is divided in the following areas:

- **Americas** including Northern America, as well as Latin America
- **EMEIA** including Europe, Middle East, India and Africa. This area is divided into some sub-areas of which one is e.g. GSA (Germany, Switzerland and Austria)
- **Asia Pacific** serving the Asian market
- **Japan** focusing on Japanese business activities

The overall organization of Ernst & Young employs more than 167.000 professionals who are divided into the above mentioned areas:



Figure 1: Ernst & Young employees assigned to different regions

2.1 Ernst & Young Service Lines

The European service line landscape of Ernst & Young is divided into six different service areas: Assurance, Tax Advisory, Transactional Advisory Services, Advisory Services, Transactional Real Estate and Law. Each service line is sub-divided into sub-services as shown in Figure 2 but specific

services can differ between countries. In the following, each service area will be briefly explained but will strongly focus on Ernst & Young Advisory Services.

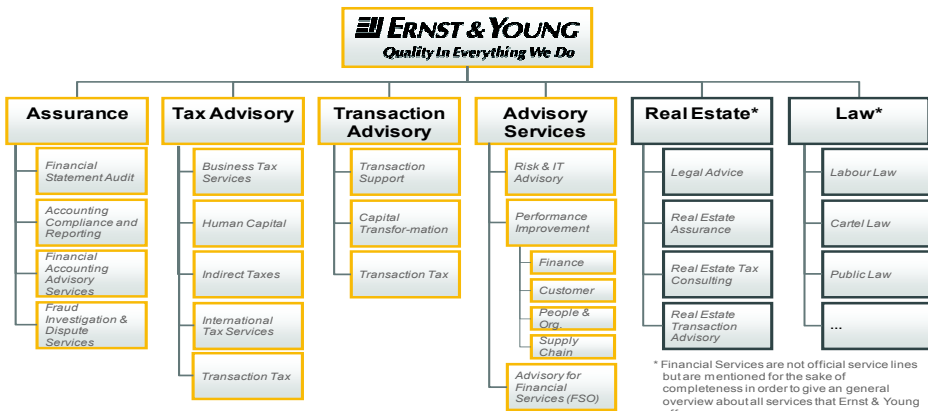


Figure 2: Ernst & Young Service Line Overview

2.1.1 Assurance

Ernst & Young is known worldwide as one of the biggest assurance companies in the world. Therefore, the assurance business with more than 66.000 employees, is essential for Ernst & Young. Companies are facing more and more challenges occurring on world markets and increasing risks regarding business and reporting structures have to be mitigated in order to take efficient decisions. Regulatory requirements especially are becoming more complex and in order to be able to meet all requirements, Ernst & Young creates transparency and provides a clear perspective to audit committees as well as providing critical information for stakeholders. (EY, 2013b)

2.1.2 Tax Advisory

With more than 31.900 employees working in this service line, Ernst & Young supports clients to manage and understand their tax compliance, reporting requirements and obligations. Tax function's processes, controls and risk management will be assessed, improved and monitored in order to maintain effective and reliable relationships to tax authorities. (EY, 2013c)

2.1.3 Transactional Advisory Services

This service line employs more than 8.500 people within more than 90 countries worldwide and supports companies to improve their decision making process regarding strategic management of capital and transactions within a changing environment. (EY, 2013d)

2.1.4 Transactional Real Estate

Real estate has been developed as attractive capital asset -although conditions are challenging due to legal regulations and the current sovereign debt crisis. The real estate team of Ernst & Young consists of more than 7.500 real estate consultants who guide companies in the banking or public sector and corporate groups as well as private and institutional real estate investors in order to stay successful in a competitive and risky market. (EY, 2013e)

2.1.5 Law

Due to globalization, the business environment becomes more complex every day. Therefore companies especially need lawyers who can manage complex circumstances in an efficient and successful way. The Ernst & Young Law GmbH is an independent law firm which employs more than 700 lawyers within 20 different countries who strongly cooperate with all other Ernst & Young service lines. The legal advice inter alia refers to labour law, cartel law, public law, law regarding fiscal offences and others. (EY, 2013f)

2.1.6 Advisory Services

Ernst & Young’s Advisory Services have one common goal: “*Making the client better*”. This philosophy crosses all advisory services that are offered by Ernst & Young and builds the base for the three pillars that are responsible for profitability of a company: company performance, risk management and information technology as shown in Figure 3. (EY, 2013g)

The Advisory Services practice employs more than 23.000 consultants worldwide and is divided into three major service blocks: Performance Improvement (PI), Risk & IT and Strategic Direction. Those key building blocks will not be explained in detail but one specific team within the PI team will be mentioned in the following. (EY, 2013h)

Ernst & Young is a global integrated company with teams all over the world. During advisory projects, all teams follow the same EY specific methodology. Some management consultancies are developing business strategies while other consultancies are specialized in methodologies. The advisory practice of Ernst & Young is focusing on the improvement of clients overall business performance (as shown in Figure 4) while strategy papers will be turned into reality and will be implemented in the running of the business. With a high degree of industry experience from more than 23.000 consultants over the world, Ernst & Young helps clients to identify potential, minimize risks and increase efficiency sustainably. Since the second part of this paper will discuss the importance of social media in today’s business environment, one specific team of the Advisory Services should be highlighted. The “Customer Team” within the Ernst & Young Advisory practice is focused on projects around the customer sector in order to develop sustainable concepts for efficient marketing, sales and distribution as well as a customer service strategy. In particular the topic of social media is changing companies marketing and sales strategies dramatically. The new internet technology and social networks are increasing transparency in the market place and can influence customers to change brands and goods according to their needs. Customers have a lot more possibilities to exactly satisfy their needs. Therefore it is highly important that companies develop strategies that are also focusing on social media activities in order to avoid losing key customers to other competitors. In today’s business environment, almost every company has done some social media activities but they don’t know what has been the value added after a certain period of time. The demand for social media strategies and measurement methods through KPIs (Key Performance Indicators) are of increasing importance within customer projects. A modern and successful customer organization is based on a deep insight into changing market conditions within one industry.

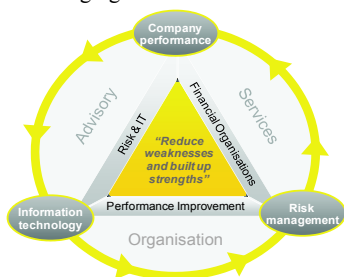


Figure 3: Advisory Services Organisation



Figure 4: Advisory Services Spectrum (EY,2013i)

3 ERNST & YOUNG AND SOCIAL MEDIA

The topic “Social Media” is highly discussed within the EY organization especially within the Advisory Services. Many of EY clients are facing the problem that they should establish a presence within the social media world but they do not exactly know how to deal with this topic. The creation of a facebook profile or a twitter account is quite easy but is becomes completely inefficient when companies are not able to update their social media community. Social Media also causes danger since strict regulations regarding data security and data protection must be taken into consideration when using social media within a business environment. There are lots of different factors which companies should consider. Today most of the companies don’t know the dangers but also don’t know the huge potential for increasing business with social media. Social media has become one of the most important channels to talk directly to existing customers but also to potential customers. It also offers the chance to listen to them as well in order to better understand customers’ needs and requirements. Therefore, social media should not be seen as something that is just hype in today’s society but moreover as a communication channel that will also exist with an increasing importance in the future. As such the use of social media should be strategically integrated into each corporate strategy in order to generate the benefit of its use.

Ernst & Young itself founded an internal “Social Media Community” with participants all around the globe. In this community people can exchange ideas and new information but also raise questions from their customers relating social media topics. First the author will explain how Ernst & Young advise their clients regarding the use of social media within the Advisory Services projects and then the author will describe how EY uses social media itself in order to increase employer attractiveness.

3.1 Social Media consulting for EY clients

Since the topic of social media is more important than ever before, EY is often being confronted by its clients during advisory projects in order to also discuss potential options for companies using social media effectively. Ernst & Young has developed a model called the “EY Social Media Governance Model” which identifies key segments that must be considered when implementing social media activities in an organization in order to create the right social media governance model within a company.

For companies that plan to integrate social media effectively in their organizations, a clear, understandable and communicated governance model will be a large factor for success. Nevertheless, in the area of social media there is no one-fits-all model that can be applied for each client. Therefore, the first step in this overall process will be the evaluation of key segments that are shown in Figure 6 in order to identify the client’s current (as-is)situation in detail.

It is highly important to identify the actual situation of each segment within an organization which will be done within the first discussion between the EY team and the client.

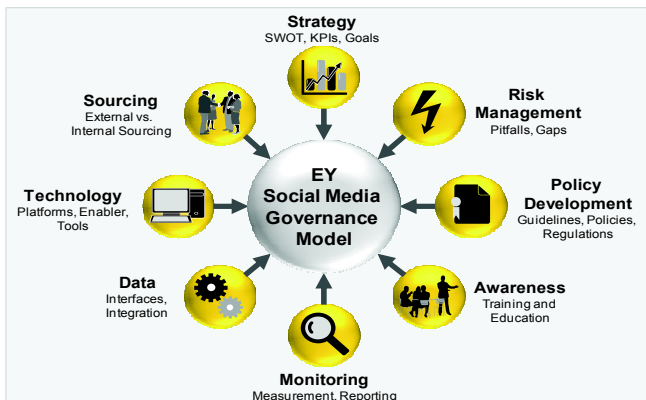


Figure 6: EY Social Media Governance Model (EY, 2013j)

In order to clearly identify the maturity level of each key segment, EY has developed a so called “Social Media Maturity Model” (SMMM). Within discussions and interviews, the EY team will evaluate together with the client where they see their as-is situation and where the client plans to be within the next year/months. The SMMM is based on five different maturity levels which are shown below in Figure 7. Each maturity level is based on a detailed questionnaire. These questions will identify the maturity level of the client within each segment separately.

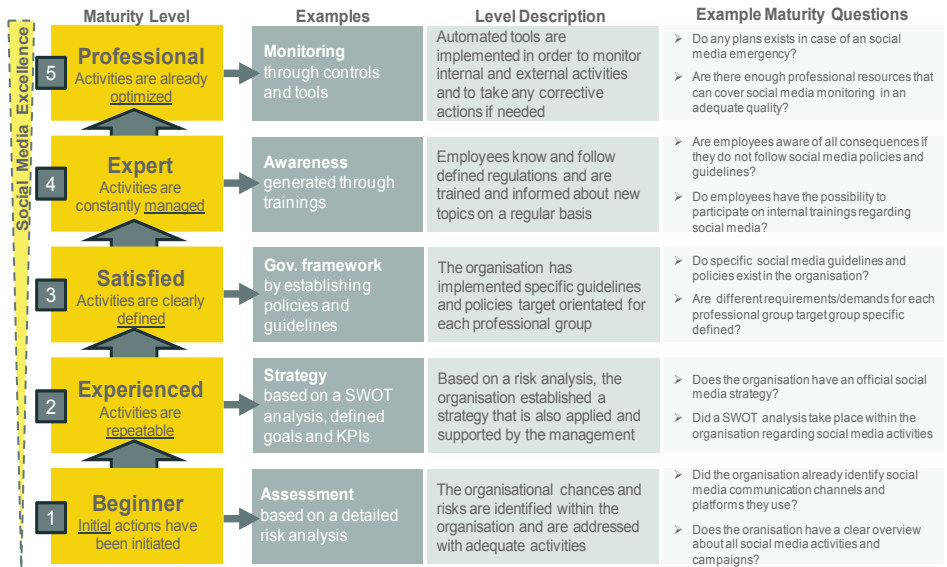


Figure 7: EY Social Media Maturity Model (SMMM) (EY, 2013k)

How to apply the SMMM together with the EY Social Media Governance Model will be explained using the segment “Strategy” as an example. Within the first interview the EY team evaluates if the company has already established a social media strategy in their organizational structure. Based on the answer to the question the EY team can define the maturity level for the segment. If the client has established a social media strategy which contains specific KPIs and goals based on a detailed SWOT analysis and which is embedded in the corporate strategy and supported by the management and all involved parties, the client can be classified as “Satisfied”. Furthermore, if the client has defined specific training sessions that will be regularly provided to all target groups and continuously developed, adjusted and evaluated, the client can be seen as “Expert” regarding the strategy segment. Being a “Professional” means that the client uses highly automated monitoring controls and tools that supervise if the strategy is followed by all parties.

This has been only an example of one key segment but this approach will also be applied for all other key segments. The results out of all the interviews will demonstrate the as-is situation of the clients organization. Together with the client, EY will set-up short-term, mid-term and long-term goals in order to start the social media journey together with the client. Based on the identified client requirements, the EY team will create and propose a customized governance model including a step-by-step implementation approach with a detailed timeline.

For the key segment “Monitoring”, EY has developed its own analytics approach that is based on a methodology which scans all social networks and defined homepages, searches within the world wide web for pre-defined key words and results in specific graphs that show detailed results.

This should only explain one of the most important methodologies and tools EY is using while consulting clients within the area of social media but should not be limited to these components. EY

has established an internal social media community with members all around the globe. Within this online based community, new methodologies, approaches and new ideas are discussed at any time in order to share knowledge and exchange experiences on a global basis.

3.2 Ernst & Young's social media activities

Besides the consulting business, Ernst & Young also uses social media activities in order to be up to date with what is new on the social media market but as well to increase attractiveness as a company itself. Social media channels allow EY to actively promote its surveys and reports and inform people about news, job vacancies, events or other activities. Ernst & Young created a presence in the most important social media channels which are: facebook, twitter, LinkedIn, Xing and YouTube. For example the EY community within the Xing network counts already over 11 million members who can always be informed about important topics. (EY, 2013) Within LinkedIn which is similar to Xing, the EY network includes more than 6.000 members who discuss topics like career possibilities, service line offerings or subject specific topics. (EY LinkedIn, 2013) On facebook for example, the Ernst & Young global page has more than 21.000 "likes" and around 380 people talking and discussing topics on the page. (EY facebook, 2013) People who are following the messages sent by EY via twitter are called "followers". They always get a notification when EY has posted a new message in order to be informed about all EY activities within a short time period. With its own YouTube channel EY uses the possibility to post new videos and information about important events e.g. "Entrepreneur Of The Year 2013 Singapore – Nominations are open" or also about specific service lines e.g. Advisory Services. These videos have already been seen by more than 330.000 viewers. (EY YouTube, 2013) Besides using social media channels as an information function, EY is also using these channels for talent management. Therefore, the aim to increase employer attractiveness can also result out of updated and efficient communication through the already mentioned social media channels.

4 SUMMARY

Ernst & Young is a global company that covers different kinds of services varying from assurance, tax, real estate, law until advisory services. The advisory services especially have been mentioned in this paper, since the advisory team has to face many challenges regarding the highly discussed topic of social media in today's business environment. With social media, customers increase their ability to listen to their customers in order to better identify their needs. But using social media is not free of risks. Many companies see social media as hype or a kind of trend which they have to follow while creating a facebook fan page. These activities are useless if they do not have any resources who will keep fan pages up to date to inform people about important news of their company. The monitoring of social media activities is also a highly important topic that costs time and time costs money. Therefore, many companies start realising that a single fan page does not fulfil their expectations after a short period of time. This is a problem that lots of companies are facing. In order to turn social media into a success factor within a company, Ernst & Young follows the approach that only an integrated approach of social media within the overall organization will result in efficient advantages for clients. Therefore Ernst & Young has founded a specialized and international team in order to discuss all questions, challenges, risks and resulting advantages with its clients. During various projects across industries, Ernst & Young experienced that an specially created social media governance model will be highly effective for companies using social media successfully. With the use of the created social media maturity model, Ernst & Young supports clients in identifying their level of maturity in each social media segment in order to evaluate further risks and chances going forward to becoming an important social media player on today's market.

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LEADERSHIP IN HIGH-VALUE SERVICES FOR MANUFACTURERS: INFORMATION AND COMMUNICATION TECHNOLOGIES AND THE DELIVERY OF ADVANCED SERVICES

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ABSTRACT

Services-led competitive strategies are critically important to western manufacturers. This paper contributes to our foundational knowledge of such strategies by examining the enabling information and communication technologies that successfully servitized manufacturers appear to be adopting. Although these are preliminary findings from a longer-term research programme, through this article we seek to offer immediate assistance to manufacturers who wish to understand how they might exploit the servitization movement.

Keyword: Servitization, Product-Service Systems, Through-life Services.

1. INTRODUCTION

Manufacturers have found themselves in a position where price is the key differentiator in global markets, even for those companies producing high value, technologically complex products such as aero engines, locomotives, agricultural machinery and machine tools. Consequently, many manufacturers have broadened their focus from production to include advanced services. These integrated product-service offerings can be distinctive, long-lived, and easier to defend from competition from lower cost economies (Baines et al, 2009). Therefore, it comes as little surprise that service provision is now a conscious and explicit strategy for market differentiation and ultimately competitive advantage. This is referred to as servitization or rather the infusion of services into manufacturing.

These advanced product-centric services frequently require the original equipment manufacturer (OEM) to take on a greater risk for asset performance, availability and reliability. Such pressures have driven manufacturers to develop technological systems that improve their visibility of assets in the field. These systems combine hardware (for example, sensor and wireless technologies) and software (for example, signal processing and analysis techniques) to identify current and predicted 'health' of an asset. This technology is a critically important enabler of advanced product – centric services. However, little is known about the generic structure of such systems and exactly how their capabilities are integrated into the more conventional information systems of manufacturers. Therefore, this paper contributes to our knowledge of servitization by examining information and communication technologies (ICTs) that support the delivery of advanced services. To realise this purpose we have organised this paper to first summarise the scope of information systems in conventional production-centric operations, then summarise our research design, before presenting the findings from this study.

2. INFORMATION AND COMMUNICATION TECHNOLOGIES WITHIN CONVENTIONAL PRODUCTION OPERATIONS

Within conventional production operations any ICT capabilities that exist tend to be focused at the planning and control of production. This is a common theme within much of the literature associated with manufacturing system design and the most popular systems are Manufacturing Resource Planning (MRPII) and Enterprise Resource Planning (ERP). Both are integrated hardware and software applications linked to a central database that stores and delivers business data and information. MRPII is concerned with the coordination of the entire manufacturing production, including materials, finance, and human relations. Such a system facilitates the development of a detailed production schedule based around machine and labour capacity, and scheduling of production runs according to the arrival of materials. A typical MRPII output is a final labour and machine schedule, along with data about the cost of production, including machine time, labour time and materials used, as well as final production numbers. Enterprise Resource Planning (ERP) can be thought of as an extension of MRPII and sets out to manage internal and external resources. Its purpose is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to external stakeholders. However, connections to the asset in the field are limited, and largely consist of customer relationship databases with records of ownership and history. Conventionally, very little data is captured about equipment condition and how it is used by customers in the field.

3. RESEARCH DESIGN SUMMARY

Our purpose has been to understand the differences between the information and communication technologies used in production operations and those used by successful servitized manufacturers. In short, our method has been to carry out in-depth and multi-disciplinary case-studies of leading manufacturers in delivery of advanced product-centric services. Our partner organisations for this study have been Caterpillar, Alstom, MAN and Xerox. Our approach has been to carry out semi-structured interviews with personnel ranging from Customer Services, and Service Marketing, through to Chief Executive Officers. Overall some 140 hours of interviews were conducted. In each case the focus of the interviews has been on the generic structure of the ICTs that are used to support advanced product-centric services, along with understanding the factors that have led to their construction. Typical advanced product-centric services include risk and revenue sharing, pay-per-use, support agreements and availability contracts. These results were then analysed to establish the findings from this study.

4. INFORMATION AND COMMUNICATION TECHNOLOGIES ENABLING SERVICIZED OPERATIONS

Competitive pressures stimulate innovations within manufacturing operations. Therefore, prior to examining the information and communication technologies that servitized manufacturers have developed, it is first necessary to explain the pressures that are particular to delivering advanced services contracts. In this section we first summarise these, then present the generic configuration apparent across the manufacturers in our study, and then present the rationale that explain their adoption.

Underlying business pressures driving the establishment of enabling technology and systems: Our case work has revealed that where a manufacturer sets out to adopt advanced service two sets of pressures incurred. One reflects the contractual obligations from the customer and is typically measured in terms of *performance, availability and reliability*. Here, *performance* is concerned with the extent to which the full capability of equipment is accessible, for example the power delivered by a gas-turbine as a percentage of that specified. *Availability* is usually assessed as the extent of time that a product or asset is available for use as a proportion of the scheduled availability. *Reliability* is taken as a measure of mean-time between in-service failures and again the capability to monitor the asset in use and to analyse and record operational performance issues enables feedback into the asset design loop to improve its designed reliability. The second principle pressure is from the host manufacturer, and is concerned with the resources required to deliver the service offering, and is typically measured as contract delivery *cost*. These pressures to deliver asset performance,

availability and reliability, with the minimum of cost to the host organisation. These pressures help to explain the emergence of ICTs by manufacturers, and the form that such systems typically take can now be explained.

The emergent technology and systems: Information systems and management processes (Brax, 2005), along with tools to allow enhancement of company knowledge and best practice (Byron, 2006), and are increasingly seen as essential to competitive success. In conventional manufacture the tendency is towards systems that control the flow of materials through production operations. However, to deliver advanced product-centric services these systems are different. In principle they appear as; *The use of Information and Communication Technologies (ICTs) to monitor assets remotely and coupled with analysis to inform and advance actions.* Figure 1 illustrates the configuration of ICTs typically used by manufacturers in the efficient and effective delivery of advanced product-centric services.

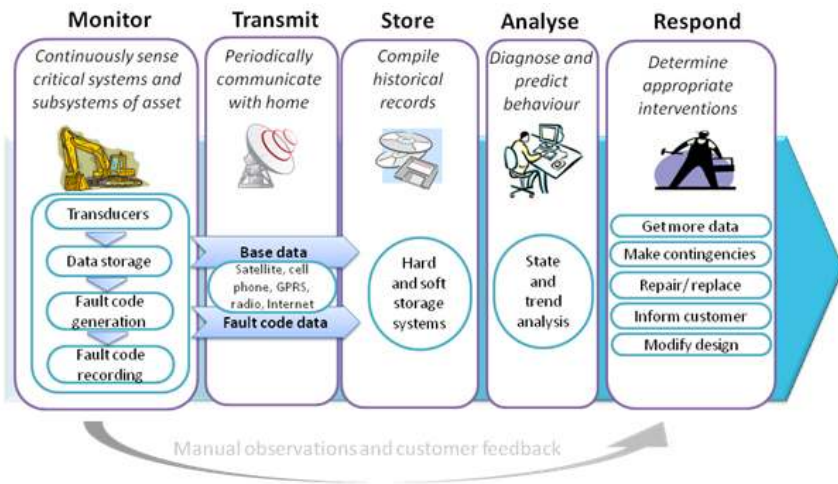


Figure 1: Illustrating the relationship between the enabling technologies

At a general level the process commences with thereal-time monitoring of critical systems and subsystems, periodic transmission of raw and/or analysed data or fault codes via an appropriate communications medium (Satellite, Cellular, GPRS), which then arrives at a control centre where the data can be automatically stored, retrieved and then analysed. Such analysis is typically performed using algorithms and / or experts in condition monitoring and characteristics of the equipment. Manual observation and customer feedback also forms part of the information set at the control centre. This information set is used to generate advanced warning of potential problems and enables the scheduling of materials and/or resources to undertake any necessary maintenance / repair activities implement contingency actions, inform the customer and also feedback to the product design process if needed.

As an example of this, the engine management system in MAN (UK, Truck & Bus) vehicles is connected using the vehicle’sCANbus to a data acquisition device that allows the continuous collection of information concerning the operation and performance of the vehicle. This data, including GPS location, is transmitted in real-time to the MAN U.K. control centre using cellular communications. The data collected can be used to provide reports showing how the vehicle is being driven together with the actual fuel consumption and whether optimum fuel efficiency is being achieved. Vehicles and drivers can be compared by vehicle type, depot, route or other parameters. Also Alstom (TLS) provides Virgin Trains UK West Coast Mainline fleet with a maintenance, repair and overhaul capability against an availability contract. To effectively and efficiently deliver this service Alstom has introduced a range of enabling technology solutions to provide dynamic data on

train status and location underpinned by an on-board Train Management System (TMS) that monitors a range of 25 train systems that include propulsion, tilt, high tension, braking, air etc. using around 15 of computers interfaced to various on-board sensors. Using GPRS the TMS sends fault codes to fleet control centres staffed by ‘experts’, who communicate with the maintenance depots the work needed, including parts, to rectify faults identified prior to the arrival of the train at maintenance depots where routine maintenance and fault rectification has to be completed in a narrow time. The TMS data, ‘expert’ analysis data and work scheduling and parts acquisition is integrated using a sophisticated ERP system.

Underlying relationship between business pressures and ICT capabilities: The relationship between the enabling ICT and business pressures is captured in figure 2. This illustrates that there are five principal routes through which these capabilities benefit the host manufacturer.

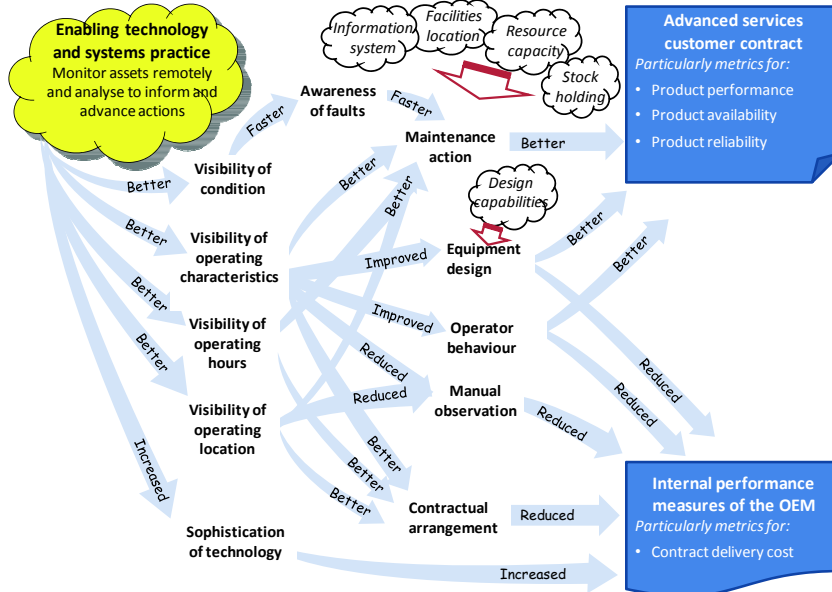


Figure 2: Relationship between ICT capabilities and key performance measures for advanced services contracts

The enabling technology and systems practices provide better visibility of the asset in use in terms of condition, operating characteristics, time in use and location. The remote access to this information for the service provider facilitates more timely awareness of faults to provide faster maintenance / repair actions and can lead to improved equipment design, operator behaviour and less need for manual observation of the asset in the field. The resulting improved responsiveness of the service provider has a positive impact on asset performance and availability, whilst the improvements in design and operator behaviour have a positive impact on reliability.

The increasing sophistication of enabling technologies and systems has a downside in that it contributes to an increase in service delivery costs. However, the visibility provided of asset operating characteristics, time in use and location can help to mitigate some of the risks adopted by the service provider and relieve contract delivery costs. Also improvements in product reliability and availability can reduce service delivery cost, and can reduce need for manual observation / intervention within the delivery system.

These enabling technology and systems practices, and their implications on business performance, are moderated by other practices within the broader service delivery system. Key here is design and technical capabilities together with integrated information systems. As illustrated in figure 1, decisions about these other practices impact the consequences of the technology and systems

practices in a number of ways. For example, design and technical capability and resources are essential to an effective problem response process, as is the ability to integrate information systems to plan materials and resources in a timely and accurate manner.

5. CONCLUDING REMARKS AND FUTURE RESEARCH

Our research indicates that ICT capabilities adopted by successfully servitizing manufactures can differ significantly to those in conventional production operations. Fundamentally this is because the business pressures and subsequent performance measures also differ. Production tends to focus on cost, quality and delivery, where as advanced services contracts centre on performance, availability, reliability and cost. These demand that a manufacturer is responsive, and to achieve this they have to ensure that they have visibility of condition and operation of the asset in use by the customer. Again, these decisions about technology and systems practices have to be considered within the context of the wider service delivery system. Our future work will therefore set out to understand some of these other factors in greater detail, and we will report on these in the near future.

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LEADERSHIP IN HIGH-VALUE SERVICES FOR MANUFACTURERS: ADVANCED SERVICES AND THEIR IMPACT ON VERTICAL INTEGRATION

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ABSTRACT

The debate about services-led competitive strategies continues to grow with much interest emerging around the differing practices between production and servitised operations. This paper contributes to this discussion by investigating the vertical integration practice (in particular the micro-vertical integration otherwise known as the supply chain position) of manufacturers who are successful in their adoption of servitization. Although these are preliminary findings from a longer-term research programme, through this technical note we seek to simultaneously contribute to the debate in the research community and offer guidance to practitioners exploring the consequences of servitization.

Keyword: Servitization, Product-Service Systems, Through-life Services.

1. INTRODUCTION

There is a growing interest amongst both the research community and manufacturers in advanced services linked to products (see Baines and Lightfoot, 2012a; Baines et al, 2012a; Baines et al, 2012b; Lightfoot et al, 2011a; Baines, et al 2011b; Baines, et al, 2010; Baines et al, 2009, Baines et al, 2005). Examples are frequently given of companies such as Rolls-Royce Aerospace, who now generating a large portion of their business revenues through availability and capability based maintenance contracts. Supporting such services demands, however, that the manufacturer adopts new and alternative practices and technologies to those traditionally associated with production operations (Baines et al, 2009). A prevailing challenge is to understand these differences and their underpinning rationale.

Our research programme has therefore set out to explore how the pursuit of a services-led competitive strategy impacts the broader operations of a manufacturer. To achieve this we have investigated a cross-section of companies who are successfully delivering advanced services coupled to their products. Our initial results indicate that several areas of operations are indeed impacted, and these include facilities, information and communication technologies, performance measurement systems, organisational processes, and human resources. In each case we have been anxious to share our findings with the broader research community to both contribute to the debate and provide initial guidance to manufacturers.

On this basis, differing practices have recently become apparent in the area of vertical integration. In particular the extent and position (within the wider supply chain) of the operations that are under the direct control of the servitized manufacture. This aspect of vertical integration is sometimes referred to as micro-vertical integration or supply chain position. Therefore, in this technical note we report on the practices of our case companies, explore the rational underpinning these, and propose a hypothesis for the impact on vertical integration of successful servitization.

To realise the purpose of this paper we first reflect on the topic of vertical integration within the context of conventional production operations. We subsequently describe the design of our study. The main body of the paper then deals with the practices we have observed in situ and the factors that appear to explain them. Finally we conclude and set out a programme for further work.

2. VERTICAL INTEGRATION PRACTICES WITHIN CONVENTIONAL PRODUCTION OPERATIONS

The term vertical integration is usually taken as the extent to which a firm owns and takes responsibility for its upstream suppliers and its downstream customers. A business is seen as being vertically integrated when it is engaged in different aspects of production, such as growing raw materials, manufacture, transportation, and retailing. Here, backwards vertical integration refers to taking over activities of suppliers of in-bound materials, whereas forwards vertical integration is concerned with taking control of activities in the outbound supply chain and otherwise carried out by customers. Vertical integration can be thought of at a macro-level (dealing with the combination of businesses) or at the micro-level (dealing with the combination of business activities). This micro-level of vertical integration can also be referred to as the span-of-process or supply chain position (Baines et al, 2005), and is the focus for the remainder of this paper.

Modern manufacturers appear significantly less vertically integrated than their predecessors. Evidence is apparent in the practices of Henry Ford with his production of the Model T in the early 20th Century. Ford chose extensive vertical integration to control quality conformance which in turn helped to minimise the overall cost of vehicle production (Womack et al, 1990). Since then improvements in capabilities within the supply base have relaxed the need for such vertical integration, and concepts such as core competences have motivated manufacturers to divest and relinquish such integration.

Choosing the appropriate position and extent of vertical integration is a complex decision making activity. Within the context of more conventional manufacture (which we refer to as production-centric operations) a wide range of studies have taken place. Some authors take a broad and integrated view of in-bound and out-bound supply chain boundaries through such concepts as core competences and competitive space (cf: Baines et al, 2005). Others have addressed vertical integration by focusing in-depth on particular boundaries between operations and the wider supply and customer networks. For example, research that specifically targets the in-bound material supply chain is addressed under make-versus-buy (cf: Probert, 1996), outsourcing (cf: Lonsdale and Cox, 1998) and strategic sourcing (cf: Greaver, 1999). Similarly the out-bound customer interface tends to be covered in the marketing literature (cf: Jones and Clark, 1990; Christopher, 1998).

The concepts of servitization and vertical integration are closely related (Schmenner, 2009). This is especially the case with advanced services which are closely coupled to manufacturer's products. Such product-centric services, such as availability contracts, require the provider to take on maintenance activities that were otherwise performed by the customer. This can be thought of as forwards integration of the manufacturer. However, questions then arise as to whether or not such forwards integration is reflected in the relaxing of backwards integration, or if the extent of vertical integration actually increases with the effective execution of a servitization strategy? Furthermore, what are the factors and relationships that begin to explain the decisions taken by manufacturing organisations.

3. RESEARCH DESIGN SUMMARY

Our exploration of vertical integration has taken place as part of a larger study to understand the impact of successful servitization on the operations of the manufacturer. In brief, our research methodology has been to carry out in-depth and multi-disciplinary case-studies of four manufacturers leading in delivery of advanced product-centric services. Data has been collected over a 15 month period through semi-structured interviews with a wide range of personnel in such companies. Typical these have been interviews with maintenance technicians, customer services personnel, through to marketing, technical, and managing directors.

Analysis has then been conducted by systematically searching for data clusters where our case companies coincide in terms of the practices they follow. For each cluster we have then sought to rationalise the data as a prevailing practice, along with the underlying logic that explains its adoption. Once this has been completed for each data cluster, we have then set out to describe and disseminate these preliminary findings as technical notes and short communications. Thus heightening our engagement with both communities of practice and research, and through their feedback helping to strengthen the validity of our results.

Following this approach, preliminary results have indicated that the adoption of servitization strategies will impact facilities, information and communication technologies, performance measurement systems, organisational processes, human resources, and vertical integration. The remainder of this paper describes our findings for vertical integration and concludes by summarising why these appear to occur for successfully servitizing manufacturers.

4. VERTICAL INTEGRATION PRACTICES WITHIN SERVICIZING OPERATIONS

Rather than the largely limited extent of vertical integration that is now apparent in many production-centric operations, it appears that those manufacturers delivering product-centric services successfully retain a somewhat unexpected tail of design and production capabilities. Figure 1 sets out to illustrate these phenomena.

The vertical integration of a conventional manufacturer tends to be arranged around design and production capabilities (see 'A' on figure 1). Often basic services are offered, such as spare parts, but typically these are produced alongside normal production and delivered to the customer through a relatively independent network of dealers and distributors. Such a model is often found in the automotive industry where manufacturers such as Toyota and Audi will have a franchised distributor network. Such distributors are themselves conventional service providers and offer a channel to the market for the manufacturer (see 'D' on figure 1). Typically they will be entirely focused on services such as show-rooms, demonstrations, and sales.

The extent of vertical integration for product-centric servitization is more difficult to observe as this picture is somewhat blurred by the structure of the host organisation. For example, manufacturers such as Rolls-Royce aerospace initially appear as having extensive vertical integration. In practice, much of this is because the company is active in both original equipment manufacture and product-centric services such as maintenance, repair and overhaul (see 'B' on figure 1).

A more clinical picture of vertical integration supporting product-centric servitization is apparent in those companies that have focused entirely on servicing their existing installed asset base. Although rare, such businesses do exist (Alstom train-life services being one example). As mentioned earlier, forward vertical integration occurs as the manufacturer takes over operations that would have otherwise been carried out by the customer. However, our study indicates that these companies also set out to retain a tail of design and production capabilities (see 'C' in figure 1). Overall, this results in their operations being considerably extended.

Evidence indicates that this tail has been purposely retained, and is not simply a legacy of a move from production-centric operations. Alstom Train-life services, for example, appear to have intentional re-integrated. Alstom holds responsibilities for the advanced services contracts on both the West Coast Mainlines and Northern Line of the London Underground. Historically subsystems such as air-conditioning units, door actuators, and coffee machines were sourced from external suppliers. More recently the overhaul and re-manufacture of some such equipment has been re-integrated into the Alstom organisation. Though such facilities are not of the scale associated with conventional manufacture, both design authority and production capabilities have been established for these sub-systems.

This tail of backward integration is illustrated in figure 1 by a triangle penetrating design and production (see particularly 'B' and 'C'). Such integration exists even when conventional manufacture and product-centric servitization occur in one company (as per the case with Rolls-Royce). Here, there is both close integration and some duplication in activities. For example, both functions of such an organisation may have assembly and test facilities. The extent of this penetration is however reduced, partly because some activities may be shared, and partly because of stronger supply chain leverage held by such a larger organisation.

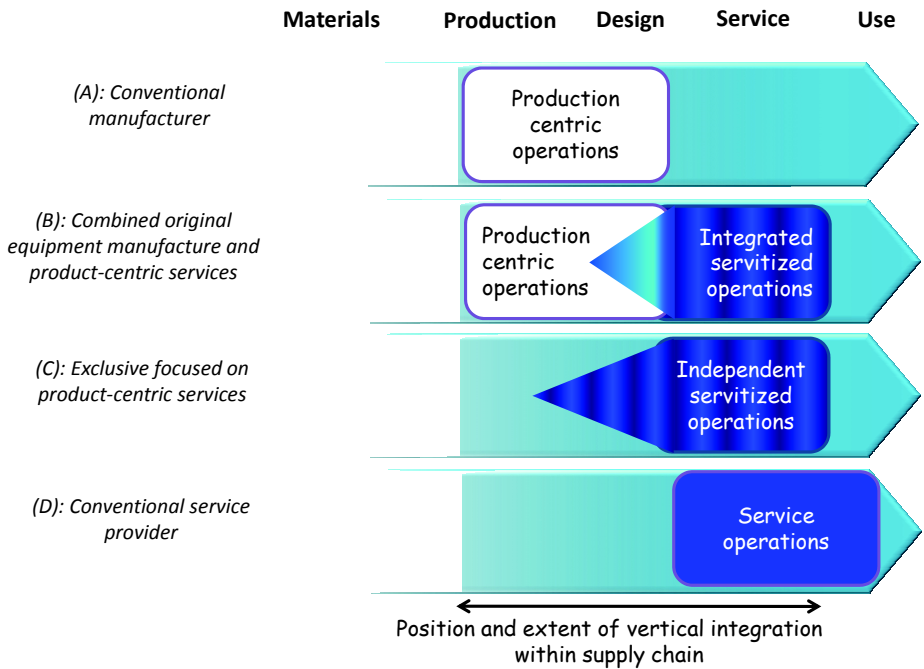


Figure 1: Vertical integration practices for production, servitizing, and service operations

5. RATIONALE UNDERPINNING THE VERTICAL INTEGRATION PRACTICE

Our study indicates that the vertical integration practices, of those manufacturers who are leading in the delivery of advanced service provision, are principally in response to two types of business pressures. A pressure to fulfil contractual obligations to customers, coupled with an internal pressure to deliver these as economically as possible. An appreciation of these pressures is requisite to understanding the impact of servitization on vertical integration.

All operations strategies are set out to deliver customer value economically. For advanced services, delivered through capability contracts, customer value is centred on the 'outcome' from services rather than the services activities themselves. These outcomes are principally measured in terms of asset performance, availability and reliability. Performance is concerned with the extent to which the full capability of an asset is accessible, for example the power delivered by an engine as a percentage of that specified. Availability is typically measured as the amount of time that a product or asset is available for use as a proportion of the scheduled availability. Reliability is typically taken as a measure of mean-time between in-service failures. The challenge within operations is to deliver against these customer metrics as economically as possible. An important business measure associated with a firm's internal economics, in such instances, is the cost of delivering an advanced service contract.

The underlying logic has two purposes: (1) Maximise the speed and effectiveness of response, and (2) Minimise the cost of response. Supporting advanced services contracts demands an ability to provide a rapid and effective response should an asset fail when in-service. For example, if an Alstom train breaks down then reliability penalties will be incurred immediately by the manufacturer (Alstom), and they are closely followed by escalating penalties for lack of availability or 'up-time'. Rapid maintenance action is aided by the readiness of spare and replacement parts. Some commodity parts and consumables (such as hydraulic oils, filters, fasteners, and brake components) can be readily held in stock and used on a call-off basis. However, with high value subsystems, economics demand that these are overhauled and re-manufactured. Retention of a production capability helps to ensure that such subsystems will be dealt with as quickly as possible, along with buffering the manufacturer

from any issues they may encounter with their own suppliers. Retaining design authority also aids continuous improvements in asset design. For example, equipment can be readily re-engineered to improve reliability and maintainability (such as improving access to inspection points, lubrication, and serviceable items). Likewise, many improvements in working practices (such as those achieved through Lean techniques) have originated from the production environment. Adoption of such techniques in maintenance activities is likely to be assisted if the organisation already has expertise of implementing them in production.

Extended design and production capabilities also provide the manufacturer with greater control over the cost of responding. As mentioned above, improvements in working practices and component design impact both the effectiveness and cost of delivering an advanced service. Likewise, the cost of stock holding in the supply chain is reduced. Finally, as maintenance operations are notoriously unpredictable, demanding high levels of buffer capacity in order to deal with unpredictable events, insourcing provides opportunities to better exploit such capacity. A practical example of this is with Alstom on the Northern Line, where the maintenance depots have chosen to insource the refurbishment of door actuators. A relatively low skilled and labour intensive activity that immediately appears as a candidate for outsourcing if not offshoring. Yet, carrying out such activities internally provides useful employment of standby maintenance staff and also helps to reduce stock holding costs of such items. The downside of this integration is that the business will invariably need to increase investment in management and resources, and this can negatively impact the cost of delivering an advanced services contract.

The extent of vertical integration is however moderated by a range of factors. Highly significant is the contractual relationship with the suppliers to the manufacturer. Stock holding costs can be reduced if suppliers can themselves be persuaded to enter an outcome-based contract that reflects the advanced services offered by the manufacture. Unfortunately, many suppliers are engaged largely around product design and manufacture with perhaps, too little consideration of their longer-term willingness or ability to support advanced services. Nevertheless, even when transactional relationships are retained with suppliers, the stockholding costs are still highly influenced by the information systems that the manufacturer has in place to track materials in the supply chain.

Investments in design and production capabilities are of course also influenced by the facilities decisions. Facilities that are located close to and distributed throughout customers operations help to reduce stockholding costs at the sacrifice of manpower and equipment utilisation. This is similarly impacted by the availability and skill sets of such resources and in particular the design capabilities. Such capabilities are difficult to re-establish once lost to the organisation. These underpin the particular advantages that manufacturers hold over more conventional service providers, indeed intellectual property can be generated that can reinforce the manufacturers own authority over their suppliers. Even when, for example, a subsystem has been sourced from the external supply base the manufacturer can acquire access to intellectual property and develop expertise in the design of equipment for serviceability that can exceed the knowledge of the supplier.

6. CONCLUDING REMARKS AND FUTURE RESEARCH

This short technical note reports on our work to understand the vertical integration practices of a cross-section of manufacturers who have embraced the servitization trend. In particular, it highlights that such companies retain capabilities in design and production, and do so because this benefits their speed, effectiveness and costs of supporting assets on advanced services contracts. We have captured these findings in the following hypothesis: *Delivery of an advanced service contract is positively impacted by the vertical integration into capabilities for sub-system design and production, as this ensures speed and effectiveness of response while minimising costs.*

Fundamentally this is because the business pressures associated with advanced services differ to those in original equipment manufacture. Production tends to focus on cost, quality and delivery, where as advanced services contracts centre on performance, availability, reliability and cost. These demand that a manufacturer is responsive and, to often to achieve this, they may have to vertically integrate if they are to avoid either excessive costs for stock holding or incur penalties for failing to deliver against a services contract.

Such pressures are mitigated by the a range of other contextual factors, such are the form of the contractual relationship with the manufacturers own suppliers, the location and structure of facilities,

and the sophistication of technology systems monitoring the asset condition in service. All such factors interact to determine the operations strategy that is most appropriate to an individual manufacturer. Our future work will now continue to explore these other factors in greater detail, and we will report on these in the near future.

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LEADERSHIP IN HIGH-VALUE SERVICES FOR MANUFACTURERS: PEOPLE AND THE DELIVERY OF ADVANCED SERVICES

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Abstract

This short paper sets out to further develop the debate around the practices and technologies within operations that are critical to success with servitization. This paper draws findings from four companies that are leading in their delivery of advanced services, and reports on the organisation and skill-sets of people within these organisations. In particular it examines the roles and activities of people within the front-office, identifies the skill-sets that are espoused as being critical, and then seeks to present the rationale that explains this importance. It concludes by proposing a working hypothesis for future studies in this field.

Keyword: Servitization, Product-Service Systems, Through-life Services.

1. Introduction

The research described within this paper has been carried out as part of a macro-programme to investigate the practices and technologies that successful companies are employing within operations to deliver advanced services (see Baines and Lightfoot, 2012a; Baines et al, 2012b; Baines et al, 2012b; Lightfoot et al, 2011a; Baines, et al 2011b; Baines, et al, 2010; Baines et al, 2009, Baines et al, 2005). Principally, this programme has conducted in-depth case studies of companies that are leading in their servitization strategies. These case companies include Caterpillar, Xerox, MAN and Alstom. Here, we have sought to explore not only the human factors, but several areas of operations that are indeed impacted by servitization. These include facilities, information and communication technologies, vertical integrations performance measurement systems, and organisational processes. In each case we have been anxious to share our findings with both the broader research community and manufacturers contemplating servitization. In this paper we deal explicitly with those aspects of our macro-study that have investigated how people are deployed and their associated skill-sets.

The intention with this paper is therefore to both present our findings and provoke debate about people and their skill-sets within successfully servitizing manufacturers. Our hope is that this will help to stimulate further studies to investigate how the skill-sets of people in the servitized organisation differ to those in production. To realise this purpose we have organised this paper to first summarise how people are allocated within the organisational structure of a servitizing manufacturer, and then explore the characteristics of such people in the companies we have studied, before setting out the rationale between these characteristics and the delivery of advanced services contracts. Finally, we draw conclusions and set out the future direction for research.

2. Context

Servitization refers to a process by which manufacturers build their revenue streams around services coupled to their products. These services can be thought of as being either base, intermediate or advanced (Table 1). This reflects the organizational stretch beyond production competences that is necessary for a manufacturer to deliver services. Table 1 summarises the characteristics associated

with each of these clusters and the examples of services offerings associated with each. In advanced services particularly the manufacturer will typically take on product support service activities (such as maintenance, repair, condition monitoring) that may otherwise be the responsibility of the customer, and in doing so has multiple interactions (or touch-points) across the life-cycle of the services contract. These would not usually occur in conventional manufacture, and these suggest the changing demands on the people who work within manufacturers and have the responsibility of delivering advanced services.

	Principle on which cluster is defined	Relative characteristics of cluster			Examples of services offerings within cluster
		Range of service activities	Extent of risk	Revenue payment	
Base services	Focus on product provision	<i>Narrow:</i> Activities centred on and around production competences	<i>Low:</i> Easily delivered for an enterprise with manufacturing competences	<i>Point:</i> Largely on completion of contract	Product / equipment provision, spare part provision
Intermediate services	Focus on condition maintenance	<i>Broadening:</i> based on the exploitation of production competences to assure state and condition of equipment	<i>Medium:</i> Increased expose to the consequences of equipment faults	<i>Periodic:</i> Some upfront and/or on completion. Maybe with interim payments	Scheduled maintenance, Technical help-desk, Repair, Overhaul, Delivery to site, Operator training, Condition monitoring, In-field service.
Advanced services	Focus on outcome assurance	<i>Extended:</i> stretching the manufacturing enterprise to take on activities that are usually internal to the customer	<i>High:</i> Financial penalties incurred almost immediately if equipment fails to perform as specified	<i>Linear:</i> Pay-through-use with period adjustments in rate	Customer support agreement, Risk and revenue sharing contract, Revenue-through-use contact, Rental agreement

Table 1: Meta-clustering of services offerings on the basis of organisational stretch from production based competences.

