Transitioning to Service

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Abstract

Purpose – The purpose of this paper is to provide further insight into operations management of the P-S transition, known as servitization, and the resulting PSS offerings. In our exploration of the dynamics of the product-service transition we adopt a Service-Dominant logic view of value creation, using it as a lens through which to explore value propositions of the P-S transition and their operations design.

Design/methodology/approach - This paper presents an in-depth case study of an Original Equipment Manufacturer (OEM) of durable capital equipment who, over the last 5 years, has expanded their offerings to include use and result orientated product-service systems. The research design uses a multi-method approach; employing 28 in-depth qualitative interviews with customers and employees and analysis of texts, documents and secondary data including 5 years of ERP, call centre and contract data.

Findings – The paper identifies 10 generic P-S attributes, which are consolidated into four nested value propositions; asset value proposition; recovery value proposition; availability value proposition; outcome value proposition. In examining the operations design for delivery of these value propositions we find that the role and importance of contextual variety increases as we move through the value propositions, we also find interdependencies amongst the value propositions and differences in operational design for each value proposition.

Research limitations/implications - The paper investigates PSS through a S-D logic mindset. First, we consider value propositions of PSS not according to 'product' or 'service' but in terms of how resources (both material and human) are optimally designed to co-create customer value. Second, we illustrate a value co-creation system of nested value propositions. In so doing our findings have a number of implications for literature on both PSS and S-D Logic. In addition, we add to the PSS literature through the identification and consideration of the concept of contextual use variety.

Practical implications – The paper demonstrates the complexity of the transition from product to service. Specifically, service cannot be seen as a bolt on extra to their product offering, complexity caused by interactions and changes to the core offering require a systems perspective and consideration of both company and customer skills and resources.

Originality/value – This paper extends existing literature on the P-S transition and its implications for operations management. Notably, it takes a Service-Dominant logic perspective of value creation and in so doing highlights the importance and role of contextual use variety in the P-S transition. It also provides further empirical evidence that the P-S transition cannot be treated as discrete stages but is evolutionary and requires a complex systems perspective.

Key Words – Servitization; Product-Service Systems; Service-Dominant Logic; Value Propositions, Value-in-use, Contextual Use Variety

Paper Type - Research Paper

Introduction

Managing organisational performance in sectors such as equipment provision has become increasingly complex as competition has heightened and firms have felt the pressure to add value predominantly through the provision of services (Baines et al, 2008). This provision has been commonly referred to as the servitization of manufacturing (Vandermerwe & Rada, 1988). Despite the interest, there have been less theoretical developments in area. Many studies into servitization capture the phenomenon as a summary of observed events or data. Unfortunately, theoretical aspects of servitization could lie in unobservable constructs which are important as abstractions of the phenomenon. This study aims to explore more fundamental theoretical aspects of servitization from a value perspective, through the lens of Service-Dominant logic, and propose its implications on operations management.

The phenomenon of servitization has been generally covered in manufacturing literature and has received relatively little attention in the mainstream engineering and management literatures (Neely, 2007; Baines et al., 2007; Vandermerwe and Rada, 1988). The academic discussions that have appeared in the mainstream literature have centred on motives, benefits and feasibility of servitization as a competitive strategy (Vandermerwe & Rada, 1988; Matthyssens & Vandembempt, 1988; Anderson & Narus, 1995; Wise & Baumgartner, 1999) and the implementation and process of servitization (Oliva & Kallenborg, 2003; Mills et al., 2008; Cook et al., 2006). More recently work has been published on the extent and impact of the "servitization" of manufacturing industries (e.g. Neely, 2008). Neely (2008) provides empirical evidence that despite increasing cases of organizations throughout the world adding value to their core offerings through services, often servitized firms generate lower net profits as a percentage of revenues than pure manufacturing firms. Neely (2008) attributes this to the organizational challenges of the inevitable changes to value propositions that servitization entails. This is echoed throughout discussions in literature as many authors continue to highlight the need to explore the operational implications of transitioning from product to service (e.g. Pawar et al., 2009; Johnstone et al., 2009; MacDonald et al., 2009; Oliva & Kallenberg, 2003). Not only do they recognise the need to explore the operations management implications but they acknowledge the need to do so with a customer orientation (Johnstone et al., 2009), many looking to the Service-Dominant Logic (Vargo and Lusch 2004;2008) as a lens through which to make this exploration (Pawar et al., 2009; Macdonald et al., 2009).