The behaviour of people within a system is affected by many variables. Kurt Lewin(1935; 1951) was one of the earliest researchers to identify that behaviour is a function of the person and the environment in which they find themselves, such that people’s behaviours are the response to the dynamic interactions between the particular set of variables in a given situation. The work environment can be thought of both as including both the physical conditions (such as heat, light, noise, vibration) and the social factors (such as leadership, team working, communication, motivation and reward structures). Likewise the person themselves can be defined in terms of their physical condition (age, gender, strength, dexterity) and psychological attributes (such as personality, attitudes, beliefs, emotions). There is a wealth of literature in the social sciences that looks at how factors, or sets of factors, affect the behaviours of people and the nature of person-environment interactions in various environments (Kristof-Brown et al, 2005). Amongst this corpus body of literature a vast amount examines behaviours in working environments, particularly from work psychology and organisational behaviour research domains. However, despite this high level of attention to work behaviour, the field of literature narrows considerably when looking specifically at services.

Research investigating people and their behaviour in the service industry that has emerged in recent years. This has focused on various topics, such as: personnel, physical environment and perceptions of corporate image(Nguyen and Leblanc, 2002), self-managing service teams (de Jong et al, 2008), personnel management systems (Lewis and Entwhistle, 1990), supervisor communications

(Johlke and Duhan, 2000). A few researchers have set out to distinguish between the types and behaviours of people in service organisations, and how these differ to those in production. Theodore Levitt (1983) argues, for example, that people in manufacturing think technocratically and by contrast people in service tend to be more humanistic. Here it is important to recognise that there are various forms of service organisation, such as professional services, and these have their own particular demands of people and how they work. Quite simply, different service operations demand different skills from and abilities from people.

The most prevalent area of service personnel research has explored the inter-relationships between service provider, personnel personality characteristics, and personal traits. These traits include 'job resourcefulness' (Licata et al, 2003; Harris et al, 2006), 'employee adaptiveness' (Gwinner et al, 2005), and 'customer orientation' (Baydoun et al, 2001; Hennig-Thurau, 2004; Donovan et al, 2004; Farrell and Oczkowski, 2009). Most of this service personality research seems to have been devoted to investigating the effects of the 'service orientation' characteristic on performance (Hurley, 1998; Teng et al, 2007; Ekinci and Dawes, 2009; Teng and Barrows, 2009; Lin et al, 2010). The interest in service employee personality has even led to attempts to generate trait measurement instruments for personnel selection and development (e.g. Carraher et al, 1998; Alge et al, 2002). Although Lioa and Chuang (2004) included personality in an attempt to bring together both the organisational and individual factors that influence service performance of employees and customer outcomes. Yet, in no aspects of services research has a comprehensive framework been established that definitively distinguishes the characteristics of people who tend to fit into the differing environments of services and production.

Servitization is a relatively new but growing field of research that fits at the confluence of the more traditional communities of production and service operations (Baines et al, 2010). It deals with the exploitation of services by product manufacturers. As can be expected, there are only a few researchers that have explored either the behaviour or the desirable characteristics of people in this context. Exceptions include Brax (2005) who notes credibility of expertise is fundamental, and similarly, Vandermerwe and Rada (1989) who stress the importance of identification with the individual customers. Other than these, studies have yet to set out the broad characteristics of people who perform best in a servitizing manufacturers, therefore gaining such insight is the purpose of this paper.

3. Research design and execution

Our research has therefore set out to identify and understand the practices and technologies that successful companies are employing within operations to deliver advanced services. Our process has been to conduct surveys and case studies to both identify and explore companies that are leading in their delivery of servitization. In this specific paper we deal explicitly with those aspects of our macro-study that have investigated people, and in particular how people are deployed and skilled to deliver advanced services.

The findings presented in this paper have principally been established through in-depth case studies of Caterpillar, Xerox, MAN and Alstom. These companies were chosen because they excel in the delivery of advanced services which are coupled to complex assets. The case studies were then designed and executed conventionally (Voss et al, 2002). The research questions were translated into a data-collection protocol that sought to capture, for each case, how people were organised and their associated skill-sets. As this a relatively unexplored aspect of servitization, our process was largely inductive, with the over-riding questions setting out to establish how and why each company deployed people in the style it did. Hence, we did not purport to extensively survey the skill-sets of people in the front-line of delivering advanced services; rather we sought to establish those principal skills that each organisation espouses as important and valued. This data collection protocol was then piloted in a large aircraft manufacturer in north America.

The data collection process was then executed at our four collaborating companies. A range of personnel were interviewed in each case, ranging from maintenance technicians through to senior executives with responsibilities for services. Complementary interviews were also conducted with a small but representative set of customers. Most interviews were conducted with two researchers, notes were taken, and conversations were recorded and transcribed. The resulting data was then collated. Cross case analysis was then conducted with synthesis being aided by mind-mapping

techniques, and this led to common themes being established as responses to the principal research questions. Those responses are now summarised in the following sections of this paper. Here, we are limited by agreement to the extent to which we can describe the particulars of each case.

4. Organisation and deployment of people delivering advanced services

Across the cases, the policy is to co-locate (most) people who are responsible for the delivery of services in a front-office with its own facilities, processes, and a large extent of autonomy. This fits with the notion of a front-office. The front-office refers to a company's departments that come into contact with customers and typically includes the marketing, sales, and other customer facing staff. The back-office is the part of the business dedicated to running the company itself and typically includes people who deal with design, development, production, and other activities that are rarely seen by customers. Here, it is important to highlight that the front-office / back-office distinction should not be confused with the physical location of facilities. The front-office is defined by the nature and focus of activities and can therefore be distributed around wherever such interactions take place.

All forms of manufacturers will have both a front-office and back-office, but in our case companies the increased demand for customer interaction results in extensive front-office operations. This breadth of operations in the front-office can be thought of as micro-vertical integration, and is impacted by the extent to which the manufacturer retains more conventional production operations and the autonomy of these. In turn, this relationship also affects whether some service-centred support activities are retained within the production business to smooth integration with the front-office.

Although the breadth of operations in the front-office may vary somewhat, evidence from our cases suggest that there are common structural characteristics to the way in which people are organised. We have set out to summarise these in table 2. Here, the differences are highlighted between the front-office (which focuses on the delivery of products into the field and then the supporting services) and the back-office (which focuses on the design and production of products). The activities of people within the front-office are then further subdivided.

Categories	Common structural characteristics		
	Front-office		Back-office
Overall focus of staff	Delivery of product-service offerings		Product design and manufacture
Typical role of staff	Frontline customer contact	Support customer contact	Enable customer contact through product manufacture
Examples of staff in role	Account sales/managers, Contract Sales, Field engineers, Operations centre manager, Customer services agreement manager	Condition monitoring technicians, Technical services manager, General managers of parts & service, Product support manager	Research scientists, Engineering design, Production management, Production engineering.
Usual contact person within customer	Project manager, Account manager, Equipment operative	Equipment operative	Equipment operatives, Project managers, Account managers
Extent and frequency of customer interaction	High / maybe weekly	Medium / maybe monthly	Low / periodically and arranged around new product introduction

Table 2: Structural characteristics common in the delivery of advanced services

The form and extent of interactions with customers varies according to this role. With an advanced services contract the frontline staff will interact with (or touch) customers perhaps weekly, indeed in some instances staff might be co-located in a control-room which is within the customer's facilities and so meet daily. These might be customer staff who are responsible for managing contracts, or staff who are operating equipment. By contrast, support staff (such as condition monitoring technicians) will interact with actual customer staff much less frequently. They may, for example, enter into discussions with operatives when diagnosing an equipment fault.

Finally, it is important to highlight that amongst the four cases Field engineers are often considered as frontline staff for the delivery of advanced services. This occurs because of the frequency and extent of interactions with the customer, especially equipment operatives. So influential are such interactions that in some cases such engineers are scheduled to always arrive at customer facilities (say for scheduled maintenance activities) just prior to equipment being shut down (rather than after). This way the engineer can meet the operatives, so sustaining relationships with customer personnel, as well as gaining insight into any early signs of equipment failure that might go undetected by other condition monitoring systems.

5. PRINCIPAL SKILL-SETS EXPECTED OF PEOPLE DELIVERING ADVANCED SERVICES

Across our cases we sought to establish those principal skills that each organisation espouses as important and valued of people within the front-office. Here, we were mindful that these would vary somewhat for differing roles (front-line versus support staff), that there are basic hygiene skills that are required of all workers (e.g.: an ability to work safely), and that in some instances people in the front-office would not necessarily fulfil the espoused expectations. Nevertheless, we set out to explore whether there is set of common skills, which re-occur across the cases, and broadly and comprehensively captured the expectations of workers in the front-office.

Analysis and synthesis of our case data using mind-mapping techniques indicated that there are indeed principal skills. These can be grouped into five themes or sets (table 3). To this end, people in the front-office are expected to possess a particular set of 'people skills' that facilitate positive relationships with customers. As described earlier, these skills may be acquired over time with experience and / or training but are usually primarily a facet of the individual's core personality. Clearly, the social skills needed to engage well with customers will be enhanced by experience but are also largely attributable to a person's natural tendency to be outgoing and socially engaging. These appear consistent with Levitt (1983) who suggested that people in service tend to be humanistic. This terminology suggests that front-line staff are likely to possess the characteristics that provide the 'people skills' needed for service job roles: concerns for the needs, well-being and interests of people. By contrast, people in production might think (or be encouraged to think) technocratically, being technically excellent, analytical, and highly reliable.

As expected, the extent to which these behaviours are demanded of individual staff do vary according to role. For example, although they can both be thought of as front-office staff, a Condition monitoring technician will need stronger technical skills relative to an Account sales manager, who will correspondingly need to be stronger at relationship building. Yet, to a greater or lesser extent all staff in the front-office will be expected to possess and apply the skills shown in table 3, whether this comes from learned ability or from their natural personality. It is also important to emphasise again that these are not the only behavioural characteristics. In general all employees are required to go about work in a safe and proper manner, turning up for work promptly, and fulfilling expectations of the employment contract. However, there are particular skills required of staff within the front-office of a servitizing manufacturer, and it is these that we have set out to identify and represent in this table.

With these humanistic skills there are inevitably trade-offs. For example, back-office staff such as designers are likely to have stronger technical skills. Therefore, front-office staff will be expected to link to these when needed. For instance, if an aircraft is damaged in use then specialist analysis may need to be undertaken by airworthiness engineers to establish the appropriate repairs. Such safety critical analysis would be undertaken by back-office staff, with the technical support team of the front-office providing the necessary field data and customer interactions. In this way the back-office are buffered from direct interactions with the customer. The reason for this was succinctly captured by the Parts and Services manager in one of our cases, who commented that 'manufacturing

people rarely understand service’. In this way the technical support staff in the front-office become brokers for finding solutions to problems.

Skill-set	Description of skill-set	Example of behaviour resulting from skill-set
Flexibility	Ability to modify working routine in order to comply with customer requirements.	Prepared to vary working hours or task to match customer demand.
Relationship building	Ability to develop and sustain close customer connections, and similar relationships with other staff internal to the manufacturer	Readily have meaningful conversations with customers. Forging strong people/team relationships with other staff within the front-office
Service-centricity	Awareness of customer’s problems and delivering against these; readily putting themselves in the shoes of the customer.	Appreciating the consequences of an equipment failure on the customers of our customer. Talking to people, engaging people, and so understand where they are coming from.
Authenticity	Genuinely committed to delivering a successful outcome for the customer	Belief in the manufacturer, its products and services. Only making commitments that can be fully delivered
Technically adept	Understanding of the principal operation and sub-systems of products and equipment	Being able to understand the consequences of an electrical sub-system failure on a machine

Table 3: Principal skill-sets expected of front-office staff

Sustaining the desired behaviour of front-office staff has particular demands of leadership. Our case companies indicated the importance of a fair and cooperative culture in the front-office, along with mutually consistent goals amongst the staff, and a shared interest in being successful. Various techniques were evident in our case companies for achieving such goals. In one instance, there were very clear ‘Rules of the depot’ which set out the values and processes of the front-office (in this instance a trackside maintenance facility). Similarly, there was evidence of staff mobility across customers, front-office and back office. In one company it was a norm to recruit staff from the customer into the front-office, with the motivation being that ‘we must think like the customer and act like the customer’. Yet, this policy was carefully managed to ensure that as far as possible relationships were sustained.

Behaviour was also sustained by a comparable balance of power across the front / back offices, and here there appears to be bias towards the office which is the principal source of revenue. Evidence was apparent of front-office staff taking senior positions within the host manufacturer, and this was to ensure all operations are orientated towards customer service. This helped to ensure that the leadership culture was consistent with the expectations and working of the front-office and an acceptance that these may be different to manufacture. For example, managers in the front-office may be more willing to accept the difficulty of attaining the same high levels of worker and machine utilisation than would be normally achieved within production.

Finally, within the front-offices themselves facilities were carefully designed and managed to complement the expected behaviour of people. For example, it is common practice to have a central control room which is the focal point for the management of advanced services contracts. Rolls-Royce, for example, has such a facility that manages gas turbines worldwide (Walters, 2009). Such facilities bring front-office staff physically close together. This stimulates communications, helps build relationships, and provides a hub for the complete solution of a customer’s problems. Such

facilities are supported by inputs from enabling technologies (Lightfoot et al, 2011) and also help to demonstrate credibility and value to the customer.

7. CONCLUDING REMARKS AND FUTURE RESEARCH

This short paper has set out to present our preliminary findings about the organisation and skill-sets of people who are in the front-line of delivering advanced services. To achieve this we have introduced our research programme, summarising how we have found people to be organised in manufactures delivering advanced services, outlining the expected skill-sets of such people, and then why such behaviour is consistent with success. To conclude this preliminary report on our research, we have summarised our findings about people in the following hypothesis: *Delivery of an advanced service contract is positively impacted by front-office staff who are humanistic in their behaviour, being skilled in flexibility, relationship building, service- centricity, authenticity and technical aptitude, as this ensures speed and effectiveness of response.*

As discussed earlier, some research has already looked at the employee characteristics needed for service job roles, such as resourcefulness, adaptiveness, customer and service orientation. It may be that the five skill sets that emerged from our work have captured some facets of these personality characteristics but our approach and context is different. We are seeking to specifically identify front-office employee skills in servitized manufacturers, and not the general personality characteristics relevant to more conventional service operations.

Our future work will now continue to verify that these are both key factors and subtly different to the behavioural characteristics in a more production-centric environment. We will also set out to combine these findings with our knowledge of practices in facilities, vertical integration, technology enablers, performance measures, and organisational structure and processes. Collectively, these will provide a comprehensive description of the factors that are key to success in the delivery of advanced services, and so key to the successful adoption of servitization strategies within manufacturers.

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LEADERSHIP IN HIGH-VALUE SERVICES FOR MANUFACTURERS: AN EXPLORATION OF THE IMPACT TO FACILITIES PRACTICES

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ABSTRACT

Servitization is a growing area of interest amongst practitioners, policy makers and academics, and much is still to be learnt about its adoption in practice. This paper makes a contribution to this debate by identifying the key facilities practices that successfully servitizing manufacturers appear to be deploying and the underlying rationale behind their configuration. Although these are preliminary findings from a longer-term research programme, this short communication seeks to highlight implications to manufacturing professionals and organisations who are considering the servitization of their operations.

Keyword: Servitization, Product-Service Systems, Through-life Services.

1. INTRODUCTION

Services offer a growing source of revenue and resilience against economic downturns for many industrial companies. In the aerospace sector, for example, engine manufacturers such as Rolls-Royce, General Electric and Pratt & Whitney, all offer some form of performance-based service contracts with commercial airlines. Such contracts provide the airline operator with fixed engine maintenance costs over an extended period of time of typically ten years. Many other western companies are also following such servitization strategies, especially those already with a high installed base of complex equipment (see Baines and Lightfoot, 2012a; Baines et al, 2012a; Baines et al, 2012b; Lightfoot et al, 2011a; Baines, et al 2011b; Baines, et al, 2010; Baines et al, 2009, Baines et al, 2005).

Servitization can however impact the entire operations of a manufacturer. Successfully supporting such advanced services will demand technologies and practices that are subtly different to those associated with conventional production (Oliva & Kallenberg, 2003). Our goal is to understand these differences and their underpinning rationale. To achieve this we have embarked upon a large and far reaching research programme to study the practices of manufacturers who are leading in the adoption of servitization. In this paper we deal with the common facilities practices for their form and location, and reflect on how of these differ to the practices typically associated with conventional production operations.

Our intention in this short communication is to simultaneously contribute to the current debate around servitization in the research community, and improve awareness amongst manufacturers to the consequences of supporting advanced services. To realise this aim, the paper is organised to first summarise the typical facilities practices that occur in conventional production operations. Then an overview is given of the research design for this study is presented. Finally, our findings associated with servitization and new facilities practices are illustrated, before drawing together our conclusions.

2. GENERIC FACILITIES PRACTICES WITHIN CONVENTIONAL PRODUCTION OPERATIONS

In attempting to generalise the practices in terms of the location and structure of production operation facilities, clearly there are many forms that such operations can take. However, clues do exist as to

the popular characteristics of such facilities (see for example; Ford (1922), Skinner (1985), Womack (1990) and Baines et al (2009)). Such authors highlight that although production operations can take differing forms (usually based around the volume and variety of products they produce, eg: project, Jobbing, Batch, Mass, and Process) there are strong similarities in facilities practices. They all seek to exploit economies of scale and resource availability. Hence, the over-riding tendency is for centralised facilities, where people and equipment are located in one place, and production materials are transferred to the location. Current examples in modern operation include the Jaguar car plant at Castle Bromwich in Birmingham which produce Jaguar XK and XF ranges; the Rolls Royce aero engine facilities at Derby producing the Trent 800, 900 and 1000; and the M.A.N. facility in Munich producing a range of trucks and buses.

This rationale is illustrated in the practices of manufacturing offshoring. The literature gives a number of examples where companies have relocated their facilities to exploit low labour cost in less developed economies. Such decisions are influenced by factors such as availability of natural resources (eg: materials and energy), market access, political environment and government incentives. However, the overriding concern appears as access to labour, and leads to the development of large and centralised factories that exploit scale and resources. The question that then arises, is how are such practices impacted when manufacturers seek to compete through a portfolio of advanced services which are coupled to their products?

3. RESEARCH METHODOLOGY

Our purpose has been to understand the differences between the typical facilities practices in production operations and those followed by successful servitized manufacturers. In brief, our method has been to carry out in-depth and multi-disciplinary case-studies of manufacturers who are leading in the delivery of advanced product-centric services.

The data collection protocol was developed and conducted over a 15 month period and completed in October 2010. Semi-structured interviews were held with senior personnel in five multinational of Xerox, Caterpillar, Rolls-Royce, MAN and Alstom corporations. Collectively these deal with the rail transport, aerospace, road transport, office products, and construction equipment sectors. The focus of the interviews was on the people, process and technologies that are used in the delivery of advanced product-centric services such as risk and revenue sharing contracts. These results were then compiled and cross-examined. At this stage, clear and compelling evidence emerged that the location and organisation of facilities in servitized manufacturers differs, to those of production operations, along with the rationale explaining this difference. This evidence motivated the construction of this short communication.

4. FACILITIES PRACTICES WITHIN SERVITIZED OPERATIONS

This section first summarises the facilities practices found in servitized operations, explains the principal business pressures driving these, and then presents an 'influence' diagram to illustrate the rationale and linking mechanism.

The emergent facilities practice: As manufacturers extend their portfolio of product-centric services, then they appear to adopt: *Facilities that are located in close physical proximity to the customers operations and distributed geographically throughout these*.

Evidence of this appears in the operations across the organisations studied. For example, Caterpillar has an extensive geographic network of autonomous dealers, and these dealers themselves may have strategically placed depots close to the customer base. MAN is somewhat similar, again facilities are carefully located geographically such that they are physically close to their principal customer base. In the London region, for example, facilities are typically within a ten mile radius of the customer (the vehicle operator).

This situation is further demonstrated by Alstom who have designed and now support the Pendolino trains operated by Virgin Trains on the West Coast mainline routes in the UK. As part of supporting this advanced service, they subsequently took over the existing rail side maintenance and repair facilities which are regionally distributed across the network. They also have a similar contract for advanced services associated with the Northern Line of the London Underground. Here, they

again they took over maintenance and repair facilities located at either end of the tube line and were previously owned by the underground operator. This is similar to Rolls-Royce Aerospace who has established facilities for Maintenance and Repair Operations (MRO), through joint ventures with major customers such as American, Singapore and Cathay, which are located close to the operational hubs of these airline customers.

The extent to which a manufacturer decentralises facilities appears dependent on the balance between delivering products and delivering services. If the company retains Original Equipment Manufacture then they may also retain a centralised production hub, as is the case with companies such as Rolls-Royce and Caterpillar. Such a hub appears to be less sustainable as the balance of the company's business moves towards advanced services.

Underlying business pressures driving the facilities decision: Our case work has also illustrated that where a manufacturer sets out to adopt advanced services two sets of macro business pressures are incurred that help to explain their facilities practices. One set reflects the direct customer demands of a service offering and, in the case of advanced services, is concerned with measures of performance, availability and reliability. Performance is concerned with the extent to which the full capability of equipment is accessible, for example the power delivered by a gas-turbine as a percentage of that specified. Availability is typically measured as the extent of time that a product or asset is available for use, as a proportion of the scheduled availability. An example of this is Alstom where their contract with the train operator specifies the units of rolling stock that must be available and fully operable for typically 20hrs each day. Reliability is taken as a measure of mean-time between in-service failures. The second principle pressure is from the host manufacturer, and is concerned with the resources required to deliver the service offering, and is typically measured as contract delivery cost.

Underlying relationship between practice and business pressures: The relationship between facilities practice and business pressures is captured by three principal routes through which the practice has an impact.

When facilities are located in physically close to a customer's operations, and distributed geographically throughout these, then product/asset performance and availability is positively impacted because the manufacturer can respond faster. This may occur as both faster fault diagnostics and response to a problem. This is achieved because staff are more likely to be on-hand when or as a failure occurs, possibly witnessing a failure themselves, and so taking corrective actions more quickly and precisely. Examples of this in practice include Caterpillar, who is likely to hold maintenance personnel and critical spare parts for quarry trucks, on-site and in reserve and at large customer mines. Likewise, Alstom support their activities on the Northern Line of the London Underground through safety stock, at line side maintenance and repair facilities located at end-of-line termini.

The proximity of facilities also positively impacts reliability, though principally through a process that centred on building strong relationships between the manufacturer and customer at the level of day-to-day operations. This is critical to a healthy communication process, which itself enables the manufacturer to witness and directly improve their understanding of the application and the way in which the user operates their product. This knowledge can be used to either arrange appropriate contingencies should failure occur (for e.g. knowing precisely where to locate stock reserves and so improving availability), and subsequently modifying the design of products so that they become more reliable. Indeed, it is this capability to improve product designs that provides manufacturers with a significant advantage over competitors who are more conventional service providers.

Although positioning facilities throughout the customer's operations positively impacts performance, availability and reliability, the downside is that contract delivery costs also increase. Replicating facilities throughout a customer's network of operations is expensive and invariably means that manpower and equipment are duplicated and cannot be utilised to their fullest extent. For example, Froude Hofmann, faced an increase of costs in setting up a series of in-country MRO

facilities to deliver its customer's service response requirements, which had to be offset by the generation of increase revenues from customers.

These facilities practices, and their implications on business performance, are moderated by other practices within the broader service delivery system. Key here are stock-holding policies, available resource capacity, capabilities in remote product sensing technologies, and design capabilities. Decisions about these other practices impact the consequences of the facilities practices in a number of ways. For example, large amounts of capacity and stock can help to compensate for a poorly located facility, similarly predictive technologies can give the manufacturer advanced warning of an impending issue with an assets performance.

5. CONCLUDING REMARKS AND FUTURE RESEARCH

Our research indicates that facilities practice adopted by successfullyservitizing manufactures differ to those in conventional production operations. Fundamentally this is because the business pressures and subsequent performance measures also differ. Productiontends to focus on cost, quality and delivery, where as advanced services contracts centre on performance, availability, reliability and cost. These demand that a manufacturer is responsive, and to be responsive they have to question the concept of a centralised factory located to best exploit materials and resources. While in some instanced such facilities may be retained for the production of equipment, providing advanced services successfully appears to require additional facilities that are integrated throughouttheir customer operations.

Our future work will now take this as a hypothesis for further testing. However, we recognise that this will be mediated by other factors within the wider service delivery system. For example, vertical integration, condition monitoring technologies, and capacity decisions all appear to influence facilities practices. Our future work will therefore set out to understand some of these other factors in greater detail, and we will report on these in the near future.

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NETWORKS AND RELATIONSHIPS

SERVITIZATION AND SMALL FIRM NETWORKS

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ABSTRACT

Servitization is the process of creating value by adding services to products, competing through Product-Service Systems (PSS) rather than through products alone. PSS have been explored from a number of perspectives: the strategic implications of service-led competitive strategies in manufacturing, the identification of processes and capabilities to deliver integrated products and services and their ability to derive economic benefit. However the emphasis is on large firms though and small firm servitization has been neglected. This paper presents a case study of a group of small manufacturers cooperating to engage in new product development and offer new services to customers. It was shown that servitization is more complex than adding a service element to existing products. Services are fundamentally different in nature to products, there is significant intangible aspect and the blending products and services makes different demands upon the workplace. For example in this case they have developed new customer service skills; different marketing practices and more time spent of coordinating operations, testing and commissioning.

Keywords: Servitization, Small Firms, Networking.

1 INTRODUCTION

Contemporary manufacturers operate in an ever more competitive business environment where products are easily commoditized and sourcing is global. In response, many firms are making a strategic decision to add a service element to their core product offering. A strategy of 'servitization' is viewed as a means by which manufacturers in high cost locations can compete against rivals based in low cost locations. The assumption being the provision of services implies a closer customer relationship, and the movement from a transactional business orientation based on the making and selling of goods, to a more customer centric approach, providing a unique combination of product and service.

In parallel, peer to peer networking among small firms has also been proposed as a mechanism to achieve a very similar goal. The literature on small firm networking suggests that to succeed in developed economies firms must innovate with their peers so they do not have to compete on the basis of cost. So it too has been advocated as a strategy by which manufacturers in high cost locations can retain their position in the value chain. This paper explores the fields of servitization and small firm networking. After considering the literature of servitization, it briefly looks at the nature and role of networking among small manufacturing firms and goes on to profile a group small firms who engage with servitization through their networking activities.

2 SERVITIZATION AND PRODUCT-SERVICE SYSTEMS

The term servitization was introduced by Vandermerwe and Rada (1988) to describe the emerging trend for manufacturers to compete with “bundles of customer-focused combinations of goods, services, support, self-service, and knowledge” rather than products alone. Servitization was framed as the process of creating value by adding services to products. The value of product-service systems (PSS) to revenue streams is well established in industries that rely on complex technologies (aero engine makers Rolls-Royce Plc and other large original equipment manufacturers (OEMs) typically being cited) and a recent study indicates that over a third of large manufacturing firms now offer services, with the proportion increasing to 58% in Western economies (Neely, 2008).

PSS have been explored from a number of perspectives: by those seeking to understand the strategic implications of service-led competitive strategies in manufacturing (Bowen et al, 1989; Cohen and Whang, 1997 and Gebauer, 2009); by those seeking to identify the processes and capabilities needed to deliver integrated products and services (Baines et al 2009; Bastl et al 2012; Johnson and Mena, 2008; Tuli et al, 2007, Gebauer et al, 2012) and there are also studies that explore the inherent challenges in securing the economic benefits from developing and managing effective PSS (Gebauer et al, 2005 and Martinez et al, 2010). However Kastelli and van Looy (2013) note in their review of the literature that the evidence regarding a manufacturer's ability to appropriate value from servitization is inconclusive, but they also acknowledge the evidence related to servitization and the creation of value is more positive. In summary within the servitization literature, there is an established body of knowledge and a growing understanding of the concept and its effective deployment. Nonetheless the emphasis remains on large OEMs, and to a certain extent, after sales service offerings. What of servitization among small manufacturers?

2.1 Servitization and small firms

With their limited size and resources (Storey and Greene, 2010), small firms may need different a different approach if they are to benefit from PSS, yet there are few studies of servitization in small firms (Gebauer et al., 2010 and Malleret, 2006). There are key differences between OEMs and small firms which must be taken into consideration when analyzing servitization. For instance Oliva and Kallenberg (2003) argue that manufacturing firms must enter the service market by serving the installed base, but this finding cannot transfer to small firms, who may sell through distributors, deliver through installers, and have limited access to their installed base (Gebauer, 2010). Even firms that supply direct to OEMs will often be supplying components and sub-assemblies. How do small firms need to redefine their market offerings and incorporate service into this role? And how can they do so with a enough critical mass to be economically viable? Despite the debate of the economic viability of servitization – a recent large scale study of European manufacturers has revealed a U-shaped relationship between firm size and servitization which indicates distinct advantages to small in servitization. Particularly with respect to product complexity and the likelihood that the firm introduces product innovation. (Dachs et al, 2013).

In parallel to this, there is evidence in the small firm networking literature of firms co-creating value to secure their position at the top of the value chain. Hanna and Walsh (2007) describe cooperative arrangements negotiated to enhance service offerings of small manufacturers, often motivated by the need to secure their supply chain position without additional capital investment. Freel (2003) reports that smaller firms with international cooperative relationships are more likely to focus on products or processes that are new to the industry, whereas locally embedded relationships focus on incremental changes.

Given the limited evidence of small firm servitization, exploring the challenges small firms face when engaging with the marketplace through PSS is an important area of research.

3 RESEARCH FOCUS

This paper presents a case study of five small firms engaged in servitization who have adopted cooperative strategy to facilitate it. Through profiling their experience it hoped to improve our understanding of the capabilities small firms require to successfully deliver PSS and gain economic benefit from servitization. It should also shed light on why small firms are choosing network with peers in this process.

In each firm two senior engineers or managers participated in an in-depth semi-structured interview and there was a factory tour. Company sales and marketing information, press releases and web content were also gathered to cross reference the responses and build an image of the firm and it's environment. Follow up telephone interviews were undertaken to clear areas of ambiguity

The aim was to understand capabilities of the firms engaged, and consider the balance of capabilities inherent to their expertise and those related to the ability to function within a PSS network. What facilitates the shift in servitization and what value was there in operating as a group versus individuals. The study adopted a qualitative method informed by a case study approach. The work was an engaged research study (Van de Ven, 2007) intended to explore the development of service offerings by manufacturing firm. The research aim was to examine closely the nature of the connections between manufacturers jointly offering service capabilities. The aim was not to develop a framework for capabilities for successful servitization but rather to explore the fundamental processes in play in a little found phenomenon – small firm servitization – therefore a single in-depth case study was suitable.

3.1 Case study

Figure 1 profiles the firms in a PSS network which has evolved to develop new products. Firm 1 manufactures mechanical and electrical products and involves suppliers in both manufacturing and design to varying degrees depending on the nature of the projects. It is the only organization the end customer liaises with directly initially, although they are familiar with all of the firms. New products are designed on a modular basis, with core aspects developed exclusively in-house in each of the firms to protect intellectual property. The primary advantage is the reduction in development time. The innovation required by a new product development project will dictate the timing of multi-firm engagement – firm 1 always takes the lead – scoping out work and then negotiating timing. Firms are integrated in the concept stage for radical new products, and later for less innovative goods. Greater complexity results in longer lead times, especially in tooling, so early customer engagement is organized for complex projects. Conversely, the timing aspect is of less importance for parts or modules made from readily available components or technologies. The interface between firm 1 and firms 2, 3, 4 and 5 has formal and informal aspects. The relationship between the design and manufacture engineers is crucial for communication and synchronizing of lead times.

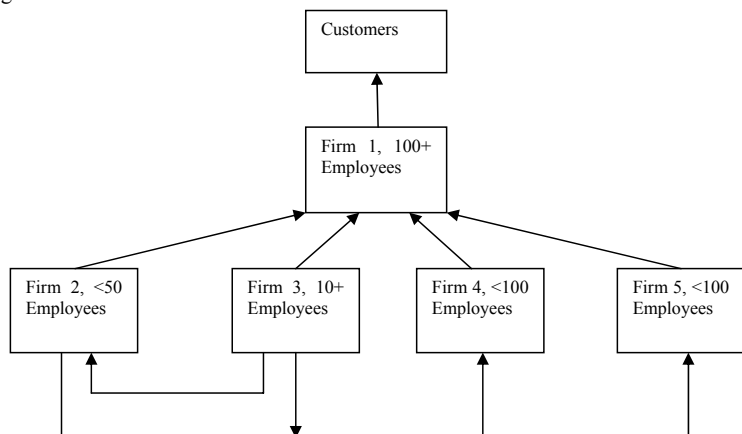


Figure 1 PSS Network

In the PSS network profiled, firms have supply relationships between themselves as well with firm 1. Firms 2 through 5 are contracted individually to develop a package of work (module) but may well work with one another to develop the module. Nor are they all engaged simultaneously, in this network firm 5 is often integrated last. Their work is reliable and cost effective, but their capabilities are neither unique nor complex. However their relationships with the firms in the network means they are aware of ongoing work and can be competitive in the process, especially in terms of just-in-time delivery. Table 1 describes firms 2 through 5 and the value they place on new product development capabilities within their PSS. It is the ability of this network to develop custom solutions that is actively marketed. They do not target exports but national markets.

Firm	Description	Added Value Processes
2	Prototyping and contract manufacturing specializes in the development, production and design of products, customers vary from inventors to major brand owners to private inventors.	Building trust based relationships with clients, proactive in offering new services and technologies. Values open and informal communication.
3	Advanced design and manufacturing skills, proactively sources new technologies.	Technology driven and engages in face to face consultation, including development and testing on client sites.
4	Design and manufacture of electrical components embedded in plastic and rubber	Structured communication (e.g. open and regular meetings) with selected clients, focus on knowledge transfer.
5	Manufactures composite parts for a range of industries.	Speed in executing requirements, cost effective and market driven product development.

Table 1 Profile of Suppliers 2 though 5

There are no formal procedures for monitoring or coordinating communication between players in the network but tensions were starting to be articulated regarding this aspect of operations. Firm 1 felt the level of work they were 'delegating' would increase long term and they needed to develop information systems to ensure they could deliver designs efficiently to the customer. More and more manufacturing and design is moving into the PSS network as both product and process technologies evolve and expand. The way in which they engage with the PSS network is effective for firm 1. However lack of structure in the involvement process and late involvement were seen as challenges to overcome by firms 2, 3, 4 and 5. The logic of firm 1's release of work packages was not always transparent, and firm 5 in particular had to manage short lead times and a cost down pressure.

All of the firms articulated the success of their PSS network was underpinned by location. All of the firms were based within a region and were committed to mobilizing people and information across sites. There was still a sense competition among the firms, none of them have exclusive contracts or skills sets (including firm 1 who interacts with the end customer), and they were proactive in communicating new technology offerings and marketing their services to one another. They market the PSS informally as a one stop solution provider.

4 DISCUSSION

Factors such as inadequate communication, lack of trust, mismatch of resources and inappropriate organizational structures and/or processes (George and Farris, 1999); and poor processing of information and management of uncertainty (Thomas and Trevino, 1993) have been proposed as reasons why small

firm networks under-perform. Within the PSS these exigencies were proactively dealt with to avoid them becoming an issue. Firm 1 had sufficient internal capabilities in order to benefit from external capabilities in the wider PSS network. They had a clear vision of how developmental projects should be managed they knew their strengths, the technical challenges to be solved and coordinated information sharing. A significant challenge raised by all the firms was the service focus had increased customer contact points (particularly in firm1) and this needs tracking as does the information sharing.

Key decisions were how much work and responsibility would be devolved within the PSS network, and when in the development cycle the full team should be engaged. These latter two issues were affected by complexity, lead time and market size. The other firms within the PSS network focused on their external skills, in particularly: networking with peers, communication lines into key clients new product development teams and technology scanning. These priorities combined to ensure they have the most advantageous balance between individual technological capability and the ability to harness their skills with others.

Universal to all firms within this study was the belief that the location is crucial – none of the innovation would be possible if they had not developed a relationship that allowed them to easily move between locations to test and commission technology, and share information/data on a real time basis to develop to maximize the performance of their collaborative efforts. In line with Weaver and Dickson (1998) goal and relationship based determinants, took precedence over differences in size/power between and the necessity for formal contracts. The contracts were always been individual firms and the end customer, but their fulfillment was leveraged through the network.

The firms felt participation in the PSS network had delivered benefits - it had enhanced the localization of business and driven their ability to outcompete low cost competitors. They also foresaw potential to enhance the product they delivered – they had effectively narrowed the gap between designer and the user, and that increased understanding could be exploited. This ability to enhance performance and secure long term business was seen as a counterweight to the risk associated with increased time (and consequently economic) investment in communication and networking. They shared the belief that firms with excellent products in a competitive industry can use service as a differentiator, strategically they have visibility and a supply chain position close to the OEMs, and financially they are not investing in extra technology but advantageously combining existing capabilities and capital investment. The PSS network allowed them to exploit their capabilities and differentiated them from low cost competition – they provided custom solutions not a product.

5 CONCLUDING REMARKS

Servitization is more complex than adding a service element to existing products, with a bundle of products and services there is a blend of standardization and customization that can be difficult to manage. Services are fundamentally different in nature to products, there can a significant intangible aspect and the blending products and services makes different demands upon the workplace. For example in this case they have developed new customer service skills; different marketing practices and more time spent of coordinating operations, testing and commissioning. The transition is more complex than realigning processes, as it requires a change in the very culture of the firms themselves. Competing as a team rather than as an individual to be successful, yet still needing to be high performance manufacturers in their own right. The findings suggest a PSS network can be a route to sustainable growth through servitization for small manufacturing firms.

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DELIVERY PROCESS AND THIRD-PARTY INVOLVEMENT IN A MANUFACTURING COMPANY'S INSTALLATION SERVICES

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ABSTRACT

Manufacturing companies commonly offer services alongside their products to better meet the customer needs and achieve better profitability. Delivery of product-service operations differs from that of products and therefore manufacturers are forced to adapt their product-oriented practices. Changes are needed in the delivery processes but also in the partner network. This paper discusses these themes from the viewpoint of a manufacturing company's installation service process. An exploratory case research was conducted in an engineering industry company. The results show that adding services to a manufacturing company's offering complicates the delivery process remarkably. Profitable provision of product related services requires seamless cooperation with several third parties but simultaneously increases the complexity of the delivery process even further. The integrator of different partners' operations plays an essential role in the success of service provision. Optimizing the delivery system for service offerings requires managing the repetitive flow of small service projects successfully.

Keywords: Servitization, supplier, service process.

1 INTRODUCTION

1.1 Delivering product-oriented services

Today most manufacturing companies add services to their product offerings. Integration of products with services allows manufacturers, for example, to add value to their products, improve relations with customers and better fulfill customer needs (Mont 2002). Additional services can be closely related to the product (e.g. maintenance) or have more service-oriented content (e.g. leasing) (Tukker 2004). The focus of this paper is on product-oriented services. These kinds of services are directly added to a product in such manner that the product remains as a central element in the integrated product-service offering (Baines et al. 2009b) and they are provided to ensure the utility of the product (Cook 2006).

Manufacturing differs significantly from perishable, complex and multifunctional service activities (Brax 2005). Also the delivery processes of products and services are divergent, because production and delivery systems are separate in manufacturing but integrated in the case of services (de Brentani 1991).

Delivery of services also requires increased interaction with customers and is more people intensive (Kindström & Kowalkowski 2009). The delivery of product-oriented services consists of both product and service components; during the delivery process materials are transformed into products that are provided with services to deliver functional capability to the customer (Baines et al. 2009b). In consequence, delivery of services requires different management approaches than product delivery, (Normann 2002) pressurizing manufacturing companies to develop their delivery processes.

However, the delivery of product-oriented services and their process development have been shown to involve significant challenges. These relate to increased customer interaction as well as understanding of the requirements and expectations (Martinez et al. 2010). Delivering product-oriented services has been stated to even require adoption of a new service based language in manufacturing companies (Baines et al. 2009a). Despite the challenges, the research on integration of manufacturing and services on the detailed level has been limited so far (Baines et al. 2009b, Bikfalvi et al. 2013).

1.2 Third party involvement in service provision

Whilst products are manufactured by one company, services are usually provided in cooperation with external parties (Cohen et al. 2006). Cooperation with third parties is essential in order to acquire know-how and competencies in the services area (Lockett et al. 2011), to acquire information of the customers' or end-users' processes (Sampson 2000), and to create more value to customers (Bikfalvi et al. 2013). Thus, many servitizing companies gather a group of closely integrated partners, such as service firms, other manufacturers and maintenance and logistics specialists, to deliver services (Baines et al. 2009b).

Third parties' involvement may increase the complexity in a manufacturing firm's service delivery (Bikfalvi et al. 2013), and at the same time they may have a crucial role in opening up or controlling a suppliers' access to the end users. For example, system integrators may have a key role as information providers of end-users' activities towards product suppliers, or as barriers to such information (e.g. Finne & Holmström 2012). Complex product-service systems often require engaging a broader network of suppliers and integrating their business processes for the delivery of customer value (Gann & Salter 2000). Although the problematic nature of developing service delivery with third parties has been noted, the detailed discussion in the context of servitization is still quite limited (e.g. Finne & Holmström 2012).

1.3 Objectives of the research

The main objective of this paper is to increase understanding on the complexities associated with the service delivery process in a manufacturing company that has increasingly started to provide product-oriented services. We investigate the delivery processes, third-party interaction and information flows in a manufacturing firm's installation services. The research questions are following:

1. What kind of delivery process does the case company have for installation services, particularly in terms of information flow? How does it differ from the product delivery process?
2. How are third parties involved in and affecting the delivery process?
3. What kinds of information sharing challenges do the actors in the process experience during service delivery?

2 METHODS

2.1 Case company

The study was conducted as an exploratory research in one business unit of a corporation operating in a selected segment of the engineering industry. The case corporation has a long history as a materials and product manufacturer but the business unit also offers installation services for their products. Installation is executed by external subcontractors but also other third parties are utilized in service realization (e.g.

external material suppliers, logistics providers and special service providers). Case company project managers serve as integrators of the third parties involved.

2.2 Data collection and analysis of the data

The research approach is qualitative, and data were collected through interviews and observations at selected installation sites. Interviews using unstructured interview protocol were realised with 15 company representatives from seven departments. Installation observations were realised at five different worksites. Each observation was carried out within one day (2–8 hours); length of the observations differed according to observed work task and work phase. During the observations a total of five customers were interviewed at the installation sites.

The interview and observation data were content analysed and the results were utilized to model the service delivery process, identify relevant third party interactions as sources of increased complexity, and map the challenges relevant to the company's servitization in light of previous research.

3 RESULTS

3.1 Delivery process for installation services

After the research was conducted, a service blueprint of the whole installation process was made with a specific focus on the information flow within the process. Based on the blueprint, the installation service delivery process was mirrored with the product delivery process. Vast differences were found between the product delivery process and the installation service delivery process. While the materials flow is fairly straightforward, the information needed for installation services organization follows a more complex path. Particularly the use of third parties as material and service providers, both in installation and its support functions, increases the complexity of the installation service delivery process. It also has to be noted that with pure material delivery, customer is only in contact with the salesperson, whereas with installation delivery there are three separate customer interfaces: salesperson, project manager, and the installers. Each installation is somewhat unique but all have common features, and the general work processes apply to all installation projects.

The product delivery process in this case is quite simple and straightforward. The case company has a long history as a materials manufacturer and its supply chain has been well defined and fine-tuned. Case company materials are delivered to the installation site fairly quickly and efficiently. The most complicated components of the process are linked to order processing, materials calculations and customer invoicing, which show room for improvement and modernization of practices. A simplified comparison of the product and installation service delivery processes is shown in figure 1.

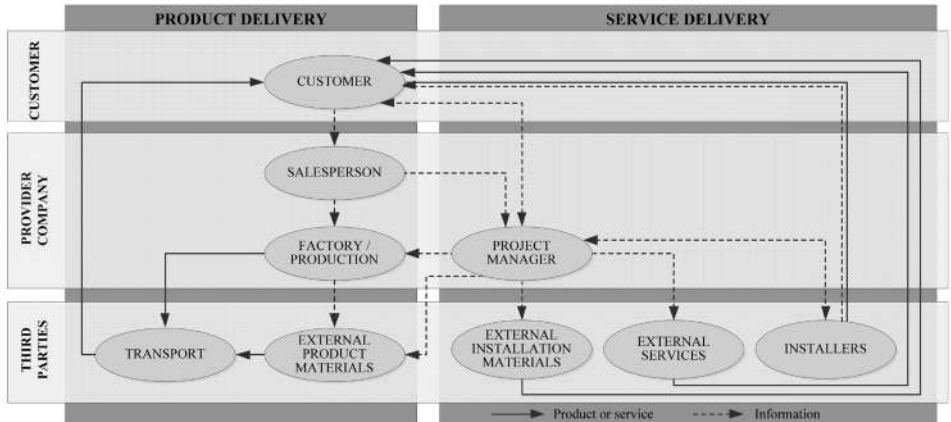


Figure 1: Simplified comparison of the product delivery and installation service delivery processes

Compared to the product delivery process, the installation service delivery process is significantly more complicated. It can be seen as somewhat of an “add-on” to the product delivery process. Most of the service delivery process is dependent on the project managers’ expertise and contacts with various suppliers. With many unofficial connections and the dependence on the project managers, the process is not uniform throughout the company.

3.2 Role of third parties and information sharing

The role of project managers was seen to be central in succeeding with the installation service delivery. Project managers were mainly in charge of the coordination of the installation process and the procurement of both the materials and services needed. Noteworthy in the project managers’ actions was the combined daily use of both official company partners and unofficial but clearly established connections with third party service providers. Often it is merely the relationship between the project manager and the supplier base that determine the selected supplier. The third parties involved and their roles in the process are discussed in the following paragraphs.

Third parties performing the installation: This group includes the personnel that are responsible for the actual installation work. In the case context, all installers were external workers. However, most installers work solely with the case company and under the control of project managers. Project managers schedule the installers’ work on a macro level, and deliver installation documents and instructions to the installers. The installers do have some own powers to make decisions: they set up the installation schedule on a micro level, can independently purchase missing materials from suitable vendors of their choice, and also have some influence on when and how other external installation support services are used.

Third parties providing materials for the installation process: These constantly used suppliers generally have a long history with the case company or a particular project manager. Project managers are responsible for selecting the suppliers, making the material orders and giving instructions and guidelines for them. These companies also have other clients, but for the case company they are the de facto providers in their respective geographical and expertise areas. In some occasions they have annual contracts with the case company’s project management. In addition to the constantly used suppliers there are companies that the installers in the area use to get supplies on a short notice. Such companies are freely chosen by the installers and generally have no deeper relationship with the case company.

Third parties providing services during the installation: These services include waste collection, sanitary facilities, logistics, and additional services and external machine rentals needed for the

installation process. They are organized, contacted and scheduled by the project manager; however, installers can somewhat influence the use of logistics services and additional services and machines. Often the providers of these services work in conjunction with materials providers, e.g. using waste collection and logistics service providers to transport materials from external suppliers to the installation site. These companies can have annual contracts with the case company's project management, but often they just have long relationships with a project manager. Sometimes the case company is their sole client.

Third parties providing specialty materials for the project: These suppliers have a smaller yet important role in the whole installation process. They provide custom-made and project specific parts to be installed with the main product. They are mainly contracted suppliers for the case company. The responsibility for material orders, depending on the component, is either on the material requirements planners or the project managers. Project managers are again responsible for the scheduling, but not the supplier selection. Parts are installed by the same installers that perform the work for the rest of the process.

Third parties providing services for the finishing phase: In addition to the installers that are responsible for the majority of the manual work in the process, there are also other parties providing installations services in the finishing phases of the process. Usually these parties perform specialty tasks at the finishing phase of the project, during or after the main installers' work. They are selected, scheduled, and organized by the project manager, and usually are unofficial partners that have a relationship with the project manager.

Project scheduling, organization and information sharing with different parties falls mostly on the shoulders of project managers. They are in contact with the customers, case company production facilities, installers, and both external materials and services providers. Salespeople are responsible for closing the deals and making installation plans and preliminary material calculations, after which the project gets turned over to the project managers who act based on the original plans. Insufficient or faulty planning by salespeople can cause extra work for installers and project managers. With the use of unofficial partners, it is the project manager's responsibility to contact, select, and inform them. Project managers form and develop relationships with companies in their respective areas. The companies selected by project managers are used repetitively because "*we don't have to teach them how things are done at every site – they know what to do*". The use of various external suppliers simultaneously provides challenges with timing and availability of services. Also the lack of synchronization between the product deliveries and installation execution can create challenges with materials having to be stored on site for extended periods of time.

4 DISCUSSION

The results show differences between the delivery processes of providing purely products and providing more complex product-service systems. The results also lend support to the previously identified complexity and bidirectionality of information flows in service provision (e.g. Sampson 2000), which can be considered a capability and learning challenge at the early phases of servitization.

Changes in the delivery system caused by servitization relate particularly to the number of network participants, the involvement of the customer, and the role of the project manager and third parties. We showed that the delivery mode of installation services resembles complex projects (Gann & Salter 2000), although on a quite small scale. According to this study, the product delivery can be realized mainly by the manufacturing company's own operations but delivery of product-services require involvement of different parties, mainly external but also within the company. This also affects customer contact points. From the customer's viewpoint, purchasing and receiving products only requires contact with the salesperson, but when ordering product-services customer also interacts with the project manager and several third parties operating at the installation site. Further, broader and more detailed information is required from the customer to ensure proper service delivery. The integral role of localized service coordinators such as project managers in service delivery makes the standardization, extension and

diffusion of product-services difficult. Moreover, the responsibility of solving the deficiencies in different parties' operations is left for the project managers.

The results showed that the performance of third parties affects the success of service delivery significantly and, hence, customer experienced quality and manufacturing company image. Previous research has already emphasized cooperation with partners in delivering product-centric services (Baines 2009b). Our findings lend support to the partners' role in knowledge brokering and capacity leveling when responding to customer requirements (ibid.), but also reveal a strong dependency between the manufacturing firm and its local, committed and repeatedly contracted third parties in their specialty tasks, through the project managers' local, informal networks.

Delivery systems in manufacturing companies have earlier been optimized for product deliveries, and additional features and phases needed to deliver service offerings require modifying the entire product delivery system. This complicates the delivery system and information flow between different parties. This study has shown the resemblance of installation delivery services with delivery projects due to the strong involvement of multiple third parties and, yet, a very small scale in terms of time, cost and scope. Further studies are needed to understand how such small and repetitive "service projects" can be delivered efficiently in connection with the rather straightforward product delivery process. The challenges and improvement opportunities with information flow and information sharing reveal unique complexities based on the use of third parties in service delivery, and the prevalence of official and unofficial interaction routines.

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THE ROLE OF RELATIONSHIPS IN DEVELOPING PRODUCT SERVICE SYSTEMS

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ABSTRACT

As part of servitization manufacturers are developing product-service systems (PSSs) to help maintain their competitive edge. The introduction of results-orientated PSSs (e.g. capability-based outputs) require manufacturers to adapt existing operational capabilities and develop dynamic capabilities. The single case in this study demonstrates that the focal manufacturer is using dynamic capabilities to address new markets beyond its core defence business. Equally, new operational capabilities are being developed to offer customers capability-based outputs, rather than products and ancillary services. These outputs cannot be delivered by the manufacturer alone, with the company having to mobilise the capabilities from actors within its network. The study provides a dyadic assessment of the dynamic and operational capabilities required to enable servitization activities. Being able to mobilise capabilities within the network and manage the risks are of key significance for the creation of value for the manufacturer.

KEY WORDS

Capabilities, Relationships, PSSs.

1 INTRODUCTION

Manufacturers are seeking new ways to maintain their competitive edge in light of growing competition and product commoditization. Servitization has been identified as a mechanism for achieving competitive advantage and creating value (Baines *et al.* 2009; Vandermerwe and Rada 1988). The product-service systems (PSSs) literature proposes a classification for delineating between different servitization offerings, generally comprising of three forms: product-orientated PSS (e.g. product and ancillary services), use-orientated PSS (e.g. availability contracting) and results-orientated PSS (e.g. capability contracting) (Baines *et al.* 2007; Tukker 2004). The servitization process implies that manufacturers move beyond the design and manufacture of products and become more vertically or horizontally integrated.

Downstream vertical integration involves manufacturers taking over service operations that may have been performed by their customers, whilst upstream vertical integration involves taking over activities in the supply chain (Baines, Lightfoot and Smart 2011). Horizontal integration involves manufacturers developing services linked to other original equipment manufacturers' (OEMs') products (Raddats and Easingwood 2010). To successfully servitize manufacturers need to develop new capabilities that go beyond traditional product design and manufacturing and encompass vertical and horizontal integration.

Extant literature often discusses servitization capabilities from a perspective that is 'internal' to the focal manufacturer (e.g. Ulaga and Reinartz 2011) and largely assumes that manufacturers take over activities previously carried out by downstream partners/customers (Spring and Araujo 2013). However, recognition is growing that internal capabilities are insufficient to fully capitalise on servitization opportunities (Paiola *et al.* 2012). Despite this, empirical research addressing how manufacturers work with partners to provide services is sparse (Kowalkowski, Kindström and Witell 2011). To fully understand how external partners support the development of new PSS capabilities requires a dyadic perspective, be it manufacturer/customer or manufacturer/service partner. This dyadic approach is missing from most studies (e.g. Gebauer, Paiola and Sacconi 2013). Hence, this study aims to investigate the capabilities required and the role of partners in developing new PSSs, using a single case study firm.

2 THEORETICAL FRAMEWORK

2.1 Product-service systems (PSSs)

Although the extant literature often presents three PSS concepts (product, use and results-orientated), some researchers suggest that results-orientated PSSs are more important because they provide customers with greater value-in-use (Baines *et al.* 2007; Tukker 2004). In results-orientated PSSs, products are typically replaced by services, aligned to the activities the customer performs with the product (Baines *et al.* 2007). In this respect PSSs frameworks are similar to other frameworks that position manufacturers on a product/service continuum (Oliva and Kallenberg 2003), with much extant research urging manufacturers to develop the most servitized offerings (Wise and Baumgartner 1999) which requires them to take on greater risk in the value creation process (Bonnemeier, Burianek and Reichwald 2010). However, studies suggest that many manufacturers often fail to successfully servitize, with a number of potential factors cited for this lack of success, such as: lack of top-level commitment to services within the manufacturer (Gebauer and Fleisch 2007); failing to make the cultural shift towards a proactive, clear and strong service strategy (Mathieu 2001); not having the right capabilities to exploit the shift to services (Neely 2008). The lack of appropriate capabilities appears particularly important for results-orientated PSSs, given the fundamental shift from product- to service-based offerings.

2.2 Capabilities For Servitization

Capabilities have been variously described in the extant literature and centre on the firm's abilities to perform productive activities (Jacobides and Winter 2012). Capabilities can be classified as operational or dynamic (Winter 2003). Operational capabilities are those that are required for a specific business environment, whilst dynamic capabilities enable firms to address changes in the business environment (Teece 2007); modifying, extending or creating new operational capabilities (Winter 2003). Dynamic capabilities are often categorised as sensing, seizing and re-configuring (Teece 2007).

A manufacturer's operational capabilities for product-orientated PSSs centre on it being an OEM with strong product-related technical knowledge and expertise, which enables the provision of a range of

product-related offerings (Ulaga and Reinartz 2011). If a manufacturer is to offer results-orientated PSSs, then dynamic capabilities are likely to be required to enable this change, e.g. sensing and seizing new service opportunities and reconfiguring the business to be able to exploit them (Kindström, Kowalkowski and Sandberg 2012). Given that servitization could involve manufacturers addressing vertical and horizontal integration, then new operational capabilities are also likely to be required. Capabilities for forward vertical integration appear particularly key, with manufacturers needing to be able to integrate their PSSs as a functional subsystem into the customer's systems (Brax and Jonsson 2009). Equally, the ability to develop and price PSSs on a risk/reward basis appears important (Cova and Salle 2008). If the manufacturer takes over service-based activities previously performed by the customer then new service methodologies or processes need to be developed (Paiola *et al.* 2012). Horizontal integration requires new capabilities to address service opportunities on other OEMs' products. For example, the ability to integrate products from multiple vendors into systems (Davies, Brady and Hobday 2006). Equally, manufacturers used to predominantly supplying their own products might need to develop a partnering capability with other OEMs to maximise synergies and efficiencies between the parties (Storbacka 2011).

The view in much of the servitization literature that the operational capabilities required for new service offerings should predominantly reside within the focal firm has recently been challenged (Gebauer, Paiola and Saccani 2013). Capabilities within a focal manufacturer's wider network are, therefore, expected to facilitate the development of new capabilities (Araujo, Gadde and Dubois 2003; Spring and Araujo 2013). The choice for a manufacturer in terms of developing the required capabilities thus amounts to 'internal' development (the company develops them itself), 'external' development (the company outsources the development to suppliers and partners) or 'mixed' (capabilities are jointly developed with customers and partners) (Paiola *et al.* 2012). We contend that within results-orientated PSSs, the 'mixed' approach may provide capability development that better matches the value outcome needs of customers and offer more value for the providers involved.

3 METHODOLOGY

Given that PSSs are an emerging phenomenon, a single case study methodology was used, with organization Alpha, in the defence/aerospace manufacturing sector, the focus of the case. Secondary data was initially collected and analysed to inform the research, including documents and notes from preparatory meetings with senior managers at Alpha. This was then followed by in-depth interviews being conducted with eight senior managers within Alpha and one manager within an IT services partner (Beta). Interview transcripts were sense checked by respondents and then thematically coded by two researchers.

4 RESULTS

The initial results from the Alpha case are presented below. A key aspect of the case is a surveillance PSS that Alpha provides. As part of this PSS, sensors are fitted to aircraft that are capable of scanning large areas of the ground to detect changes in the environment. The PSS would typically be bought by military customers and potentially civil law enforcement agencies. Results in section 4.2 provide an indication of an on-going development rather than an existing contract to enable the exploration of capability requirements as they become apparent.

4.1 Servitization Activities at Alpha

Customer drivers for servitization come in the form of new required outputs from the service and/or a reduction in the cost of providing the service themselves. In developing new PSSs, the starting point for

Alpha is to use its own products wherever possible, so a surveillance product-orientated PSS would include its own sensors plus ancillary services, e.g. repairs and spares. If Alpha's own products are not the most suitable for the customer then those from other OEMs might be used instead. For sensors, cheaper alternatives are provided by other OEMs, albeit with lower performance. Alpha's use-orientated PSSs are 'availability' contracts that have been developed both for own and third party products. These involve charging the customer on a 'pay-as-you-fly' basis, dependent on the number of flying hours of the plane and operational hours of the sensor. The benefits of availability contracts are greatest when a single provider can consolidate products from multiple OEMs into a single output. Alpha has developed capabilities in streamlining the supply chain and creating efficiencies leading to significant cost savings for the customer. The ability to provide PSSs using third party equipment is therefore a key capability for Alpha. However, this capability is not necessarily based on technical knowledge of the other products but rather the capability to manage the end-to-end service process, so that product repairs are still being performed by the OEM. Despite being able to offer use- and results-orientated PSSs, Alpha is still able and willing to provide product-orientated PSSs. While there are benefits to both supplier and customer in having more complete service offerings, managers at Alpha believe that it is important to contract with customers on the basis that they require. In contrast to research that urges firms to see servitization as a 'one way' journey towards a fully servitized future, Alpha currently develops a portfolio of different PSSs that cater for the needs of different clients in different markets and countries.

4.2 Results-Orientated PSSs

In line with acknowledged difficulties in developing result-orientated PSSs capabilities, Alpha set up a new business unit to develop these services, focusing on both core and new markets, such as the civil law enforcement market. The new capability bundle being developed involves coordinating the passage of the sensors over a particular area of ground; capabilities Alpha is already strong in, having its own sensors and strong relationships with aircraft manufacturers/operators, onto whose vehicles these sensors are integrated. However, it also requires taking data from an aircraft's sensors, analyzing it and providing the output to the customer. A key Alpha respondent, noted that it is important to have a broad perspective on the output from the service, with a number of key questions to address:

"If a customer wants a surveillance service... then you've got to think about what is the best way to do that; what equipment do you need; how is it going to be operated; is the customer going to do that themselves; how do we actually help them achieve that; how are they going to exploit the data that they get; what is the actual end performance that they're trying to achieve?"

In this case, the customer does not want to own the assets (the sensors or the aircraft). Equally, the customer does not want to manage and interpret the data coming from the sensors, but rather only wants to be advised of notable changes in the ground environment (the output). At this point in the development it is unclear whether the customer will commit beyond a short-term contract. From a capability perspective, this poses a number of challenges for Alpha; whether to develop the necessary capabilities, how to manage the end-to-end service risk and determining whether this can be done in a timeframe that delivers an acceptable ROI. What is also clear is that as the capabilities required to provide the customer's output become more complex so the need to partner with other companies becomes greater. Alpha must determine what elements of the service it can perform in-house, which could be provided by a partner and who that partner should be. For this surveillance service, the significant data analysis requirement means that Alpha need to explore working with an IT partner. Beta is already providing IT services to Alpha, such as desktop and applications support and had also demonstrated capabilities in 'big data' analytics. This has made them an attractive partner to engage with.

5. DISCUSSION

Initial findings show that all three types of PSSs are either provided or planned by Alpha, with network partners important for many of the offering that it provides. Alpha has suitable operational capabilities (built on a heritage of strong product-related technical knowledge and expertise) largely without recourse to network partners, for product-orientated PSSs (in line with Ulaga and Reinartz 2011). Alpha has also extended these PSSs with third party products, developing the capability to manage the services processes for other vendors' products (supporting Raddats and Easingwood 2010). Alpha has also developed the capability to provide multi-vendor availability contracts (use-orientated PSSs) which enables the company to generate additional value for customers. The capacity to create efficiencies in the supply chain is a key differentiator for Alpha, but also a considerable source of risk (in-line with observations by Bonnemeier *et al.* 2010). However, Alpha have drawn on current capabilities to developed new risk assessment capabilities in order to cope with this.

There is evidence of dynamic capabilities within Alpha through its investment in a new business unit tasked with seeking customers outside of the core defence market, e.g. civil law enforcement agencies (Teece 2007). This market appears likely to need 'capability' services focused on output, rather than ownership, with management of the risks in delivering these services paramount for Alpha (Cova and Salle 2008). The provision of such PSSs means that Alpha has to develop partnerships, not only with aircraft manufacturers but also IT providers, to provide specialist analysis capabilities for the significant amount of data generated from the surveillance service. In order to deliver output-based offerings, that would be hard to fulfil using in-house capabilities, Alpha is mobilising relational capabilities (Gebauer *et al.* 2013). Results-orientated PSSs represent a significant development of Alpha's and Beta's capabilities, which neither can deliver alone, nor without wider network support. Being able to mobilise network capabilities, while also managing risk becomes of key significance for Alpha's creation of value.

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SERVITIZATION CHALLENGES WITHIN TELECOMMUNICATIONS: FROM SERVICEABILITY TO A PRODUCT-SERVICE SYSTEMS MODEL

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ABSTRACT

This paper takes a Product-Service Systems (PSS) perspective on the servitization process in the telecommunication industry and by presenting findings from both a retrospective study in a telecommunications company and current trends we aim to answer why and how PSS could be a preferred strategy going forward in this industry. Growth markets and cloud is presented as special cases and also targeted as key drivers for servitization in this context. It is also argued that a PSS approach would support the co-existence of products and services, their mutual dependency on each other, and thus gain competitive advantages for telecommunications companies. The paper concludes on five key principles to address in pursuing servitization; climb the pyramid, create balance, act on challenges, create mutual understanding, and focus on one offering.

Keywords: Servitization, Product Service Systems, Telecommunications

1 INTRODUCTION

Telecommunication companies are in a state of transition, going from product focus towards more service focused business approaches, and the development has been ongoing for many years. Today, the vendor industry in telecommunications is under great pressure, which is clearly seen in the quarterly reports, showing up as pressure on margins, or, as in some cases, negative margins being reported causing the industry to respond by reducing the workforce. The vendor landscape has changed somewhat over the years with mergers and acquisitions in a number of areas as vendors aim to get a complete portfolio as possible, here major examples would be Nokia Siemens Networks and Alcatel Lucent. However the industry has also suffered casualties where companies that were unable to compete, for example Nortel Networks and the break up in 2009. Meanwhile, the competitive differentiators has narrowed over time, starting with (1) breadth and depth of the hardware and software products, i.e. vendors competing to have the most complete networking portfolio, (2) performance and quality, competition between Chinese and Western vendors, and (3) service delivery and the ability to deliver on the promises in terms of competence and global reach. These differentiators have been eroded and although individual differences in the various areas can be seen, the similarities are great between the vendors. One area that is suffering and can be seen to some extent in all the companies' recent quarterly earnings results is the erosion of margin. The purchasing power of operators has grown and with variables comparable across vendors in terms of hardware, software and services being similar, the only remaining item to compete on being price. Thus, to remain competitive telecommunication companies need to differentiate themselves and their offerings in totally new ways. Meanwhile trends such as commoditization of products and complexity (Wood et al., 2011), forces the industry to make a standpoint; to either remain on the path of a technology driven industry or to change towards a more customer value driven business.

This paper takes the latter standpoint; a Product-Service Systems (PSS) perspective on the servitization process in the telecommunication industry. By presenting the case of Ericsson – going from serviceability of products to a PSS model of doing business, we aim to shed light on the challenges a PSS approach brings and how such approach affects the day-to-day operational business.

1.1 Research Approach

The research presented in this paper is based on a longitudinal case study (including retrospective study) executed from within one case company. The study is on-going per today and the result presented here is a subset of the expected final results. We aim to examine the product-to-service transition process, servitization, in the telecommunication industry from an organisational maturity and offering perspective over time. The unit of analysis are thus (a) the organisation and (b) the offering portfolio.

It is not possible to generalise from this standalone case, however, a longitudinal case study, as it is presented here, gives valuable data and contributes to the understanding of how and why this particular company has pursued the journey of servitization. Further, case study research is also used as the preferred strategy when ‘how’ and ‘why’ questions are being posed (Yin, 1994) and when looking for in-depth insights of empirical phenomenon and contexts (Dubois and Gadde, 2002). We continue to post the how and why questions in a telecommunication industry context as stated in Elfving and Urquhart (2012). However, in this paper we add data and findings from one of the growth markets. Thus, the results presented here add on to the mapping of the case company’s transition. Three context specific research questions are thus addressed accordingly: (1) How has the case company’s product and services organisations developed over time and why are that? (2) How has case company’s offering portfolio developed over time and what characterise it? (3) What are the key principles in the servitization process?

Several different sources of data have been used in the study to approach the research questions, e.g. interviews, documentation and archival records, and digital physical artefacts, e.g. Intranet, webpage, and IT tools etc. The data has then been analysed by adopting a PSS perspective on the organisation and offering over time, and then the findings have been analysed in relation to existing theory.

2 CHALLENGE DRIVEN SERVITIZATION

The transition of going from goods-to-services, has been on the research agenda in academia for quite a while and is still accelerating (Baines et al., 2007), however the applicability and awareness among the industry is still limited. Companies do transform their business, relying more and more on services, however whether that has been an outspoken strategy or not, seems to differ from company to company. From academia there exists several parallel approaches to this paradigm (Baines et al., 2007), whereas two of them are; Service Dominant (S-D) logic (Vargo and Lusch, 2004) derived from marketing, and PSS, which is more or less derived from design and production research and manufacturing industry (Baines et al., 2007, Mont, 2002).

The emergence of cloud computing concepts during the recent years (Smith, 2011) has put focus on a market trend that has been on-going for decades in both the manufacturing and telecommunication industry; servitization of business. Servitization as a concept is not new, however, the penetration cloud has had in technology has catered for a shift in mind-set among many technology companies today. The concept of cloud moves focus from owning hardware and software towards buying functionally or capacity on demand but also shifts risk from customer to provider, going from complexity towards simplicity, and changes in the actor ecosystem (Wood et al., 2011). Furthermore, the trend indicates that there is still much to come in terms of new functionality and technologies related to cloud in upcoming years (Fenn and LeHong, 2011). Cloud is here to stay, so are services.

Cloud as well as PSS drives collaborative aspects and the increased need for a product and/or service provider to interact with its surrounding to form value creation networks. This puts pressure on the organisation to change to cope with the increased demand for collaboration and interaction. However, companies encounter difficulties trying to adopt to the transformation process, especially within the

manufacturing and technology intensive industries like telecommunication where the product focused culture is strong and services are bundled with the products late in the delivery process (Oliva and Kallenberg, 2003, Aurich et al., 2006, Mont, 2002). This could be concluded to be a result from poor organisational maturity, however, findings from manufacturing industry shows that companies that integrate product and service development often fail; the service development process becomes ad hoc. While companies with separated product and service development seem to have a better position to develop services initially (Fundin et al., 2012). Consequently, combining products and services into a single offering demands close collaboration between two development processes which initiate several challenges, e.g. how to share profit and loss, how to cope with clashes in organisational culture and social behaviour, how to gain trust, get commitment and share risk, how to agree on common goals, sharing of information systems etc. (Davenport and Prusak, 2000, De Wit and Meyer, 2010, Elmuti and Kathawala, 2001, Wynstra et al., 2001). Thus, companies are confronted with a diverse number of challenges adopting PSS, both organisationally and offering wise.

3 THE CASE OF ERICSSON

This section presents the case of Ericsson AB and their journey towards a more service driven business. Ericsson is a telecommunication company with a long history in designing and delivering communication solutions. The company was founded in 1876 in Stockholm, Sweden. Today Ericsson is world-leading in providing telecommunication equipment and services, fixed as well as mobile networks. Ericsson is a global company, having business in more than 180 countries and employs close to 110 000 people (December 31, 2012). With 22 000 employees in R&D and with more than 30 000 patents (16 patents sought for every day) Ericsson is a technology driven company. However, since the 1990's the services part of the business has grown immensely. Ericsson's service portfolio nowadays includes customer service, network rollout, consulting and system integration, and managed services.

3.1 Current State in Relation to PSS

Today, the telecommunications industry is spearheading the very latest in both device technology and latest mobile standards to deliver data at increasing speed and capacity over the mobile networks. However, it has its roots going back over 130 years. With Ericsson that history goes back to 1876 when repairing telegraphy equipment which was later replaced with designing telephony equipment. In late 1970's mobile telephony was delivered commercially with Ericsson introducing their version of NMT (Nordic Mobile Telephony) which launched in Saudi Arabia. Then the solutions relied heavily on both proprietary hardware and software. The sales cycles were long, and the commercial pressures of competition faced by the operators were minimal. Since then the share of services has grown over time. In recent years company financial visibility externally of those services has grown as well and latest full year results for Ericsson shows a services percentage of the total business revenue coming in at 43% in 2012. As of 2013 Ericsson has separated organisational units for products and for services, with separate profit and lost responsibilities. Although, services are a vital part of the company's business the balance between products and services side of the business is still skewed.

Ericsson's offerings are mainly separated between products and services although there exist other types of offerings in the portfolio that are approaching a more integrated way of offering solutions, similar to, but not equivalent to a PSS. In some cases the integration stretches to serviceability of the product being considered during the design phase. Looking into the intention of why these integrated offerings were created, it has mainly been driven from a sales perspective and not a value creation perspective. Existing services and products have been bundled into offerings to facilitate the sales process. Further, parts of the business units within Ericsson have a more integrated way of working. This seems more or less to be a consequence of the type of product offered and the need for closely bundled services to that specific product. Different business models are also being used depending of the type of service delivered.

3.2 Cloud as a Disruptive Technology

As the telecommunications industry had begun its adoption of cloud as a technology to deliver the functionality of mobile networks, there are indications that the transition will provide reason for a change in how Ericsson is organised and what is offered. The as-a-service model is becoming prevalent with many successful ICT (Information and Communications Technology) examples being delivered on a global scale. The impact in the ICT offerings via cloud has significantly changed the way the solutions are sold, delivered and supported. As for other ICT companies this is also the case for Ericsson. Cloud can be categorized as a disruptive technology in the context of telecommunications. Thus, cloud has put pressure on the organisation to act, especially on product management that needs to evaluate and act upon the technology. As a disruptive technology cloud has introduced a number of challenges, where several of them have bearing on Ericsson being a product and technology focused company. The challenges span financial structures to routines and goal settings etc. many of them are also being pinpointed in the literature as general challenges related to PSS, thus not unique for the company. As cloud by definition is something sold as-a-service and also considered as a disruptive technology, it challenges the existing infrastructure of the company, such as processes, routines and business models. As for today cloud is becoming one of the incentives for integrated products and services.

3.3 Challenges in Growth Markets

For a market that is either (1) establishing mobile technology for the first time, so called green fields, (2) introducing new mobile networks to an existing market or (3) for a market that adapts quickly to the latest technology, the challenges are somewhat similar. The value to the end user is to be able to access the network seamless wherever the user may find them. Japan is considered to be a growth market that is quick to adopt the latest technology and where competition between the various mobile operators is strong. In the early phase of establishment the focus is on coverage of the main populations and areas such as major cities. In the case of Tokyo metropolitan area unique problems of having to design and deploy radio networks covering multi-layers of physical infrastructure to ensure users having access to mobile services at whatever level they find themselves appears. For Ericsson this means many thousands of base stations being deployed monthly and the story is repeated in other growth markets such as China and India. This naturally leads to a focus on the immediate tasks of finding suitable sites, designing networks for seamless coverage and ensuring the networks run continuously during changes. The natural focus is therefore to deploy and integrate hardware for the ability to provide coverage, and not on how to bring together services and products in the most effective way.

4 DISCUSSION

Looking at the current state of the business it is clear that the company is already on their way towards a PSS way of working, both solution and organisational wise. However, so far trends and market forces, e.g. cloud and growth markets, have pushed the company towards this direction rather than pulling it through strategies and new types of business models. Today, the services and the products organisations are to a large extent independent of each other with *separate organisational business units*, which are consequently confronted with challenges related to collaboration in general. The balance is still somewhat skewed between the units, services does not have an *equal seat at the table* of business compared to the product side. Mapping Ericsson's transition in a model combining the models from Baines et al. (2007) and Fundin et al. (2012) gives us a clearer picture of where Ericsson is today (Figure 1).

Ericsson, as well as any other company with a long history in telecommunications cannot disregard its legacy as a technology driven company in servitization. Telecommunications companies having in-house design, production, and services, will most likely not profit from a complete transition from product to services. Thus, *climbing the pyramid* presented from the 'product' side towards the top 'product service system' could be a more suitable approach than adopting a service-centric view fully. In the context of the matrix presented by Elfvig and Urquhart (2012) this means that the strategy going

forward for such company should not be the upper right corner in the upper right quadrant, but going for a *balance between products and services*, the PSS, and a mutual dependent organisation.

A not farfetched assumption is that as cloud solutions will become prevalent in telecommunications industry and it will require the industry to rethink its approach not only to how design is carried out but also to the fundamental business models that are used to generate revenue streams for the companies. However the offerings from the telecommunications industry in general is very similar between vendors, thus, it can be expected that other companies faces the same problems and challenges, but also the same opportunities as Ericsson. The question is how the different actors in the market choose to act on these challenges. From both the cloud case and the growth market case there are challenges that needs to be *acted upon*, both within the service side of the business and the product side.

Based on the initial findings presented here five key principles have been formulated to support the servitization in telecommunications. The principles can be considered rather general, however based on the retrospective study combined with current market trends this is what we see needs to be done. Note that there is no specific order among the principles:

- *Shift focus to one offering* - focus on the offering itself, rather than on organisational set-up
- *Climb the pyramid* - from the product towards the PSS
- *Create balance* - go for a mutually dependent organisation
- *Act on challenges* - address and act upon the challenges
- *Create mutual understanding* - share an equal seat at the table of business with customers

5 CONCLUSION

The basic thesis that is pinpointed in this paper is that the case company as well as telecommunications companies in general are swimming in a ‘red ocean’ (see Kim and Mauborgne, 2005) and that new disruptive business models and strategies are needed to meet the challenges of the future. In telecommunications going from serviceability of products towards an integrated PSS model, competing on delivered value instead of price is both an attractive and more sustainable strategy going forward. However, as in the case described in this paper different business models are being used, but none really addressing the integration of products and services.

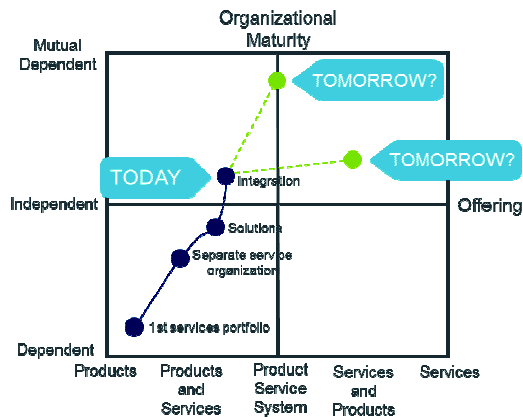


Figure 1: Organisational Maturity and Offering Matrix. The matrix describes the evolution of Ericsson’s offering and organisational maturity over time and possible direction for the future.

Although not a panacea for curing all the issues that are faced, learning shows that PSS will play a significant role in addressing the challenges and supporting the transformation, especially in the cloud case. PSS will support a clearer understanding in the areas of cross functional collaboration between the products and the services side of the telecommunication business. PSS although simplistic, applying the logic of the benefits will need significant change in the way telecommunication companies approach the business, design the solutions for delivery and how to organise to deliver on company promises.

To conclude, companies need to act now. Without action and adoption of a PSS approach, the on-going technology advances and increasing features in products, will not be taken advantage off and reflected in the value offered to customers. Five key principles are presented to support the next steps in the servitization, going from serviceability to a PSS model. These principles are not definite, more research should be performed to complement and validate those. Going forward, a strong area of understanding why PSS will be necessary is cloud, and it is time to put theory into practice and to start measure the outcomes of cloud and PSS.

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GAMES, MODELS AND ANALYTICAL TECHNIQUES

USING VALUE ANALYSIS TO DRIVE SUSTAINABLE PRODUCT-SERVICE SYSTEM (PSS)

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ABSTRACT

Product-service system (PSS) has been regarded by both academia and practitioners as a potential way of achieving business goals and sustainability simultaneously. This research aims to investigate the exchange of PSS solutions in the context of industrial symbiosis (IS) to achieve sustainability. For this purpose, the paper proposes a sustainable PSS solution which offers service that re-use the waste between companies (termed industrial symbiosis). First, the rationale behind the integration of PSS and IS is illustrated based on the literature review; second, a value analysis method is proposed for identifying opportunities for the exchange of PSS solutions among companies, which is expected to better utilize the waste of manufacturers to achieve sustainability through industrial symbiosis. The proposed method will be tested and implemented in practice in some manufacturing companies.

Keywords: Product-service system (PSS), Industrial symbiosis (IS), sustainability

1 INTRODUCTION

1.1 PSS and Sustainability

PSS has been studied from many different perspectives in recent years. Some researchers consider PSS simply as a competitive business model in which manufacturers shift their focus from producing products to providing service (Beuren et al. 2013), while others suggest that PSS goes beyond this view by pursuing a sustainability goal – satisfying customer demands in an environmental friendly way (Maxwell and Van Der Vorst 2003). The literature review on PSS shows that the term “product-service system” is highly combined with the term sustainability (Beuren et al. 2013). The main reason is that the exchange of service enables the reduction of the material consumption not only in the production stage but also in other phases of the life cycle (Baines et al. 2007; Manzini and Carlo Vezzoli 2002), i.e. dematerialization of the life cycle. However, PSS does not automatically drive business towards the sustainable directions (Tukker 2004). PSS needs to be carefully designed to balance the economic, social and environmental issues. For this purpose, sustainable PSS design methods have been studied by researchers from different perspectives, e.g. the sustainable product and/or service development (SPSD) strategy (Maxwell and Van Der Vorst 2003), methodology for product service systems (MEPSS) (Van Halen et al. 2005), and a product-service blueprint approach (Geum and Park 2011). Sustainable PSS design is challenging since it requires a fundamental change of production and consumption, as well as the business relationships among different stakeholders.

1.2 Industrial Symbiosis

Industrial symbiosis is defined as “*a collective approach for the physical exchange of materials, energy, water, and/or by-products*” among industries (Chertow 2004). Analogous to the biological symbiotic

relationship among organisms, the underlying concept of IS is that the waste from one company can become the feedstock of another company (Frosch and Gallopoulos 1989). In this way, companies can find mutual benefits and achieve a higher value than the sum of the values the companies achieve by acting on their own (Chertow 2004). IS has been regarded as a system approach to improve the environmental and economic performance by reducing the physical waste of the entire system. Most IS research focuses on the physical flows of waste such as materials, energy and water (Chertow 2000), while some researchers claim that the flows should also include information and service sharing (Cohen-Rosenthal and Musnikow 2003), and Chertow (2008) regarded this as a means of resource sharing. A new way of making use of IS is proposed here - to implement it for the PSS concept.

PSS and IS have both been investigated by several authors, but the research on their integration is limited. This paper investigates the question: *how can sustainable value be exchanged by delivering PSS between companies?* This paper proposes a PSS solution based on the IS concept to achieve sustainability - the waste identified in PSS can use the concept of IS to turn into opportunities not only the product/material exchanges but service exchanges in a system. The aim is to embed PSS and industrial symbiosis, while using value analysis to drive sustainable PSS among industries through service exchange rather than physical waste exchange.

The following sections describe the rationale of the integration of PSS and IS, introduces the proposed value analysis method for developing IS of sustainable PSS and finally presents the main conclusions of this paper.

2 INTEGRATION OF PSS AND INDUSTRIAL SYMBIOSIS

The integration of IS and PSS has the potential to create more value than the current waste exchange in terms of sustainability by re-using other companies waste and turning it into services which can be provided to other companies. Figure 1 illustrates the IS of PSS in the context of sustainability. PSS is about creating additional value by delivering service rather than only physical products (also termed servitization), and the authors believe that servitization does not necessarily lead to sustainability but it has the potential to happen. IS is about the exchange of material and energy waste among a group of industrial plants, which aims to reduce waste and improve sustainability. The IS of PSS can be defined as the exchange of PSS waste - product and service waste. Here, the combination with IS can be used as a PSS solution - offering service that re-uses the waste in an industrial system.

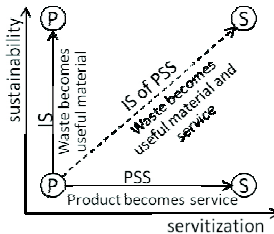


Figure 1: PSS, IS and IS of PSS for sustainability

2.1 Characteristic of IS of PSS

The characteristic of IS of PSS can be analyzed by comparing the difference between product exchange and PSS/service exchange. In the industrial symbiosis context, product exchange refers to the exchange of physical waste, while the PSS/service exchange focuses on the exchange of the service. The service exchange is connected to the physical waste, or the intangible waste such as information, knowledge and labour etc. Figure 2 is an illustration of IS (product exchange) and IS of PSS (PSS exchange) between companies. It is assumed that: 1) each product component can be accompanied with a

certain number of service components; 2) service does not exist without physical resource, e.g. product, equipment, etc; 3) service is composed of product related service and non-product related service.

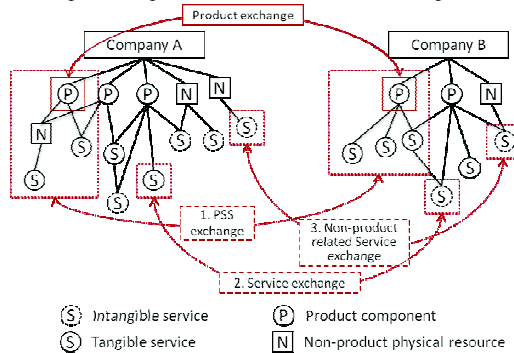


Figure 2: Product exchange vs PSS/service exchange between companies

Figure 2 shows three types of service exchanges: 1) PSS exchange, in which service is exchanged as an additional package to products. For example, the conventional way of managing the wasted apples by an apple manufacturer is by selling apples to an apple juice company or dry fruit company. The additional service can be attached to the product – the delivery service, the storage service, and the customized pre-processing service 2) Service can be delivered individually – without delivering products. For example, if there is an over capacity of labour in one company the company can let their employees do similar tasks (e.g. packaging) for another company. 3) Non-product related service can also be exchanged, for example, “apple manufacturers” need more warehouses and employees during apple festivals and have extra capacity during off season . They can provide the “storage” service to the “winter food manufacturers” in winter and rent “storage” service in autumn.

It can be observed that there are more ways of exchanging service than products, such as sharing of utility, information, facility and labour. PSS/service exchange has the potential to create value than the product exchange in terms of sustainability as illustrated in the above example. The sustainability of PSS exchange depends on the PSS design and implementation. Therefore, there is a need for a method of integrating sustainability concerns into the PSS design process and of PSS exchange in an industrial system. However, the realisation of service exchange in PSS solutions is challenging because it is difficult to identify intangible service waste within firms, and also difficult to identify opportunities for the service exchange (e.g. matching the service needs and providers).

3 PROPOSED VALUE ANALYSIS METHOD

3.1 Value Creation in IS of PSS

The nature of PSS determines that it needs to be designed from the life cycle perspective. The target is to provide value to the all stakeholders during the whole use phase instead of only providing it at the moment of sale. The integration of IS concept allows the value exchanging across the entire network by one company utilising another company’s waste (including product waste and service waste).

3.2 Value Analysis Method

This paper proposes a value analysis method to drive sustainable PSS exchange among companies. It is composed of internal value analysis and external value analysis , as shown in Figure 3.

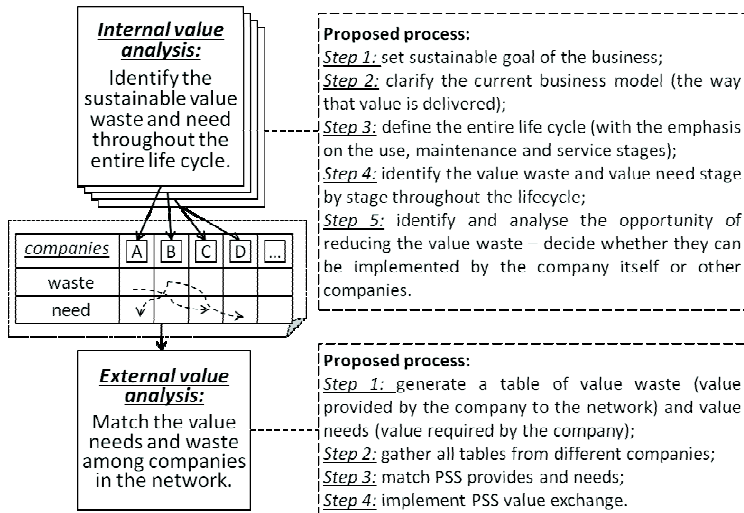


Figure 3: Process of Value Analysis

Internal value analysis is a process of analysing value across the entire PSS life cycle from the dimensions of economic, social and environmental sustainability. It aims to understand sustainable value elements within a company, and so as to identify value waste and value need on both product and service sides. However, value waste and need is usually intangible and difficult for company to identify without experience and knowledge. Hence, it needs guidance and existing business examples to inspire companies to map out the value waste and need stage by stage throughout the life cycle. The authors assert that:

1) The value waste can be considered from the dimensions of current value proposition and value surplus. The value proposition is the benefits delivered to stakeholders. It is usually the value activity which the company is good at, e.g. a well-running recycling system. The value surplus is the redundant value which is larger than the requirement – a waste for the company, e.g. under-utilised resources, over capacity of labour.

2) The value need can be considered from the dimensions of value destroyed and value absence. Value destroyed is the negative value outcomes of the current model, e.g. depletion of non-renewable, environmental damage, negative social impacts. Value absence is the value required but which has not been created, e.g. the lack of resource, technology and labour.

The internal value analysis helps designers to understand sustainable value waste and need throughout the life cycle in a holistic way, based on which the value opportunities of reducing/utilising the value waste, and meeting the value need can be identified. These value opportunities can then be analysed and decided to be implemented by the company itself or other companies.

External value analysis is a process of analysing value waste and need among different companies based on their individual internal value analysis. It aims to identify opportunities of value exchange among companies by exchanging PSS solutions. Companies share their the product and service waste and need to the network, which allows them to 1) identify similar value needs of other companies so that they can enjoy the benefits as a group; 2) identify whose value waste can become the other's need. The value waste and need can therefore be matched by certain industrial symbiosis methods. It is noted that the value mentioned in this paper needs to be considered from a service-oriented perspective, with an emphasis on social, economical and environmental sustainability.

4 DISCUSSION

Figure 4 presents an imaginary example of the PSS exchange among companies. The value analysis method introduced above can be employed to identify the value waste and value need. Company A is a clothes and food retailer with a recycling system for taking back the used clothes from its customers. This recycling system can be considered as a value proposition and as a value surplus when it has over capacity. Company B is a clothes retailer with a plan to start a similar recycling system, which can be considered as a value absence. The value waste exchange could be that Company A provide either the individual recycling service or the whole pack of services to B since company A has an existing recycling system. In return, company B can provide the storage service to company A, since it requires substantial space to storage and dealing with the recycled clothes (can be viewed as a value need for A). Also, the recycled clothes might be a value waste for company A, but a value need for a charity organization. By giving some of the recycled clothes to a charity the company creates social value and potentially improves its image among customers. In this way, the waste can be well used among companies, whilst generating mutual benefits through integrating industrial symbiosis into PSS for delivering sustainability .

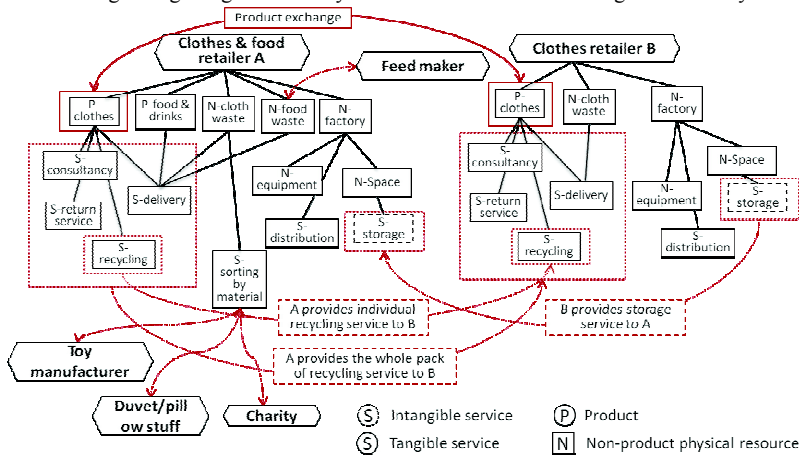


Figure 4 : An imaginary example of PSS exchanging value among companies

This paper investigates the exchange of PSS solutions in the context of industrial symbiosis. The key novelty is the proposal of integrating PSS and IS to achieve the sustainability. The authors analyzed the rationale of the integration based on literature and believe that the PSS exchange among industries is expected to be a promising approach to utilize the waste and realize sustainability in an industrial system. A value analysis method is proposed to achieve the value exchange (in terms of PSS solutions) among companies.

Future work will further explore the concept of integration of PSS and IS through case studies with companies, while understanding the underlying benefits and challenges. The value analysis method will be further developed and improved by exploring/testing it with manufacturing companies

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LINKED DATA FLOWS IN MULTI-PLAYER GAMES FOR SERMITISATION

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1 ABSTRACT

The increased data complexity and task interdependency associated with servitization represent significant barriers to its adoption. The outline of a business game is presented which demonstrates the increasing complexity of the management problem when moving through Base, Intermediate and Advanced levels of servitization. Linked data is proposed as an agile set of technologies, based on well established standards, for data exchange both in the game and more generally in supply chains.

2 INTRODUCTION

Servitization was introduced by Vandermerwe and Rada (Vandermerwe & Rada, 1989) to describe how manufacturers extend their operations beyond making products to services associated with those products as a strategy to counter low cost competitors. Servitization is used as a means to move manufacturers up the value chain thus increasing their profitability. Implementing servitization is challenging however, and to date most best practise examples focus on larger companies (Baines, Lightfoot, Benedettini, & Kay, 2009). The desired improvement in profits may also not be easy to gain, with some authors reporting lower profit margins from servitized manufacturers, e.g., (Grönroos & Ojalsalo, 2004). Particularly for smaller companies, the challenges associated with the major strategic change of adopting servitization can act as a barrier.

Serious computer games have potential for accelerating adoption of servitization by manufacturing companies. Games can be used to entertain, educate and inform decision makers in companies. Helping them to devise good strategies, to apply servitization in their manufacturing businesses and to understand how business processes and information systems might have to change to ensure success. Studies related to servitization that use games are currently limited but promising, we are only aware of (Laine, Paranko, & Suomala, 2012). However the serious games have been used in the development of business practices (an essential step in servitization) (Liukkonen, 2009), and simulation has been used in the design of services (Oliva & Bean, 2008). Therefore we are confident that games which will allow manufacturing decision makers to learn about and experiment with servitization concepts can be built.

In this paper, we will examine one barrier to servitization, namely the requirement for increased complexity of communication and data exchange inside companies and between companies and their customers and suppliers in order to support the product service model. This is related to the notion of task interdependency identified by (Turunen & Neely, 2012) and may need to be tackled by changes to the organizational structure, such as enhancing vertical integration, to processes, such as ensuring the input of service staff into product design, and to information systems, such as improving their agility in the face of change. The games must be built as multiplayer games to simulate these communication and interdependency issues.

In this paper, we make the case for using web standards for data exchange, specifically the linked data approach (Bizer, Heath, & Berners-Lee, 2009), which provides a lightweight approach to data exchange and interoperability.

3 THE GAME: WIDGET PRODUCER

To illustrate the issue of increasing data complexity we present the outline of a business game for servitization. This follows the established pattern of computer games with ascending levels where the aim of the players is to ascend to higher levels in the game. The levels in this game are Base, Intermediate and Advanced, drawing on (Baines & Lightfoot, 2013). The game scenario concerns a manufacturer of machine tools, which manufactures a tool called the Widget Producer and at the start of the game operates in a traditional, product focused, way. The players begin at the Base Level.

3.1 Base Level: Sell the Widget Producer

- At the Base Level the players must make and sell Widget Producers. One aim of this level is to familiarize players with the scenario and game controls.
- Players at this level are:
 - Sales (who must negotiate sales at a profitable rate),
 - Factory (who controls manufacture of the Widget Producer) ,
 - and Buyers (simulated).
- Data needed:
 - production costs (economies of scale may be factored in),
 - number of units (Widget Producers) sold,
 - price for each unit (the Sales Manager can negotiate price),
 - production capacity of factory (set).
- Targets: players move to the Intermediate level when they have maintained 10% profitability for one round of the game at Base Level.