A primary motivation of this study is to address the operations management community calls for further investigation of the transition from product to service through a service-dominant logic lens. In seeking to address this call we look to take a customer orientation by exploring the changes in value proposed to the customer as a consequence of a change in core business offering. In addition, we investigate the firm's operations resources and design to support the delivery of these core business offerings.

The paper is organised as follows, section 1 reviews the product service systems literature with particular focus on the issues of managing operations. Section 2, considers the insight provided by service dominant logic and the co-creation of value between producer and customer. Section 3, draws on the product service systems work of Pawar et al (2009) and Johnstone et al (2009) further interpreting their work through the lens of service dominant logic. Through this we identify two research questions, what PSS value propositions are offered throughout the P-S transition and what are the implications of those value propositions for operations design. Section 4 describes the use of a single exploratory case to investigate these questions. Section 5 uses the findings from the case research to address the questions. In section 6 and 7 we discuss the implications of these findings for the literature on product service systems.

1.0 Product-Service Systems

The "servicizing" phenomenon that has pervaded manufacturing has resulted in organisations offering complex packages of both product and service to generate superior customer value and thus enhance competitive edge. In the literature, servitization is referred to as the Product-Service (P-S) transition and represents the transition between pure product and pure service offerings (e.g. Oliva and Kallenberg, 2003; Pawar et al., 2009; Tukker, 2004). Within this transition exists

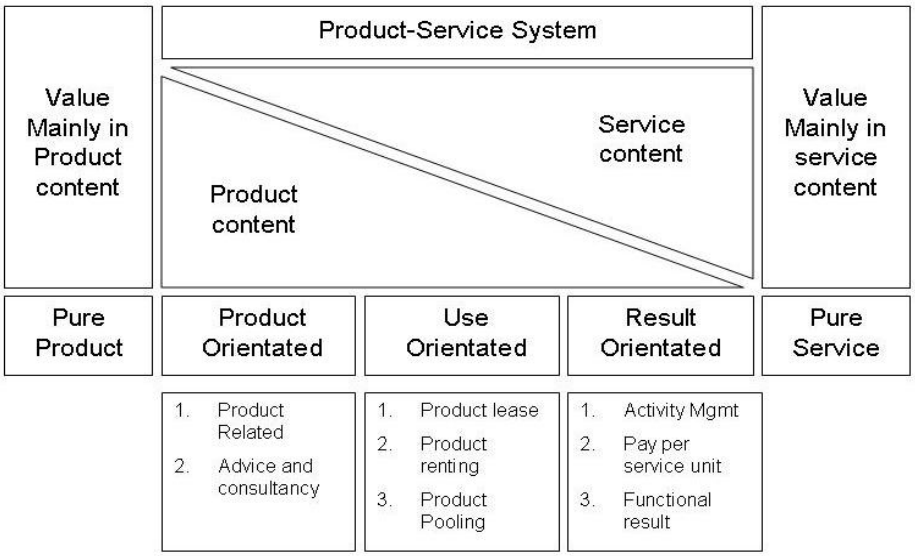
combinations of products and services which have been called Product-Service Systems [PSS]. PSS studies appear in the literature of many different academic disciplines including engineering, management, design and environmental studies (Lamvik 2001; Morelli 2002). Although its root meanings and concepts are similar across these disciplines, its research approach and aims differ. While some researchers refer to PSS as a "value proposition" (Tukker and Tischner 2006), others refer to it as an "innovation strategy" to remain commercially competitive (Manzini and Vezzoli 2003). Additionally, other streams of researchers refer to PSS as a "concept", "form", "structure" or "platform" from which to innovate efficient "systems" and "models" for the benefit of the consumer (Bullinger et al. 2003; Mont 2001).