3.2 Intermediate Level: Sell and Service Widget Producer

- At the Intermediate level the company introduces a service contract. Buyers may opt for the service contract, which provides an overhaul of the machines, either once a year or after 100,000 widgets have been produced.
- Players at this level are:
 - Sales (who must negotiate sales at a profitable rate, and try to persuade buyers to opt for the service contract),
 - Factory (who controls manufacture of the Widget Producer, and of spare parts),
 - Service (who monitors the servicing needs of the buyers and deploys servicing staff with spare parts as required),
 - Designer (who monitors the servicing reports and improves the design of the Widget Producer and its spares to minimize servicing costs),
 - and Buyers (simulated).
- Data needed:
 - production costs
 - number of units sold,
 - price negotiated for each unit,
 - production capacity of factory (expenditure on design time can increase this),
 - number of units with servicing contracts and their value (the Sales Manager can negotiate price),
 - unit average quality (percent components needing replacement at service)

- cost of spare parts required and their value (expenditure on design time will reduce this cost),
- cost of warehousing for a stock of spares,
- cost of service personnel time (expenditure on design time will reduce this cost),
- Buyer satisfaction levels (simulated),
- cost of design time.
- Targets: players move to the Advanced Level when
 - they have maintained 10% profitability for two consecutive rounds of the game at Intermediate level,
 - with at least 50% of Buyers taking the service contract option,
 - and 70% of Buyers with service contracts indicating that they are satisfied with the service at the end of each round.

3.3 Advanced level: Guarantee Widget Production Capability

- At the Advanced Level a premium service contract is introduced in which the manufacturer guarantees a maximum one day downtime for Widget Producer owners, i.e., if a unit cannot be fixed in a day, a replacement unit will be provided until the Buyer's unit is repaired.
- Players at this level are all of above, plus:
 - Strategic Planner (this player may be a servitization expert or a simulation, they should monitor the data and suggest targets for the next round, their aim is to improve player performance).
- Data needed, as above plus:
 - number of days for which a substitute machine must be supplied and cost thereof,
 - number of substitute Widget Producer units held in stock, and cost thereof,
 - number of units with premium servicing contracts and their value (the Sales Manager can negotiate price),
 - number of substitute units held in stock, and cost thereof,
 - number of substitute units requested,
 - number of substitute units loaned on time (within 24 hours of service personnel call out).
- Targets: players are deemed to have won the game when:
 - they have maintained 10% profitability at this level for two consecutive rounds,
 - with at least 40% of Buyers taking the service contract option and 20% of Buyers taking the premium contract option,
 - with 70% of all contract holders indicating they are satisfied with the service,
 - with no premium service contract holders who have not been supplied a substitute machine on time when required.

3.4 Game Features

This game design has features which we believe simulate some of the barriers to servitization. At each level of the game more information needs to be exchanged between the players, and the number of players increases; between Base and Intermediate levels the number of players doubles. Furthermore the interdependency of tasks is increased. At the base level, the interdependency is governed only by production capacity and the need for Sales to negotiate a price that allows 10% profitability. At the intermediate level, poor quality (the manufacturing task) and poor design of units will affect profitability through the costs of spares, and will also impact on customer satisfaction. At the Advanced Level this effect is heightened: the more likely a machine will break the more replacement units need to be kept.

Servitization supply chains are classical demand lead, distribution channels, and as such are prone to phenomena such as the Bullwhip effect, in which oscillating customer demand magnifies up stream as suppliers build increasingly large inventory buffers to manage unpredictability. Our game should be able

to simulate this effect in the Intermediate and Advanced levels because of the need to keep stocks of spare parts and stand-by units. Better information exchange and a culture of openness are known to mitigate these effects in the real world. The multiplayer aspect of the game is therefore important: it must contain game play algorithms that control incentives to promote cooperation between players. These in turn help build communication flows and affect overall success. The objective being to help manufacturers understand how they need to improve communications between participants in their own business processes and supply chains in order to succeed with servitization.

4 LINKED DATA

Standards such as EDI (Electronic Data Interchange) were designed for Business to Business activity, and underpin significant parts of modern commerce (e.g., the automotive industry) allowing the efficient and accurate exchange of data between organisations. However, EDI requires complex mapping rules to fit standard data to individual organisation's internal requirements. Standards for commerce, such as those provided by GS1¹ for unique identification numbers, allow for considerable detail with respect to the category and location of resources. Both approaches are currently unable to model and capture the range of data needed for effective use of servitization. One problem is the number of players who may be involved and the need for flexible adaptation of data to exchange with new, rather than long established, partners. Another problem is that the type of data needed for different servitization scenarios can change substantially.

Linked data initiatives based on Web technologies (Bizer et al., 2009), by contrast, impose limited standardisation burdens combined with powerful flexibility. Linked data uses RDF, an XML based standard, to format data. XML has already proved itself to be a flexible format and is widely used to exchange data. What linked data adds is to give entities unique identifiers that are URLs: this allows web protocols, such as HTTP to be used to find information. An entity could be any thing in our game: a player, a particular Widget Producer, a type of spare part, a buyer company, a service visit etc. The fundamental feature of the Web, what makes it what it is, is the hyperlink; this allows people to browse the web, moving from one page to another related page gathering information. The same linking feature is essential in linked data also, with links being made between entities, providing mechanisms by which an interesting entity can provide the seed to find related data. In our game, the data might for example link a buyer company to the Widget Producers it owns, and those in turn to the service visits that have been made.

One further feature of linked data makes it appropriate: it does not assume that all data producers will agree standardised data representations (XML schemas defining the vocabulary used and how the data are structured) before hand. Instead mappings between schema are built using simple "SameAs" links between concepts that represent the same things. For example: the "Widget Producer" in our manufacturer's schema may be described in the Buyer's schema by the more general "Machine Tool" (perhaps Buyer runs a job shop and has a number of different tools allowing them to take on a range of manufacturing contracts). By placing a SameAs link between Widget Producer and Machine Tool the two sets of data about the unit can be combined. This feature makes possible the interoperability of data between different actors in the supply chain, and also makes it easy to integrate a new customer or supplier.

4.1 Linked Data in the Game

The use of a standard data format in the game design supports flexibility when planning game extensions or reuse. Imagine a case where we wish to design a game involving players who represent different organizations in a supply chain. For example, we chose to extend the Widget Producer game so that some of the Buyers are real players not simulations. These players also want to servitize their business, maybe

¹ <http://www.gs1uk.org/what-we-do/GS1-standards>

moving from batch ordering of widgets to a model in which they have access to their customers' production plans and contract to supply the right number of widgets at the right time as a service. A standard data model facilitates this type of extension and supports reuse of any underlying game play algorithms.

The advantage of using Web standards is even more apparent when we consider the possibility of integrating publicly available Linked Data - so called Linked Open Data. Let us consider two possibilities: globalizing the Widget Producer game, and reusing it for a scenario in the Media Industry.

For the Global extension, say we wish the Advanced Level to take account of the fact that Widget Producers are sold worldwide. To honour the Capability Guarantee it becomes necessary that standby units are available in different regions. Firstly, players must decide the location of depots where stocks are to be held. Secondly, Sales must have data to determine whether the Guarantee can be offered to a given Buyer. Data to support the global extension to the game could be supplied from open linked data sets such as OpenStreetMap², with delivery times from depots to the Buyer location being calculated using GPS data.

In a Media Industry version of the game, the aim would be to support music producers in testing out different servitization models. Media is a sector which is, in effect going through enforced servitization, with consumers switching from the established product ownership model (based around CDs, DVDs etc.) to a service model based on downloads. For this game, the open data version of a resource such as MusikBrainz³ could be used to simulate a Product Catalogue.

4.2 Linked Data in Supply Chains and Servitization

To compete in a globalized marketplace manufacturers need to be agile, taking on new customers, new products and materials. For information systems to support this agility they need to be based on standards that are equally flexible and can accommodate new data types rapidly and allow information exchange with new business partners without complex negotiation over proprietary data formats. Linked data offers this flexibility.

The linked data approach is well suited to the supply chain context in which different players need to model data to meet the internal needs of different styles of operation (raw materials, component production, assembly, fitting, repair and maintenance) and require access to information from other players in the chain. Furthermore, extensive work already exists to integrate into the linked data paradigm the use of networks of sensors (e.g. usage data for condition monitoring and servicing operations), and other heterogeneous sources of information (e.g. customer reports, structured and unstructured evaluations, or third party certifications). Open data can support access to valuable data in the public domain (e.g. continuous weather or road or air traffic reports). The absence of effective tools for rapid and easy data integration of customers and service providers remains a significant barrier to the uptake of servitization. Linked data may hold the key to providing an agile, information architecture to help overcome this barrier.

5 CONCLUSIONS AND FUTURE WORK

Our aim in this paper has been to contribute to the development of game technologies, design principles and protocols for servitization. In this paper, we have presented an outline of such a game, in order to open the debate on what games designed to accelerate adoption of servitization should look like. We applied three principles in our design: the game should address barriers to servitization, it should have game play aspects to challenge players and engage their interest, and it must have a learning objective. The barrier we chose to address concerned the increased task interdependency associated with servitization, and the consequent increased communication and data interchange needs. The game play

² <http://www.openstreetmap.org/>

³ <http://musicbrainz.org/>

aspects were provided by producing a three level game in which players must achieve pseudo-realistic business targets to move up the levels. The learning objective is for users to experience the increasing communication needs by having them play cooperatively in a multi-player gaming environment. From this they should be able to take away an understanding of the kinds of changes to business practices and information systems they will need to make in their own businesses to succeed at servitization.

The second theme of our paper is to advocate the use of linked data and its associated technologies as a flexible approach to modeling data in the gaming environment. Potential advantages of this approach for the game are that extensions and new games become easier to design with a standard data model, and that open linked datasets, such as geographical data, can be used in the game design. There is also a case to be made for using linked data as an information exchange standard in supply chains. Testing linked data protocols in the safe context of the games provides an opportunity to test the robustness of this approach.

Next steps involve a detailed requirements elicitation process, involving manufacturers, servitization experts and games designers, in order to produce details specifications of games for servitization. These will then be implemented, tested and used to transform the adoption of servitization strategies by UK manufacturers.

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GAMIFICATION FOR SERVITIZATION A CONCEPTUAL PAPER

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ABSTRACT

Manufacturing organisations can leverage their product offerings through services to increase their competitive advantage. The combined product and service offering is often referred to as servitization. Manufacturing organisations have shown increasing interest in this area and promise to increase their services but often lack the capabilities necessary for a successful upgrade. Serious Games, through 3-D simulation and other gaming techniques, offers potential transformational technologies, which can be used to engage and support participants develop capabilities in a virtual business environment to mitigate barriers to servitization. This paper offers the first step towards bridging servitization and these new technologies.

Keywords: Servitization, Serious Games, Resource Based View

1 INTRODUCTION

Stagnating markets, growing product commoditization and increasingly demand for customization are challenging manufacturing industries worldwide to undergo significant changes (Baines and Lightfoot, 2013). It is strategically important to retain a viable manufacturing capacity and must complement strong science and engineering research capabilities which directly underpins export activities. Furthermore, there is a growing consensus that the service economy is highly dependent on manufacturing. Product manufacturers can apply a service led competitive strategy through creating value adding capabilities to differentiate from the price based competitors (ibid). Although the servitization concept has gained increasing interest by academia, government and industry, the uptake of servitization practices in the UK is however slow. Research shows that changing the 'mind-set' is a major barrier in the adoption of servitization in manufacturing (Baines et al., 2009). Serious Games by adopting gamification mechanisms through 3D immersive, interactive and engaging game design can help to facilitate organisational learning and training for senior managers and give them the means to visualize the potential impact upon their business.

This paper aims to bridge the link between servitization and Serious Game technologies, first by identifying challenges and barriers to servitization (section 2). The arguments adopts a resource based view (RBV) as its theoretical lens, which enables the identification of the resources and capabilities required and that manufacturers can sensibly develop (section 3). The outcomes of this reasoning arguably points to better decision-making frameworks for the types of servitization approaches (section 4). Serious Games and their associated technologies is reflected upon and challenges, resources and

capabilities and types of servitization strategies identified (section 5). Finally, this paper concludes that the design of Serious Games requires clarified dimensions for resources, capabilities and types of servitization strategies.

2 SERVITIZATION CHALLENGES

Manufacturers despite increasing investment in their servitization efforts, growth and returns do not match senior managers' expectations. Research on servitization observes that an increased number of published papers but focus only on large organisations with a well know brand value. For example, the Rolls Royce Aerospace 'power by the hour' total care package, where major airlines and defense customers buy the capabilities the engine delivers (Baines and Lightfoot, 2013), yet, wider adoption of servitization across the supply chain is limited. Servitization through advanced product service systems requires high level collaborations among suppliers, manufacturers and customers. Reconfiguration and changes are necessary to ensure successful servitization operations. For instance, about 60% of Alstom's sales are now made together with their partners. With increased supply chain control, Alstom are able to maintain a stable service platform (ibid).

Suppliers can to enter into extended advanced service contracts with the manufacturer in a collaborative supply chain. For example, tool care concepts of precision cutting tool manufacturers revolve around a win-win situation as the customers' handling costs, such as storing, ordering, administering or controlling, exceed the purchasing cost of the products. The tool care concept, by transferring from embedded fixing and assembly materials to comprehensive logistics services for small value, high volume parts has helped tool manufacturers to capture new market potentials (Fischer et al., 2010). However, many product suppliers would not offer to run customers' operations since it involves taking over and assuming risks of an entire process (Oliva and Kallenberg, 2003). This is because servitization is less well known to many suppliers that narrowly focus on their design and manufacturing capabilities. Similarly, Fischer et al. (2010) argues that capital goods manufacturers still have a narrow understanding when it comes to scanning, searching and exploring service opportunities. They seem to have become the prisoners of the deeply ingrained assumption that the service business development emphasizes the provision of basic services such as spare parts, repair and inspection and maintenance for the installed base (ibid).

Customers may not be enthusiastic about ownerless consumption, for example, delegating too much power to top suppliers undermines the ability to innovate, manage risks and increase efficiencies. In particular, Japanese style of manufacturing, with a heavy reliance on supplier reduction techniques, and despite benefits from volume discount, new production introduction and risk in developing sub systems, the manufacturers also risk a weakened control over upstream operations, ecological impacts and missed opportunities in emerging new technologies (Baines et al., 2009, Shi et al., 2012).

Baines et al. (2009) formalized conventional manufacturing barriers to servitization into three dimensions including service design, organisational strategy and organisational transformation. First, and with regards to service design, through the expansion into the service domain, manufacturers may face unexpected rivals from their own supply chain (Oliva and Kallenberg, 2003), operational risks in the reconfiguration of tasks previously carried out by customers, and problems with communication strategies that clearly describe the value proposition to customers (Baines et al., 2009). Manufacturers also risk unclear assessment of capabilities required that offer services beyond the scope of the company's competencies (Oliva and Kallenberg, 2003). Second, organisational structural and process changes are required to deliver combination of product and services such as installed base services (ibid). This requires that manufacturers sometimes need to work with competitors to provide solutions for customers, that will potentially put the manufacturer's service business in conflict with its product businesses (Davies et al., 2006, Galbraith, 2002). In addition, conventional manufacturers may perceive the service business as secondary in importance to products, since they may lack support from the company (Brax,

2005), difficulties in customer-based pricing methods and a lack of capabilities to adapt and leverage (Baines and Lightfoot, 2013). Finally, organisational transformation requires changing the mind-set, and an organisational culture shift to more service orientation which is likely to result in resistance within the organisation where the service strategies are not well understood (Baines and Lightfoot, 2013). Thus, those challenges offer an opportunity for advanced service manufacturers to provide training internally to its employees and managers, external to supply chain partners and further into spatial supply chains (Fischer et al., 2010) to familiarize with risks, resources and processes involved in servitization.

3 RESOURCE AND CAPABILITIES OF SERVITIZATION

Manufacturing organisations have shown increasing interest and promise to increase their services but often lack the capabilities necessary for the successful upgrade. Thus it is essential to identify what capabilities can be developed and leveraged based on manufacturers' unique organisational resources. Traditional capital goods manufacturers that view services as cost centers rather than revenue streams pervade contemporary business thinking (Fischer et al., 2010). Such reactive attitudes which separate the product and service are due to the long history of the industrial era where economic growth is achieved through a country's ability to produce an excess quantity of goods and export excess to generate wealth (Ng et al., 2012). According to Ng et al. (2012), a firm's value proposition that over emphasises on the tangible good transactions is more likely to be the victim of price based competition. Instead, firms that integrate tangible products with highly intangible service offerings are more likely to differentiate from the rest of the competition and retain prolonged customer relationships.

The resource based view (RBV) offers an opportunity for product manufacturers to conceptualise the transformation into a combination of product-service offerings, through identifying the firm's unique resources that pure service provider's lack and thus can leverage in the service domain to create distinctive inimitable capabilities (Ulaga and Reinartz, 2011). RBV explicitly focuses on the productive resources and capabilities of a firm and how the tangible and intangible resources, controlled by the firm, create value (Shi et al., 2012). The fundamental assumption of the RBV relates to a firm's resource heterogeneity and immobility. This is because firms could not expect to obtain sustained competitive advantage if strategic resources, such as human, organisational, and financial resources, are evenly distributed across competing firms and that they are highly transferable (*ibid*). The key features of the RBV relate to the inimitability of a firm's strategic resources that protect the firm from competitors acquiring similar resources. For example, through sharing value creation activities (VCAs) between firms and customers, and the ability to optimize VCAs with customers are unique resources that are highly inimitable, and can help firms to differentiate from other transaction based suppliers (Ng et al., 2012).

Complex industrial product manufacturers' moving towards servitization can leverage their unique resource position and develop capabilities that are highly inimitable for creating competitive advantages (Ulaga and Reinartz, 2011, Ng et al., 2012). According to Ulaga and Reinartz (2011), resources are productive assets the firm owns; capabilities are what the firm can do. Resources must be transformed into capabilities to achieve competitive advantage (*ibid*). Their research focuses on identifying four types of critical resources: 1. Product and process usage data derived from the installed base, 2. Product development and manufacturing assets, 3. An experienced product sales force and distribution network, and 4. Field service organisation. In leveraging critical resources, firms can build five types of critical capabilities: 1. Service-related data processing and interpretation capability, 2. Execution risk assessment and mitigation capability, 3. Design-to-service capability, 4. Hybrid offering sales capability and 5. Hybrid offering deployment capability, that can be developed based on the firm's primary resource base, to help firms create competitive advantage in terms of cost leadership and differentiation. Their research shows higher resource and capability commitment for more complex product service offerings (*ibid*). Thus, manufacturers can identify their resource and capability requirement status to make strategic decisions on the types of servitization offerings.

Service dominant logic towards value creation activities can be separated from traditional transaction based activities such as sales of assets and labor hours on maintenance contracts (Ng et al., 2012). Ng et al. (2012), study based on an in-depth case study of the aerospace engine manufacturer Rolls Royce, identified two types of value proposition: 1. Goods dominant logic (G-DLogic: the firm's value proposition which considers resources as 'exchange units' such as physical products, time in terms of man hours, spares and information). 2. Service dominant logics (S-DLogic) as VCAs (the firm's value proposition which focuses on value in use through co-sharing VCAs between the firm and customers). In comparison, with G-DLogic, based on transfer of ownership, the customer achieves outcomes through the use of assets but may not be the most optimal solution. S-DLogic optimizes bundles of value creation activities to achieve a best fit with the customer's capability and resources; the assets are designed and engineered for achieving the best outcomes and could be better designed for use (ibid).

Fischer et al. (2010) suggest that dynamic capabilities serve to transform goods dominant manufacturers to manufacturing goods for service. Their study complements the RBV and argues that traditional manufacturers that focus on operational capabilities fails to describe the dynamic capabilities necessary to answer the questions on how capital good manufacture can change their operational routines to develop services. In order to avoid tendencies to fall into a competency trap and, consequently, a rigidity of resources, dynamic capabilities encapsulate the evolutionary nature of resources and capabilities. Fischer et al. (2010) propose that dynamic capabilities, through sensing, seizing and reconfiguring organizational capabilities, are used to evaluate servitization transformation. Research identifies two dimensions for service development in capital goods companies, 1. Exploitation which focuses on incremental improvement with temporal expansion within the primary customer activity chain, and consists of integrating the basic services into the product price, separating the product and service businesses to extend service profit and revenues, and making use of the service expansion along the primary customer activity chain. 2. Exploration which focuses on radical transformation, in particular spatial reconfiguration within the adjacent customer activity chain, and involves integrating basic services into the product price, creating a new value constellation, and making use of the service expansion along the adjacent customer activity chain (Fischer et al., 2010).

4 CONTENT OF SERVICITIZATION

The key feature of servitization is a strong customer centricity through selling product service systems (PSS). Baines, Lightfoot et al., (2009 p.10) argue that '*servitization is the innovation of an organisations capabilities and processes to better create mutual value through a shift from selling product to selling PSS*'. Servitization can have a variety of forms. They can be positioned a product-service continuum ranging from product with services as an 'add-on', to services with tangible goods as an 'add-on' and provided through a customer centric strategy to perform against customer expectations (Baines et al., 2009). According to Baines and Lightfoot (2013), a typical PSS can involve the following three types: 1. Product-oriented PSS (aftersales services to guarantee functionality and durability of the product owned by the customer) 2. Use-oriented PSS (selling the utilization of the product that is not owned by the customer) 3. Result-oriented PSS (selling the result and capability instead of product).

Fischer et al. (2010) suggest that manufacturers can seize service opportunities through: 1. System integration (integrating components into business process and technical application systems) 2. Operational services (services for operating and maintaining products to maintain and increase efficiency and effectiveness of the installed base) 3. Business consulting (services focusing on knowledge sharing and advice on design, financing, purchasing, maintaining and operations of capital goods). Ulaga and Reinartz (2011) identified that servitization can be based on the service recipient (service directed at the supplier's good or the customer's process) and the nature of the value proposition (the supplier's service value proposition is grounded in the promise to perform a input-based deed or achieve out-put based performance. The authors also identify four types of product-service combinations: 1. product life-cycle

services (PLS: services that are directly attached to the supplier's good, that promise to perform a deed on behalf of the customer) 2. Asset efficiency services (AES: service suppliers provide productivity gains from assets invested by customers) 3. Process support services (PSS: service manufacturers provide assistance to customers in improving their own business processes) 4. Process delegation services (PDS: services a manufacturer provides when it performs processes on behalf of customers). In addition, Ulaga and Reinartz (2011) implicitly point out that the levels of risks and responsibilities involved in each type of servitization which is useful for manufacturers to benchmark against their resources and capabilities to better position themselves in a combined product and service offering. From the above discussions, this paper proposes that manufacturers can develop capabilities through the leverage of unique resources to establish servitization strategies that can create competitive advantage.

5 GAMIFICATION FOR SERVITIZATION OPPORTUNITIES

Although the servitization concept has gained increasing interest by academia, government and industry, the uptake of servitization practices in the UK is however slow. Research identifies the challenges for manufacturers moving towards servitization and include risks in the design of service systems, changes in operations structure and processes, and the significant transformation required for a service mind-set and value in a service culture (Baines et al., 2009). The application of gamification principles arguably offers potential opportunities for the successful adoption of servitization strategies through informing, educating and training senior manufacturing managers about servitization and giving them the means to visualize the potential impact upon their business. Increasing gamification development is associated with advances in computer games, real-time computer graphics, virtual and augmented reality and artificial intelligence (Anderson et al., 2010). In comparison to computer based simulation techniques, which require specialist's knowledge, a large amount of complex and highly customized data, gamification bridges simulation with entertainment. The construction of serious games offers a promising alternative to simulation that can encourage better user engagement, a user interface that is more generalizable for practice and without a high demand on specialist knowledge (ibid).

The development of serious games combines pedagogical and game-like, fun elements (Anderson et al., 2010). The main strengths of serious gaming applications may be generalized as being in the areas of communication, visual expression of information, collaboration mechanisms, interactivity and entertainment (ibid). In particular, gamification allows design mechanisms to incorporate psychological techniques such as Self-Determination Theory (SDT). According to Werbach and Hunter (2012) SDT consists of three dimensions of human motivation. First, competence means being effective in dealing with the external environment. Second, relatedness involves social connections and a desire to interact with others. Third, autonomy is the innate feeling which is meaningful and in harmony with one's values. SDT can encourage a learner's internal motivation and proactiveness. In addition, recognition of extrinsic and intrinsic motivations can be used to stimulate user engagement in the gamification process (Werbach and Hunter, 2012, Edery and Mollick, 2008, Zichermann and Linder, 2010). According to Zichermann and Linder (2010), extrinsic motivations refer to tangible rewards such as salary and promotion that stimulate learners to engage. In contrast, intrinsic motivations are more complex that addresses more on the personal cognitive level (Werbach and Hunter, 2012). According to Csikszentmihalyi (2009) 'cognitive flow' suggests competence, autonomy and relatedness and tends to be absorbing, interesting, and fun, regardless of context. Similarly, Zichermann and Linder (2010), based on observations of intrinsic motivation, suggest that by adopting point, level and badge (PLB) in games stimulate learner's 'flow status' in their learning experience. However, Zichermann and Linder (2010) also note, gamification design needs to balance extrinsic and intrinsic motivations. If extrinsic stimuli are offered too early, it would diminish the intrinsic stimuli which would be difficult to be recover.

6 CONCLUSION

With the identification of the barriers, resources and capabilities, the dimensions of servitization, and the key aspects of serious games, this research offers the first step in bridging serious games with servitization. This paper proposes that product centric manufacturers can adopt serious games to create capabilities for servitization. Applying advanced gamification technologies through immersive virtual reality and interactive game design in organisational learning processes, would encourage the intrinsic motivations of learners to engage in developing knowledge and experiences of servitization. Future research could focus on developing a 3D virtual industrial demonstrations that incorporate identification of resources and capabilities that enable manufacturers to exploit or explore a best fit type of servitization strategy.

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A Game-based Approach for Raising Awareness on Sustainability Issues in Public Spaces

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ABSTRACT

The paper reports on the ‘Sustainability Game’ evaluation with computer science university students as means of understanding their experiences and conceptualisations of sustainability issues in public spaces. Deployed targeted questionnaires with 33 students in UK, the game’s evaluation demonstrated that a conceptual change may be implemented in relation to how sustainability has been experienced before engaging with the game. A questionnaire with 20 questions was distributed to students for evaluating various elements of the game such as usability characteristics, accumulation, assimilation and consolidation of new knowledge patterns related to the educational-based features of the game with an implicit focus on whether the game can be integrated within an academic setting. The overarching conclusion from the analysis of the game uptake is that it may enhance student’s engagement with sustainability issues, especially in blended learning contexts for ‘blending’ different pedagogical approaches with tools and media as means of improving the educational practice.

Keywords: serious games, sustainability, public spaces

1 INTRODUCTION

Promoting learning through public participation is key element in raising awareness regarding the sustainability of open public spaces among university students and professionals (e.g. engineers, architects, planners and public authorities). Traditionally, sustainability issues for urban cities are predominantly addressed through decisions and actions performed by local authorities in consultation with experts in designing, implementing and sustaining public constructions. It is, therefore, essential that tools are developed which support students in learning issues, policies and practices in designing and sustaining public spaces in collaboration with specialists in the field. The outcome of this is twofold: Firstly students are able to enhance their knowledge on sustainability issues through applying and transferring content knowledge in real world contexts; and secondly a direct contribution is achieved towards improving a designated public space.

This paper explores the use of a serious game to address these issues, which predominantly focuses upon promoting awareness whilst raising interest among students and professionals in the evaluation of sustainability as part of improving the quality of life in urban cities. In the following section, the state-of-the-art in game-based learning is linked to the issue of teaching and learning about sustainability in urban cities, leading to the description of the ‘Sustainability Game’ approach¹ in Section 3. An analysis of the game in terms of user engagement and its potential to be used in an academic setting is then provided in Section 4. The results analysed were obtained by eliciting players’ experiences of playing the game through 20 semi-structured questions, in a small-scale survey carried out during 2 piloting workshops. The overarching conclusion from the analysis of the user engagement and efficacy of the game for use as

¹ <http://aspisgame.i-maginary.com/EN/home/index.html>

a learning tool within an academic setting is that the game may enhance student's engagement on sustainability issues, especially in blended learning contexts for 'blending' different pedagogical approaches with tools and media as means of transforming the educational practice.

2 BACKGROUND

The Commission for Architecture and the Built Environment (CABE)² principally promotes the importance of urban design and has a central tenet to incorporate the principles of sustainable development into all aspects of urban design and planning. The quality of public spaces plays a major role in the economic, social and environmental sustainability of our cities. The benefits of well-designed and managed public-space include encouraging social interaction and community cohesion as well as a more outdoor lifestyle, reducing stress levels and adapting to a change climate (CABE, 2008). In line to this, public spaces are vital assets that would need to be designed and managed more flexibly in future. Local authorities may improve the quality of public spaces by developing public realm strategies, appointing public space champions and regenerating streets as active and comfortable spaces.

Barton (2000) examines the practicalities of reinventing neighborhoods. In particular the nature of local communities is examined for building social capital. The focus is on ordinary localities in which people actually live, examining the changing nature and role of local place communities to develop a fresh perspective on the planning and design of neighborhoods in urban areas, based on the eco-system approach. A more recent study from Thompson and Travlou (2009) analyses the nature and value of people's access to outdoor environments, offering a useful insight into people's engagement with open spaces and thereby recommending the key criteria for sustainability such as engaging the community and users in the design of public spaces and promoting dialogue between city council/planners with citizens as means of explaining the city's plan and the challenges faced.

2.1 Game-based learning

Over the past few years, with the widespread use of commercial games the domain of game-based learning has received increasing attention. However, until very recently strategies for supporting the more efficacious methods of learning with games were uncertain. Research has shown that teachers were unsure which games to use, which context to use games and how they could be evaluated and validated (de Freitas & Oliver, 2006). Work coming out of these studies led to the development of conceptual frameworks that were then used over the next few years for testing game-based learning. In particular the four dimensional framework with its four dimensions of the learner, pedagogies used, the representation of the game itself and the context, allowed researchers to evaluate serious games and to interrogate what metrics and measures could be used both to validate game-based learning, and to support the learning design process.

Studies that compared traditional learning and game-based learning (S. Jarvis & de Freitas, 2009) found significant difference in favour of game-based learning. Studies in the US have also confirmed this finding (e.g. Mautone, Spiker, & Karp, 2008). Empirical studies reflecting the efficacy of game-based learning providing greater support for developing effective games for learning, and addressing user expectations of high fidelity games and 'immersive experiences' (de Freitas & Neumann, 2009).

Some of the main strengths of game-based learning includes motivating of learners and the ability to provide personalised approaches to be modelled for individual users and user groups. However, studies have opened up the importance of games as tools for supporting socially based learning, or social interactive learning.

² www.cabe.org.uk

3 THE SUSTAINABILITY GAME

The game contains an overall mission, focusing on public participation and negotiation, which is structured into quests, implemented by short, simple mini-games (Figure 1). Through the mini-games the player gets introduced to the process of urban planning, the design of sustainable spaces and the participation of citizens in this process.



Figure 1: The sustainability game structured into 8 quests implemented as mini-games.

The player steps into the role of Peter - a first year architecture student, who turns to his professor for help in solving the problem of his brother Larry. The decision to demolish the skating wall in the public park appeared to be only a small part of a bigger problem. Seeing Peter's interest and passion towards this cause, Professor McNutty challenges him to get involved in the redesign of the public park and offers to guide him through a series of short quests leading to the final goal which is to pitch the idea to the City Council. Each quest is presented to the player from McNutty in the form of an email screen-shot addressed to Peter. The aim of the first quest is for the player to understand needs of multiple users and identify park user groups. In the second quest, the player meets various people in the park for extracting information as a way of collecting as many correct suggestions as possible within a given time and match them with the needs that have been collected in quest 1. In the third quest the player's goal is to identify problems related to the current state of the park by clicking on pictures and classifying them under the correct category in the inventory. In the fourth quest, the player is directing as many people as possible by offering them flyers for launching voluntary maintenance schemes for planting trees and cleaning the park. In the fifth quest the player's goal is to raise awareness around the design of sustainable spaces and recruit more park users by collecting their signatures. In the sixth quest, the player selects the top three needs that must be realized in order to satisfy maximum park users. A 3 by 3 matrix puzzle is developed in which each square represents a particular need. The player must arrange the squares such that each line in the matrix lines up to reveal one area of conflict.

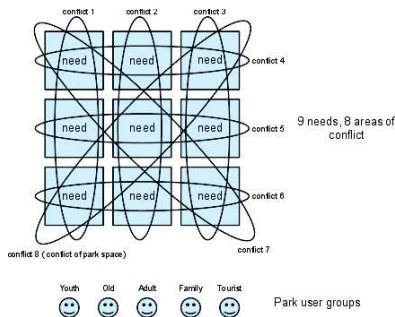


Figure 2: Nine needs that can be arranged to give rise to eight areas of conflicts.

4 METHOD

This section provides an overarching analysis of the game questionnaire that was provided to computer science students, during 2 workshops organised in Coventry, as means of understanding their experiences, approaches and overall evaluation of the ‘Sustainability Game’. The findings suggest that the game is more akin to be used for educational purposes as it enhances content and process related knowledge with regards to sustainability hence it encompasses pedagogically-rich elements which afford the alignment between teaching and learning strategies, assessment methods and learning goals. The evaluation was implemented with undergraduate (UG), postgraduate (PG) and doctoral students (n=33) studying computer science at Coventry University, UK (see table 1). Students completed a small-scale questionnaire with 20 questions for evaluating various features of the game such as usability characteristics, accumulation assimilation and consolidation of new knowledge patterns related to the subject-based features of the game.

Contextual elements	Description
Country	Coventry, United Kingdom
Place of the event	Serious Games Institute
Date	26 April 2012; 14 September 2012
Target group	UG, PG and PhD students
Number of participants	23 (26 April); 10 (14 Sept) n=33

Table 1: Contextual elements of the ‘Sustainability Game’ evaluation.

Against this background, a brief presentation was given to students with the propensity of introducing the scope of playing the game in enacting sustainability in an open and collaborative way. Furthermore, an overarching demonstration of the game aided to immediately grasp basic functionality, as all students were familiar with computer-based environments and simulation tools and especially in the development and use of games for educational purposes. Students used the game through laptop and desktop computers installed in a dedicated state-of-the-art facility especially designed for educational related purposes with large screen panels and immersive learning spaces for collaborative and game-based learning. Students then completed the questionnaires informed by their experiences and actions of using the game.

5 DISCUSSION OF RESULTS

From the summary of the questionnaires, it seems that computer science students tend to perceive the game as intuitive, fun and immersive for understanding an array of aspects and issues of sustainability beyond traditional face-to-face teaching. This is advocated through the question that asked to students whether their knowledge has been improved after playing the game (see figure 3). It was clear from students’ responses that their knowledge has been improved through personal construction of meaning resulting from their interactions with the virtual environment (see figure 3). From this perspective students experienced that different cognitive patterns of sustainability could be made explicit through the game and thus it created opportunities to explore sustainability ideas and test their robustness in explaining relevant phenomena, accounting for events and making predictions. Although, however, most of the students reported that they did not have any prior experiences in sustainability and ways of improving it through public consultation and co-creation of ideas, they felt that fragmented information gained on sustainability issues mainly informed through discussions with family and friends helped them

to understand basic meanings and to transform them to cohesive information that could be consolidated and assimilated to knowledge. Students also highlighted the feature of listening, considering and understanding other peoples' views on sustainability, which seemed to be of a paramount importance for valuing other's people needs and circumstances. For example, they felt that the dialogue between them and the different avatars within the game created a dialogical process that recognised awareness, knowledge and understanding are constructed when individuals engage socially in discussions and activities about shared tasks and problems. This observation open a window for studying and exploring particular forms of collaboration in games (between physical and virtual characters) that may support students in gradually mastering some of the practices and norms that characterise collaborative knowledge creation within games. Recognising that the students have constructed their current understandings from their previous experiences, they felt that their knowledge was usefully related while playing the game. This may imply that the game allowed students to apply their knowledge to new contexts, through which students may generate, new questions and new investigations and thereby transfer of learning may occur.

Students stated that the level of human-computer interaction was in a satisfactory level and natural promoting a sense of developing a virtual community between them and the virtual characters; while through gathering an interpreting their requirements (mainly in the 1st and 2nd quest) they could work together to address the different challenges. Furthermore, students felt that the game was immersive enough to keep them interested throughout the quests although some additions and/or improvements might be necessary in the richness of the animations or around the area outside the park which does not have many events and/or interactions to explore.

In general terms all students would recommend the game to fellow students and friends as it was conclusive that they have never realised that sustainability is a key element for improving quality of living in large cities. In summary, the game felt natural and responsive, consistent with academic learning and would be probably introduced to friends and family and/or would be played again (see Figure 3).

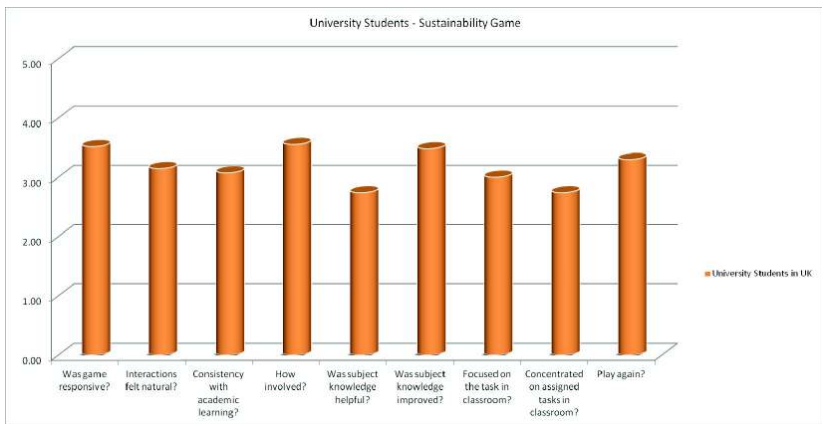


Figure 3: University students responses to survey questions.

6 CONCLUSIONS

The findings of the game evaluation have provided broad pointers to a wide range of considerations that should inform the practical implementation of the serious game in an academic setting. Against this background, the Sustainability Game seemed to be more pervasive for academic teaching and learning as

it provided the foundations for actively constructing knowledge resulting from student's interaction with the virtual world. Moreover, the interaction with the virtual characters created the triggers to actively participate in completing the different quests as well as to identify and connect prior knowledge with new information that aid in creating meaningful learning. The Sustainability Game is a useful tool for accumulating, consolidating and extending knowledge in sustainability within an academic environment because:

- It provides experiences, materials and sources of information for students to use directly from the virtual environment (Quest 1).
- Students may act in response to the different tasks required, showing the use of instruments necessary for completing a quest (Quests 1 and 2).
- Students may test their ideas or answer their questions through diverse ways of investigating and exploring a plethora of sustainability phenomena that take place in all quests.
- It facilitates integration of different learning quests, paths and objectives that have complementary tools which allow students to take different pathways towards solutions (All quests).

ACKNOWLEDGMENTS

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A STRATEGY FORMULATION PROCESS FOR THE DELIVERY OF TECHNOLOGY ENABLED SERVICE DELIVERY SYSTEMS

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ABSTRACT

The Product Service Systems, *servitization*, and Service Science literature continues to grow as organisations seek to protect and improve their competitive position. The potential of technology applications to deliver service delivery systems facilitated by the ability to make real time decisions based upon '*in the field*' performance is also significant. Research identifies four key questions to be addressed. Namely: how far along the *servitization* continuum should the organisation go in a single strategic step? Does the organisation have the structure and infrastructure to support this transition? What level of condition monitoring should it employ? Is the product positioned correctly in the value chain to adopt condition monitoring technology?

Strategy consists of three dimensions, namely content, context, and process. The literature relating to PSS, *servitization*, and strategy all discuss the concepts relative to content and context but none offer a process to deliver an aligned strategy to deliver a service delivery system enabled by condition based management. This paper presents a tested iterative strategy formulation methodology which is the result of a structured development programme.

KEYWORDS: Service delivery system, servitization, strategy, condition based maintenance

1 INTRODUCTION

The mantras that are lean and six sigma are no longer enough when seeking to protect and expand the organisation's competitive space. Typically such initiatives are reductionist in nature with companies seeking to focus on core competencies thus reducing waste and cost. With the impact of global markets and the emergence of competition from low cost economies coupled with the drive for sustainability one sees Product Service Systems [1] [2] [3] [4], servitization [5] [6] [7] [8], and service science [9] [10] evolve. These approaches offer a paradigm shift in the business models employed by organisations who seek to establish 'whole life' added value by offering various levels of service in support of their manufactured products. The literature offers many examples of servitization of such organisations as companies move from the traditional make and sell contract offering base level services (equipment and spares), through intermediate levels of service, to complex service delivery systems (figure 1) [11] [12].

As organisations adopt intermediate level services one sees the emergence of condition monitoring in support of the product. Whilst the use of such sensor technology is applied to the product, its use at this level is predominantly for monitoring rather than management of the product but does facilitate product oriented PSS business models [3]. Finally advanced services include integrated support agreements, advanced rental and leasing solutions, and the facilitation of availability contracting all provided by technology enabled service delivery systems [12].

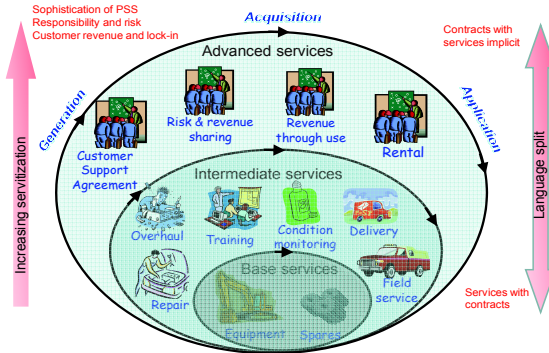


Figure 1: Increasing levels of servitization [11]

When reviewing the literature relative to PSS, servitization, Condition Based Monitoring (CBM) [13] [14], and Integrated Vehicle Health Management (IVHM) [15] [16] one sees that in order to offer a service delivery system enabled by sensor lead technology there needs to be alignment between the level of servitization undertaken [3], the organizational structure and the impact on vertical integration [7], the level of sensor integration and system architecture [17] [18], and consideration of the products ability to accept such applications and its relative position in the value chain [12].

The fulfillment of these requirements is dependent upon the effectiveness of the operations strategy followed by the organisation. Gaps identified within the literature [12] which are concurred by a survey of UK manufacturers [19] identify the need for a strategy formulation process which enables either a planned strategy to be developed or an emergent strategy defined. Such a strategy seeks to align these parameters to the needs of the stakeholders and the ability of the organisation and product to support. This paper introduces a strategy formulation process which has been tested and found to be feasible, usable, and useful [20].

2 RESEARCH METHODOLOGY

The identification of the gaps within the literature and the reported needs of the practitioner informed the research aim:

“To understand the landscape relative to condition based management of products whilst in use within the field and identify potentially high value enabled applications and operations. To deliver a strategy formulation methodology which seeks to target such applications to deliver an aligned service delivery system”.

This section of the paper presents the research approach, the development process employed, and the means of testing the pre-pilot, pilot, and final strategy formulation process.

2.1. The research programme and development of the methodology

The research programme consists of five phases. The first phase involves gaining an understanding of the landscape and issues relative to Condition Based Monitoring and the Condition Based Management of manufactured products whilst in use, with particular focus upon Integrated Vehicle Health Management (IVHM). This entailed a review of the literature which identified specific gaps to be addressed [12]. These gaps were also identified when analysing data returned from a survey of UK manufacturers who produced complex products [21] and who indicated that they were, or were planning to support their products using CBM/IVHM techniques.

The second phase of the research required an improved understanding of the concepts supporting a service delivery system together with documented strategies that may exist to deliver them. This phase identified that strategy consists of three dimensions, namely content, context, and process. Whilst the literature offers a plethora of contributions that deal with content and context, there are very few that deal with the process of strategy formulation and none that dealt with the process in the context of this research.

The third phase adopts an existing methodology [22] as a pre-pilot methodology and applies this to an on-going case study within a UK manufacturer producing sound equipment. The existing methodology was observed and audited during its implementation and areas for development were documented. The task was to ascertain if this pre-pilot methodology would lead its users to consider servitization (and PSS) as alternative solutions to the traditional reductionist responses of 'lean', six sigma, and other moves to core competences. From these observations a requirements document and subsequent specification for the methodology was generated for the next stage, the pilot methodology.

Phase four focuses on the primary evaluation of the pilot methodology using multiple case studies which through serial iteration enables the refinement of the emergent specification. The final phase of the research programme seeks to validate the methodology through additional case studies and present the final methodology.

2.2. Testing of the methodology

After a review of the literature relating to the strategy formation process and the subsequent testing and assessment of such processes this research assesses the derived methodology against three key parameters, namely usability, feasibility, and usefulness. This assessment adopts and applies the guidance of Platts et al [20] when selecting these criteria and applies them to a series of case studies that were undertaken at the three development stages of the methodology (Figure 2). By following the iterative development and testing process illustrated in figure 2, and employing such research methods as structured interviews, observations, and practitioner opinions and recommendations obtained during company visits and workshops, the final methodology is developed and defined.

3.0. Description of the tested methodology.

The methodology is presented by way of 3 part work book which can be used by practitioners (with or without the aid of a facilitator) seeking to formulate their operating strategy. Part 1 of the work book introduces the reader to the concepts of PSS, servitization, and operations strategy with part 2 presenting an overview of the methodology. The final part of the work book presents signposted detail of the methodology with worked examples to guide the user in its application.

Redding and Baines

The application of the methodology seeks to identify the actual operating strategy being applied and the gaps in alignment to stakeholder requirements. Whilst not offering prescriptive solutions to the

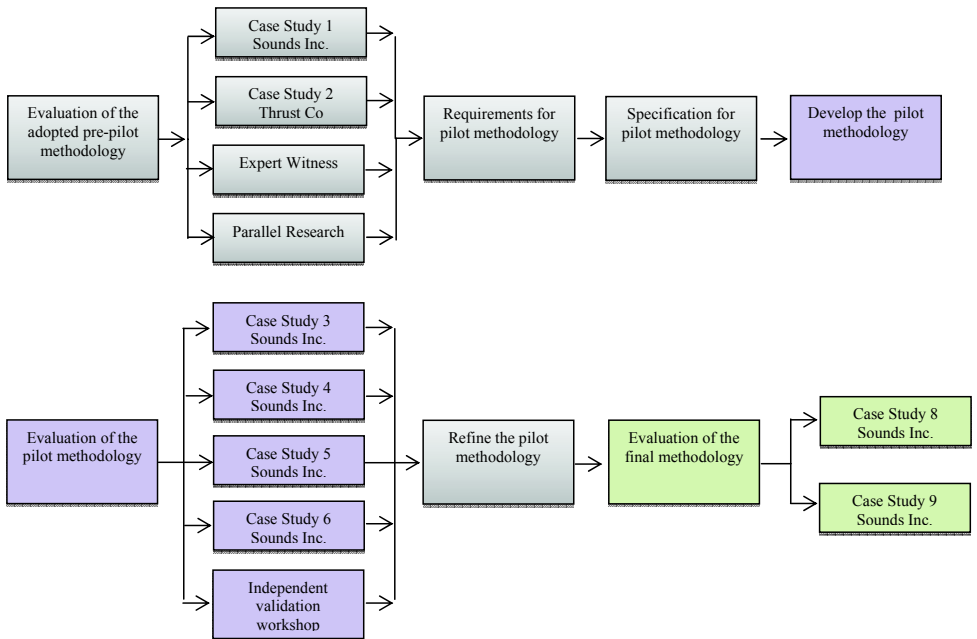


Figure 2: The development and testing process for the methodology

operating strategy question the methodology allows for a structured and iterative gap analysis to be conducted which facilitates the formation or emergence of alternative operating strategies one of which is competing through condition based management enabled service delivery systems. The use of the ‘service temple’ is adopted to guide the user through the process of applying the methodology and developing the final strategy (figure 3).

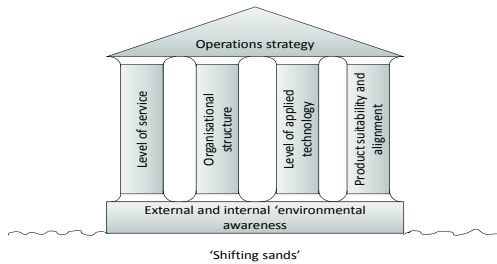


Figure 3: The ‘Strategy Temple’

It is seen that the structure comprises seven elements which if assembled correctly will deliver an operations strategy which is aligned to stakeholder needs, whilst possessing the best suited organisational structure and level of technology inbuilt to the product and support system. It also allows for a test to see if the product is suitable for such an initiative finally delivering a strategy which if followed will deliver an operations strategy which facilitates competitive advantage through the adoption of enhanced service delivery systems [12].

The shifting sands that the structure sits upon denotes the changing environment. Various tools and techniques including surveys and structured interviews are applied to both internal and external stakeholders in order to appraise and understand these ‘sands’ (*the needs of the stakeholder*) and recognition is made that these are in fact dynamic. By the application of a structured but iterative gap analysis the foundation (*the external and internal environmental awareness*) is laid.

The research recognizes that the formulation of an aligned strategy is in fact a product development exercise. That is strategy is the result of critical thinking. For this reason the methodology looks to the product development tools, and in particular the ‘House of Quality’ (HOQ) development tool as one which offers sufficient rigor, structure, repeatability, and auditability when seeking to formulate such a strategy. Whilst not innovative today the use within the strategy and operations management arenas is. The four pillars represent the four iterations of the HOQ method. The four houses applied within the process are the service house, the technology house, the technology house, and the product suitability house. The aim, rationale, and outcome for the application of each house is listed in table 1 with an overview of the application of each house illustrated in figure 4.

Whilst there is insufficient space within the size parameters of this paper to describe in full the complete process as illustrated in figure four, a description of the first house (*the service house*) as identified in figure 5 is presented. The laying of the ‘foundation’ and the construction of the ‘service pillar’ builds on the pre-pilot stratagem methodology previously published by the author [22] [23].

In laying the foundation for the ‘*service temple*’ an understanding of the following was achieved through the use various data acquisition tools (observation, questionnaire, structured interviews...etc):

- The definition and scope of the area organisation under study (Corporate, SBU, department etc),
- The definition and scope of the operations and offerings under review,
- The environment in which the organisation operates and the change inhibitors/drivers that prevail,

- How the organisation really achieves competitive status,
- How the competitive status may be improved giving due consideration to all alternatives (servitization).

Redding et al (2010) describe the processes undertaken in laying the ‘foundation’ of the ‘service temple’ within their paper previously presented at ICMR2010. The output of these processes are a list of improvement initiatives which are then entered into the service house (Box A – Figure 5). These initiatives are then assigned an importance rating as identified from the data returned from the stakeholders (Box B). Typically a multi-disciplinary team identifies the organisation’s offerings which can, or could serve to satisfy these requirements in the service house (Box C – Figure 5). It will be noted in the example (figure 5) that these offerings represent the offerings as illustrated in figure 1, namely base, intermediate, and advanced services.

Table 1: Aim, rationale and outcome for each phase of the methodology [12]

	House of Service (The Service Pillar)	The Organisational House (The Organisation Pillar)	The Technology House (The Technology Pillar)	The Product House (The Product Pillar)
Aim Service strategy	To understand which forces and drivers are acting upon the organisation, and align the operations strategy to these forces.	To understand the optimum organisational structure required to deliver the service expectation within the service house	To understand the level of technology to adopt in order to support the organisation to deliver the required level of service as identified within the service house.	To assess the manufactured offering for suitability and purpose to deliver data by way of 'intelligent' product.
Rationale Technology strategy	The need for an holistic methodology which identifies threats to the organisation and aligns operations strategy to that threat (considering initiatives other than cost or lean)	There needs to be alignment between the service expectation and the organisational structure in order to deliver the service offering	As the company moves through the service continuum, greater knowledge of the product's performance in the field is required	Not all products are suited to the application of IVHM type technology. It may be necessary to increase the product offering in the value chain.
Outcomes Product strategy	To set service targets and levels to be offered by the company to align with customer, market, stakeholder expectations	To align the organisational requirements of the business with the service expectations.	To align the technology requirements by way of 'intelligent' product to that of the organisational requirements and service expectations	Assessment of the product's suitability to be fitted with required technology and to what level to deliver the desired 'in field' data.

The multi-disciplinary team then seeks to rank the correlation between the initiatives listed in box 'A' and the offerings that are listed in box 'C'. For example, when reviewing the correlation between 'equipment' and 'Greater understanding of customer needs' it is observed that the team recorded a correlation index of '2', that being of medium importance. The team then discusses the correlation between each pair of parameters and enters an index score from 0-3 (see key- figure 5). Upon completion of the correlation index the team can then complete the final stage in completing the service house by calculating the service targets. This is achieved by applying the following formula:

$$\text{Service Target (T)} = \sum \sum_{i=1}^n (R_i \times W_i)$$

Where: R_i = Importance Ranking..... (Box B)
 W_i = Correlation index (Weighting)..... (Box D)

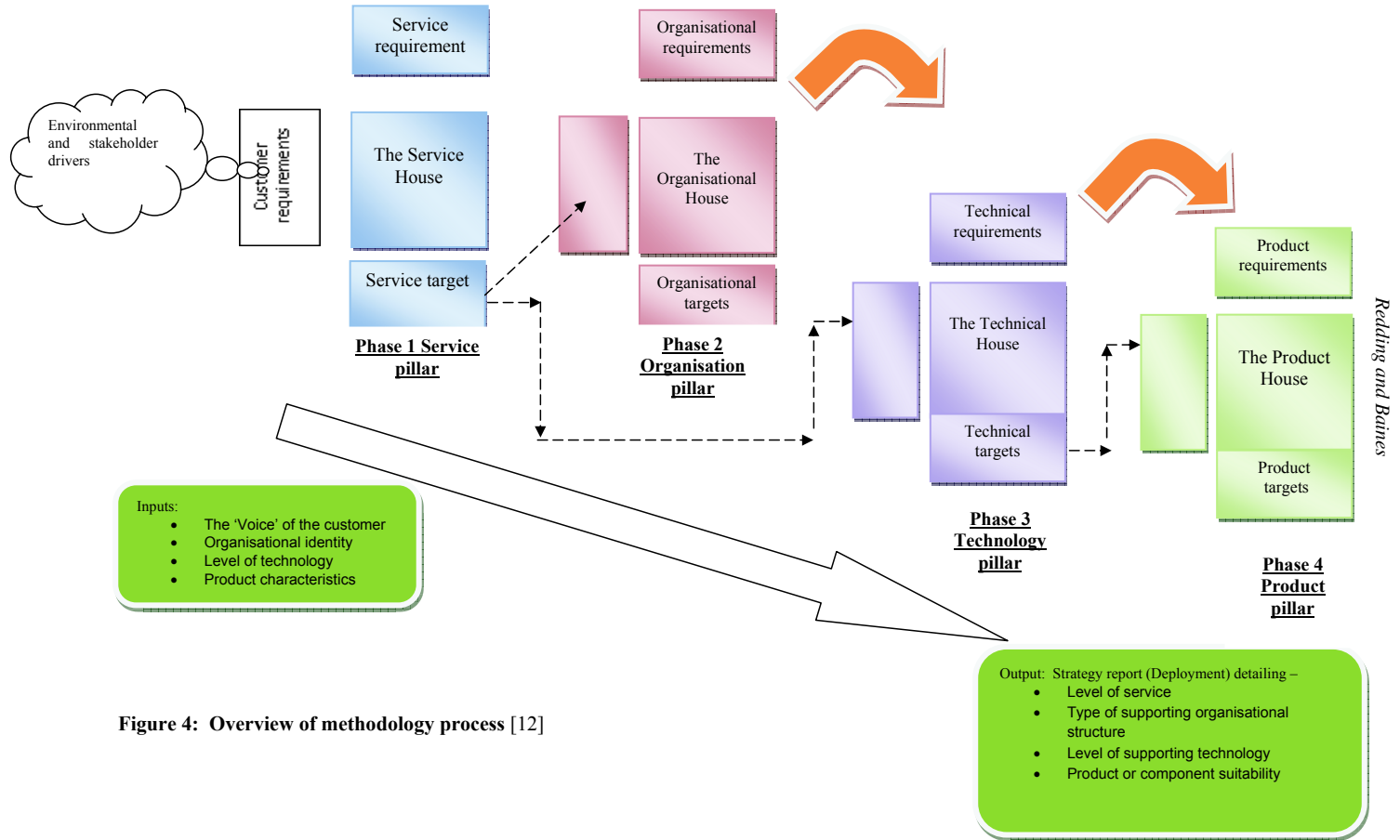


Figure 4: Overview of methodology process [12]

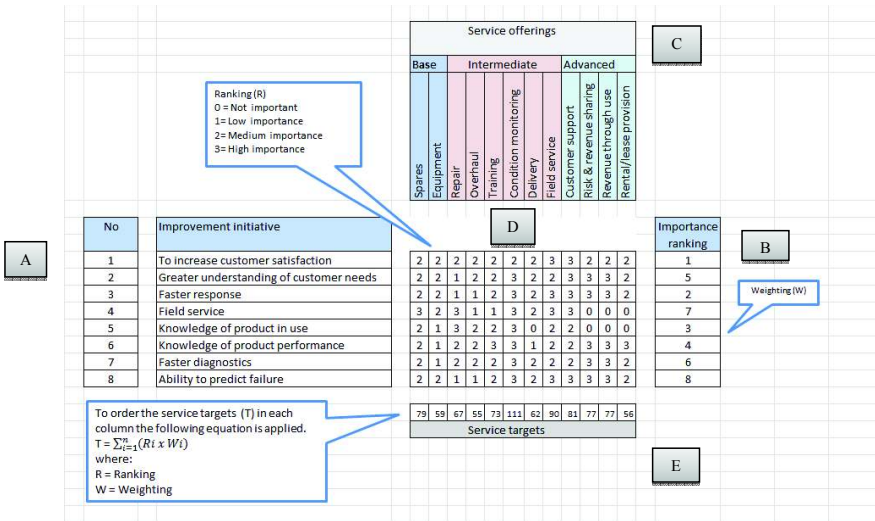


Figure 5: The completed service house [12]

This results in a set of service targets which are entered into Box 'E'. These data present a ranked list of service targets which are aligned to the needs of the customer (stakeholders) and the level of service that the organisation can, or has the potential top offer. Thus the service pillar of the temple is constructed and the service targets are then entered into the following house within the sequence. Full and illustrated details of the process with examples are found in Redding (2012). The final phase of the process having constructed each pillar is the presentation of the final operations strategy (the temple roof). In disseminating and communicating the final developed operations strategy which is fully aligned to the needs of the customer, the organisation's ability to provide a level of service, the operational structure and infrastructure of the organisation, the level of CBM technology to apply, and the suitability of the product to be supported by such technology, the methodology uses the policy deployment matrix as a means to present and monitor the strategy (Figure 6).

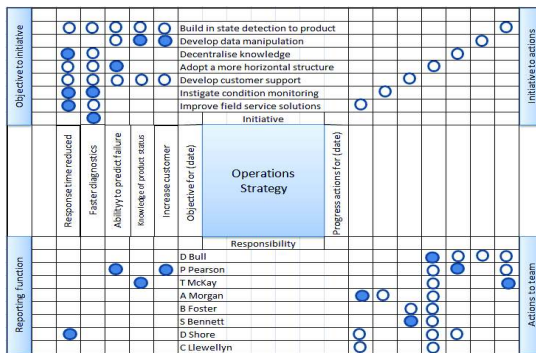


Figure 6: Completed policy deployment matrix [12]

4. CONCLUSIONS

This paper reports recent research relating to the development of a strategy formulation process for the delivery of a technology enabled service delivery system. The requirement for such a process is identified as a gap within the literature relating to Integrated Vehicle Health Management and is verified by a survey of UK based manufacturing organisations producing complex mechanical, electro-mechanical, and/or electronic components and systems. The literature relative to strategy (*as a process*) is reviewed for guidance and an accepted test method selected. An existing pre-pilot methodology is chosen and applied in order to define the requirements of the process and specification to meet the needs of the stakeholders. Namely to develop an operations strategy which aligns the needs of the customer (*level of service*), the organisational structure, the level of technology to adopt to support the product in the field, and to ascertain if the manufactured product holds the correct value added position to deliver a servitized offering to the customer. The process is developed through two design iterations after testing with (and seeking informed opinions from) senior executives with responsibility for strategy development and implementation. The process is assessed for feasibility, usability, and usefulness in each stage of its development. Whilst further testing and development is required, the authors present this methodology as an iterative process which fills a gap in the literature and a need identified by practitioners. It allows for the formation of a defined (or emergent) operations strategy which waymarks the path towards an aligned service delivery system.

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MANAGING MULTI-ORGANIZATIONAL COLLABORATIONS AND ERP SYSTEMS IN A SERVICIZED ENVIRONMENT: AN EXAMINATION OF PRINT-ON-DEMAND SOLUTION

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ABSTRACT

Services-led competitive strategies are critically important to manufacturers and service providers. Nevertheless, most research studies exploring the implications of ‘servitization’ put more emphasis on single organization rather than multi-organizational landscape. Also, there is little guidance in the existing literature on how Enterprise Resource Planning (ERP) systems enable the servitization. This paper aims to examine how multi-organizational collaborations and ERP systems can be governed (designed and managed) in a servitized context. Empirical inductive research has been conducted using a single case study in the UK printing industry. Data were collected through semi-structured interviews and analyzed using the grounded theory approach. This has involved transcription and codification of interviews to derive theoretical propositions. This research proposes a new conceptual model – the Dynamic Enterprise Reference Grid for ERP (DERG-ERP) which can be used to guide servitization strategy adoption using ERP systems in a multi-organizational setup.

Keywords: servitization, multi-organizational collaboration, ERP information systems.

1 INTRODUCTION

As a response to easily imitable product- and process-based competitive advantage, manufacturers and service providers are adopting a strategy of bundling products and services into integrated solutions or delivering pure services. This strategy is referred to as servitization (Vandermerwe and Rada 1988). The servitization research to date has been mainly focused on investigating servitization from the perspective of a single organization (i.e. intra-company). The effect that servitization has on multi-organizational collaborations remains under-explored.

Multi-organizational relationships are a strategic source of competitive advantage and play an important role in the development of integrated (product-service) solutions. From the network perspective, services are more easily deployed through relational exchange and may be provided by members of the supply network (Cohen *et al.* 2006). Therefore multi-organizational collaboration to deliver services has become more prevalent; and it is suggested that the most effective mechanism for facilitating supply networks that support the provision of servitization is through effective management of inter-organizational relationships. Although the issues about dyadic/triadic collaboration for service delivery have been discussed in the extant literature, there is a dearth of research on how servitization takes place in orchestrated multi-organizational collaborations rather than on the supply chain level.

The emergence of servitization strategy also requires companies engaged in multi-organizational collaborations to facilitate greater levels of information and knowledge exchange, and increased interdependency (Johnson and Mena 2008). This has driven the technological systems development to improve the visibility of assets spanning inter-organizational boundaries; whilst ERP system is considered as a critically important enabler of servitization (Lightfoot *et al.* 2011). However little is known about

how the ERP information systems capabilities are integrated into the servitization adoption; and this is another gap that the authors seek to address in this study.

The research programme has therefore set out to explore how multi-organizational collaborations and ERP systems should be designed and managed to achieve a services-led competitive strategy. A new management contingency framework known as the DERG-ERP is outlined; and its associated rationale is described within the context of servitized operations.

2 THEORETICAL BACKGROUND

2.1 Multi-Organizational Enterprises in the Context of Servitization

Customers are increasingly seeking holistic integrated solutions. However, few organizations are able to provide one-stop, systemic product-service solutions from their own resources and so meeting this need, particularly in a complex servitized context, is typically achieved by entering into collaborative relationships where partners engage in collective activities with common enterprise goals (Binder and Clegg 2007). The term 'enterprise' is adopted in this paper to refer to the complex arrangements of sub-organizational units from a variety of provider and client organizations that collaborate to deliver a given service. This research focuses on three types of enterprises: Vertically Integrated Enterprises (VIE), the Extended Enterprises (EE), and the Virtual Enterprises (VE).

Vertically integrated enterprises (VIEs) operate as large single well-integrated multi-functional firm striving for scales of economy, which typically have bureaucratic reporting hierarchies and evolve as, "a response to pre-existing market power problems or as a strategic move to create or enhance market power in upstream and downstream markets" (Joskow 2003). Existing research on investigating the vertical integration practice in the adoption of servitization (Baines *et al.* 2011) can be criticized as there are lack of sufficient considerations to the impacts on extended and virtual integration of successful servitization.

It has been argued that servitized value networks need to be more responsive and agile to be able to offer varying service solutions. Therefore EEs and VEs paradigms should be used in addition to VIEs. EEs are defined by Lyman *et al.* (2009) as "... a business value network where multiple firms own and manage parts of an integrated enterprise". Thus EEs are conceived to be more agile than VIEs. However even EEs cannot manage to follow very high economic turbulence and business unpredictability; this can be best coped with by the VEs structures and strategies. Generally, VEs are best thought of as a jigsaw of operations and information systems from more than one business entity very loosely governed by specific decentralized objectives. Thus VE can facilitate innovative agile service delivery more easily and deal with dynamic market change (a.k.a. instability) and uncertainties through web-based information and communication technologies (ICT) tools.

2.2 ERP Information Systems Support the Servitization Strategy

As the servitization context requires greater levels of data synchronization and multi-organizational integration, it has been suggested that there will be bidirectional, more rapid and transparent information exchange compared to the 'product only' mode. This can be achieved by effectively making use of the sophisticated ERP systems. However, traditional ERP systems are internally integrated information system used to support core internal functions (e.g. production planning and control). Although coordination of inter-functional divisions is made easier by ERP system, its origins are firmly based in manufacturing and do not readily support the servitization requirements. In response, new functional modules have been developed to form ERP II systems which is recognized as an integral part of business strategy to enable multi-organizational collaborations (Bagchi *et al.* 2003).

In the servitization context the systems of companies within the supply network should be linked to the integrated product-service solutions to provide a more efficient response to the customer (Cohen *et al.* 2006). Although ERP II is currently the dominant information systems type to support inter-organizational linkages, companies still endeavor to re-design their collaborative operations and ERP systems to become

more dynamic in order to anticipate change and increased uncertainties in a servitized context (Johnson and Mena 2008). As a result information systems solutions based on technologies such as SOA (Service Oriented Architectures), SaaS (Software as a Service) and utility computing are becoming prevalent. These technologies bring with them further flexibility, efficiency, scalability and re-configurability for collaborative operations in a servitized environment.

In this paper the authors refer to the next generation of ERP systems as ‘ERPIII’ which is defined as a flexible, powerful information systems incorporating web-based technology which enables enterprises (i.e. multi-organization) to offer increasing degrees of connectivity, collaboration and dynamism through increased functional scope and scalability.

3 RESEARCH METHODOLOGY

An exploratory and qualitative empirical research approach was used based on inductive grounded theory (Strauss and Corbin, 1990) from a single case study in the UK printing industry. 6 semi-structured face-to-face interviews with managers covering functional roles such as operations, manufacturing, IT systems, supply chain and client service was conducted. Interviews took place between February 2011 and March 2011, lasting between 1 - 1.5 hours (producing 7 hours and over 90 pages of validated transcript).

Grounded theory coding and analysis was conducted using the NVivo 9.2 software tool based on Strauss and Corbin’s (1990) theoretical coding paradigm as follows (1) interviews were coded using *open coding* – during the coding process, memos were created that explained how the data were opened up to get a greater understanding of the responses, and a total of 268 initial free nodes were extracted (2) during the comparison of codes across all interviews the relationships between the codes became clearer and the authors started to condense and group codes with similar meaning into sub-categories, categories and abstract core categories using *axial coding* and *selective coding*. This led to 137 codes, 20 sub-categories, 23 analytical categories, and 7 core categories (3) through abstraction and iteration, the codes inducted 15 propositions, which are presented in a theoretical narrative later in this paper and can be seen in Table 1.

No.	Propositions relating to multi-organizational collaborations and ERP systems governance in a servitized context
1	Increasing business complexity, cost-effectiveness and shorter turnaround time requires organizations to move towards more collaborative strategies
2	Multi-organizational relationships change over time, which is dependent upon individual core competencies
3	Service based multi-organizational collaborations have greater propensity to become virtual than product based multi-organizational collaborations
4	Organizations could use different approaches to multi-organizational collaboration, structure and strategy within different supply networks simultaneously
5	Responsibilities and functional roles of each different organization needs to be clearly defined within the servitized supply network
6	Collaboration with new external organizations requires internal business processes to be reengineered to accommodate new changes
7	In the servitized context, multi-organizational collaborations predominantly concentrate on managing performance and consumers’ expectations
8	Organizations are more willing to collaborate with other organizations who have a proven track record of successes in servitized multi-organizational business collaborations
9	Once organizations obtain a similar set competences at a similar level of maturity as their partner organizations, the partnerships could change as a result
10	The role of ERP systems in supporting servitized operations has evolved from intra-organizational optimization and integration into multi-organizational collaborations
11	Services-led multi-organizational integration requires different companies within the same

	collaborative supply network to use ERP system(s)
12	The tighter multi-organizational collaborative structures and strategies become; the more integrated and flexible ERP systems also need to become
13	Initial motives for multi-organizational collaborations in a servitized environment are based upon the attractiveness of an organization's core competences
14	Collaboration between different organizations can create new meta core competencies and specific systems resulting in 'end-to-end' product-service solutions
15	Building multi-organizational collaborations is an effective way to reduce cost and lead time, increase the efficiency, improve flexibility and reactivity to demand; and encourage innovation

Table 1: Propositions Relating to Multi-Organizational Collaborations and ERP Systems Governance in a Servitized Context

4 EMPIRICAL CASE AND FINDINGS

To explore how multi-organizational collaborations and ERP systems can be designed and managed in a servitized environment, this study used a single case which was multi-national manufacturers and service companies. This was chosen as it was known to be an innovative company with servitization strategy to grow quickly through its servitized printing solutions, close collaboration with other companies, and its use of ERP information systems.

4.1 LS: Print-on-Demand Book Printer

LS was established in 1997 and has become a leading company in providing a comprehensive suite of print-on-demand (POD) and distribution services to the book publishing industry. LS offers a book printing service that can be from batch sizes of one upwards to thousands. It is a POD service with advanced technologies enabling highly customized products and services that can be delivered profitably.

LS can be viewed as a servitized manufacturing company in printing industry characterized by increasingly 'demand-driven' e-marketplace; where establishing multi-organizational relationships is crucial to increase the company's flexibility and agility while shortening lead times (cf. proposition 15). Therefore, LS decided to concentrate on its core competencies (cf. propositions 2 and 13) and extended its activities into other valued members in its supply network through an extended enterprise paradigm to cope with industrial changes and create new meta-competitive advantage (cf. proposition 14).

Oracle Content Management Systems were initially installed as the main ERP platforms to support rapid information exchange, knowledge sharing, and electronic book storage. LS then realized that incumbent ERP systems were only interfaced rather than properly integrated, which was not suited to extended enterprise operations (cf. proposition 12). Thus the company improved the traditional ERP type system towards an ERPII system that could facilitate a fully integrated system-to-system linkage between LS and its business partners which was conceived to be fully integrated 'order and request system'. This information systems architecture was based on the Oracle 'Online Store' Internet applications (e.g. EDI (Electronic Data Interchange)) and further integrated with an e-procurement system.

To further this servitization development more LS decided to extend the ERP systems capabilities by holding book titles in its digital library with e-backlist and providing an e-reader interface; thus enhanced LS's core competencies to include a 'virtual book warehouse' which could also eliminate the need of stock on the demand side (for downstream partners). Also, the POD strategy enabled LS to establish more temporary and in-depth relationships with many publishers, authors, raw materials, machinery suppliers, and channel distributors. Thus the LS operations are tending towards a virtual enterprise concept as co-dependent valued members within the multi-organizations implement the same servitization strategy with clearly defined responsibilities (cf. proposition 5) which make contributions to the overall product-service

being delivered to the end-customer. Supporting web-based ICT tools are regarded as flexible and relatively low cost systems which can support timely communication, increased transparency, and multi-organizational decision-making which is akin to the ERPIII type systems.

4.2 Discussion: a Theoretical Narrative

Multi-organizational collaborations can be regarded as an effective approach to maintain and achieve competitiveness for the whole *enterprise* (inter-organization) and its individual members (cf. propositions 1, 14 and 15). Different multi-organizational structure and strategies may change over time (cf. proposition 2), and can be supported by different ERP systems under different servitized contexts (cf. propositions 10, 11 and 12).

Identifying the value drivers (a.k.a. competitiveness) and managing core competencies are considered as principal factors when making decisions to achieve the multi-organizational success as the value drivers determine the *enterprise* structure and strategy whilst the competencies determine the role of the individual partners within the collaborative venture (cf. propositions 2 and 13). Particularly services-led multi-organizational collaborations would have greater propensity to become virtual enterprises by using web-based ERP systems than those production-based strategic alliances (cf. proposition 3). This is because the adoption of servitization requires more flexible and agile business performance with quicker and more accurate responsiveness to unpredictable customer demands (cf. proposition 7). Furthermore, the existence of multiplicity of dynamic multi-organizational relationships within an *enterprise* (cf. propositions 4 and 9) may allow for a certain degree of autonomy within the collaborative venture (e.g. LS and its distributors). Besides, any effective multi-organizational collaborations would require internal business processes of each individual member to be re-engineered to accommodate new changes (cf. proposition 6) which is a big challenge. Hence organizations are more willing to collaborate with other organizations that have a proven track record of success within the servitized multi-organizational business collaborations (cf. proposition 8).

In respect to ERP systems design and management, it is firstly observed that the role of ERP systems in supporting servitized operations have evolved from intra-organizational optimization and integration into multi-organizational collaborations (cf. proposition 10). Additionally, it has been widely accepted that within the servitized multi-organizational collaboration context, different organizations are requested to not only use ERP systems but also use the same ERP systems to become highly integrated and flexible (cf. propositions 11 and 12). Moreover, information security, cost and flexibility of ERP systems deployment are considered as key determinants in their adoption and use in multi-organizational collaborations; this is also the provision of complex and innovative product-service systems.

5 DERG-ERP FRAMEWORK AND CONCLUSION

This research has undertaken an investigation how multi-organizational collaborations and ERP systems can be governed in a servitized context. From a single case study 15 theoretical propositions were formed using inductive grounded theory. The new Dynamic Enterprise Reference Grid for ERP (DERG-ERP) is shown in Figure 1 below which distills the generic principles from this research into a single contingency management framework.

DERG-ERP can be used to explain correlations between ERP system types and multi-organizational structure and collaboration strategies from service perspective. It was observed that traditional ERP was associated with VIEs, ERPII with EEs, ERPIII with VEs and limited IS and IT was observed in DEs. Therefore the authors claim that there is a correlation between each of these pairings.

DERG-ERP is limited by being based on a single case; and so is currently being tested and applied on other service-oriented companies. This work contributes to a gap in extant literature about the co-development between servitization strategies, collaborative enterprise governance and ERP information systems; and gives some practical decision support to guide information systems and enterprise managers in a servitized environment.

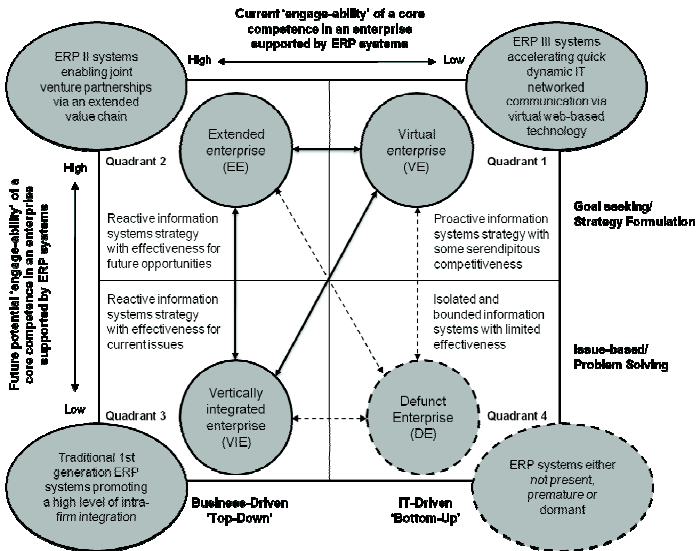


Figure 1: Dynamic Enterprise Reference Grid for ERP (DERG-ERP)

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INNOVATION AND KNOWLEDGE MANAGEMENT

DISRUPTIVE INNOVATION AND SERMITISATION – COMPETITIVE ADVANTAGE THROUGH PRODUCT SERVICE VALUE PROPOSITIONS

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ABSTRACT

This study explores the introduction of product-service offerings in which the manufacturing firm may lose its product based competitive advantage. Conceptually, the study furthers understanding of the role that capabilities have in servitisation. It also establishes the link between product-service system and discontinuous innovation. Empirically, the study provides insights into management considerations when faced with the dilemma of having to pursue product service propositions that weaken or marginalise existing product or technology based capability advantages. This affects firm value proposition, creation and capture in a substantially different way than in existing servitisation models.

Keywords: Servitisation, Disruptive innovation

1 INTRODUCTION

The boundaries between products and services are increasingly blurred, with many manufacturers offering services in support of their products (Heineke and Davis, 2007). The servitisation shift towards greater service content has resulted in a variety of new business models and conceptual frameworks, such as Product-Service Systems (PSS), experiential services, and service-dominant logic. Manufacturing firms face different incentives for incorporating services into their product offerings. There is an economic argument of capitalising on services throughout the product life cycle by providing product support and enhancement (Markeset & Kumar, 2005)(Markeset and Kumar, 2005; Legnani et al., 2009). Studies show that there are higher margins in services than in products (e.g. Anderson et al., 2007). Also, customers are demanding more services as technological complexity increase and higher degree of customisation. Furthermore, services may be used for competitive reasons as they are intangible competences that are difficult to imitate and thus could create a differentiating advantage (Kindström, 2010)(Heskett et al., 1997).

In the servitisation literature, whether the offerings take the form of products and services, products with services, or product functionality, the assumption remains that the firm retains a product or technology capability that provides competitive advantage (Alvizos and Angelis, 2012). For instance, aerospace engine maker Rolls Royce derives substantial income from post-sale engine service and maintenance due to its retained engine capability and competitive advantage as the offering has servitised. Product specific innovation or technology change is assumed to be incremental or in line with the technological paradigm while introducing a greater service element in the business model. But in conditions characterised by innovation and technology shift, such advantage may be significantly eroded or indeed lost (Tidd & Bessant, 2011). The fundamental challenge of disruptive technologies is incompatibility with established business models (Christensen, 2006). Accordingly, Tukker and Tischner

(2006) argue that there is a need to consider the implication of product-service innovations. As such, this study explores how PSS is affected by disruptive innovation which may result in the loss of firm core competence. The research question is: How do firms servitise in the context of discontinuous innovation?

In answering the research question, the study uses an extensive longitudinal case study within the automotive industry. It relies on multiple sources of empirical data and covers interviews with respondents from different organisations involved in the development of the Electric Road System (ERS), covering truck manufacturers, electrical power utilities, railroad manufacturers, road administration and energy agencies, industry experts and researchers. The focus is on truck manufacturers that pursue servitisation to become providers of transportation solutions, and face a technology shift from diesel to electric engines where the role of the diesel engine is substantially diminished and marginalised.

2 THEORY

The study utilises two strands of theory to explore the research question, covering product-service offerings and innovation. For product manufacturing firms there are different incentives for integrating a higher level of service into their products. It could reduce the environmental impact compared to the traditional business model (Mont 2002). There is also an economic argument of making money through services during the product life cycle through product support (Markeset & Kumar, 2005)(Markeset & Kumar, 2005). Anderson et al. (2007) show that there are higher margins in services than in product. Customers are demanding more services as the technological complexity increases and they want to have higher degree of customisation. Furthermore, services could be used as a competitive argument as they are intangible competences that are difficult to imitate and thus could create competitive advantage (Kindström, 2010)(Heskett et al., 1997).

Product Service System (PSS) is a model that manufacturing firms may use in transforming their business model. It is defined as “a system of products, services, supporting networks, and infrastructure that is designed to be competitive, satisfy customers’ needs and have a lower environmental impact than traditional business models” (Mont, 2002). Thus PSS emphasises selling the result of a combination of products and services instead of focusing on selling the product or service alone. Tukker (2004) presents three main categories of PSS; product-, use-, and result-oriented. Each category gives a different business model configuration. The product-oriented category means that the business model is based on the sale of the product to the customer with extra service added. The use-oriented category means that the product stays in ownership with the provider but is available through different contractual forms. The result-oriented category is based on a result as a pure service that the customer buys from the provider(Tukker, 2004). Kley et al. (2011) have adopted Tukkers categories of PSS and used them for the mobility concept in the automobile industry. The difference for a customer demanding mobility is to either buy the product or the service. For the vehicle manufacturer or product provider there are different possibilities selling the vehicle or the services connected to the product. The traditional business model does not support those services that are product integrated.

Oliva and Kallenberg (2003) identified three problems for the product-manufacturing firm in the transition from products to services. First, it is difficult to believe in the economic potential of the product service component. Second, the firm does not feel it has the right competencies and does not want to invest in them even if the service market potential is appreciated. Third, even if the firm enters the service market it may still fail in deploying a successful strategy and business model. Research also show that PSS concepts affects firms differently based on company size (Lindahl, et.al., 2009).

PSS focuses on business models from a system and value-chain perspective, as a strategic concept that may create a profitable business with reduced environmental impact. Morelli (2006) highlights the importance of designing and creating a set of standard tools and methods to design and develop PSS successfully. PSS requires a systemic aspect where the value is co-produced by a network of social actors (Morelli, 2006). Meanwhile, Tukker and Tischner (2006) argue that there is a need for comprehensive

longitudinal case studies that focuses on management aspects and strategic decisions making, as the inclusion of system innovation in the value chain.

(Abernathy & Clark, 1985) Innovation theories typically divide innovations into incremental and radical based. Incremental innovation is competence enhancing and in line with the progress of the current technological paradigm (Dosi, 1982) whereas radical innovation tend to destroy competence and lead to a paradigmatic shift (Abernathy & Clark, 1985) (Abernathy & Clark, 1985). Established firms often encounter difficulties and problems when faced with radical change as the technology is changed (Utterback, 1994). The concept of disruptive innovation is based on radical innovation but could mean that innovation could come from both a technical point of view and from the market (Christensen, 1997).

The servitisation literature assumes a incremental or marginal technical development and that there is no significant technology shift –in which firms increase the product and service mixes to enhance value, position the brand and control the market. In conditions of disruptive innovation, PSS may not generate a win-win solution for the firm and customers. Often the radicalness of innovation means that there will be a creative destruction, not only for established actors but also for network relationships, markets etc, which may fit poorly with servitisation strategies as typically conceptualised or employed. In accordance, Tukker & Tischner (2006) remark that there is a need to link innovation to PSS in order to understand the change process.

3 RESEARCH DESIGN AND SETTING

Since the internal combustion engine has a negative impact on the environment and dependent on fossil fuels, automotive manufacturers have been exploring new energy efficient technologies together with other actors (Kley et al., 2011; Wolfson et al., 2011). One possible technological trajectory is the ERS, electric road system, which support dynamic power transfer from road to the vehicles. The power transfer could be carried out through different technologies (inductive and conductive power transfer from underneath, and trough overhead line technology) and in different applications (bus systems, mining transportation, long haulage, and passenger vehicles).

The transformation towards the ERS constitutes a disruptive or radical innovation as the technology could substitute the complex and highly sophisticated internal combustion engine developed over the past century (e.g. Christensen, 1997). This kind of innovation constitutes change in the device concept; change in infrastructure and in user learning (Williams, 2006; 2007). It challenges the system and established OEM business models as value is co-created with other actors or differently than previously (such as utilities, construction companies, agencies, infrastructure companies) (Kley et al., 2011). Thus, the value proposition and value capture of the offer will also change.

The study is based on a case study that observes the transformation towards ERS from the truck manufacturers perspective, see Table 1 for data sources. It is an example of disruptive innovation in an existing industry structure with a dominating technological paradigm. The case study includes projects that have developed and evaluated ERS technology and includes industrial, governmental and academic stakeholders. Furthermore, one truck manufacturer is studied more in-depth and one more broadly to understand their servitisation strategy in the context of the transformation to the ERS.

The study primarily relies on the collected material of eighteen managerial interviews and observations from thirteen program meetings. The interviews were semi-structured, recorded and transcribed, while the formal observations were documented by hand and with help of an extra researcher to ensure reliability. Interviews were also conducted with other actors involved in the development of the electric road system. The approach enabled observations through meetings of the project and longitudinal observations at the hybrid development department, to capture project obstacles and phenomena that need to be addressed to provide understanding of the challenges that comes with disruptive innovation and business model challenge. The method enables a description of an evolving context (Yin, 2008), and gave

insight to the ERS development process. The longitudinal approach furthered understanding of change. The use of more than one truck manufacturer increases the generalisability of the results.

<i>Data source</i>	<i>Actors</i>	<i>Positions</i>	<i>Documentation</i>
18 Interviews	Truck manufacturers	Managers from different departments, CEO of one firm	Audio
25 documented informal observations	Truck manufacturer	R&D department of one truck manufacturer	Notes, blog
10 Interviews	ERS Stakeholders	Project managers, stakeholder experts	Audio
13 Participant observations	Slide-in stakeholders	Engineer and business managers	Notes
Document studies	Agencies, truck manufacturers	Technology, emissions, project details, patents	Internal and formal documents
Websites, industry conferences, visits	International ERS initiatives	Firms with ERS technology, debates, initiatives	Notes, blog

Table 1: Data sources of the case study

4 DISCUSSION AND ANALYSIS

4.1 Moving towards solution based business models while facing ERS technology shift

The case study shows that truck manufacturers in the premium truck industry are transforming their business model from a product and service based to system based. There are three main reasons for this: higher technological complexity due to increased regulation restrictions on the diesel engine, increased customer demands on services; and balance the demand variation. First, institutions have aimed at decreasing the negative environment impact of diesel based trucks through legislation (e.g. on particles and local gas emissions), which has increased the level of technological complexity in the diesel engine and increased demand for high quality maintenance and repair services. Second, customer demands in the mature truck industry are based on Total Cost of Ownership (TCO) which in turn is dependent on quality over the product lifetime. The road transportation industry is characterised by low margins, and a substantial share of the TCO is constituted by truck operating costs (e.g. energy efficiency, uptime, durability). Hence, is essential for customers that services benefits extend over total product lifetime. Third, many truck manufacturers have high profit margins in the after market (e.g. service and maintenance) and have increased their presence with their own service network. This has ensured high margins in economic downturns when customers are reluctant to buy new trucks and instead prefer to service and repair old trucks. The high level of technical complexity in the vehicles has made high quality service and spare parts essential for low TCO.

The increased level of servitisation has meant challenges for the truck manufacturers in how to sell the new offer. Traditionally truck sellers receive provision for each sold truck with no incentives for sold services. Customers typically buy vehicles separately from added services. The move towards selling transportation utility rather than vehicles puts new capability requirements on organisational. Further, increased data and information services on how customers may use products more efficiently (ie through fleet management) requires business models benefiting all parties.

So far the key value proposition, i.e. low TCO and energy consumption and high energy efficiency, is dependent on the diesel engine. It remains the core capability of the truck manufacturers as the engines become more sophisticated with increased demands on regulation restrictions and energy efficiency. The diesel engine ensures the role of truck manufacturer as key stakeholders in the transportation system as it is the most critical component in the system that gives the system its flexibility and cost effectiveness compared to other transport modes (such as train and boat, which are more rigid transportation systems).

But the diesel engine based road system is facing disruptive innovation with ERS where the role of the diesel engine is diminished and changed.

ERS involves different technical interfaces with new stakeholders. Electric power companies are likely to compete with oil companies, while power transfer companies active in the railway industry are likely to compete with truck manufacturers in developing powertrains and controlling the energy management system. Even if the vehicles themselves will still require diesel engines, these will be scaled down and less complex. A diminishing role of the diesel engine will also affect the service network of truck manufacturers largely based on the diesel engine capabilities. Hence, while the diesel engine may remain, it is likely to be commoditised, with other capabilities become the focus for the firm in order to continue delivering high value for the customers.

The study results indicate that the marginalised product remains important in the customer based relationship. If the core technology is lost, the knowledge of how the product is best used may be used to create a solution based value proposition. Thus, in the context of disruptive innovation the focal firm still have an advantage due to the customer interface and overall product/system knowledge. The results also show that with a PSS strategy the firm may be less vulnerable of discontinuous innovation. Indeed PSS could be seen as an enabler to create competitive advantage in light of disruptive innovation.

Servitisation implications

In the focus on the transition from product-oriented to service-oriented business models, firms seek to benefit from higher value capture, or profit margin. However, while this has assumed that the focal firm will retain its core capability and accordingly integrate services in the value proposition, this study has shed light on conditions where the firm competitive advantage based on capabilities is lost or marginalised due to the discontinuous aspect of given innovations. In other words, the core technology becomes commoditised or indeed obsolete. This study indicates that the implications of disruptive innovation depend on the level of servitisation: Products and additional services offered; Products with service as an integrated part of the offering; Offerings based on functionality use of product, with required services incorporated. This has three implications.

First, services are used to increase revenue when the value proposition is based on the product. Technology leadership is important to be able to reach and retain competitive advantage. Disruptive innovation would reduce the added value of the product. Consequently, it would be difficult to leverage product expertise to sell added services.

Second, with value propositions that are product based but with services integrated, offer increased value to the customer through increased revenue, uniqueness, customer loyalty etc. If the core capability is lost the offering is significantly reduced, as there are difficulties to deliver the integrated product-services. The firm may become dependent on other actors that take on a stronger role in the system and in turn weaken its value position.

Third, in solution based value propositions the functionality aspect is the core competence. It defines what products and services should be offered to the customers. In case of disruptive innovation the functionality based offer remains relevant but will however change the core product and services. A transition from a product to a solution based value proposition would require system capability and the interface to the customer.

5 CONCLUSION

To summarise, the study has explored product-service systems conditions in which manufacturing firms may lose their product based competitive advantages due to technology changes. Truck manufacturers may experience a value loss as the exiting technology capability in diesel engines becomes commoditised in the shift to ERS, but may also benefit of their deep customer knowledge and the different interfaces in the transportation system. The results indicate that the product and functional knowledge of the market and customer remains important in a service-oriented business model, even

when core capabilities are lost. The practical implication is that firms new core capability lies in system integration and network knowledge. A business model transition to PSS may enable the firm to achieve competitive advantage in the new technology system.

Moreover, since much of the servitisation literature is based on the assumption that core competence remains an important competitive advantage for manufacturing firms in the new context, there is a need for more research on both the effects of disruptive innovation on servitisation and effects of servitisation on disruptive innovation.

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MANAGING KNOWLEDGE-INTENSIVE/PROFESSIONAL SERVICES IN A SERVICIZED SYSTEM?

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ABSTRACT

This paper contributes to the emerging debate regarding product-service systems by exploring the role of knowledge intensive/professional (KIP) services. It presents preliminary answers to a framing research question: *what are the distinctive challenges associated with the management of KIP service elements in a servitized system?* To begin to generate insights regarding the research question, this paper focuses not on the extant servitization literature but on the adjacent KIP services and strategic outsourcing literatures. Throughout the paper, detailed conceptual insights will be used to present a series of more specific research questions, that together should form the basis for future research in this neglected area for servitization scholars.

Keywords: Knowledge Intensive/Professional Services, Strategic Outsourcing, Exchange Governance.

1 INTRODUCTION

To date, servitization research has mostly discussed generic and relatively simple service components (e.g. preventative and field maintenance). Far less consideration has been given to the more knowledge intensive and/or professional (KIP) service elements - from complex legal and financial advice to specific technical design/analysis to the generation of accurate operational forecasts (e.g. air traffic volumes, patient numbers, etc.) – that can have a profound influence on the overall product-service (P-S) mix. This KIP ‘gap’ in servitization research is significant for a number of reasons but one is particularly worth highlighting. A substantial number of KIP services are bundled together in P-S arrangements because the buying organization has outsourced these services (to reduce costs, leverage economies of scale and scope (Davies et al., 2007) and access new innovations and capabilities (Antonelli, 1998), etc.) – consider the example of a military aircraft manufacturer also being tasked with developing complex safety/airworthiness cases that would have traditionally been developed ‘in-house’ by specialist military/government staff. Unfortunately, if a KIP service has been subject to substitution-based outsourcing (i.e. the process of completely “replacing internal production”: Gilley and Rasheed, 2000: p.36), there is the corollary effect that, over time, a significant capability gap will develop between the buying organization and supplier (i.e. “buying more than they know”: Flowers, 2007). Given the complex, contingent nature of KIP service processes (Lewis and Brown, 2012) and their idiosyncratic managerial control challenges (Goodale et al., 2008), this knowledge asymmetry makes specifying and monitoring the performance of such services very difficult. These observations give rise to the exploratory research question that in turn provides the structure for the paper:

What are the distinctive challenges associated with the management of KIP service elements in a servitized system?

To begin to generate insights regarding the research question, this paper focuses not on the extant servitization literature but on the adjacent KIP services and strategic outsourcing literatures. Throughout

the paper, detailed conceptual insights will be used to present a series of more specific research questions, that together should form the basis for future research in this neglected area for servitization scholars.

2 WHAT ARE KIP SERVICES?

KIP services are well represented in a range of generic service classifications (Silvestro et al., 1992, etc.) with the interaction between two defining characteristics to the fore: (1) high levels of customer contact/service customization and; (2) fluid/flexible processes based on individual judgment and knowledge (with low capital and high labor intensity). In addition it is important to consider the distinctive nature of ‘knowledge workers’ and/or ‘professional’ employees (Goodale et al., 2008, p. 669) – such as their relative autonomy and market power - and the organizational structures that are commonly adopted to co-ordinate their activities – such as the partnership model.

2.1 Customers and Customization

Customers play a critical definitional role in most discussions of service. Sampson and Froehle (2006, p. 331) for example argue that the “presence of customer inputs is a necessary and sufficient condition to define a production process as a service process”. The exact degree and nature of the customer input has been the subject of debate and classification. Wemmerlov (1990) categorized both the interactive medium (i.e., physical presence, indirect technology-mediated communication, or no interactions) and its object (e.g. information, goods, physical self: Lovelock, 1992, 1996). Others, noting that it is not the physical presence or otherwise of the client that influences variability, have emphasized the relative ‘activity’ of the interaction. The combined logic, that control with high levels of customer input variability is more challenging and reduces the opportunity to deploy standardization and automation, explains how and why high customer contact (front-office) and low contact (back-office) services are routinely ‘de-coupled’. With specific reference to KIP services, it is typically argued that this type of service has the ‘most’ customer interaction and/or customization. More focused investigation of specific KIP services however reveals evidence that “not all services rendered by ‘professionals’ necessarily involve a high degree of customer influence” (Kellogg and Nie, 1995: p. 326). In their study of a law firm for example, Lewis and Brown (2012) found a highly contingent degree of ‘reactivity’. An individual’s specialism and/or expertise and/or experience (and the relative scarcity of this capability) created the opportunity for some employees to treat customers with a degree of distance. They further highlighted “plentiful evidence of inexperienced and/or unprepared and/or emotional clients deferring to the [...] professional in nearly every aspect of the service design and delivery” (Lewis and Brown, 2012: p.9). Given the specific context of a servitized system, where a ‘professional’ buying organization may face a number of partner organisations, this ambiguity regarding the customer’s role in specifying a KIPS service gives rise to the first research question:

RQ1. How do customers (i.e. who is involved, what are their roles, etc.) specifying KIP service components in a P-S system?