Clearly, PSS research is evolving from varying perspectives and motivations. Nevertheless, despite differing lenses, there are a number of common themes. First, is the common understanding that the provision of services plays an important part in the growth of GDPs in most industrialised economies. Traditional manufacturing firms are discovering that their revenues are dominated by its service offerings compared to its manufactured products (Cook et al. 2006). Second, is the concept of the firms offering as an integrated view of material (tangibles) and non-material (intangibles) components with the collective aim of fulfilling customer needs (Botta and Steinbach 2004; Cook et al., 2006). Finally, researchers across disciplines and perspectives recognise that PSS is able to change the manner in which firms produce and customers consume. The underlying assumption that the customer's value of a product lies in the benefits that they can attain suggests that the provider could shift focus from the means of achieving such "results" to providing the results themselves. It can then be argued that customers would then be encouraged to become more interested in purchasing the function of the product rather than in owning the product which provides the function.

Where PSS has appeared in the mainstream management literature, predominantly within operations management studies, this notion of a 'functional economy' is explored in its translation to business models. So called "function-oriented business models" have evolved where "tangible products and intangible services are combined so that they are capable of fulfilling specific customer needs" (Tukker, 2004). These business models are documented as presenting opportunities for organisations to enhance competitiveness by directly fulfilling customer desired results or outcomes. One of the more fundamental studies to arise from PSS management research is the categorisation of different types of PSS model. In general, the classification of PSS is found to fall into three categories; (a) product-oriented services, where the ownership of the "material product" is considered as transferred to the customer and a service arrangement is provided to 'ensure the utility' of the artefact over a given period of time; (b) use-oriented services, which refers to a configuration of ownership where the "material product" is retained by the service provider who sells the "function" of the product to the customer. Examples of this type of PSS are leasing (e.g. photocopier, DVD rentals) and; (c) result-oriented services, here the service provider sells "results" rather than "functions". In other words, the customer purchases "utility" as an outcome instead of the "function" of the product and typically, under the result-oriented PSS, there is no-predetermined product involved (Brezet et al., 2001; Cook et al., 2006; Zaring, 2001).

Tukker (2004) expanded on these generalised PSS models to highlight that within the spectrum of pure product to pure service there exists eight sub-categories of PSS. Figure 1 below illustrates the spectrum of possible PSS types. Tukker (2004) goes on to argue that as the reliance on the product as the core offering of the PSS decreases (left to right), the needs of the customer are formulated in more abstract terms and opportunities for determining the true final need of the client increase. However, he warns that due to the complexity of the PSS types abstract demands are often difficult to translate into concrete (quality performance) indicators, which complicates the supplier – customer relationship. MacDonald et al (2009) further highlight this point when they argue the need for use orientated performance measures in PSS.

Figure 1. Main and subcategories of PSS, Tukker (2004)



1.1 Operations Management of PSS

A number of authors have echoed this interest in the operations management implications of such fundamental changes in business model inherent in PSS strategies. Authors such as Pawar et al (2009), Johnstone et al (2009) and Oliva and Kallenberg (2003) have noted that whilst PSS motivations have been addressed and operational issues are often recognised, empirical research is lacking into operations management issues related to the transition itself. In particular research is needed into 'how' these product-service combinations are delivered and managed.

In their exploration of the PSS evolution in an exemplar case, Johnstone et al (2009) draw attention to the transition from product to product-service and its implications. In particular they seek to understand the dynamic of the transition and what product service systems means for those organisational actors engaged in enacting the transition. In so doing, their results challenge the notion that the transition is between two steady states. This has implications for models like Tukker (2004) who present the transition as a linear illustration, in Tukker's illustration 'value is added' through service in apparently neat evolutionary stages. This notion of PSS as a set of neat evolutionary stages is reflected across the PSS literature (e.g. Oliva & Kallenberg, 2003; Vandermewere & Rada, 1988). Johnstone et al (2009), however, identify a more complex situation where transition is affected by issues of power, politics, constantly shifting organizational priorities, changing customer demands, and a turbulent business environment. They recognise that central to transition is the need for a more proactive customer orientation whilst also acknowledging the challenge of '*seeing value through the eyes of the customer'*. Furthermore, they suggest that this orientation presents implications for operations management topics such as, knowledge management, human resource management, resource scheduling and capacity management and job and work design. Pawar et al (2009) also look at the operational implications of taking a proactive customer orientation in PSS. Through a Service-Dominant Logic perspective and with a particular focus on the issues for external partners and suppliers they raise three key challenges centred on the definition, design and delivery of value to the customer.