2.2 Fluid Processes and Knowledge

KIP service processes are generally understood to be more fluid/flexible, labour intensive and largely independent of significant amounts of capital – be it inventory, equipment and/or infrastructure. One significant implication is that KIP service delivery typically focuses less on traditional forms of work/process management. For example, standardization and automation is less common and more emphasis is placed on forms of leveraged work management where greater use is made of lower cost (e.g. junior lawyers) and/or differently (less) qualified (e.g. paralegal) employees. Similarly, in a servitized system a product supplier can leverage their organizational reputation (for example, as a design authority?) to justify providing a KIP service element but the customer may subsequently find it difficult

to establish if they are getting a thorough job (“opaque quality”: Von Nordenflycht, 2010, p.161) – it is not unheard of, for example, for KIP service suppliers to simply deliver large reports to convey quality. This potentially different approach to management gives rise to the second research question:

RQ2. Are KIP service processes managed differently (e.g. in terms of process control, automation, etc.) from other service processes in a P-S system?

Deploying a medical metaphor, Abbott (1988, pp. 40–49) explained professional service interactions as a process of diagnosis, inference and treatment. Figure 1 illustrates this interaction in the context of a servitized system. Diagnosis takes information into a particular knowledge system, treatment brings instructions back out and critically, inference is the reflective process that KIP staff engage in “when the connection between diagnosis and treatment is obscure” (p. 49). All expert/knowledge workers ‘locate’ their judgments within a particular knowledge system; but for some (professional) employees this body of knowledge is externally (but non-governmentally) regulated and controlled in its content and application (von Nordenflycht, 2010). These ‘knowledge monopolies’ (i.e. you cannot practice as a lawyer in country A unless you gain entry – passing exams, apprenticeship, etc. – to country A’s legal system) exclude nonprofessionals and are central in the maintenance of high labour costs. Professionals also adhere to explicit external codes of ethics and implicit norms that guide appropriate ‘professional’ behavior. These external ‘controls’ can act to minimize the influence of managers (Harvey, 1990) but also reduce the need for, and associated costs of, internal service quality monitoring (Goodale et al., 2008, p. 670).

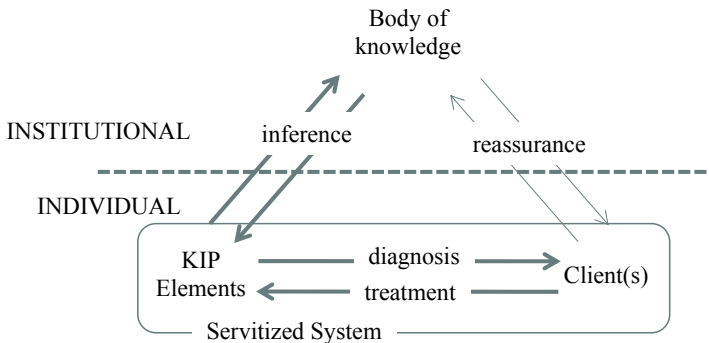


Figure 1 The different dimensions of KIP service delivery

Any conceptualization of a KIP service needs to include via inter-related levels of analysis; echoing Durkheim’s (1964) conceptual separation of regulation by law (i.e. institutionalized protections from fraud and coercion), from the contracts agreed between individuals. To date most servitization research gives consideration to the (meso) level analysis of ties between organisational actors (e.g. buyer-customer-supplier; buyer-supplier-supplier) but active consideration also needs to be given to the (macro) role of external bodies of knowledge and standards, codes of conduct, etc. The extent to which these institutional phenomena constitute discrete ‘actors’ is an important consideration for the management of a KIP service component. If bodies of knowledge/standards are externally controlled, like law or medicine, then control over individuals and their service delivery by the organizational actor is inevitably diminished. If this tie is weaker; perhaps as the result of it being a less bounded body of knowledge (e.g. the safety engineering capabilities are not associated with a formal license to practice) or it residing within organizational boundaries (cf. the IDEO design method) then the supplier has more control but the

buyer may have less confidence in the quality of what they are buying. In both cases significant tensions can emerge between how individual employees interpret (and deliver) tasks and how they may have been specified ex-ante.

RQ3. What role does the nature and 'location' of the associated body of knowledge have on the KIP service elements in a P-S system?

Knowledge asymmetries also shape the relationship between KIP employees and their firms (Abbott, 1988; Friedson, 1986; Haywood-Farmer and Stuart, 1990). In many settings, the mobility and transferability of employee skills and the relative lack of effective mechanisms for embedding KIP judgment in operating equipment, products and 'routines' significantly increases employee bargaining power. The KIP service firm does have control in some circumstances; such as those where the firm controls specific IPR or certifications, where reputation is important (perhaps supported by a large marketing spend), or where the client is seeking a volume and variety of services (i.e. accountancy firms providing audit, tax and consulting) that lie beyond the skills of an individual professional.

RQ4. To what extent do individual service employee characteristics (i.e. relationships with specific professionals) shape the performance and co-ordination of KIP service elements in a P-S system?

3 STRATEGIC OUTSOURCING

Whether it be HRM or R&D or mission critical IT, the outsourcing of complex, KIP-type services is increasingly common in private and public-sector procurement. Correspondingly, there are more and more examples of KIP service in P-S arrangements. Although the primary strategic rationale for the 'serve or buy' decision remains efficiency maximization, a range of factors, including narrower definitions of core competencies and greater technological complexity (Balakrishnan et al., 2008, Oliva and Kallenberg, 2003) have shifted the scale and scope of outsourcing.

3.1 Drivers for KIP Service Buying?

Intriguingly this 'strategic outsourcing' trend appears to challenge the dominant theoretical, transaction cost economics (TCE), logic for selecting market or hierarchy. Assuming opportunism and bounded rationality (Rindfleisch and Heide, 1997), TCE logic concludes that firms should *internalize* activities where adverse costs might arise from operational difficulties in a market exchange such as uncertainty, frequency, and asset-specificity (n.b. an asset is transaction specific if its value in a transaction with another party is reduced and correspondingly, the larger the value 'gap' between its best and best-alternative use, the greater the specificity of the asset). In other words, exactly those conditions that apply when considering KIP services.

RQ5. What are the drivers (e.g. buyer outsourcing) that lead to the inclusion of KIP Service elements in a P-S system?

3.2 Contractual Governance

Given the description of KIP service knowledge asymmetries, it seems almost certain that most organizations will face significant governance challenges as they buy rather than make KIP services. In a long-term arrangement, such as is typical with a complex P-S system, it is possible/probable that over time a significant capability gap will develop between the buying organization and supplier. As Ellram et al. (2008) have noted, "[w]hen making an outsourcing decision, the future is not known with certainty. But by committing to a specific path, for example outsourcing programming, the firm has limited its future possibilities for developing the code internally" (p.128). In sum, outsourcing serves to reinforce

high levels of knowledge asymmetry between customer and provider, and correspondingly the KIP service governance challenge of a 'typical' P-S arrangement is that as the supplier builds (strong) ties to the buyer (and potentially the buyer's customers) this becomes the basis for some kind of enhanced bargaining power. One specific result of endemic knowledge asymmetries therefore is that it may encourage exchange parties to seek more 'complete' contracts, that is contracts containing all the necessary safeguards to mitigate opportunistic behaviour and reduce transactional ambiguity by clear specification of what is and what is not allowed within a relationship (Lui and Ngo, 2004). In a servitized system this might mean the articulation and refinement of an ever more 'comprehensive' service level agreement for example?

RQ6. What impact does the inclusion of KIP service components have on the time and costs associated with contracting for a specific P-S arrangements?

Even in those circumstances where a supplier may have delivered the additive capability and originally specified performance, knowledge asymmetry means that the buyer will remain concerned that they are not enjoying the most innovative, cost-effective and appropriate service? In many PFI/PPP markets for example, this concern over a lack of long-term flexibility (Dixon *et al.*, 2005) and minimisation of alternative supply options has given rise to the inclusion of market benchmarking processes in the original contract; whereby key elements of the bidding process are re-enacted every few years (e.g. in the UK, every 5 years is typical) to ensure 'fair competition'. Although an interesting mechanism, the same challenges of asset specificity and uncertainty – together with a declining long-term incentive - give rise to the enduring prospect of supplier lock-in.

RQ7. Does increasing the number of KIP service components being offered as part of a P-S system, increase mutual inter-dependence and negate subsequent market options?

3.3 Relational Governance

As discussed, the knowledge assets that underpin any P-S arrangement service will inevitably exhibit exchange-specificity (i.e. their value in transactions with another party would be reduced) but with the introduction of a KIP service component this tendency to strong ties is further reinforced. In their discussion of strategic outsourcing for example, Holcomb and Hitt (2007) concluded that because complete contracting is unrealistic in complex (i.e. KIP service) situations, it is relational governance (e.g. complementary capabilities, cooperative experience and information sharing) that determine the success of such arrangements. Although such relational mechanisms (i.e. strong ties, limited risk of disintermediation) can provide effective governance, it places significant emphasis on continuity of staff and individual relationships (cf. RQ4) which can itself be problematic (e.g. in a multi-year P-S arrangement it is typical that buying and service staff will change over time).

RQ8. How important is relational governance in coordinating the KIP service elements of a P-S system?

4 CONCLUSIONS AND FURTHER WORK

This paper set out to begin to investigate the distinctive challenges associated with the inclusion of KIP service elements in a servitized system. It is not an empirical paper. The concepts and specific research questions presented are however intended to provide a clear starting point for additional theory-driven empirical research. Further investigations should seek to challenge, test and modify this set of research questions that are inevitably 'work-in-progress'. Accepting this limitation, these reflections strongly suggest that the specific characteristics of KIP service elements will, when introduced to a P-S system, engender additional, distinct operational and governance challenges. Specifically, the context of strong

knowledge asymmetry creates a series of on-going challenges regarding the specification and monitoring of the service. Similarly, the extent of asset exchange-specificity creates the context for relational governance to predominate and is likely to reduce the degrees of freedom available to the buying firm in any subsequent market interactions.

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STRATEGIC CHANGE IN PROFESSIONAL SERVICE FIRMS: CASE OF A LAW FIRM

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KEYWORDS

Service Operations Management, Systems Thinking, Soft Systems Methodology, Professional Service Firm (PSF), Process Oriented Holonic (PrOH) Modelling

ABSTRACT

This paper will present the case of a medium-sized law firm based in the West Midlands, UK which is undertaking a Knowledge Transfer Partnership (KTP) project with Aston Business School to achieve organisational renewal under the banner of cultural and operational transformation. To enable the desired organisational transformation systems thinking has been used as an intervention. The use of Process Oriented Holonic (PrOH) modelling a novel methodology developed from the principles of Soft Systems Methodology (SSM) has allowed the firm to adopt lean thinking and carry out process improvement towards achieving operational efficiency. To plan, design and monitor the cultural change throughout the transformation process this project has also used the Change Kaleidoscope framework. By using these academic techniques we have delivered change in several operational routines and achieved cultural transformation in firm. There is evidence from a firm-wide survey indicating the readiness of staff towards embarking on change initiatives has increased over the duration of the project. Our main focus in this paper will be to explain how our KTP project has contributed to the success of a law firm by driving transformation in culture and operations within a period of two years.

INTRODUCTION

Although manufacturing firms are steadily pursuing the route of servitization, conventional service industries, like law firms, are keen on commoditising their services wherever possible to offer greater price-certainty to clients. Academic literature indicates that professional services are relatively under-researched in the area of service operations management; despite some recent insightful work in law firms by Lewis & Brown (2012). The UK's legal sector is currently facing unprecedented challenges posed by two major factors:

- i. increasing demands of the client on price and value of legal services and
- ii. intensified competition in the marketplace introduced by recent deregulation allowing non-lawyers to setup and own law firms through Alternative Business Structure (ABS) as detailed in Legal Services Act, 2007.

While changing client expectations are forcing law firms to rethink their service models and pricing strategies, increased competition and the threat of new entrants, such as supermarkets and insurance companies, has pushed many of them down the path of consolidation as a means to survive and grow. According to a survey, 86% of the law firms considered the possibility of a merger in 2011 (Legal Consultancy Network, 2011). Several firms have reacted to these changes by resorting to inorganic growth strategies such as mergers and acquisitions. Higgs & Sons Solicitors, a medium-sized firm based in the West Midlands region has taken a different route by embarking on a strategic change programme aimed at developing firm-wide capability for building stronger client relationships, improving operational efficiency and delivering higher-valued services.

HIGGS & SONS SOLICITORS

Higgs & Sons is a long-established legal practice, trading for over 135 years delivering a wide range of legal services to clients of all sizes – individuals, SMEs and large PLCs. It is a medium-sized law

firm based in the West Midlands region of England with 18 equity partners and about 200 staff. Once a high street practice with small offices distributed in this region, Higgs has gone from strength to strength over the last few years and developed into a significant player in this region. It currently competes with large international firms in many service areas. With increasing competition in the market place and changing client expectations, Higgs acknowledges the importance of building lasting relationships with clients and offering them added value services. To achieve this, they need to reinforce the current service delivery model and put clients at the centre of the process. Such a focus on clients should go deep into the firm's culture and must resonate in all layers of the organisation, which is only possible through an organisation wide change programme.

For delivering this much needed strategic change, Higgs has joined forces with Aston Business School through a Knowledge Transfer Partnership (KTP) project. The aim of this project is to firmly establish Higgs as a go-to firm for individuals and businesses of all sizes. Central to this project is transformation in culture and operations of the firm towards increasing its competitiveness and building a sustainable future.

PROFESSIONAL SERVICE OPERATIONS

Professional services represent a distinct form of service that involves high levels of knowledge intensity, labour intensity, customer interaction and customisation as characterised in Schmenner's service process matrix (Schmenner, 1986). Based on this premise that professional service operations (PSO) are distinct compared to the other service operations (Schmenner, 1986; Silvestro, et al., 1992), Lewis & Brown (2012) aimed at refining the existing theory in light of their research findings and clearly indicated that 'PSO is a distinct environment for managing operations' and that professional and organisational factors can undermine even the most robust efficiency logic in these settings (Pg. 10).

Operations Management (OM) differs from other areas of management research in terms of addressing both physical and human elements of the organisation. Besides the tangible elements, much of the research is also focused on the softer elements such as people and their interaction with the tangible aspects of systems (Drejer et al., 1998). OM concepts have been widely applied to service settings but mainly in areas that operate similar to production lines, such as fast-food restaurants, retail stores and hospitals. Researchers argue that limited research has been conducted in the field of OM, specific to PSFs (Lewis, 2009) and the existing literature suggests that PSFs are a challenging territory for OM theory and practice due to their distinctiveness, high client-contact and complexity of operations.

Service itself is an elusive concept, in that professional service falls at the extreme intangibility end of the tangibility spectrum (Amonini, et al., 2010). Many believe that 'professional services' is an under-researched sector in the areas of service operations management, marketing and strategy (Lewis & Brown, 2012; Amonini, et al., 2010; Gummesson, 1981). Ertel & Gordon (2012 Pg. 132) question 'how far can legal services be mapped out, specific activities delineated and sequenced, and the work distributed among providers?' and they argue that there is no answer yet. Sampson (2012) argues that Service Operations Management (SOM) itself has not sufficiently contributed to research and practice. In spite of a plethora of 'process mapping' and 'flow charting' tools currently in use by both service and production operations professionals across the globe, Sampson advocates that there is an imminent need for new tools that help conceptualise, visualise and analyse service operations.

SYSTEMS THINKING FOR DELIVERING CHANGE

For many years systems thinking has been used as an intervention to deliver change, it goes back to some of the earliest writings produced at the beginning of the twentieth century (e.g. Bogdanov, 1913-1917). There is a long history of work in systems thinking geared to facilitating organisational change and wider social improvement (Midgley, 2003) especially in complex organisational settings.

Complex systems are those with multiple causes and effects that are highly context-sensitive and not responsive to linear, prescriptive methods of intervention (Jackson, 2006).

Delivery of legal services can be considered a complex system because there are multiple stakeholders involved in the transaction and interactions between them can result in varied outcomes depending on the contexts (Benedettini & Neely, 2012). Systems thinking can provide us with an unconventional perspective for viewing legal service delivery as a complex system, and a tool to appreciate the interconnectedness of contextually dependent components (Clegg, 2007).

The intuition provided by systems thinking can enhance our world view of legal service delivery by emphasising its systemic behaviour. There are various methodologies within systems thinking, out of which our primary interest is on Soft Systems Methodology (SSM). SSM was developed to find a better way of dealing with situations that we continually face in our everyday life, those which we feel “something needs to be done about this” –problematical situations (Checkland & Poulter, 2006 pg. 3).

Process Oriented Holonic Modelling

Process Oriented Holonic (PrOH) modelling is a novel methodology developed from the principles of SSM using cases from the manufacturing and engineering sectors as a real-life application of systems thinking in the domain of business process design (Clegg, 2007). PrOH modelling is being used in a professional services environment for the first time through our KTP project. In our project PrOH modelling has been used to build high level views of legal processes in order to visualise the interactions between people, systems and other tangible and intangible entities involved in legal service delivery. Thus we were able to model the entire service delivery process within each of the legal service areas. This is a powerful tool that can be used for various purposes such as conceptualising, visualising, and analysing service operations that are intangible and often vague. Above all, the most unique feature of this tool is that it can be used to create a storyboard of any service process that enables the modeller to conduct a structured enquiry by gathering several stakeholders in a place and narrate the process scene by scene.

Recent work on professional services that led to a paper highlighting the distinctiveness and complexity of service operations in a law firm (Lewis & Brown, 2012) indicates that little research has gone into development and application of SOM theory in the context of PSFs, especially law firms. Through the use of PrOH modelling we have successfully applied theory to improve practice in Professional Services. (See Figure 1)

The Case of Corporate Services at Higgs & Sons

Our project examines five different legal service areas as pilot cases to sufficiently cover the breadth of operations inside a typical law firm using the volume-variety criteria. Table 1 depicts a volume-variety matrix mapped for each of the five service lines that will be studied in our project.

Service Line	Volume	Variety
Road Traffic Accident Claims	High	Low
Wills and Lasting Powers of Attorney	High	Low
Commercial Property	High	High
Dispute Resolution	Low	High
Corporate Services	Low	High

Table 1: Volume-Variety matrix for five departments at Higgs & Sons

Providing corporate legal services poses several managerial challenges for lawyers at Higgs & Sons. For example, Negotiating legal fee for large management buyout matters is a difficult task as clients supply with insufficient information at the outset, making it hard to scope and price the matter. There are many unknowns at the time when lawyers are asked to provide a price quote for corporate transactions. For example, the information on pensions, claims, disputes, lawyers of other side, lawyers of bank, amount of documentation involved all of which affect the time spent by the lawyers, will sometimes only come to light during the course of the matter. Hence lawyers in corporate services face difficulties in negotiating fee for such large transactions. In addition, there is excessive competitive pressure to win the work and lawyers must provide an attractive quote to outdo competition. In doing so, lawyers will make several assumptions at the outset to arrive at a price quote which may involve inaccurate projections of time and effort ultimately resulting in loss of revenue in the form of fee write-offs. The ability to produce near-accurate projections of billable hours can prove greatly helpful in negotiating and winning new business. As there is currently no support for lawyers at hand in this process, there is imminent need to design new tools and approaches for acquiring and executing large corporate transactions. Some of these major problems coupled with several other issues related to legacy internal processes have to be addressed to unleash the full potential of the department in two areas mainly large transactions such as M&A and relatively smaller transactions such as business structures and commercial contracts.

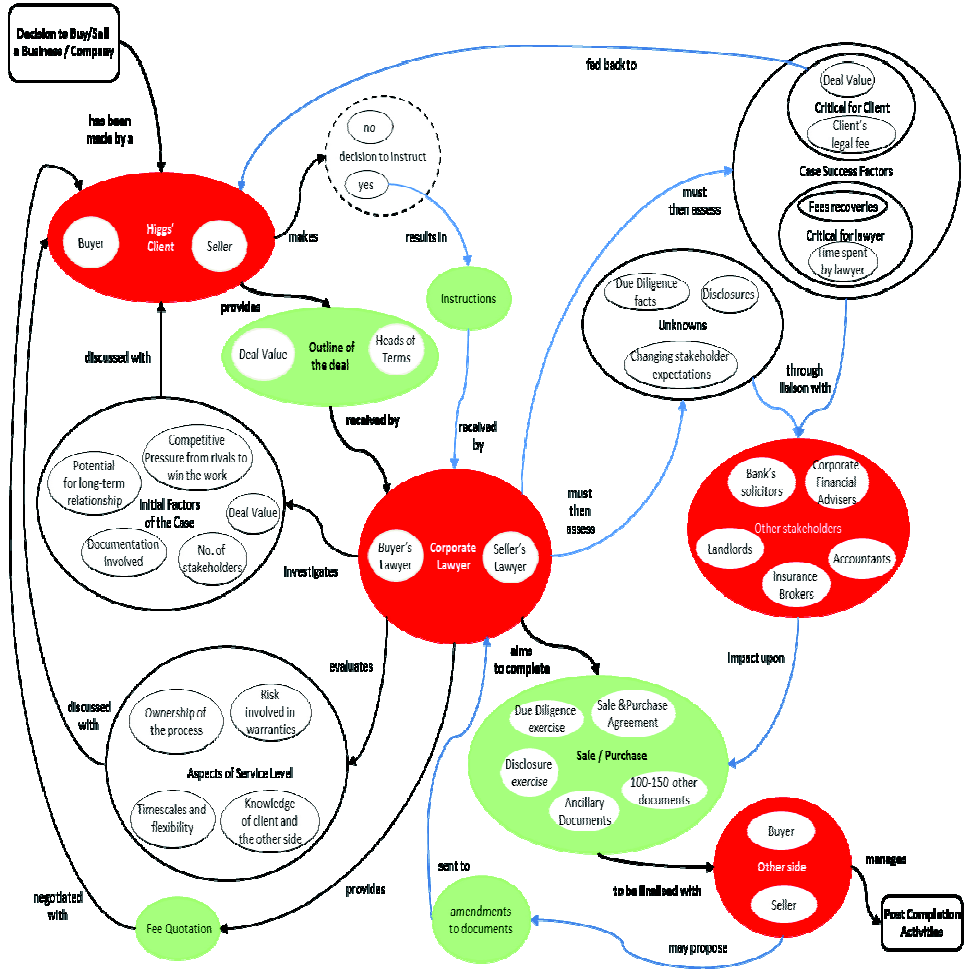


Figure 1: ProOH model narrating the high level view of processing 'buying/selling of a business' by a lawyer in the Corporate department.

METHODOLOGY

Building a ProOH model requires full understanding of the process being modelled. Modellers gather information from the process owners through consultation. Necessary data to build ProOH models has been gathered from key people within respective legal and business support departments. All the process owners and stakeholders associated in creating and delivering the legal service have been identified and interviewed in order to understand the status quo of operations. Then ProOH models were built using that data to depict the service process at different granularities, high-level to detailed-level. Once the models were built, the stakeholders were gathered together to discuss the process in the form of a storyboard presented with the help of ProOH model in a scene-by-scene narrative. During each scene in the process, participants will brainstorm on several issues and actively provide input that leads to identification of key issues in the process. ProOH model has enabled us to create a

common thinking platform where people with multiple viewpoints would interact and come to a consensus on the best way to deliver the service.

In each department 5-6 interviews lasting for 60-75 minutes have been conducted before the PrOH models were fully built. Each storyboarding session lasted for 2 hours leading to around 35-40 hours of total recorded time in the process of gathering and validating data for building the PrOH models.

By reflecting on legal processes through structured brainstorming facilitated by PrOH modelling, several areas of improvement have been identified. These are small improvements with a potential to create a significant impact on the way services are created and delivered towards adding value to the client. Making these improvements does not require capital investment but access to innovative ideas from staff. To access the collective knowledge of staff and their ideas we formed cross-functional teams by recruiting members from relevant legal and business support departments. Each team was empowered to work autonomously with the right level of support from line management for solving long-standing problems that were never before attempted as a team. This methodology has enabled us to plan and implement several changes to the departmental operations that produced positive results in the form of revenues, client satisfaction rates and above all improved the readiness of staff towards embarking on change initiatives.

CONCLUSION

So far, four departments at Higgs & Sons have participated in the KTP project through pilot stages. In each case, the above methodology has been applied to achieve successful change that had both tangible and intangible impact on the business performance. The results for each department ranged from increased revenue to improved client experience. Besides that, several innovative tools have been designed and deployed to be used by the lawyers such as the Case Assessment Radar, Scoping & Budgeting Tool, Client On-boarding Process, Case Management Dashboard etc. The cumulative business impact created by these innovations is yet to be quantified.

Based on the Change Kaleidoscope (Balogun & Hope Hailey, 2008) framework, which suggests that designing and managing change is a context-sensitive process, with the aim of understanding such context-sensitive features of Higgs & Sons, we have gathered data from staff at all levels in the firm during the initial stage of the project. Ten months later, after implementing several operational changes and engaging with at least 30% of staff members in various stages of the project through various activities such as involving them in focus group discussions, PrOH model storyboarding sessions, one-to-one interviews, presentations, project teams etc., we have recalibrated the Change Kaleidoscope through a firm-wide survey to monitor the progress towards the desired cultural change. From the results of this survey, we have evidence to state that, participation in KTP project activities, of which PrOH model storyboarding sessions are prominent, has contributed to improving the perception and orientation of staff towards strategic change.

The need for change within Higgs & Sons arises primarily to meet the potential threats triggered by new regulations and to readily internalise the paradigm shift in delivering client-led legal services. Such change is inherently difficult to implement because detecting the informal systems (cultural or operational) that guide people's behaviour is time consuming, tacit and stochastic. In this paper we have demonstrated that, by using systems thinking as an intervention, cultural and operational change can be successfully delivered in professional service firms and the case of Higgs & Sons stands as a testimony.

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THE SERVITIZATION OF INNOVATION MANAGEMENT

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ABSTRACT

Innovation is key for building up service business. Hence, servitizing product firms have to establish corresponding R&D capabilities and processes that better facilitate service innovations. This case study, analyzing the servitization of ABB, highlights that a critical success factor for traditional product or technology firms to also develop services successfully is to focus more on problems rather than solutions. Understanding the customer's problems and needs for new services is a challenge; and the best method is through customer involvement and building long-term relationships with customers. Here, the innovation process is not a strict linear left-to-right process similar to product development, but a rather informal and iterative process which highly depends on winning and convincing people – people within the customer's organization but also people within the own service organization.

Keywords: Servitization, Service Innovation, Organization Development

1 INTRODUCTION

With many traditional product firms a strategic shift of the firm's business model towards providing more and more services can be observed. In literature, this phenomenon is typically referred to as the *servitization* of product firms. A rationale that appears to have gained in importance in the industry is the observation made that service is less dependent of cyclic fluctuations in the markets as compared to the product business. Here, the service business provides the opportunity of having a relatively stable second source of revenues during economic downturns, which became evident especially during the 2008 world crisis. In response, ABB has launched a strategic growth initiative in 2010 to further expand the share of its service business in total revenues (cf. Hogan, 2012).

Moving through the stages of servitization (e.g. from transaction-based towards more relationship-based services, cf. Oliva and Kallenberg, 2003) will require service innovations. This raises the question for possible challenges arising from servitization for innovation management: What are the critical success factors for a product or technology leader such as ABB, who has already built up a strong core competence "R&D" over its long firm history, to now also develop services?

2 RESEARCH APPROACH

To address this question, the first step in this study was to carry out a literature search about typical challenges arising from servitization, especially with regard to innovation management. In the second step the perspective was changed from the external view to ABB, to analyze how different challenges identified in literature have been coped with in the servitization of ABB, and how in ABB new services have been developed. For this purpose a survey using closed-ended questions was conducted with service managers and service business developers at ABB locations worldwide, and semi-structured follow-up interviews were held with some of the questionnaire respondents, in which the respondent's answers were discussed in more detail. This paper highlights some of the key findings from this analysis.

3 CHALLENGES ARISING FROM SERVITIZATION FOR INNOVATION MANAGEMENT

Product and service organizations have in common that they both provide a solution to a problem. The key difference is that product organizations “store” their solution into a tangible product, whereas service organizations have to provide their solution “directly” (Biermann, 1999) to customers. When developing services, *service firms* therefore have to put special attention to the customer as well as the communicative integration of customers with the service organization; as it has been stressed in service marketing literature, and especially by the influential work of Zeithaml and Bitner (2000) with the help of the *service marketing triangle* framework. In order to get there and also develop services successfully, *servitizing product firms* have to invest into corresponding *organizational capabilities* (Neely, Benedettini, and Visnjic, 2011). This will not be an easy task; and various challenges arising from servitization have been identified in literature, which ultimately can be grouped into *two key challenges* (cf. Van der Have, 2011; Oliva and Kallenberg, 2003):

- (1) Strengthen a service-oriented organization and culture that better promotes service innovations
- (2) Strengthen the customer understanding and involvement in service innovations

To provide a framework for servitizing product organizations, these challenges can be described very well as the *edges* of the above named service marketing triangle of Zeithaml and Bitner (2000), which forms the following triangle of servitization challenges for innovation management.

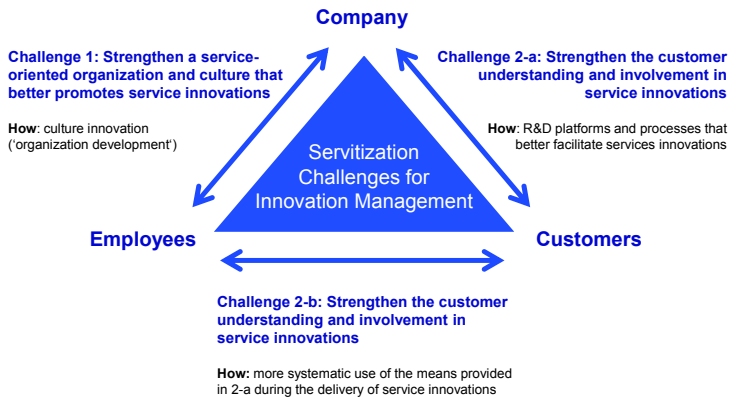


Figure 1: The Servitization Challenges Triangle

(based on Zeithaml and Bitner, 2000; Van der Have, 2011; Oliva and Kallenberg, 2003)

Challenge (1) is an intra-organizational challenge. It concerns the *organizational readiness* of the servitizing firm for developing services. It needs to be coped with by shaping a more service-oriented organization and culture that better promotes service innovations, or doesn't inhibit them respectively. Challenge (2) is an external challenge regarding the deficiency in the customer orientation when developing services. It needs to be coped with by a better customer understanding and involvement in service innovations. In the servitization challenges triangle, challenge (2) has to be divided into two edges: Firstly (2-a), the company to provide *better R&D platforms and processes* with which customers can better share their problems and needs and get involved in service innovations. Secondly (2-b), employees to make *more systematic use of these means* provided in (2-a) during the actual delivery of

service innovations. By overcoming challenge (1) the company will increase the required readiness in the organization at (2-b) to do so.

4 CHALLENGE (1): STRENGTHENING A SERVICE-ORIENTED ORGANIZATION AND CULTURE THAT BETTER PROMOTES SERVICE INNOVATION

A critical success factor in the servitization of innovation management is a transition in the innovation culture from being mainly technology/solution-driven to one with a stronger focus on customer problems (Bessant and Davies, 2007; Martinez et al, 2010). In other words: *to focus more on problems rather than solutions*.

How is this explained? As shown in figure 2, an innovation essentially consists of three parts: a *problem*, a *solution*, and a *match* between the two (Terwiesch and Ulrich, 2008). In the *product business*, the problem is typically known already. Product developers are experts in their application domain, so they know the domain-specific problems very well, and their focus and challenge is rather finding a solution. In the *service business*, on the other hand, the problem is typically not known initially. As the firm has to provide its solution “directly” within the value chain of the customer, it needs a much deeper understanding of the customer’s business and related business problems to solve. Once the problem is known, the solution is often already obvious. But identifying the problem is much more important.

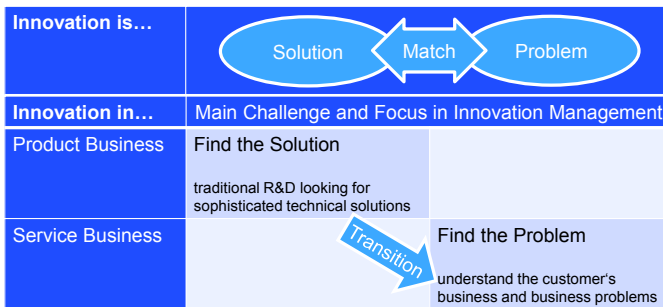


Figure 2: Critical success factor: focus more on problems rather than solutions (based on Terwiesch and Ulrich, 2008)

The challenge in the servitization is that this transition in the innovation culture also has to *actually take place*. However, organizations with a strong technology-oriented mindset often find it difficult to servitize (Martinez et al., 2010). Hence, there is the risk that service innovations end up being also very technology-driven – i.e. being *solutions looking for problems* (Bessant and Davies, 2007). What is therefore just as important as finding the right approach to service innovations itself (challenge 2) is this required culture innovation (challenge 1).

As highlighted by Staes (2008), culture innovation never takes place on the basis of existing consensus. Rather, it is a *discourse model*, in which the existing views in R&D and right R&D-approach towards the new service business is questioned. Through group dynamics this discourse then eventually leads to a new common consensus and innovation culture in the organization. Hence, creating an awareness in the organization for the need to think about service is an essential element in the process of an *organizational development*, which to manage is highlighted as challenge (1) of the servitization challenges triangle. Now, some servitizing companies have created a separate organization unit to handle the service business, suggesting that here the emerging service culture could be better protected from the strong values of the technology organization (cf. Oliva and Kallenberg, 2003). However, there is a risk that isolating service in a silo can lead to inhibiting a discourse and organizational learning, rather than

promoting it. After all, complementary products and services (*product-service systems, PSS*) cannot be developed and sold well in isolation. For the very same reason, ABB has decided against this separation, but to make service an integral part of its business units. Servitization, and essentially overcoming challenge (1), comes from making the *whole* organization service-aware.

5 CHALLENGE (2): STRENGTHENING THE CUSTOMER UNDERSTANDING AND INVOLVEMENT IN SERVICE INNOVATIONS

So far we have highlighted that focusing more on the customer’s problems and needs for service innovations is key to succeed in the servitization of innovation management. This now raises the question: Exactly *how* do we develop new services? How do we identify what the customer needs? And for an identified need: how do we come up with a new service idea, and *convince* the customer of this idea so that he likes it and wants to have it? In other words: What is the *service definition process* (in contrast to traditional product development)?

Figure 3 presents the service definition process at ABB. It is illustrated again based on the service marketing triangle of Zeithaml and Bitner (2000). However, instead of suggesting a very *top-down* approach (where the company management makes promises to customers about services and enables employees to fulfill these services), the suggested approach of figure 3 is more *bottom-up*, where a vast number of business developers (the “employees” in the triangle) in the various *local business units* of ABB define new services together with their local customers; and when service ideas have proven successful, they are generalized (i.e. “productized”) and brought bottom-up to a more *global/strategic* organization level in order to make those services available also to other areas in ABB (other countries or businesses).

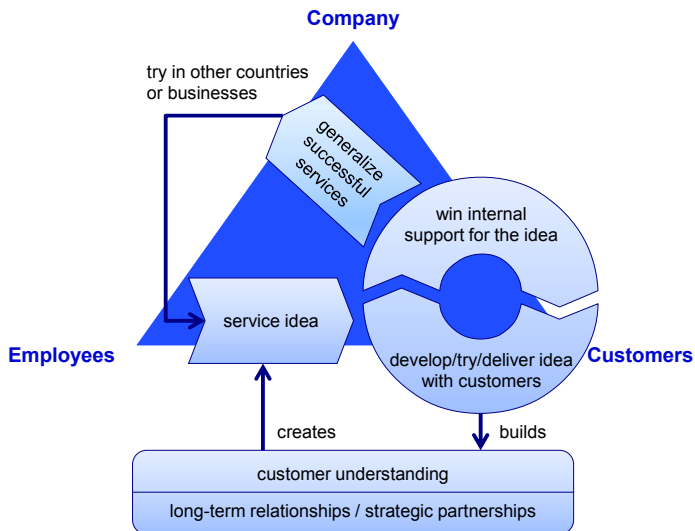


Figure 3: Service Innovation Process at ABB
(based on Zeithaml and Bitner, 2000; ABB interviews)

The innovation process starts where we *know* what we can talk about with the customer. Hence, we need to understand the customer’s business and related business problems to solve. This understanding

does not come from just a single service that was developed and delivered, or just a single customer workshop that was done. It comes more from *long-term relationships* that are built over time, and which often start off with more transaction-based services such as providing spare parts, but then evolve into more relationship-based services up to having even *strategic partnerships*, where the business developer gets an increasingly deeper understanding of the customer's business and can therefore focus more on his *business outcomes*. This deep understanding of the customer creates the most value-adding ideas.

When having a new idea, it has to be well developed, and the business developer has to win support for his idea. As illustrated in figure 3, this is not a strict linear left-to-right process similar to product development, but a rather *informal* ("fuzzy") and *iterative* process that highly depends on winning and convincing people – people within the customer's organization but also people internally within the own service organization. There are no formal gates; the selection of ideas takes place more "naturally" where the non-compelling ideas are simply not further discussed and followed up on. A critical success factor to gain internal support for ideas is through *customer examples* which can show that an idea will work (cf. Staes, 2008). Therefore, when talking to customers about ideas, the business developer has to make sure to *discuss and try the right ideas with the right customer* for whom this idea would be most valuable. Otherwise there is the risk of meeting little customer interest for good ideas – not because the idea was not good but because it was simply not relevant for that particular customer. This would lead to a loss of internal support, and ultimately to abandoning good ideas internally.

To identify what type of ideas could be interesting for what type of customers, the organization has to *segment its customers based on customer needs* ("need-based segmentation"). Segmentation can often not be done by industries, but industrial customer needs are very individual, and even within the same customer contact there can be different segments. Secondly, the business developer should also determine for each of those segments who his *innovative customers* are – with an "innovative DNA" – because not every customer is open to trying out new ideas.

If the customer liked the idea and would be further interested in it, the business developer can go back to his organization and motivate to go into the next round and concretize the service concept and try it out with this customer in a pilot. Here, it is important to involve the customer in *every* iteration (cf. Little, 2005), as the first iteration only provided an initial information from the customer, but customer needs will become more and more concrete with every phase, while additional customer buy-in to the co-created solution can be won. This brings us back to challenge (1): If the organization has not yet succeeded in the transition to focus more on customer problems, there is the risk of discussing ideas with customers only during the first iterations, but then relapse into the traditional R&D push mode, assuming that problems are already sufficiently captured.

At some point, when an idea has proven successful and there is enough internal and external support for this idea, there will be the initiative to generalize this service and offer it to the broader market, such as trying to transfer the service to other local country subsidiaries within the same business unit, or even to completely different businesses of ABB (cf. figure 3). This generalization phase is rather *goal-oriented*, because it has a clearly defined outcome and timeline. Therefore, the phase is preferably run according to the *stage-gate model* in order to have a tool that pushes people and to assure that the outcome goes into the right direction.

Here, a challenging question for distributed global organizations is: how do we get an overview of all the ideas that are "running around" the innovation wheel of figure 3, in order to get the successful ideas out of this wheel and into the generalization phase? As described before, services have to be developed very locally. Particularly, the innovation wheel is run by the local business developers within their day-to-day projects, project deliveries, and service contracts with their local customers. When having turned an idea into a successful solution for his customer the business developer is happy – and initially he has no reason to globalize his idea from his local perspective.

Hence, in order to make a global business out of this, there has to be a *global business model* for sharing ideas bottom-up across the organization. A key element of this business model is to define the *sharing of costs and revenues* for sharing ideas; i.e. what the *incentive* would be for the local business

developer when his idea is sold in other areas of the organization, as well as how his time and effort would be *funded* for feeding ideas into the generalization phase so that they can be used and sold by others. Secondly, a question of the generalization phase should be: to what level do we generalize/productize services that are very customer specific; and: does everything have to be global? Addressing these questions is the task of a more globally/strategically set service product manager or *portfolio manager*.

CONCLUSION

As we have highlighted in challenge (2), the *service definition process* is a very *bottom-up* process with a strong focus on understanding customer problems and needs for new services, which typically starts with a market implementation of ideas, followed by a generalization/standardization of ideas as going upwards in the R&D organization. Visnjic, Turunen and Neely (2012) also refer to this as “*innovating backwards*”. By contrast, the traditional top-down *push* of innovations from the R&D into the market, which may have worked well for technology, does no longer work in service. Hence, a critical success factor for servitizing product or technology firms to also develop services successfully is to *focus more on problems rather than solutions*, which was highlighted as challenge (1). This proposition should not be misinterpreted that there were no problems in the product business (just as much as it does not mean that services require no solutions). In fact, several interview partners in this study have indicated that also in the product business understanding the distinct customer problems and needs is becoming increasingly important. As highlighted by Staes (2008), this may be explained by the increasing dynamics of world economies (mainly driven by globalization and information explosion) which requires companies to be ever more responsive to changing customer needs in order to stay competitive. With regard to this development in the company’s environment, and the emerging new *service-dominant logic* in marketing (as proposed by Vargo and Lusch, 2004), it is yet to be seen to what extent the traditional push of innovations can continue to provide competitive advantage even in the product business, or if the issues of the *servitization of innovation management* become generally more relevant without still making a big distinction between products and services.

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ESTIMATING THE COST OF THROUGH-LIFE AVAILABILITY

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ABSTRACT

The research presented in this paper describes the weaknesses with the current approaches to estimating the cost for Product Service Systems and proposes a conceptual approach to address these weaknesses. First we describe the changing business model that original equipment manufacturers are facing and describe the current approaches to estimating the cost of such systems. The challenges with the current cost estimating approaches are discussed and the need for underpinning research is identified. Based on this analysis, the way forward utilizing systems thinking and an operations-based approach to enable a true representation of the cost of availability is then described.

Keywords: Cost of Availability, Systems Cost Estimating, Through Life Costing.

1 INTRODUCTION

Many High Value Manufacturing (HVM) industries have moved from selling products to providing product service systems (PSS), where the product/asset is offered with support arrangements. In particular, availability-based contracts are a form of long term service agreements aimed to guarantee the performance/capability associated with the major function of an asset, and hence its usability (BS EN IEC 2009). This is demonstrated through these businesses now contracting for availability, being paid to provide capability and performance such as the Rolls Royce £865M contract with the UK Ministry of Defence (Rolls Royce, 2010) and BAE Systems £446M Typhoon contract (2012). Some of the challenges for such contracts is the aim to control the costs and deliver the performance required by the customer, as well as managing the cost exposure to the supplier of the service. These challenges are not new, Perrigo and Easterday(1974) identifies that only representing the customers viewpoint when determining the contractual requirements such as reliability does not result in a 'satisfactory' deliverable. In the 1990s the concept of Integrated Logistic Support (ILS) stressed that to control costs more emphasis was required on the ability of an asset to deliver the output for which it is designed (Galloway, 1996). Hence, estimating the costs of an asset to deliver the contracted output requires more than modelling the cost of the actual asset but estimating the cost of all the activities. For example the £446M Typhoon availability contract, is delivered through a coordinated activity of stakeholders such as the Royal Air Force, the Ministry of Defence (MoD), BAE Systems and their supply chain.

In cost estimation, through-life costing (TLC) has encompassed non-monetary metrics related to the availability of an item Ntuen (1985) provides an early overview. However, the focus has been on the attributes of a stand-alone product instance such as reliability (mean time between failures) and maintainability (mean time to repair). The assumptions are, that in general, this reliability is inherent for the life of the asset. How an asset operates, fails and is restored to operation is typically described by

means of time distributions that are known or can be estimated. Essentially, the instance of interest is stripped of the broader context in which it is delivered and employed. In parallel to this current approaches for estimating the cost of PSS's normally identify the cost of a PSS with the cost of the in-service stage of an asset (Jazouli and Sandborn, 2011). There are problems with this asset focused approach. For example, Patel (2011) demonstrated for an experienced highway maintenance company that the move from being paid by a cost plus contract to a performance based contract resulted in a 50% reduction in the companies' profit. When the cost estimation approach was examined it was noted that the model used traditional product focused analysis such as mean time to repair and the type of repair (major, minor). Huang *et al.* (2012) identify the challenges of adapting such product focused techniques for the purpose of service cost estimation, but without addressing TLC as an autonomous methodology. Datta *et al.* (2010) review the literature and outline a framework aimed at overcoming the challenges of estimating the cost of a PSS, but eventually suggest combinations of existing cost estimation techniques. These approaches focus predominantly on the asset, and in many cases they do not consider the system as a whole – this requires a paradigm shift in the way one estimates the 'cost of availability'.

In the remainder of this paper section 3 identifies the major methodological challenges to costing through-life availability as a type of PSS. It is concluded that the multitude of interrelated cost objects constituting the flow of work delivering products and services should act as the point of focus in TLC. In section 4 we provide a conceptual outline of our proposed approach aimed at addressing these challenges.

2 METHODOLOGICAL CHALLENGES

When one evaluates what a PSS encapsulates, it becomes evident that what enables the customer to attain beneficial outcomes – 'value in use' – is a combination of activities and physical assets (Ng *et al.*, 2011). This is consistent with the general view that performance is achieved through the actions a business undertakes, their effectiveness and efficiency (Neely *et al.*, 2005). For example, the availability of aircraft, such as those within the Typhoon availability contract, is delivered through a coordinated activity of stakeholders. Another example is civil aviation, where areas of importance include leaner maintenance, repair and overhaul operations to deliver value through aircraft, which are in a suitable state to perform their designed function when required by the operator (Ayeni *et al.*, 2011).

From the design viewpoint, PSS modelling draws on the analysis of systems as a social construct (Morelli, 2002). Morelli's view is that a technical representation of PSS contains indications about the potential functions delivered by the technical system, the interaction between different actors and these functionalities, and the flows of events, usually through a diagrammatic representation. However, when one investigates the views of cost estimators, they are not necessarily consistent with the views of the designer. Settanni *et al.* (2013b) identifies this is mainly due to concepts and assumptions which are normally just stated in the literature, and rarely questioned in practice. Even when a service oriented approach to cost estimation is adopted, from a methodological viewpoint the approaches fail to recognise that 1) the delivery of performance embedded in the concept of PSS cannot be just designed into an individual end-item; and 2) the consequence of a series of decisions taken independently is not necessarily the sum of the effects of each individual decision, and may not result in an immediately observable change in cash flows.

Table 1 identifies the associated methodological challenges for TLC, which, to the authors' knowledge, are not adequately dealt with in the literature. Although these are bold claims the aim of the analysis presented within this paper is to demonstrate that a shift in the way that costs are estimated for PSS is necessary to reflect more consistently aspects already embedded in the PSS design methodology.

PSS Implications	Challenged aspects of TLC methodology	Aspects to be taken into account
<p>Commitment to deliver target performance over time</p> <p>Efficient and effective delivery requires managing both internal structure and network of partners</p> <p>Contain cost through the flow of interrelated actions taken, outcomes delivered, and resources employed</p>	<p>Cost object(s) – “What”</p> <p>Scope and boundaries of the analysis – “Why/to which extent”</p> <p>Metrics and computational aspects – “How”</p>	<ul style="list-style-type: none"> • Allow the handling of multiple, interfering cost objects simultaneously. • Reflects an understanding of the processes involved in the delivery of specific performance. • Shift emphasis from one-off cost estimation to cost monitoring. • Accommodate an internal viewpoint to ensure cost targets are met whilst performance is delivered through-life. • Overcome the traditional ‘over-the-wall’ approach, by extending the boundaries of the individual firm where necessary. • Causative, resource-orientated approach to: <ul style="list-style-type: none"> ▪ Address interplay between the quantitative flow of goods and services and the monetary metrics. ▪ Show reciprocal influences between multiple, interfering deliveries.

Table 1: Challenges in PSS through-life costing

3 PROPOSED CONCEPTUAL APPROACH

The proposed approach to overcome these challenges, rests on the principle that the cost of performance is not just designed into a product. Rather, it is the cost of either doing something ‘right’ from the customer’s point of view (delivering value ‘in use’ through an outcome), or dealing with the consequences of failing to do so. As such, cost is contained in the flow of work through the organisational system (Seddon *et al*, 2011). This departs from the typical view on TLC i.e. dealing with one product instance at a time, characterized in terms of its features, and assumes that all the relevant costs relate only to such features (Emblemsvåg, 2003). From a modelling viewpoint, some causal understanding of the quantitative flow of goods and services involved in the delivery of a PSS is developed prior to cost estimation. Therefore the information need is of a *dual* nature (van der Merwe, 2007):

- (1) A quantitative model of flow of goods and services within defined boundaries, highlighting:
 - a. **Processes**: structured collections of interrelated actions or operations aimed to produce some result of value to internal or external customers;
 - b. **Ends**: the intermediate (outputs) or final achievements (outcomes) delivered by each transformation operated within the defined boundaries;
 - c. **Means**: the resources and capabilities that must be, or must have been involved in each transformation, taking part in it (inputs), supporting (mechanisms) or enabling (controls) its execution;
- (2) A corresponding value representation of these means-ends relationships, with monetary metrics serving as a meta-language to express the flow of goods and services.

Theoretically, detailed process understanding (or technological knowledge) enables the commonalities between the service and the physical artifacts involved in its delivery, and exploiting such

commonalities for cost estimation purposes, to be captured (Thenent *et al.*, 2011). This results in the need for the proposed approach to adopt a 'layered' structure, as depicted in Figure 1.

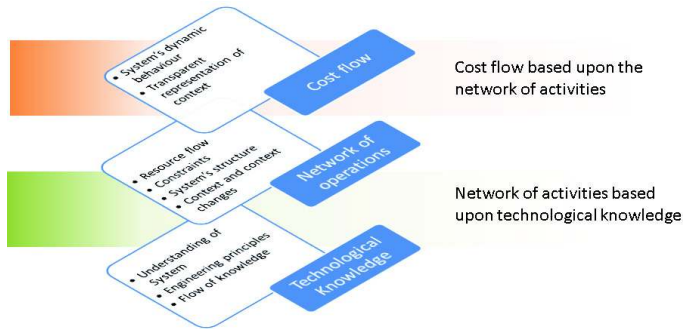


Figure 1: Layered structure of the proposed conceptual approach to PSS costing

From a system engineering perspective, a life cycle model can be expressed in terms of processes, their outcomes, relationships and occurrence, since a system progresses through its life cycle as the result of actions, performed and managed by people in organisations, using processes for their performance (BS ISO/IEC, 2002). Process-thinking, system-thinking and life-cycle thinking are intertwined (Emblemsvåg and Bras, 2000). Hence, the need for a systems based approach to be utilised when estimating the cost of a PSS, in particular the cost of availability, is essential if one is to enable a 'true' representation of the cost. However as identified by Settanni *et al.* (2013) although system concepts are encompassed by the designer, they are not readily used within cost estimation. The first step to enable such an approach to be adopted is a conceptual model. This conceptual model for estimating the cost of a PSS, in particular through-life availability can be structured as a sequence of steps, as shown in Table 2.

4 CONCLUSIONS

This paper highlights that current approaches to estimate the cost of a PSS tend to focus on the in-service stage of an asset where the cost of availability is estimated by using designed-in asset features. Here, no major discontinuity exists between PSS costing and the TLC methodology developed in the same business context that availability or performance-based contracts are meant to overcome. We proposed that TLC should encompass the methods for PSS representation developed in other disciplines such as design. A conceptual approach to through-life costing was presented building on the principle that performance is attained through the actions a business undertakes, and that cost is contained in the flow of work throughout an organisation. Here, the necessary level of information for PSS cost estimation is dual, promoting the view that to understand the costs of an PSS contract, it is necessary to have a preliminary understanding of the quantitative flow of goods and services within defined boundaries. Monetary metrics serve as a meta-language to express the flow of goods and services. Emphasis is placed on technological knowledge to exploit commonalities between the product and service elements of a PSS, rather than exacerbating their differences. A more quantitative implementation of the conceptual model is described by Settanni *et al.* (2013a) where a network formalism and principles derived from Input-Output Analysis to base PSS cost estimation and management on a representation of a PSS delivering through-life availability as a 'system' are described.

Step	Need	Aspects of interest	Practical example	Potential issue	
1	Set scope and boundaries of analysis	<ul style="list-style-type: none"> - Define the limits of control (what is exogenous for the purposes of the analysis) and align individual elements with the overall purpose of the PSS's. - Declare existence of PSS's attributes and their relationship for a time interval (i.e. how they interact) 	<ul style="list-style-type: none"> - Time horizon over which the system of interest is considered; - Organisations/economic actors involved (depth); - Level of aggregation/detail (breadth) 	A through-life service enterprise such as ATTAC (Tornado Availability) would theoretically encompass interdependent activities carried out by the System Integrator/Prime contractor; major sub-system supplier; and Customer/User.	How responsibilities for operational unavailability of main system (aircraft) are flowed-down through the value chain
2	Identify array of outcomes meeting exogenous demand	Declare functions/capabilities to be delivered	<ul style="list-style-type: none"> - Articulated and unarticulated customers' needs for the system versus purpose(s) of the engineering system; - Allocation of functionalities (e.g., aircraft and aircraft sub-systems), if necessary. 	BAE System defines an available aircraft as one which is on the apron in a fit state for the men and women of the Air Force to fly.	<p>Different ways of defining availability</p> <ul style="list-style-type: none"> - Static - Average - MFOP <p>Also, the availability of an aircraft subsystem may be met, but the aircraft may be still grounded</p>
3	Build-up means-ends relationships to deliver such function.	Represent a PSS progressing through its life cycle as the result of actions taken (endogenous variables) as a response to a demand for outcomes imposed exogenously	<ul style="list-style-type: none"> - What the system does to achieve the objective. (Functional architecture) - Current and perspective technological knowledge, as detailed understanding of activities performed within or by the system (process dimension); - Architectural/physical entities needed to carry out the system functions or used by the stakeholders (technical dimension). - Human contribution and relationships within the system (social dimension) 	<p>Process maps</p> <ul style="list-style-type: none"> - Conceptual (e.g., IDEF0; FRAM) - Quantitative (e.g., Petri Net) 	Need to isolate "failure demand" from value added demand, as well as waste/by-products and their associated treatment.
4	Implement TLC as value representation of the dynamics of the interrelated operations	Cost is " <i>an emergent property</i> ": i.e. primarily it is the dynamic behaviour of the system being analysed that determines cost.	<p>Monetary value of externally acquired resources/enabling conditions.</p> <p>Flow of goods and services to meet exogenous demand, with a distinction of those associated with inefficiencies (e.g., waste/by-product treatment)</p>	<p>Implemented mostly outside reliability engineering.</p> <p>Examples include Material and Energy Flow Analysis</p>	Linking system/process-thinking. The cost is justified with the aim being to improve consciousness of the implications (in terms of cost) of the actions taken

Table 1 – Conceptual Model for estimating the cost of Product Service System

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REQUIRES INDUSTRY APPROVAL BEFORE PUBLICATION

TRANSFORMATION

METAMODELING SERVITIZATION: CONCEPTUALIZATIONS OF TRANSITION

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ABSTRACT

In this paper we identify three generic conceptualizations of the transition associated with servitization in the literature; the basic continuum model, the continuum with steps, and the model of punctuated stages.

Keywords: industrial services, servitization, transition process, integrated solutions, capital goods.

1 INTRODUCTION

In response to the growing manufacturing capabilities of developing countries, former traditional manufacturing firms are increasingly servitizing their business, i.e. they are organizing themselves to deliver solutions made of both products and services. The relevance of the servitization phenomenon is by no means anecdotal. Neely's (2008) international study of companies classified as manufacturing in terms of their primary SIC codes shows that 30% of the studied companies (3,196 out of 10,634) have actually servitized. Based on an analysis of the EUROSTAT 2007 data, Santamaría et al. (2012) conclude that the average weight of services in the sales of European manufacturing firms is around 6%. Similar results emerged from the 2006-2007 European Manufacturing Survey which is based on a sample of 3376 companies; the vast majority of these 'manufacturing' companies offered some sort of service (Lay et al. 2010) and that around 16% of their turnover, directly or indirectly invoiced, came from the sale of service (Bikfalvi et al. 2012). Similar trends can be observed in USA and Asia as well. For example, Lertsakthanakun et al. (2012), for example, report that the servitization level of Thai companies has increased from 18% to 24% in the 2010-2012 triennium, although they still consider it low compared to similar countries in the region such as Malaysia and Taiwan.

While research activities in this area are rapidly increasing (Baines et al. 2009b), a closer look at the servitization literature reveals that the concept of servitization in itself is unclear. It has been defined or conceptualized as:

- "a wave consciously driving ... companies into services to gain competitive ground" (Vandermerwe & Rada 1988, 315)
- "offering fuller market packages or "bundles" of customer-focussed combinations of goods, services, support, self-service, and knowledge... [by which] ...services are beginning to dominate." (Vandermerwe & Rada 1988, 314)
- "the innovation of an organisations capabilities and processes to better create mutual value through a shift from selling product to selling PSS." (Baines et al. 2009b, 555)

To be clear about when the phenomenon is observed in the reviewed papers we need a pragmatic way to define servitization. For our research purposes in this paper, *we conceptualize servitization as a change process whereby a former manufacturing company (deliberately or in an emergent fashion), introduces service elements in its business model.* While this may not fully correspond to all previous definitions, we

find it sufficiently clear for the current study. Furthermore, we base our conceptualization on a process-based view on defining services (see also Sampson 2012; Brax 2013).

Among the most influential studies that model the transition process is the paper by Oliva and Kallenberg (2003). Other transition related studies have appeared later proposing variations or alternatives (list here). Although several literature reviews charting this area have already appeared (Baines et al. 2007; Baines et al. 2009b), none of these appears to systematically focus on the transition path. Martinez et al. (2010, 453) note that while there are generic change models available in strategic management, “there are no models specific to the issues of servitization as a change process”. Based on reviewing 169 servitization-related papers, Velamuri et al. (2011, 27-28) conclude that

“static assessments will not be enough to unpack the value creation paradox in hybrid value creation.

Dynamic assessments of the transition paths that lead to hybrid value creation and farsighted conceptualizations of the overall innovation strategies that are needed to realize the value creation promise in hybrid value creation are desperately missing and thus need to be researched.”

Thus, we argue that the abundant literature on servitization still lacks a comprehensive process model of the transition. In this paper we synthesize generic servitization patterns from the literature, and develop a meta-model of the transition process of servitizing manufacturers based on a focused review of the literature.

We group our findings based on the type of servitization model or generic conceptualization, and proceed starting from the most rudimentary concepts towards the more sophisticated and detailed models. We identify generic conceptualizations of the transition: 1) a gradual continuum model, 2) a continuum model with steps, and 3) a punctuated model with steps. Within the generic types, we identified variations of the model, and our analysis aimed at synthesizing these into one coherent description of each. In addition we note that many typologies do not indicate a transitional aspect, and many describe servitization as an end-state (e.g. ‘servitized offering’) and through a particular hybrid offering (e.g. integrated solutions). We next present our methodology, and move forward to explain and discuss each of the generic conceptualizations respectively, and briefly discuss our contribution and future research topics.

2 METHODOLOGY

2.1 Searches

We searched all major databases in November 2012 for research literature (number of identified articles appear in brackets): Ebsco (89), Emerald (51), Proquest (61), Sage (8), Science Direct (37), and Springer (28). We set out to identify scholarly or peer reviewed research papers that focus on servitization and hence limited the search to titles, abstracts and keywords where this was possible – papers using the term in full text only were considered low in relevance. In addition to search words *servitiz** and *servitis** we used the terms *service infusion* and *integrated solution* as well, knowing this term is preferred by some journals. Search strings were kept as similar as possible as identical searches were not always possible due to the differences in the provided search engines. In broader databases searches were limited to the business and management field, as some search terms are used in other fields (e.g. ‘infusion’ in chemistry). For the term integrated solutions we limited the sample to 50 most relevant papers in Ebsco due to relevance issues. In total, we identified 274 articles.

2.2 Filtering

We first compared the article sets and removed duplicates, which reduced the papers to 193. Next, articles were sorted based on relevance following a systematic procedure. Based on data available on the abstracting information, non-articles (such as editorials, book reviews, and opinion pieces) were separated from the research papers (total 176). Then, articles that clearly did not represent the broadly conceptualized area of business and management studies were omitted (e.g. literary science, total 129);

then articles not concerning manufacturing industries (92) and servitization (78), and finally, 5 articles that showed up in searches but were inaccessible in full-text. Thus, the final set consists of 73 articles.

2.3 Analysis procedure

The articles were first carefully read through, and reviewed and sorted, using the Atlas.ti software for analysis and an Excel file to record findings, as follows. A brief, unstructured description note of the article was written down. Then, the comparisons described in Table 2 were made. An Excel sheet was used to document findings. Steps 1-6 in the procedure were done based on reading through the article. Steps 7-10 were based on a detailed content analysis using the Atlas.ti program. Although in the quantitative research tradition a duplicate analysis has been considered as improving reliability (Krippendorff 2004), the articles were divided between the authors due to the large amount of reading, and to manage time as coding papers with software takes more time than reading in the usual manner. During the analysis the authors used a single Hermeneutic Unit (Atlas.ti file) which was duplicated for each and synchronized often, enabling the authors to see and discuss each others' coding, kept regular phone meetings to develop the analysis procedure and to consult for an opinion when appropriate.

A focused coding structure was generated at the beginning of the analysis, but new codes were allowed to emerge from the data along the analysis. As an example, the authors set out to code the stages of the models, but identified some models represented a continuum rather than a more precise model, and the codes '*continuum start*' and '*continuum end*' were created. Codes as such are not the ultimate goal of the analysis, but their purpose was to label and tag observations and in this manner enable a systematic further comparative analysis across the data. However, codes can serve as simple tags or they may develop into categories and concepts. When a new code was created, the code was described in the notation spaces and memos provided in the software. Further observations and interpretations were collected in this manner. This approach also ensured both researchers used the codes in a similar manner. After the initial round of coding, the analysis progressed gradually and iterative in parallel with writing: as a developing concept was identified and discussed between authors, further exploration and more detailed coding of the data supported the analysis. As the main types of meta-models were observed, the coding was used to derive queries that enabled a thorough but focused analysis.

3 CONCEPTUALIZING TRANSITION IN SERVITIZATION

In our analysis, we noted that a majority of the published research concerns a specific type of 'servitized offering' – in other words they focus on an end-state without addressing the transition. Since our aim is to look at transition models, we exclude such studies from this discussion. We next present the main conceptualizations, but first, however, we need to address the challenges we faced with the terminology.

The literature lists many alternatives to implement servitization: product-service-systems, integrated solutions, systems integration, turn-key solutions, and so on. These are characterizations of offerings. The offering of integrated solutions and the like can be seen as a 'symptom' of an underlying servitization process of the firm. Servitization is a change process whereby a former manufacturing company (deliberately or in an emergent fashion), introduces service elements in its business model. The presence of these symptoms or signifiers as such (e.g. the offering of integrated solutions), however, does not imply that the company has servitized, i.e. it does not necessarily mean that service elements have been added to a previous business model which was traditional manufacturing. Equivalently, the servitization process does not necessarily imply the delivery of integrated solutions as an end point as service dominance can increase even further. Nevertheless, in our visualizations, we include the level of servitization as the dependent variable, and conceptualize the other variables of interest as the explaining variables. We do not focus on any particular variable since literature has identified several independent variables. We deal with these in the discussions of the studies we relate with the basic models.

3.1 Gradual continuum model

The gradual continuum models address a change is happening, but only address the direction of transition through identifying the start and the end, or utilize terms such as ‘increase of servitization’ without further detailing. Yet, some studies are very detailed but are categorized as basic model because they identify a shift between two positions, such as traditional manufacturing and integrated solutions in Brady et al. (2005). Figure 1 visualizes this generic conceptualization of transition. In the figure, letters A and B denote the start and end positions, respectively, which are observed at different points of time. Letter a marks the transition step. The continuum view emerged from such statements:

“There are various forms of servitization. They can be positioned on a product-service continuum ranging from products with services as an “add-on”, to services with tangible goods as an “add-on” and provided through a customer centric strategy to deliver desired outcomes for the customer.” (Baines et al. 2009b, 556)

In this synthesis, the focal concept is the *relative importance of physical goods and services* in the firm’s total offering. For Brady et al. (2005) the focal variables are four sets of *organizational capabilities*: systems integration, operational service, business consulting, and financing. Brax (2005) concludes that the literature at that time conveyed a continuum view with incremental transition and argues that implementing a more punctuated shift should allow firms to break rigidities not beneficial for the services approach.

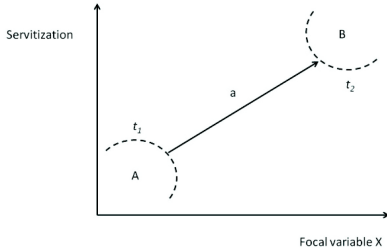


Figure 1: Gradual continuum model

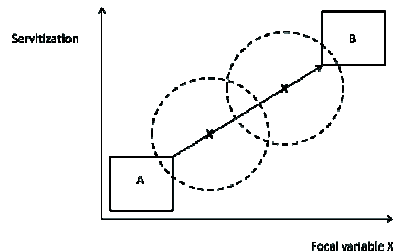


Figure 2: Continuum model with steps

3.2 Continuum model with steps

Continuum models with steps are a more detailed variation of the basic gradual continuum described above. In addition to the start and end position, these studies describe various phenomena associated with the transition process but do not intend these as stages of transition that are likely to take place in a particular order (Figure 2). Note we emphasize a difference here between the terms of *implementation step* (marked with X in Fig. 2) or *offering type* (illustrated with circles) and a *transitional stage* (rectangles). Although several steps and offering types may be indicated, the transition is conceptualized as a shift between a non-servitized and a servitized stage. The modification of Tukker’s (2004) classification by Baines et al. (2009a, 499) is an example of this type of approach. It identifies a continuum between product and service and arranges three PSS offerings along the way but does not suggest the transition proceeds through them in a particular order.

3.3 Punctuated model with stages

These models identify positions signifying a *stage* or a level of servitization and conceptualize transition as a pattern in which firm moves from one step to another (Figure 3). The number of stages may vary between models. The focal variables vary, but positions (A, B, C, D) typically signify a particular offering type or characterize the provider-customer-relationship. Some of the models identify the transitive steps between the positions (a, b, c) through challenges to be resolved, capabilities to be built, or other types of implementation steps. The focal variables vary and can be the composition of the offering offering

(Vandermerwe & Rada 1988) or relational integration between the focal firms (Holmström et al. 2010; Martinez et al. 2010; Bikfalvi et al. 2012).

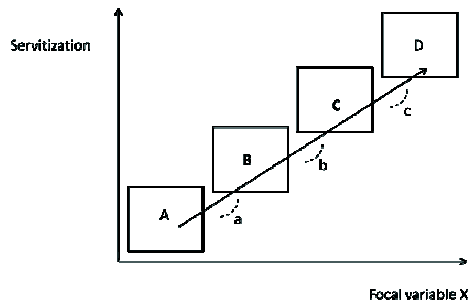


Figure 3: Punctuated model with stages

In their seminal work Vandermerwe and Rada (1988) identify three stages corresponding to three different types of offerings through which the importance of services increases in corporate strategy: i) goods or service; ii) goods with services; and iii) goods, services, support, knowledge and self service. Since they consider pure services as a potential starting point, their view of servitization represents moving towards holistic hybrid offerings. This view is clear in that it makes the distinction based on the type of the element added, but is not helpful in further distinguishing between different mixed offerings. Also, it can be debated whether companies add knowledge and self-service on the later stages of the evolution as these may be easier to implement than the more traditional provided services.

Davies (2004) modeled the capital goods value stream in the industry level, and noted that companies can move forwards, i.e. ‘downstream’, as well as backwards or ‘upstreams’ from i) manufacturing, to ii) systems integration, iii) operational services, and iv) service provision. Thus the focal variable in the model can be viewed as being position in the vertical supply chain. Positions are explained through the function of each stage in the chain, such as designing and integrating systems. (Davies 2004) Later work addresses further details in the original model, for instance by comparing system sales and system integration business models (Davies et al. 2007). Holmström et al. (2010) develop a punctuated model based on the *customer asset visibility* as focal variable. By visibility they refer to data and information about customer’s asset maintenance processes and decision making. The default constellation is i) arms length after-sales service, and the value constellations that follow are ii) collaborative service supply chain, iii) condition based maintenance as a service, and iv) visibility based asset management. In moving towards the more advanced constellations they identify three transition challenges, respectively: a) resource positioning, b) planning, and c) feedback challenge (cf. Figure 3). (Holmström et al. 2010)

Martinez et al. (2010) focus on the *customer-supplier interactions* to support an evolving offering. They conceptualize transition through four offerings: i) product with peripheral service, ii) product with service, iii) customized product and service, and iv) total solutions. Their focal variables are intensity and scope of integration between internal functions, the organisation and the customer using the offering, and with suppliers. Based on a large scale survey, Bikfalvi et al. (2012) identify four typical stages of servitization based on the number of service offered and on the revenues companies realize with them: i) traditional manufacturers, ii) providers of standard services, iii) service high performers, and iv) non-effective servitizers. Their conclusion is that servitization is positively linked with increasing *service networking activities* of manufacturing companies, which supports the approach of Martinez et al. (2010).

4 DISCUSSION

We have differentiated models that suggest implementative steps or map the position of offering types in a continuum and the models that suggest transitional stages in servitization. Most stage approaches

perceive the firm as developing the capabilities through particular stages but note that the firm can continue providing offerings associated with the previous stages as well. In addition to the transition models, we recognized a number of servitization typologies without transitive relations. In other words, these papers do not arrange different servitization-related business models as developmental steps or differentiate them based on a servitization level. Good example is for instance the typology by Kujala et al. (2010). We have not included these in our analysis due to the lack of transitional aspects but we recognize this as an important future research avenue. The typologies, as well as the different end-state models should be analyzed against the punctuated transition model, to further integrate the field. Moreover, we recognize that in this task we will encounter alternative, equally servitized transition steps. The challenge thus will be to compare the focal variables used in the studies to identify a generic way of arranging the different alternatives to implement servitization in the offering level.

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BARRIERS OF SERVITIZATION: RESULTS OF A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

This paper is based on a systematic literature review of servitization, where papers on servitization published from 1988 to 2011 were reviewed. The paper will focus on the question of what are the barriers to servitization. The literature suggests that there are seven categories of servitization barrier – these include: (i) competitors, suppliers & partners; (ii) society & environment; (iii) customers; (iv) finance; (v) knowledge & information; (vi) products & activities and (vii) organizational structure & culture. It appears that the research community has paid more attention to those barriers associated with customers and organizational structure and culture. The financial barriers to servitization have started to receive more attention recently

Keywords: servitization, systematic literature review, barriers

1 INTRODUCTION

There is tremendous change in the manufacturing sector. Services contribute over 50% of the revenues in many manufacturing firms and in a traditional manufacturing firm, employees working for service functions can be as high as 65%-75% (Doultsinou et al., 2009). Increasingly manufacturing firms are moving away from manufacturing pure physical products to service provision. There are several factors motivating this change, including increasing competition, decreasing profits and increasing customer demands (Vandermerwe and Rada, 1988). Servitization, which is “the innovation of an organization’s capabilities and processes to better create mutual value through a shift from selling product to selling Product-Service Systems” (Baines et al., 2009, Neely, 2008), is a research area that has grown in popularity in the last two decades.

With the increasing research on servitization, a literature review is necessary to gain an overall understanding of this topic, especially a systematic literature review (Tranfield et al., 2003) where papers should be reviewed in an exhaustive, reduced biased way. Though five research questions were used to guide the systematic review, this paper focuses on barriers of servitization, which is one area that attracts interest from both the academia and industry. In the second part of the paper, the methodology will be introduced. The third section will present the results and discuss the findings from the systematic review, focusing specifically on research trends and the barriers of servitization. The paper will close with a discussion of limitations and conclusions.

2 METHODOLOGY

Clearly defining the scope of the research is important for a systematic literature review. Regarding the topic of servitization, one critical problem is that different researchers tend to use different words to describe the transition to services in manufacturing firms (Baines et al., 2009) and the boundary of each concept is still blurred. To make it more focused and clear, in this review, only the concept of “servitization” is reviewed, so four searching strings are used: “servitization”, “servitisation”, “servicizing” and “servicising”.

The second issue is to decide research questions for the systematic review. Though five questions were actually reviewed in the process – definitions, drivers, barriers, prerequisites and implementation of servitization, this paper focuses on one question – what are barriers of servitization.

Third one has to selected which databases to use in the systematic review. In this study four databases were used: ABI/INFORM Complete, EBSCO, Web of Knowledge and ScienceDirect. These four databases are widely accepted as world leading resources for literature and research. Using these four databases compares favourably with previous servitization reviews (Baines et al., 2009, Valtakoski, 2010).

The fourth issue to address is what should be the search strategy? The four search strings “servitization”, “servitisation”, “servicizing” and “servicising” were searched in “full text” in ABI/INFORM Complete, EBSCO and ScienceDirect and were searched in “topic” in Web of Knowledge, where “full text” search is not available. The search process was carried out in February, 2012 and only papers written in English were chosen. To get a full understanding of knowledge from both academia and industry, academic papers and industry magazine articles were all included. Papers published from 1988 to 2011 were included. The year 1988 was used as a criterion because the word ‘servitization’ was proposed in 1988 (Vandermerwe and Rada, 1988). This search strategy resulted in 351 papers being identified, 59 of which were without full text. So the initial sample was 292 papers. The abstracts of all of these papers were reviewed and 126 papers were found irrelevant to servitization or service provision of manufacturing firms. The reasons why these papers were excluded were recorded and include (i) out of scope – papers regarding pure service industries such as tourism and the law industry and (ii) focus missing – papers focusing on topics such as sustainability and supply chain management without specifying the context of servitization. The final sample was 166 papers, which were finally used for detailed analysis.

The detailed analysis of each paper was completed using NVivo 8 was used. Five tree nodes (one for each of the five overarching research questions) were created and all information to these questions extracted from the papers was included as sub tree nodes. This process included the coding of sentences and paragraphs in the specific papers. A clustering analysis identified seven barriers to servitization – these include: (i) competitors, suppliers & partners; (ii) society & environment; (iii) customers; (iv) finance; (v) knowledge & information; (vi) products & activities and (vii) organizational structure & culture.

3 RESULTS AND DISCUSSIONS

As previously stated, this paper focuses only on the barriers to or challenges of servitization. In this section, distribution information of selected papers is given in the first place, followed by discussions on barriers or challenges of servitization.

3.1 Research interests on servitization increase rapidly from 2003

The annual distribution of the 166 selected papers is shown in Figure 1. Figure 1 highlights that even though the word ‘servitization’ was first proposed in 1988, there was a lack of research on the topic for the first decade. Research on servitization gained some interest in industry around 1999-2000. Within the 8 articles published in 1999 and 2000, three are academic papers while five are from industrial magazines or project reports. However, after a promotion in 2003 when Journal of Cleaner Production published a special issue of “Product Service Systems and Sustainable Consumption”, the level of research increased year by year, reaching a peak in 2010.

Journals publishing four or more papers on servitization are listed in Table 1. Some of the journals that include the most papers have published special issues on servitization. For example, 6 of the 14 papers on servitization published in the Journal of Cleaner Production come from two special issues: volume 11, issue 8 – “Product Service Systems and Sustainable Consumption” and volume 14, issue 17 – “Product Service Systems: Reviewing Achievements and Refining the Research Agenda”; 6 of the 10 papers published in the Journal of Service Management come from the special issue volume 21, issue 5 – “Service Infusion in Manufacturing Industries”.

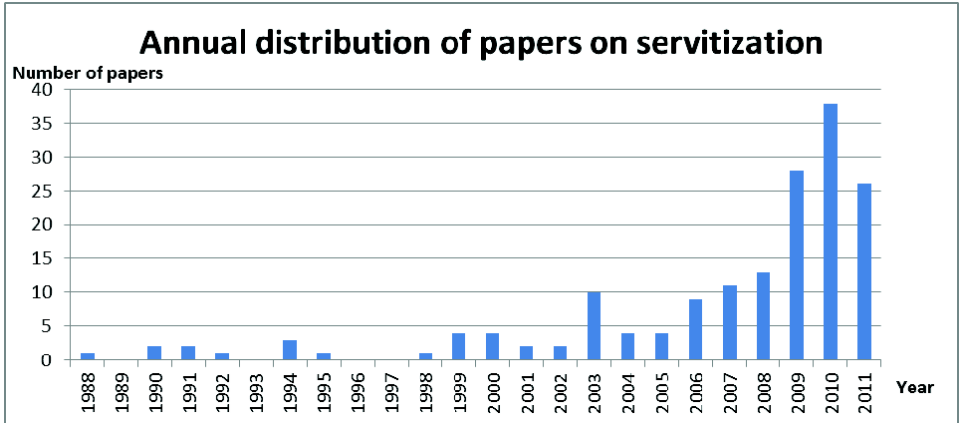


Figure 1: Annual distribution of papers on servitization

Journal name	Number of papers
Journal of Cleaner Production	14
Journal of Service Management	10
Industrial Marketing Management	9
European Management Journal	8
Journal of Manufacturing Technology Management	8
International Journal of Operations & Production Management	5
CIRP Journal of Manufacturing Science and Technology	4
Managing Service Quality	4

Table 1: Journals with over or equal to 4 selected papers

3.2 Seven classes of servitization barriers

Barriers to or challenges of servitization are summarized in Table 2 (one reference is given for each barrier for the purpose of saving space). By clustering coded sentences and paragraphs of each paper based on sources of barriers, it is found that the barriers to servitization come from seven aspects, shown in the first column of the table. One of the issues that the literature review highlighted is that some barriers are existing conditions that manufacturing firms need to consider or have to deal with before servitization and some barriers are barriers that firms will encounter during servitization – hence the second and third columns on Table 2.

Aspects	Existing barriers before servitization	Barriers during servitization
Competitors Suppliers & Partners	•A more complex competitive environment involving different actors (Vandermerwe and Rada, 1988)	•Difficult to get coordination and cooperation from different actors (Mont, 2002)
Society &	•Lack of policy and infrastructure support	•Difficult to achieve environmental benefits,

Environment	(DiPeso, 2000) •Lack of incentives to pursue environmental benefits (White et al., 1999)	which largely depend on circumstances (Mont, 2002)
Customers	•Heterogeneous demands (Vandermerwe, 1994) •Lack of trust from customers (White et al., 1999)	•Difficult to get cooperation & acceptance from customers (Vandermerwe and Rada, 1988) •Lack of control over customers' behaviors (Heiskanen and Jalas, 2003)
Finance	•Lack of financial competence for early investment (DiPeso, 2000)	•Service paradox (Neely, 2009) •High risks (Stremersch et al., 2001) •Unexpected costs (Ottman, 1999) •Difficult to price services (Steinberger et al., 2009)
Knowledge & Information	•Lack of expertise (Brax, 2005) •Lack of understanding of customer demands and product properties (Mont, 2002) •Lack of innovation ability (Macdonald et al., 2011)	•Difficulties in knowledge & information management (Vandermerwe, 1994)
Products & Activities	•Lack of cheap labour (Cook et al., 2006) •Lack of infrastructure (Maxwell et al., 2006)	•Difficult to design service packages or scenarios •Difficult to measure services (White et al., 1999)
Organizational Structure & Culture	•Lack of service based organizational structures (White et al., 1999) •Lack of service oriented culture (Mont, 2002) •Preconceived thoughts and resistance to change (Vandermerwe, 1994)	•Conflicts between different sectors and different hierarchies in organizations (White et al., 1999) •Internal resistance to servitization (Vandermerwe and Rada, 1988) •Difficult to build service oriented organizational structures and culture (Vandermerwe, 1990)

Table 2: Barriers of servitization

3.3 Organizational barriers and customer barriers are paid more attention to

Barriers from the organizational aspect and from the customer aspect were earliest mentioned barriers (Vandermerwe and Rada, 1988) and coding analysis also reveals that these two barriers were paid more attention to considering both number of papers mentioning these two barriers and words coded into these two aspects.

In organizational structure and culture aspects, managers and employees are used to focus on efficiency and economy of scales and it is difficult for them to change mind sets to services where customization, flexibility and innovation are more important (Turunen and Toivonen, 2011). Within a company, the change of emphasis from manufacturing to services can cause internal conflicts between different sectors. Manufacturing sectors are unwilling to lose both authority and resources, leading to the increase of political costs (Mathieu, 2001).

Customers' lack of acceptance and cooperation is another major barrier. Some service scheme, such as leasing and sharing, are not easy to get acceptance of customers – customers get used to the ownership of certain physical products (Mont, 2002). On the other hand, even if customers are willing to accept services, lack of management and control over customers' behaviors and usage habits is a concern for some service providers, such as chemical management services providers (White et al., 1999) and performance based contracting providers (Steinberger et al., 2009). Besides, customers' demands and expectations of services are usually heterogeneous, easy to change, require timely actions (Johnstone et

al., 2009) and difficult to standardize (Van Dierdonck, 1992), which gives great challenges for firms to fulfill customers' demands.

3.4 Financial barriers start to attract detailed analysis recently

Even though financial barriers of servitization have been realized for more than a decade (Ottman, 1999), detailed analysis is lacking in early time of research, when financial barriers were considered mainly narrative and from two aspects: hidden costs and high investments for servitization (DiPeso, 2000). However, barriers in the financial aspect start to attract detailed analysis from 2007. Both qualitative analysis (Halmea et al., 2007) and quantitative analysis (Neely, 2009) reveal deeper understandings of financial barriers.

Firms usually need a high amount of investment for development of infrastructure, assets capitals and knowledge base during the early stage of servitization, which gives a high burden to manufacturing firms (Bartolomeo et al., 2003, Neely, 2009). During servitization, it has been found that firms cannot increase profits continuously by increasing their service provision, especially for large firms and firms with a wide range of service provision. In fact it is found that servitized firms can be more easily to bankrupt and service paradox happens (Neely, 2009).

4 LIMITATIONS

There are several limitations of this research – First, as previously discussed, researchers tend to use different words to describe servitization, which means only searching for “servitization”, “servitization”, “servitizing” and “servitising” leads to the possibility that some important papers may be ignored. Second, four online databases were used for the searching process, which is not inclusive. Journals that are not contained in the four databases, hardcopies of library material and articles without peer reviews such as online working papers are missed. Third, papers without full text available based on the subscription of University of Cambridge Library are not included for detailed analysis and coding, which leaves a bias for the selected 166 papers.

5 CONCLUSION

In this paper, a systematic literature review was carried out on servitization. The review shows that research on servitization increases rapidly after 2003. Journals publishing more papers on servitization include Journal of Cleaner Production and the Journal of Service Management. Discussions focus on the barriers to servitization, which are split into seven categories. Within these seven categories the organizational and customer related barriers have received the most attention by researchers. The financial barriers to servitization have started to attract detailed analysis more recently. The paper reveals that even though there is an increasing trend for manufacturing firms to provide services, there are many barriers which firms need to take account of, some of which will only become apparent during the process of servitizing.

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TRANSFORMATION OF PROVIDER AND CUSTOMER ORGANISATIONS TO ACHIEVE CO-CAPABILITY IN OUTCOME-BASED CONTRACTS: A VIABLE SERVICE SYSTEMS APPROACH

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ABSTRACT

This paper reports on a research investigating organisational transformation of equipment-based service providers and customers which are establishing joint capabilities to achieve combined equipment and service outcomes based upon outcome-based contracts. The viable systems theory and the viable system model provide the theoretical ground for investigation of communication processes between key personnel, main activities, organisational structures and the systemic viability of both the provider and the customer to co-create activities to achieve equipment performance, as well as the transformation required by both provider and customer to achieve co-capability in terms of achieving contract performance. Initial findings confirm that contextual variety threatens the stability of the system and challenges co-creation. The findings also suggest that intervening in the customer-controlled supra-system to ensure its structural and systemic stability reduces variability in the system-in-focus. Assisting the customer organisation to transform also implies the provider's participation in supra-system activities.

Key words: outcome-based contracts, co-capability, viable service systems

1 INTRODUCTION

To remain competitive, manufacturing organisations have increasingly felt the need to provide uninterrupted availability of their equipment through services such as repair, maintenance and overhaul (Neely, McFarlane & Visnjic 2011). This is commonly referred to as servitization (Vandermerwe & Rada 1988). While much of servitization literature has focused on the transformation of the provider organisation, there is considerably less research of the effect on customer organisations who are using the equipment. The role of the customer is particularly important when the provision of service is through outcome-based equipment contracts, since achieving such outcomes often occur within the customer's space, and outside of the control of the provider firm.

Traditional equipment-based service contracts are anchored on billable time and materials, with the cost of spare parts sometimes included for the maintenance, repair or overhaul of equipment and the customer is billed for the service once the activities have been performed (Van Weele 2002). Alternatively, the firm could also provide the customer with a cost-plus contract with detailed cost structures to ascertain reimbursement with a pre-determined profit percentage (Kim *et al.* 2007). Performance of such contracts are typically assessed based on respond time to breakdowns, speed of

repairs, price and other activities where there is a measurable way to assess the provider's performance (Dehoog 1990).

Of late, there have been a growing number of contracts focusing on outcomes of equipment rather than the activities involved in its service provision. For example, some of Rolls-Royce's service contracts to maintain engines are paid on the basis of how many hours the engine is in the air – a concept known as 'Power by the Hour®'. Such outcome-based contracts focus on achieving required outcomes rather than meeting a set of prescribed service levels (Bramwell 2003). We argue that such a fundamental change to the value proposition of the service provider constitutes a major change in the configuration of the service system. This is because achieving outcomes in the customer space places a requirement on the provider to have much closer cooperation and coordination with the customer. Therefore not only does the provider need to transform to achieve co-capability with the customer, but needs also to assist the customer organisation to transform to ensure a tightly coupled, well-coordinated system. This has echoes with the strategy literature where the ability to establish strong partnerships as capabilities is often recognized as a core-competence (Johnson, Christensen & Kagermann 2008).

This paper reports on an investigation into the organisational transformation of equipment-based service providers and customers which are establishing joint capabilities to achieve combined equipment and service outcomes based upon outcome-based contracts. The paper is organised as follows. We first present the theoretical basis for outcome-based contracts (hereafter OBCs) and viable systems that underpin the focus of the study. This is followed by the presentation of the research methodology. We then present the initial research findings to shed light on issues concerning organisational transformation to achieve co-capability in OBC contexts. We conclude the paper by presenting some preliminary findings derived from initial analysis.

2 THEORETICAL BASIS

2.1 Outcome-based contracts

From a servitization perspective, OBC can be seen as a manufacturer service provision underlined by complex value-creating systems of products, people and processes centred on the outcomes of equipment instead of the resources required for its provision (Ng, Ding & Yip 2012). In this form of service contract, the customer pays only when the provider has achieved outcomes, rather than merely delivering activities and tasks.

As it is often not possible to achieve an outcome without the customer co-creating or co-producing the service with the provider, OBC implementation requires both parties to mutually align resources towards value creation and value realisation by the customer (Kale, Dyer & Singh 2002). This is a direct application of the value-in-use concept proposed by Vargo and Lusch (2008) under a service dominant logic which proposes that the customer is an essential resource within an outcome-based contract (Ng, Maull & Yip 2009). In the context of OBCs, changing the focus from exchange value (i.e. billing for time, materials and information) to value co-created in context (i.e. achieving measurable outcomes) entails the development of co-capability in provider and customer systems to achieve the expected outcomes and this creates increased complexity to OBCs implementation (Ng & Nudurupati, 2010). Previous studies in the strategy domain have frequently highlighted the challenges in achieving collaborative coordination, including information sharing, cultural differences and conflict management (Das & Teng 2000; Reuer, Zollo & Singh 2002). Notwithstanding the challenges, other studies have stressed the benefits of firms being able to cooperate and combine resources (Nickerson & Zenger 2004).

Given that successful implementation of OBCs depends on co-capability of the provider and the customer, we can conclude that competitive advantage resulting from service delivery under OBC models would require the provider to effectively manage collaboration with its customers across all aspects of operation, management, governance and coordination. This implies that the dynamics of provider-customer relationships in an OBC need to be properly considered in a systemic manner. In other words, the role of the customer in the service delivery system as a whole requires holistic perspectives of analysis

that also capture operational, managerial and governance functions of collaborative value-creating systems under OBCs (Ng, Maull & Yip 2009). This study has drawn upon the viable systems theory to capture and analyse the complexity of provider-customer relationships under OBCs.

2.2 Viable systems

The emphasis on collaboration between provider and customer and the establishment of ‘joint capabilities’ (co-capability) to achieve combined equipment and service outcomes is ultimately a boundary question, where the boundary is extended beyond the firm to include the customer. This fundamental aspect of OBCs leads us to consider systems theory to understand and explain the OBC phenomenon in a holistic way. To analyse the relationships, activities and adaptability to variety across the operational, managerial and governance dimensions of OBC systems, we have considered the work of Beer (1985) on systems viability and, more specifically, the Viable Systems Model (VSM) as the theoretical framework of analysis for the study.

Beer (1972, 1979, 1985) introduced the VSM and the principles of viable systems to describe the necessary conditions for viability, which is generally defined as the ability of a system to maintain its existence within a specified environment. We summarise here the key conceptual aspects of viable systems that underlined the study.

A first fundamental concept we have taken into account is that contextual variations coming from the external environment of a system, as well as the multitude of events that may arise within the system itself, confront the system with ‘variety’. Contextual variety as described here is a measure of complexity, for it represents the number of different states in a system caused by different contexts of use. It is when contexts begin to change differently from expected contexts of use that the degree of contextual variety increases. From the perspective of OBCs, a high degree of contextual variety is an increase in the heterogeneity of the contexts that deviate from the most likely contexts of use for which the service was originally designed.

A second important fundament considered in the study addresses the question: How do organisations cope with variety? The answer builds directly upon Ashby’s (1956) law of requisite variety often stated as “only variety can absorb variety” and managing variety is the very essence of management (Beer 1985). A system has requisite variety when it has subsystems or mechanisms to attenuate and amplify variety so that variety can be met with variety. More specifically, the viability of a system fundamentally depends on the ability of its parts to attenuate or amplify variety so that the system as a whole can absorb and generate as much variety as it receives. As Holten & Rosenkranz (2011) put it, while attenuation means to decrease high variety to the number of possible states a system can handle, amplification means to enhance low variety to the number of possible states the system needs to remain fit to its environment. Both attenuation and amplification can take place between a system and its external environment as well as between the internal subsystems of the system.

A third conceptual aspect of particular relevance to the research refers to the constituent parts of a viable system as proposed by Beer or, more specifically, the VSM structure. Due to space limitations, the details of each VSM component will not be discussed here. It is important however to point out that the VSM describes the necessary organisational structure for a system to survive in a constantly changing environment (Holten & Rosenkranz 2011). Every viable organisation has five core components or systems necessary to ensure viability, namely: 1. Operations; 2. Coordination; 3. Control; 4. Intelligence and 5. Policy. These systems are connected via information channels that work as two-way communication loops of variety attenuators and amplifiers. Moreover, they recur within various instances of an organisation, comprising critical organisational functions.

Finally, a viable system has to deliver despite changes in the environment. Hence, it must have the capacity to dynamically adjust its structure and behaviour to achieve consonance with its context and thus preserve its stability (Barile & Polese 2010). This relates to the homeostasis property of systems (von Bertalanffy 1968). There are three main collaborative homeostats in the VSM to ensure the continued viability of the system. The first is the “horizontal homeostat”, which refers to an organisation’s ability to

stabilise its operations with its customer's markets (the "adapt and respond" capability). The second is the "vertical homeostat", which is about stability in terms of managing the present with focus on the future (the "present and future" capability). The third homeostat is a combination of the first and second homeostats to balance the horizontal and the vertical variety of the system as a whole.

From this background, the main objective of the research was defined as to investigate the threats to the viability of OBC service systems and to identify organisational transformation aspects necessary to maintain viability when value is co-created within a system of processes combined with customer activities and under high contextual variety conditions. These issues relate directly to the research questions the study seeks to answer.

3 METHODOLOGY

In the study, two major OBCs with the UK Ministry of Defence (MoD) involving the achievement of outcomes for a bank of aircraft flying hours and related engine and missile system availability were investigated. The contracts were awarded to two prime contractors in the aviation and defence industry. One of the contracts was for the support of the UK's fleet of Tornado aircraft and the other was for the UK's new Typhoon aircraft fleet. Typical of OBCs, the service performance is rewarded on the basis of measurable outcomes in terms of the timely availability of fighter jets, spares, trained maintenance personnel, and technical advice. Moreover, such partnered support contracts generally involve a degree of co-location of customer and supplier at either the customer's or the supplier's premises, and typically involve the supplier's day-to-day use of the customer's own resources, usually termed Government Furnished resources (GFx: personnel, facilities, spares, services and data).

Under a case study approach, qualitative method was used to derive insights into the service delivery of the contracts. According to qualitative research strategies (Bryman 2012), we employed different methods such as observation, analysis of texts and documents, interviews, and recording and transcribing to extract data for the purpose of understanding and analysis. The logic behind using multiple methods is to achieve an in-depth understanding of the dynamics arising from OBCs (the phenomenon in question). The interviews were audio recorded and subsequently transcribed, coded and categorised. Participant observation on service sites was also employed to document the interactions between supplier and customer.

The viable systems theory and the VSM provided the theoretical ground for investigation of the viability of the joint outcome-achieving service system which includes the main activities, organisational structures and the systemic viability of both the provider and the customer to co-create activities to achieve equipment performance, as well as communication between key personnel from both sides. Through the application of the theory onto the outcome-based service system, we can ascertain the transformation required by both provider and customer to achieve co-capability in terms of achieving contract performance.

Based upon underlying principles and building blocks of viable systems (Badinelli *et al.* 2012), the VSM helps to depict the structure of an organisation, its main operational and managerial components or systems, and the information and communication channels between the key components of a viable system (Beer 1985). In this respect, it is fundamentally a common framework for making organisational structures visible and comparable which consequently allows us to better visualise and compare outcome-based service systems.

We investigated both the system-in-focus and the supra-system (Golinelli 2010) of the OBC service systems under study. The system-in-focus is the provider's system of equipment provision and availability and the supra-system is the system where the provider's equipment and various other equipment and resources are integrated within the customer's space for use in combination to achieve the expected outcomes. Such supra-system is controlled by the customer at a recursion level above the provider's system-in-focus. Understanding the supra-system that is controlled by the customer therefore allows an

understanding of the variability faced by the system-in-focus of the equipment service providers so that co-capability and transformation of both parties could be examined holistically.

Through the homeostasis principle of complex adaptive systems (Wiener 1948; Ashby 1956) we will analyse the stability of the OBC systems under study by investigating aspects related to the three collaborative homeostats presented in the previous section. To analyse horizontal homeostats, we will look at stability in terms of the provider's ability to adapt and respond to varying circumstances of the customer's environment. To analyse vertical homeostats, we will look at processes to manage the present and the future concerning the achievement of equipment outcomes and the potential conflicts and tensions involved. Finally, to analyse the third homeostat, we will look at the total adaptability and agility (combined vertical and horizontal) of the system to adapt to varying conditions of the environment.

4 PRELIMINARY FINDINGS AND CONCLUSION

The analysis of the data obtained in the study is still a work-in-progress. At this stage, we are able to report initial findings and to point out some preliminary conclusions derived from the groundwork analysis conducted thus far.

Examination of OBCs origins and background in the subject context revealed that the MoD reached towards 'partnering' with its major industry suppliers as a contractual philosophy through intuition and an extension of practice and precedent rather than from any robust theoretical foundation. The logic was simply that traditional maintenance, repair and overhaul contract models were demonstrably wasteful and leading inexorably towards an unaffordable future. Moreover, at least for the Tornado that has been in operation for a number of years, there would be a reliance on both customer manpower and equipment resources i.e. GFx that was best managed jointly. Indeed, in terms of manpower, there were severe doubts that the industry could resource all of the necessary trained maintenance technicians from the local economy at a reasonable price.

Investigation of contextual variety of operations subsystems showed that modern warfare is expeditionary in nature, requiring aircrafts to be deployed to locations where they and their supporting cast of aircrew and ground-crew may be put in harm's way. Also, fast jet aircrafts are complex engineering systems, densely packed with mechanical, electro-mechanical, electric, hydraulic, and electronic equipment that are required to operate at the top of their performance range in a far from benign environment in terms of temperature and vibration. In consequence, they develop faults far more frequently than their civilian equivalents operated in far more sedate environments. Moreover, to ease the maintainability of so densely packed products a philosophy of repair by replacement of "line replaceable items" (LRIs) has evolved i.e. items consisting of a cluster of parts that can be taken out when each part was faulty. This approach creates a modular boundary for changing systemic components that was a trade-off between what is efficient for the maintainer and effective, in terms of time, for the customer. This also resolved the tension between squadron operations and off-aircraft repair sites and a potential cost resulting from 'information hiding' regarding the LRI's usage and its fault history. For example, it is not uncommon for an LRI to be removed from an aircraft only to be diagnosed as 'no fault found' when tested in the repair bay. It is not unreasonable for this LRI to be returned to service in this case as it has been removed in error through erroneous front-line diagnosis. However, from a customer perspective, it would be unreasonable for the same LRI to cycle back and forth to the repair bay without some alternative intervention. A contractor paid a fixed amount per 'repair' may see it otherwise.

These findings confirm that contextual variety threatens the stability of the system and challenges co-operation for outcome performances. This calls for re-evaluation of operational elements and homeostatic processes to keep the viability of the system. Furthermore, safeguarding generalisations to the scope of the subject context, the study confirms that OBCs operate under complex relationships between customers and service providers and they rely heavily on tangible (equipment) and intangible (knowledge and experiences) resources as well as information-based relationship assets to achieve the outcome of the contract. Our findings suggest that intervening in the customer-controlled supra-system to ensure its

structural and systemic stability reduces variability in the system-in-focus. Assisting the customer organisation to transform also implies the provider's participation in supra-system activities.

It seems plausible that a systemic transformation aligned towards equipment use by the customer could achieve greater viability and stability for long term equipment outcomes. We propose a viable systems approach to analysing the inclusion of customer activities within the provider's boundaries of management and operations for value co-creation. This analysis will be carried out in the next phase of the current study.

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**SERVITIZATION AND ENTERPRIZATION IN THE CONSTRUCTION INDUSTRY:
THE CASE OF A SPECIALIST SUBCONTRACTOR**

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The current economic climate and a continuing fall in output of the UK construction industry has led to falling prices and margins particularly affecting those lower down in the supply chain such as specialist subcontractors. Coen Ltd. is one such company based in the West Midlands. Faced with a need to up its game it has embarked on a business improvement programme concentrating on better operational efficiency, building stronger client relationships and delivering value added services. Lacking appropriate internal resources Coen has joined with Aston Business School in a 2 year ERDF sponsored project to fulfil the transformation programme. The paper will describe the evolution of product- service offerings in construction and link this with the work being carried out at Coen with Aston and outline the anticipated outcomes.

Keywords: Enterprise management, Process Mapping, Servitization

1. INTRODUCTION

Construction is a major contributor to UK GDP, peaking at 10% overall in 2008, and a major driver of historical GDP growth. The construction industry value chain consists of approximately 300,000 firms the majority of which are small and medium sized family and local businesses. A significant proportion of construction employees, approximately 60%, are low skilled labourers with relatively limited alternative employment opportunities (LEK Consulting 2010).

UK government investment has played an important role in growing the country's capital stock, this has been historically focussed on infrastructure, education, housing and health, historically representing 30-40% of construction demand. Compared to its European counterparts, the UK has suffered from a more pronounced decline in construction activity since the onset of the recession. The continuing dearth of new orders in the UK (construction output fell by 8% in 2012) is forcing many construction related

industries to fail and a number of those remaining to reconsider their strategies and *modus operandi* (ONS 2012).

Coen Ltd is one of those businesses that has chosen to revisit its traditional role as a West Midlands based specialist subcontractor. Established in 1968 the company is a privately owned successful business supplying subcontract support to the regions construction industry, repeat order levels are high. In seeking to refine their business processes, get closer to customers and build a more sustainable future Coen have joined together with Aston Business School on a European Regional Development Fund (ERDF) sponsored Knowledge Exchange and Enterprise Network (KEEN) project to achieve these goals. This is a 2 year project which commenced in January 2013.

The KEEN project incorporates consideration of the wider enterprise requiring product, process, supply chain and client body to be viewed as a single entity and engaged simultaneously in a process known as enterprise management (Binder, Clegg 2007). Enterprise management has evolved from external changes such as globalisation, outsourcing and virtualisation which are outside the boundaries of the traditional company. An extension of these collaborative relationships is to re-examine the output provided to the client in terms of added value linked to a more holistic offering - satisfying a need and providing a service as opposed to merely delivering a product (servitization) (Baines *et al.* 2009) This application will be tested during the on-going KEEN project.

2. UK CONSTRUCTION

The complex nature of the contractual arrangements and communications between the many parties involved in construction projects both large and small has over the years generated an adversarial culture which lasted well into the 1990's. The advent of the consolidated 'Design and Build' service with related contracts in the '80s had opened the industry's eyes to the benefits of collaboration at a critical point in a projects lifecycle, design development, and the integration of contractors expertise before the end product was "cast in stone" A natural progression from closer working between client, design team and contractor came about under the name of "partnering" where project teams worked for the same client on multiple projects benefitting from accumulated experience and established relationships. It is here that we see the first glimmerings of servitization appearing in the industry, albeit in a very modest way.

It was against this background that the government commissioned a report on procurement and contractual arrangements in the UK construction industry, aiming to tackle controversial issues facing the industry during a period of lapse in growth (Latham 1994). The report identified industry inefficiencies, condemning existing practices as adversarial (not for the first time), ineffective, incapable of delivering for its clients and lacking in respect for its employees. Latham urged reform and advocated partnering and collaboration by construction companies. The reports spawned a raft of initiatives including the Construction Industry Board to oversee reform. Subsequent initiatives included (Egan 1998) which also focussed on collaboration and movements such as Constructing Excellence. A proportion of enlightened clients including property developers and retailers such as Tesco saw the advantages of working in this way, however the industry's move towards servitization was given a major boost by a change in government procurement policy. The Private Finance Initiative (PFI) was a move by the government to generate a healthy public building programme without the necessity to borrow from the market to fund the capital expenditure up front. Instead the providers would receive a performance related payback over an agreed term (*circa* 25 years) Bids were requested to fund, design, build operate and maintain new hospitals, schools, roads *etcetera* and major contractors such as Balfour Beatty, Interserve and Carillion transformed themselves into service based organisations. Subsequent major outsourcing initiatives for maintenance of infrastructure and facilities both public and private sector boosted this sector. PFI is currently under review due to cuts in Government expenditure and suspicion that providers may have overpriced in particular with the cost of the after-build service. However there is currently a division between the classic servitization process based around PFI and a significant contributor to industry output

regarding house-building which operates as a trader of land and manufacturer of homes with limited after sale service.

Concomitantly methods of constructing the structure and fabric of homes and the installation of heating and ventilation need to comply with carbon reduction and related government regulation becomes more sophisticated house-builders will need at the very least to be more alert to the need for user training in operation and maintenance. The Government's plan to introduce post completion testing (PCT) for residential properties will also place an additional burden on the builder and possibly involve an extended relationship with the purchaser. PCT has appeared on the agenda due to some evidence of deficiencies in actual thermal performance against design for completed properties). In another step towards servitization builders, have responded to a government initiative to increase provision in the affordable private rental market.

The Government's public surplus land holder, the Homes and Communities Agency (HCA), has joined with Berkeley Homes subsidiary St. Edward and Prudential's asset manager M&G to provide 534 private rented homes, and in a separate initiative M&G are funding a build to let model to be rolled out across the country by Willmott Dixon to build 1000 private sector rented homes spread across London and the South East in partnership with local councils.

3. COEN & THE KEEN PROJECT

The on-going recession has hit the construction industry hard and company failures are being reported on a regular basis, mainly at the SME level, including contractors, subcontractors and suppliers. Coen Ltd. recognises that to survive and flourish in this climate there is a need to retain existing clients and expand its offering organically. From its origins specialising in traditional services (e.g. plastering, dry lining, suspended ceilings, insulation for the private house building sector), it increasingly supplies more specialist services such as structural framing systems and more environmental and technical focussed services including external wall insulation (EWI) to a diverse client base in both private and commercial markets where significant growth and diversification opportunities have been identified.

However, although adequate for current business activity and level, internal business processes are inefficient and inadequate for the significant growth and diversification that is planned. This project will underpin the company's aspiration to become an integrated provider of construction services, offering enhanced service provision to a wider range of national clients.

A recent review highlighted that 50% of current business comes from commercial building, (i.e. social new build, schools and care homes). This yields significant repeat business from large contractors such as Wilmott Dixon, Bullock & Wates. The established relationships with such larger contracting organisations provide opportunity for Coen Ltd. is to offer extended product/service provision within current arrangements and agree additional contracts in new product ranges that fit with Coen's skillset - especially those offering increased environmental benefit e.g. Coen Ltd.'s entry into the External Wall Insulation for existing solid wall housing stock market with the contractors E-On, Mark Group & Lovell. This market alone has the potential to more than double Coen Ltd.'s turnover in the next 12months.

Coen Ltd. will grow by offering additional added-value project and customer management services to clients which will be prompted by the application of enterprise management and engagement with the wider enterprise. Achieving this will facilitate entry into new markets and regions and contact with larger national clients. Coen Ltd. is a successful business with high levels of experience of the current construction sector. However, management processes and supply chain processes are inefficient (very common in the construction sector). Coen Ltd currently lacks the knowledge to identify, develop and embed strong and forward thinking processes and culture required to take advantage of the strategic growth opportunities it is well placed to secure. In particular, skills in the following are required:

- Planning and scheduling
- Process and relationship mapping and optimisation

- Process automation through increased use of IT
- Customer relationship management/opportunity spotting
- Continuous improvement
- Basic self-promotion /marketing.

The company realised that the construction sector is developing at such a pace there was insufficient time to grow these skills naturally and pro-actively sought assistance from a partner organisation in the implementation and successful completion of a business improvement plan.

The project is being carried out under a two year programme commencing January 2013 and has three phases:

- Phase 1 – Review of current operating procedures, culture and strategy, identify improvement plan for Coen Ltd.
- Phase2 – Engage with companies in Coen Ltd.’s wider enterprise, hold workshops and plan implementation of ideas generated by the wider enterprise
- Phase 3 – Implement business improvement measures and change throughout the enterprise and reposition Coen as an integrated provider of construction services.

At the time of writing the project is well into Phase1 and initial ‘as is’ process mapping (Paton *et al.*, 2011) nearly completed and knowledge gathering of the company’s organisation, culture and strategy has been collated into a preliminary improvement plan. From this improvement plan work has started on ‘should be’ process maps and organisational change. Initially a strategic business process was drawn up (Figure 1) showing in summary the basic building blocks of the company and their subsidiary functions.

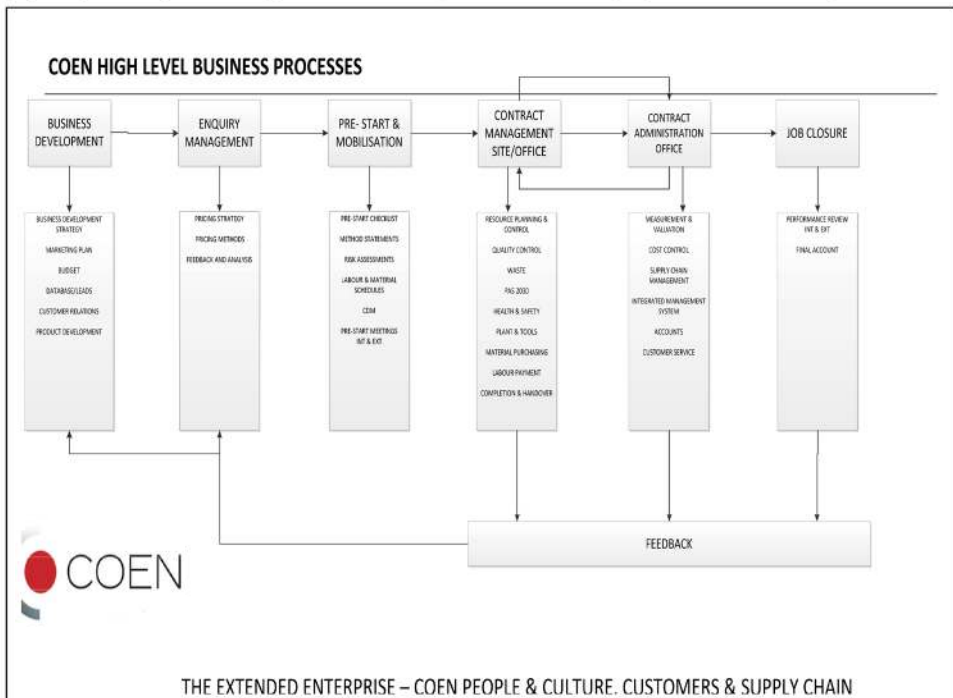


Figure 1: High Level Business Processes

Having mapped out the high level process each of the six building blocks was then broken down into their constituent tactical process maps. At this stage detailed consultation took place with staff involved directly and indirectly to identify areas of wastage and opportunities for improvement, including appropriate IT based systems. The final stage is to identify and draw up operational maps which detail basic tasks such as labour payments and credit control. As strategic and operational maps emerged staff were nominated to champion their introduction into main stream management of the company in recognition of the absolute need to gain buy in to the overall improvement programme.

The project is currently entering the early part of Phase 2 where opportunities and initiatives will be explored with the wider enterprise to collaborate and identify process links (Boardman and Clegg 2001).

An example of the project stimulating improvement and possibly enhancing the company's offer in the future is the process for payment of directly employed and subcontract labour. Historically this has been a source of waste, mainly of staff time checking variable quality information, and dealing with incorrect payments. The rapid growth of Coen Ltd. over the past 12 months had highlighted the need for reform in this area assisted by the production of a 'should be' process map. Coen Ltd.'s managing director had been working on an online solution with checks and balances which could be accessed by mobile phone or computer for the labour force to book in their times on the normal weekly or fortnightly cycle and this initiative (project Gemini) is one of the first to be included in the emerging improvement plan. The proposition is that once Gemini has been launched and proven the process could be commercialised and marketed to other subcontractors and businesses with multi-site mobile labour forces.

At the same time Coen Ltd. are working with Carillion, the Green Deal provider for Birmingham Energy Savers (BES) to provide EWI services. The Green Deal is an ambitious government sponsored programme to retrofit energy saving measures to the existing housing stock with no additional cost to the occupant, the cost of installation of the energy saving measures being covered by the reduction in gas/electricity bills. The Green Deal process covers an initial assessment with recommendations for energy saving, funding for a loan which the occupier pays back over a set period and installation of the energy saving measures. The whole process is managed by a provider. Coen Ltd. are taking part in a pilot scheme for BES with Carillion and providing cost plans, advice on specification, working methods, programme and process mapping thus extending the range of traditional supply and fix on site work. All of these initiatives are aimed at allowing Coen Ltd. to become more service orientated (i.e. through servitization) and engage with their wider enterprise (i.e. through enterprization) increasingly tightly.

4. SUMMARY/THE FUTURE

The UK construction industry continues to struggle in the face of reduced orders from both public and private sectors. The coalition's March 2013 budget provided a stimulus to the private house-builders through the Help to Buy scheme and continued financial assistance to first time buyers, other sectors likely to grow are renewable energy, care homes, budget hotels, education, health and rail (The Thomas Consultancy 2012). It is against this background that Coen Ltd. are striving to improve their business performance and embrace modern operational tools such as enterprise management and servitization. As a result of participating in the KEEN project it is anticipated that through an enhanced service and enterprise management capability Coen Ltd. will create competitive advantage, improve return on existing contracts, support more sustainable relationships, facilitate access to new contracts with larger clients, and support a more resilient enterprise wide strategy. Coen Ltd.'s current position towards the bottom end of the supply chain makes it difficult to provide an improved product-service along the lines of the major construction companies without such servitization and enterprization initiatives - which will move them towards becoming turnkey providers of construction services. The company therefore has to be that much more pro-active and opportunistic in pursuing a broader product-service offering.

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RECONFIGURING THE PRODUCT-SERVICE MIX: SERUITISATION STRATEGIES IN MEDICAL DEVICES

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ABSTRACT

This study draws particular attention to the role of process analysis in business modelling to explore how, by undertaking customer-oriented service analysis, manufacturer of medical products follows a non-linear path to servitisation contrary to the classic model to service provision. A structured literature review and following case study research were conducted to verify applicability of the existing product-service models to a recognised leader in the production of orthopaedic implants. Semi-structured informal interviews with management and sales staff revealed the change point of product-service provision marked by evolution of both product and service components to establish more customer focused value proposition. The key element in the transition is the emerging consultancy service offering to support introduction of new products and capture critical process data for further solutions enhancement. Findings of the study indicate the need for existing servitisation concepts reconsideration.

Keywords: Servitisation, medical devices, business-modelling

1 INTRODUCTION

Providers of orthopaedic equipment have traditionally viewed their business model as that of a traditional manufacturing organisation. Competitors have vied for the attention of medical staff with the introduction of more sophisticated products variants, such as improved material properties, longer lifetime performance, and improved design. The focus stayed on tangible outputs, whereas the level of services was limited to supportive solutions such as delivery and revision of instrument kits. The trend was historically dictated by complexity of surgical procedures necessitating use of tools and techniques established by manufacturers of orthopaedic implants. Conformity with manufacturers' standards has resulted in building long-term relationships with the contracting hospitals having a strong need for specialised, fully compatible with implants surgical equipment. In exploring these issues, the study has the following research question: how a manufacturing company organises provision of both tangible and intangible outputs to satisfy clinical and non-clinical stakeholders? In answering the question, the study

employs semi-structured and open-ended interviews with a marketing team to reveal the example of a company under review.

The studied company is a recognized international leader in the production of orthopaedic products and additional equipment for surgical procedures. The company management understands the importance of customer value creation leading to mutually beneficial terms between customers and producers as enabling surgeons to achieve excellence in their orthopaedic surgical practices through products that solve unmet needs and tailored educational initiatives. The changing power of stakeholders has enabled more focus to non-clinical stakeholders as operations and procurement managers holding budgets and making financial decisions. As a result, versatile product and service mixes were established to meet increasing requirements of both clinical and non-clinical sides; these measures have a potential to offer greater benefit for the healthcare systems- reduce operational risks, enhance productivity, allow greater competitiveness and maximisation of revenues on the market.

2 THEORETICAL BACKGROUND

Service orientation strategies allow companies to create added value by establishing appropriate product-service mixes or independent services that better fulfill a given customer need than pure product offerings. Moreover, due to service intangibility and labor dependability established product-service solutions may be more difficult to realistically replicate and thus provide the incumbent firm with a competitive advantage (Heskett et al., 1997; Vandermerwe, Rada, 1988).

The service concept has been the subject of much debate, with many definitions of service suggested. For application, the relationship between the service provider and its customers has to be developed so that understanding of the key requirements can be integrated to the value creation process (Vladimirova et al., 2011). Shifting from discussions on differences between services and goods, recent definitions have primarily been externally oriented with a stronger customer focus (Vargo, Lusch, 2008). Many product-oriented companies have recently drawn their attention to the establishment of supplementary service offerings in addition to existing product offerings. Baines et al. (2007) classify such combination of product and service solutions aimed at a final result rather than pure service or product realization as Product Service Systems (PSS). Tukker and Halen (2004) expand on the categorization of various product-service solutions into three groups: product-oriented (realization of products with additional related services such as maintenance and consulting); user-oriented (selling possibility of using the product characterized by rent, leasing, etc.); and results-oriented (selling final solution instead of a product, which often remains the property of the service provider with all ensuing obligations aimed for further maintenance).

Following these categories, providers may choose the extent of service integration to their original product offerings. This provides a competitive differentiation strategy that offers unique products and services based on providers' product competencies that customers are willing to pay for (Tan et al., 2009). However, as noted by Smith et al. (2012), PSS is conceptually a product-oriented or centric activity that seeks provision of additional product value through the establishment of related services. Further, studies by Vargo and Lusch (2004) explore the importance of services in the service-dominant logic framework, which has a strong element of customer contribution to the value creation. This finds support in studies by Ng (2009) and Smith et al. (2012) that explores the need for understanding customer roles in process establishment, making active customer participation in value realization a necessity for successful offerings. Further studies have emphasised the importance of customer roles in the development of models with product-service combinations (Ballantyne, Varey, 2006). However, since such models are generic and not necessarily applicable to the specific context, the employment of a product-service model may require modification to fit with the case situation.

As noted in several studies (Olivia, Kallenberg, 2003; Manzini, Vezzoli, 2002; Tan et al., 2009; Osterwalder et al., 2009), moving from pure product to more service-oriented offerings, similar to the

shift explored in PSS, involves several linear steps (Vargo, Lusch, 2004; Smith et al., 2012; Johnstone et al., 2009):

- First, assignment of market opportunities and customer requirements is needed. A clear understanding of possible outcomes of service implementation including risks, opportunities, customer wants and overall market attractiveness have to be considered.
- Second, an internal capabilities analysis should follow. The step covers analysis of existing service solutions and methods according to the internal capabilities and resources of the company. The analysis is marked by an assessment of the value proposition inherent in the existing service solutions. Identified limitations of current methods can induce development of modified service offerings.
- Third, the formulation of an appropriate product-service strategy is made. This stage defines the way of value proposition by means of structured system development consisting of products, services and infrastructural elements organized in accordance with customer requirements.

For the development of a product-service strategy, the PSS model has to be explored further. The transition towards service provision is a complicated process requiring certain level of accuracy and precision in each of the stages involved. A number of different examples from the healthcare industry have shown the need for further understanding of the establishment and ongoing improvement of product-service solutions (Abdalla et al., 2005). Hence, data concerning possible service utilization by the end user should be considered, as well as additional characteristics measured during the performance phase (Mont, 2002).

Shifting the business model towards a more service-oriented one may require education of customers and the front line orthopaedic sales staff to help them understand this shift in value proposition. Having the ability to see the processes of their customers, managers at the case company are able to analyze processes in terms of effectiveness and efficiency and report the results back to their customers on how operations can be improved. Process management and monitoring is important at this stage, with cost saving options and overall performance levels considered.

3 METHODOLOGY

The aim of the study is to explore how a medical device company furthers its service provision. For this purpose a case study was conducted. Based on the established three-staged approach to servitisation, the research revealed distinctive case characteristics giving a scope to refine conventional model. Following details reflect the algorithm of data analysis and acquisition.

The study utilised semi-structured and open-ended interviews with case company respondents from the worldwide marketing department. The interviews lasted between 45 and 60 minutes. They were arranged through email requests to individuals identified as relevant to investigated topic. Close cooperation between the researcher and interviewees facilitated intensive and comprehensive communication. To gain deeper insight into specific themes, follow-up clarifying questions were given individual interviewees in some cases.

The interviewer was the main evaluator of information validity from the meetings. Therefore, it was essential that the researcher had sufficient prior knowledge and expertise to direct dialogues and deal with unexpected issues.

The following table summarises the in-company meetings that were held, all conducted in a group format at the company site in the UK:

Interview dates	Interview group composition
23 January, 2012	Group Product Manager
10 April, 2012	Product Manager
6 July, 2012	Marketing Manager

26 July, 2012

Health Outcomes Analyst

Figure 1 – Interview group composition

The nature of questions in each individual meeting was considered with regard to prior investigation of existing literature, helping to define the main issues of product-service provision. Four sets of relevant qualitative data were obtained from the interviews. The topics addressed reflected market requirements, the company vision on customer information, and technical aspects of the new strategy propositions. The researcher analysed which sources of information were more important than others, specified indicators of success, defined issues requiring more attention in the future and finally came up with sources of evidence for drawing conclusions. Follow up individual questions helped to identify potential biases; while the academic focus ensured broader understanding of the servitisation concept applied with regard to existing models of product-service provision.

4 RESULTS AND DISCUSSION

The study results indicate how a medical device company focused on production of orthopaedic products has turned towards establishment of related services such as surgical equipment provision. The strategy was formed on the grounds that high levels of orthopaedic product complexity require utilization of specialized instruments for operations. As a result, a set of multiuse surgical tools for installation of orthopaedic implants was developed. Due to relative complexity and high cost of such equipment separate sales of instruments were not justified. Therefore, reusable instruments were provided not as individual products, but as supplementary service offerings giving surgeons the right to utilise those instruments within a specified time limit for installation of primary orthopaedic implants. Arguably, implementation of the very activities defined in the product-service transition model has resulted in provision of orthopaedic solutions characterised by both product and service components of the offer.

However, further development of the service model is subject to much debate among the respondents. The general transition model gave an overview of the basic strategy for product- service systems provision with regard to gradual stages to complement a product with a service offer. Despite the growing tendency of introducing a similar pattern among other manufacturing firms, the current situation is characterised by a different scenario based on the grounds of process research organised by the case company in a number of hospitals around the UK. According to interviewees, process study takes advantage of both quantitative and qualitative means of analysis, in this way not only defining subjective judgments of researchers, but also presenting data from customers' operations- quantitative measures of product-service utilisation. Quantitative indicators are determined through a system for process analysis provided to sales representatives to reflect the main stages of an operation. Such service strongly contributes to identification of inefficient processes intrinsic to the main surgical stages and provides the company with a crucial knowledge to improve the existing product- service mix.

Despite the on-going transition of the servitisation model, considerable disadvantages typical for the basic way of products- service systems development can be revealed at this stage. The following disadvantages inherent in the provision of multiuse equipment are outlined below:

- Complexity of conventional surgical equipment requiring use of a relatively high number of different tools in each operation
- Considerable number of tools utilized in each operation leading to use of cumbersome containers for their storage and transportation
- Large weight of containers and equipment
- Need for all equipment sterilization even in case only one item from a container is used
- Instances when instruments in a kit are missing or unclean, risks related to sterilisation
- High costs for instruments maintenance and sterilisation

In addition to these implications, results of process analysis organised by the company characterising critical time intervals in each surgical operation reveal:

- Considerable inconsistency of total processing times
- Considerable differences between surgeons' performance
- Notable correlation between total preparation-finishing times and total processing times

With regard to the problems identified, the company has focused on the development of new more convenient equipment. The new concept originates from single use surgery/patient specific supportive instrumentation providing stable positioning of cutting elements, allowing less variability, less labour intensity and consistent reproducibility of high quality results. Changes in product material, leading to reduction in weight, clear focus on a particular prostheses type contributing to reduction in container size and options for patient size specific tools, have a potential to provide hospitals with a scope for both quality and efficiency improvements. Beyond that, elimination of maintenance costs and related timings such as sterilisation and cleaning could broaden the scope for surgical efficiency enhancements allowing higher margins for both customers and providers. Latest results indicate broad acceptance among the interested sides including clinical and non-clinical stakeholders, which opens a new pathway for further development- market release of single use instrumentation to verify the new concept against the classical reusable equipment.

In addition to that, separate free consultancy services by means of process analysis are provided. This very offer is not less important than the emerging single use solution. The service initiative does not only ensure a source of accurate data for investigation of hospital performance. This helps identify bottleneck processes, causes of inefficiencies and introduce more effective solutions to the market. Importantly, it also allows hospitals to understand strengths of new equipment and fully appreciate greater convenience, accuracy and cost savings generated through application of single use instrumentation. In this way, hospitals are free to choose which offering best suits their needs whether it is conventional equipment, new single use instrumentation or just a free of charge consultancy service.

5 CONCLUSION

The case described a business shift towards new, more customer oriented value proposition to satisfy the changing requirements of both clinical and non-clinical stakeholders. On one hand, this example indicates the need for a new product creation, rather than provision of multiuse instrument service practiced to this time. On the other hand, the very area of supplementary services provision plays a crucial role for new product introduction. From any perspective, the central theme is greater attention to customer needs and deeper analysis of customer operations. Particular interest of this example is the way the purpose of a product-service mix can be changed when greater detail to customer processes is provided. Such findings could indicate incompleteness of the existing models viewed as a stepwise process originating from simple additional to products services, such as after sales and maintenance, where the extent of service provision could gradually substitute the original, tangible products and lead to pure service rendering (Sundbo, Toivonen, 2011).

The phenomenon has to be explored further to obtain more evidence for the basic model revision through greater attention to customer needs via process analysis tools embedded in changing sales concepts. Studies are ongoing to validate current findings through introduction of additional expert opinions from other business units such as senior representatives of other marketing spheres, sales teams and clinical stakeholders.

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THE EXTENT OF AND MOTIVATIONS FOR SERVICE PROVISION AMONGST UK BASED MANUFACTURERS: A REPORT OF SURVEY FINDINGS

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ABSTRACT

Whilst servitization strategies have attracted growing interest, relatively little is known about the extent to which manufacturers provide services, their motivations for so doing, and the organizational arrangements associated with providing services. Drawing on a bespoke survey of 256 manufacturers in the UK that was conducted in 2010, this paper reveals that manufacturers typically provide several services – very few do not provide any services at all. Factors such as the complexity and price of the firm's main product influence the extent of service provision (systems providers selling expensive equipment are more servitized), as do specific organizational arrangements. Structural factors, such as firm size and age have no significant impact, and nor does customer dependence or the extent of competition. There is some variation by sector: machinery firms tend to be more servitized. Overall, we need to understand why manufacturers provide services, and when they benefit from so doing.

Keywords: Servitization, Motivations, Drivers.

1 INTRODUCTION: EXISTING EMPIRICAL EVIDENCE

Remarkably little is known about the extent to which manufacturers provide services, or indeed the extent to which predominantly service firms manufacture goods. With a few notable exceptions, most existing academic studies of servitization have examined case studies of individual companies. The aim of this paper is to substantially enrich the picture of the extent to which manufacturers are providing services, and to shed light on the 'drivers' and motivations for so doing. We also identify the factors associated with extensive and narrow provision of services.

2 THE 2010 SURVEY OF UK MANUFACTURING FIRMS

To examine the extent of service provision amongst UK based manufacturers we conducted a bespoke survey of firms in the autumn and winter of 2010. After piloting with six firms, a sample of firms was drawn from FAME, a dataset based on company accounts information. Our aim was to include product based manufacturing firms, especially with an engineering orientation. We selected firms in the following 2 digit SIC(2003) code industries 25; 28; 29; 30; 31; 32; 33; 34; 35 and 36, which, according to the records in the FAME database had between 7 and 1,500 employees.¹ This sample generation process produced a list of 2,515 firms, which was considered sufficient given our anticipated response rate of 10% and target of 250 responses. We did not set quotas by firm size or sector of activity. We received responses from 267 firms, although 11 of these were not usable and were discarded. The dataset is therefore comprised of responses from 256 manufacturing firms. Amongst these firms, the item response rates are generally very good. The overall response rate is comparable with those achieved by other, similar surveys.

¹ We sought to avoid very small firms, due to the response burden and consideration that the questions were less likely to be appropriate. Because it is difficult for individual respondents to have an accurate view on the whole of the business we also excluded very large firms. Large businesses also receive a disproportional number of requests for information from academic and other surveys, which often leads to lower response rates.

The survey asked the firms about their engagement in services, and specifically asked the firms whether or not they provided 15 different services. All but two of the firms reported providing at least one of these, with the most widespread being delivery services, whilst the least widespread was product leasing, with or without operatives. Interestingly, our 'top five' services are the same as those identified by Baines et al. (2009), i.e., training, delivery, spare parts, repair, and customer helpdesks. Like Baines et al, we also find widespread provision of installation services, but less provision of systems integration, preventive maintenance and condition monitoring; by contrast, we find greater provision of financial services, and more consulting.

To analyse which firms provided these services, and which did not, we estimated a series of logistic regressions (not reported here). In each model we included: [Firm size] the size of the firm, measured by the natural log of its employment; [Sector] a set of indicator (or 'dummy') variables for sector of activity, with 'other manufacturing' acting as the reference sector; [Ownership] an indicator variable identifying subsidiary firms owned by others (with independent firms acting as the reference group); [Age] an indicator variable for relatively young firms established after the year 2000; [Type of Product] an indicator variables for firms that manufactured stand-alone appliances or equipment, and another for those that manufactured systems (often tailored to particular customer's needs) that combine a large number of components (here, the manufacture of 'components or parts' was the reference category); [Unit Cost of Product] a set of indicator variables relating to the unit cost of the firms main products. This varied from 'less than £10 per unit' (the reference category) through to 'over £100,000 per unit', with four intermediate categories; [Main Customer Dependency] an indicator variable for firms for which their largest customer accounted for at least half their total revenues. A second indicator variable was included for other firms whose five largest customers accounted for half or more of their income; [Competition] an indicator variable for firms that claimed to have no more than two competitors. A second indicator variable for firms with over 10 competitors. Firms with 3 to 10 competitors were the reference group.

Models for ten of the fifteen services were significant, meaning that some of the variation in whether or not firms provide these services can be attributed to these variables. These models, which implicitly assume each of these services is provided independently of the others, show a variety of factors influence the provision of services amongst manufacturing firms. The nature of the product is often important. Firms that make stand-alone appliances are three times more likely than those that make components to provide spares or consumables and a customer helpline, and twice as likely to provide financial services such as insurance and warranties. Those that manufacturer systems are at least 2.5 times more likely than those that make components to provide all of these services except a customer helpline and financial services. They are also roughly seven times more likely to provide systems integration services. The sector of production also matters, with metal product firms being less likely to provide most of these services. Most probably, this relates to the robust and static nature of most metal products, such that they require little after-sales servicing. Electrical and electronics firms are three times more likely to provide systems integration services, and twice as likely to provide regular product or systems upgrades. Instruments companies are four times more likely to provide regular upgrades. The cost of the product (which probably reflects its complexity), has a strong influence on whether or not the firms provide almost all of these services, the two exceptions being a customer helpline and financial services. With all the other services the manufacturers of the most expensive products are several times more likely to provide the service than manufacturers of the least expensive products. This stands to reason, as low cost product are typically discarded and replaced when worn out or damaged, whereas expensive equipment is repaired and maintained. Generally the provision of services increases incrementally with the cost of the product. This is true of all services except customer helplines and financial services, and spares and consumables, the provision of which appears most widespread amongst producers of medium-cost products. This suggests that whilst the customer or a third party often carry out repairs on mid-cost products, the manufacturer typically provides repairs and maintenance on the highest cost equipment. Other factors, such as firm size, age and ownership had very little effect.

3 MOTIVATIONS AND ORGANISATIONAL ARRANGEMENTS

Another interesting question is why do firms provide services, and the survey asked the respondents about this. Specifically, we asked “How important are the following reasons for your provision of product support and services”, with thirteen statements then provided, which the respondents scored on a 5-point scale between ‘of no importance’ and ‘crucial’. Six of these motivations can be considered aggressive or offensive reasons (improving understanding of users’ needs; helping to differentiate the offer; increasing opportunities for customisation; increasing opportunities for cross-selling; increases total turnover; increases profitability), whilst five others can be considered defensive (required to comply with regulations; necessary because key customers require them; increase customer loyalty; helps tie customers in; and increases the stability of turnover). Two environmental or ecological reasons were also included. Interestingly, the defensive motivations tended to be identified as more important than the offensive motivations, with the ‘environmental’ motivations less important still. However, further analysis showed that firms tended to provide services for a mix of offensive and defensive reasons (with the correlation between the scores on the two sets of components being 0.8).

We also asked about the organizational arrangements associated with providing services. It is sometimes argued that the provision of services requires different organizational arrangements from those required to produce physical products (e.g. Oliva and Kallenberg, 2003). Our survey asked about the extent to which firms agreed (or disagreed) that they had introduced eight organizational arrangements related to providing services (e.g., ensuring service provision is in close communications with production, giving the services operation its own profit and loss responsibility, etc). Examined by Principal Components Analysis, these answers were found to load onto a single component with an Eigenvalue of 4.4. This accounted for 55% of the variance in the data, with item loadings varying from 0.61 to 0.82. The Cronbach’s alpha for the set of eight items was 0.88.

4 MODELING THE EXTENT OF SERVICE PROVISION

We then modeled the extent of service provision. We first classified the firms in our sample into three groups: those that provide fewer than the ‘expected number’ of services (i.e., none to 3); those that provide around the ‘expected number’ (i.e., 4 to 9), and those ‘extensive service providers’ that provide more than the ‘expected number’ of services (i.e., 10 to 15). Our aim is to uncover the factors that distinguish firms that provide few and many services, from those in the middle that provide a ‘normal’ number of services.

We built the models (the results of which are reported in Table 1 below) incrementally, starting with the structural characteristics of the firms: i.e., sector, size, age and ownership. Specifically, four sectors, and “new firms” (established after 2000), are separately identified with dummy variables. Size is measured by the natural log of employment. And an index for ‘autonomy’ is calculated and added: this is derived from a survey question with four items. The mean score amongst subsidiaries is 0.87 (with full autonomy being 1), whilst because independent firms are autonomous by definition, these were assigned a score of 1.

Model 1 with only these structural characteristics found nothing statistically significant to distinguish firms with no/limited services from those with a ‘normal’ service orientation. Several factors do however distinguish firms with an extensive portfolio of services, including being machinery, instruments or electrical/electronics manufacturers, and having a high level of autonomy. There was also some indication that young firms are more likely to provide several services.

In Model 2 we added in the type of products manufactured – i.e., dummy variables for the manufacture of appliances and of systems, with the manufacture of components acting as the reference category. We also added a set of dummy variables reflecting different unit prices for the firm’s main product. This revealed relatively strong evidence distinguishing firms with extensive service portfolios from those providing no or few services. In particular, systems manufacturers and high cost goods manufacturers were much more likely to provide an extensive range of 10 or more services.

Table 1: Modeling the Extent of Service Provision: Multinomial Logistic Regressions

	Model 1 Exp(B)	Model 2 Exp(B)	Model 3 Exp(B)	Model 4a Exp(B)	Model 4b Exp(B)	Model 5 Exp(B)
No and Limited Service Provision (i.e., Firm provides 0 to 3 services, compared with 4 to 9 services)						
Sector: Metal Products	1.32	2.01 ^{18%}	2.05 ^{18%}	1.97	1.78	2.00
Sector: Machinery	0.70	1.25	1.35	1.95	2.55 ^{17%}	2.53 ^{19%}
Sector: Electrical/onics	0.74	1.08	1.12	0.82	1.15	0.83
Sector: Instruments	0.19 ^{12%}	0.28	0.27	0.31	0.24	0.29
Size (Ln Employment)	0.99	0.93	0.92	0.87	0.97	0.90
Established after 2000	1.00	1.61	1.84	5.44 ^{10%}	1.88	4.52 ^{15%}
Autonomy Score	0.76	1.59	1.65	1.85	1.96	1.76
Manuf. Appliances		0.57 ^{16%}	0.57 ^{16%}	0.43*	0.63	0.48*
Manuf. Systems		0.48*	0.49*	0.57	0.51 ^{12%}	0.57
Unit Cost: £10 to £100		1.46	1.60	1.55	1.91	1.69
Unit Cost: £100 to £1k		0.53	0.54	0.45 ^{15%}	0.53	0.48 ^{18%}
Unit Cost: £1k to £10k		0.19**	0.20**	0.15**	0.18**	0.15**
Unit Cost: £10k - £100k		0.24 ^{11%}	0.24 ^{11%}	0.18*	0.17*	0.15*
Unit Cost: Over £100k		0.35	0.35	0.29	0.32	0.26
Top Cust. >½ sales			0.89	0.53	0.73	0.57
5 Top Custs >½ sales			1.25	1.35	1.14	1.25
< 3 Competitors			1.48	1.38	1.39	1.33
> 10 Competitors			1.06	0.94	0.89	0.89
Motivation PC1				0.61**		0.70 ^{18%}
Motivation PC2				0.48***		0.52***
Motivation PC3				0.72 ^{16%}		0.75
Arrangements PC					0.50***	0.75
Extensive Service Provision (i.e., Firm provides 10 to 15 services, compared with 4 to 9 services)						
Sector: Metal Products	1.26	0.78	0.75	0.68	1.41	1.43
Sector: Machinery	4.70***	2.35*	2.51*	2.49*	3.50**	3.42**
Sector: Electrical/onics	2.39**	1.75	2.00 ^{18%}	2.17 ^{14%}	3.23**	3.09*
Sector: Instruments	2.92**	1.91	1.92	2.07	3.19 ^{11%}	3.30 ^{10%}
Size (Ln Employment)	1.11	1.20	1.19	1.11	0.80	0.79
Established after 2000	2.79 ^{13%}	2.45	3.13 ^{12%}	3.02 ^{15%}	3.90*	3.79*
Autonomy Score	6.78*	7.05 ^{13%}	6.03 ^{17%}	8.63 ^{11%}	18.46**	15.60*
Manuf. Appliances		1.45	1.35	1.55	1.59	1.62
Manuf. Systems		3.35***	3.62***	3.59***	4.59***	4.36***
Unit Cost: £10 to £100		3.75	4.39	4.25	3.71	3.79
Unit Cost: £100 to £1k		3.85	4.23 ^{19%}	4.21	3.27	3.66
Unit Cost: £1k to £10k		3.20	3.89	3.75	2.86	3.08
Unit Cost: £10k - £100k		16.83**	20.18***	20.65***	15.96**	18.22**
Unit Cost: Over £100k		22.04***	28.16***	27.95***	10.62*	11.82*
Top Cust. >½ sales			0.50	0.51	0.72	0.69
5 Top Custs >½ sales			1.27	1.18	1.66	1.61
< 3 Competitors			1.47	1.34	1.50	1.28
> 10 Competitors			2.07 ^{18%}	2.09 ^{18%}	2.49 ^{14%}	2.47 ^{14%}
Motivation PC1				1.22		0.93
Motivation PC2				1.15		1.06
Motivation PC3				1.30 ^{16%}		1.16
Arrangements PC					4.00***	4.13***
Model χ^2	31.7	117.65	121.7	146.9	162	174.4
McFadden Pseudo R ²	0.06	0.23	0.24	0.29	0.32	0.35

All models have 251 observations. *** Significant at 1%; ** Significant at 5%; * Significant at 10%

In Model 3 we added in the extent to which the firms dependent on one or a few customers, and the extent to which they face many or few competitors. However, our analysis found that neither customer dependence nor the extent of competition had any significant impact on the extent of the service offered by the firms.

In Model 4a, we added in the principal component scores associated with the motivations for providing services. Here, Motivation PC1 relates primarily to the impact of offering services on the business itself (e.g., increasing turnover, profitability, the stability of income, etc.); Motivation PC2 relates to engaging with customers (e.g., increasing customer loyalty); whilst Motivation PC3 relates to complying with regulations and ecological benefits. We find that none of these motivations is associated with having an extensive portfolio of services (compared with providing an 'expected number'), but the first two are significantly associated with offering numerous services: firms which score highly on these components are much less likely to provide no or a small number of services.

In Model 4b, we substitute the principal components associated with the motivations for providing services with the principal component associated with organizational arrangements for service provision. The results show that scoring highly on this Arrangements PC significantly reduces the probability that the firms will provide no or few services, and significantly enhances the probability that it will engage in extensive service provision.

Finally, in Model 5, we reintroduce the three variables for the Motivations, whilst retaining that for the Arrangements. The reintroduction of the Motivations PC variables removes the significance on the Arrangements variable with respect to the provision of no/few services, but (unsurprisingly) Arrangements remains important for the provision of an extensive set of services. Motivations are not significant for the provision of an extensive set of services, but Motivation PC2 (enhancing customer engagement) is important for the provision of some services (i.e. it is negatively related to the provision of no or very few services). Meanwhile, customer dependence and the extent of competition still has no significant impact on the extent of service provision, whilst structural factors (sector, size, age, autonomy) are generally more important for distinguishing between firms that provide many services from those that provide "around the expected number", than for distinguishing between firms that provide none or very few from those that provide around the 'expected number'. Autonomy seems to be particularly important for the provision of an extensive range of services, which is also higher amongst young firms, and those producing machinery, electrical and electronic products and (more marginally) instruments.

5 CONCLUSIONS

Servitization, the provision of services by manufacturing firms to their customers, and a shift from 'making and selling products' to providing combinations, or packages, or 'integrated solutions', of products and services, has been advocated for some time as a means by which manufacturers in high cost locations such as the United States and Western Europe can compete in an era of globalization and against lower-cost producers in Eastern Europe and East Asia. However, surprisingly little is known about the extent to which manufacturers in advanced economies such as the UK provide services, their motivations for so doing, or the organizational implications of providing services. This paper therefore contributes significant evidence where previously there was little.

Based on a bespoke survey of manufacturing firms, we have found that almost all manufacturers provide at least some services to their clients, and the extent of service provision is substantially greater than that revealed by the analysis and coding of trade descriptions. The most commonly provided service is delivery of products, followed by the provision of spare parts and consumables, a customer helpline or support desk, and product or systems training. Interestingly, these same services were also found to be the most widespread in a previous, but much smaller survey, undertaken by Baines and colleagues (2009).

In relation to their motivations for providing services, firms tend to cite both defensive and offensive reasons simultaneously. Defensive reasons include tying customers in, and increasingly the stability of turnover, whilst offensive reasons include learning about customer needs and increasing turnover and

profitability. Firms also vary substantially in the extent to which they have implemented organizational arrangements thought favourable to the provision of services, and establishing a service oriented culture.

We examined the factors that distinguish between firms that provided no or few services, and those that provide many services, both compared with firms providing a modest number. Generally speaking, manufacturers of high value products, of systems, and to a lesser extent of appliances, were much more likely to provide services than were manufacturers of components. This is understandable, as cheap goods are normally discarded and replaced, rather than repaired and maintained, which is the case with expensive, complex equipment. Another factor here is likely to be the scale of the market. Because there is strong demand for low cost products, the scale of the market will tend to be large, encouraging an increased division of labour, with third party service providers often in a stronger position to provide services than the original manufacturer. Manufacturers of machinery were also more likely to provide many services, which is understandable due to the dynamic nature of machines. Interestingly, the number of competitors did not generally influence the extent of service provision, and nor did high dependency on one or a few customers. We did find that firms motivated to learn more about their customers were more likely to be providing at least an average number of services, whilst those that had implemented service oriented arrangements tended to provide the most extensive range of services.

All told, this paper suggests there are many factors that influence the provision of services by manufacturers, and this is important if we wish to understand (and recommend) strategies and managerial choices. Too often, in our view, bold or sweeping statements are made urging all manufacturing firms to 'servitize' (e.g. Benedettini et al, 2010, p. 6). We need to understand that change comes at a price – it has costs as well as benefits. It makes considerable sense for manufacturers of expensive systems to have and to develop a services strategy, but, we suggest, the same strategy would not be sensible for a manufacturer of low cost components, or highly durable metal products. This said, the provision of services can create valuable spillover benefits. For example, by engaging in installation and training the manufacturer can gain considerable insight into how its products are used, which can lead to further product improvements. The key here is to identify and exploit the complementarities that arise when offering both products and services. In this context, there may be circumstances where it is sensible to provide services at a loss in order to gain market intelligence. A full consideration of these matters is beyond the scope of the present paper, as is an analysis of the performance implications of providing services, which we will address in future work.

[Note that this is an abridged version of a longer paper which examines the survey findings more fully – readers interested in the longer version are welcome to email the first author to obtain a copy]

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