It is clear from the above discussions that the concept of PSS has developed on a foundation of customer utility and function. To this end, Baines et al (2007) define PSS such that they embody "*an integrated product and service offering that delivers value in use*", highlighting the importance of customer value in the conceptualisation of use or to use the language of Tukker (2004), result orientated offerings. Moreover, at the centre of the operations management calls is the challenge of seeing value through the eyes of the customer and ultimately designing and managing PSS operations accordingly (Johnstone et al, 2009; Pawar et al, 2009; MacDonald et al, 2009; Brady et al., 2005). As a result, current academic literature suggests that one of the biggest challenges facing the P-S transition is a change in mindset. This shift requires firms and scholars to renounce a mindset founded on value created in the production and exchange of goods, to one in which value is founded on the use of an offering towards the achievement of customer goals. In the following section we consider insights from the service dominant logic as a lens through which to examine this change in mindset.

2.0 A Goods-Dominant vs. a Service-Dominant Approach to Value Creation

Traditionally, creating customer value has focused on customer needs, satisfied predominantly through core production business activities. Over recent years the concept of P-S transition has increasingly evolved to value created in the function and utility provided rather than in the product itself. Whilst PSS recognises that superior customer value resides in utility, much of the development of PSS has been made through the lens of product based thinking. This was evidenced in a PSS setting by Johnstone et al (2009) who found an embedded engineering culture of 'product centricity' present in a firm considered exemplar in its transition from manufacturing to PSS and was manifested in a lack of understanding of customer 'needs'. This product based thinking is often termed as a goods-dominant logic (G-D logic).

Servitization has led to manufacturing firms 'adding value', often through the provision of service. Yet despite the centrality of utility to PSS, the literature often equates the idea of 'adding value' to a higher exchange value. For example, Tukker (2004) suggests that by creating 'added' value through the addition of service, the provider makes the client willing to pay more. Value in exchange is often presented as the selling value of a product. Despite its prevalence in the literature exchange value is not useful when trying to understand the value of PSS because the exchange, or the transaction, only represents one part of the value creation process. For example, Lapierre (1997) show that value created during exchange transactions represents only one level of the service value proposition. A second level must be provided once the exchange transaction is complete, that is value in use (Lapierre, 1997).

In the seminal papers on Service-Dominant Logic (S-D logic) by Vargo & Lusch (2004, 2008), it is contended that exchange is not primarily about the exchange of goods, but the exchange of service. In the exchange of service, value is considered the comparative appreciation of reciprocal skills, or operant resources, that operate on each other or on operand resources (such as a product) to achieve value-in-use. Indeed, most current literature would now describe value as that which is evaluated by the customer, rather than the currency for the transfer of ownership of a particular good. Consequently, whether benefits to customers are attained through tangible products or through human activities, a customer-focused orientation would focus on value-in-use, delivered by the outcomes enabled by products or activities. Such is the intention of PSS.

The foundations of PSS recognises utility but does not fully comprehend the conceptual difference between utility and value in use. Utility is seen as a Goods Dominant Logic as it implies a passive customer whose main preoccupation is the evaluation of the product benefits i.e. its utility. S-D Logic, conversely, proposes that value-in-use is co-created as a phenomenological experience of the beneficiary. This means that both the firm and the customer are accountable in achieving value-in-use – the former through its value propositions and latter through its realisation of the propositions be they direct (human activities) or indirect (through equipment) propositions. So a firm's offering, is merely value unrealized i.e. a 'store of potential value', until the customer realizes it in use through co-creation and gains the benefit (Ng et al., 2009). Value-in-use, as evaluated by customers, must therefore include themselves as active participant in the process and by logical argument, an evaluation of their own performance in the realisation of the value. In manufacturing terms, the customer must learn to use, maintain, repair, and adapt the appliance to his or her unique needs, usage situation, and behaviours'. Thus, value co-creation implies that customer resources to realise the value are central to achieving end benefits. Therefore, for co-creation to be understood in the fullest sense the customer's role in attaining benefits cannot be ignored and researchers would have to face the challenge of understanding customer consumption processes (Ballantyne and Varey, 2006; Ng et al., 2009).

2.1 Towards an S-D Logic Approach to PSS

Recent research into PSS has seen a step towards adopting an S-D Logic perspective. Notably, Pawar et al (2009) explicitly draw on the work of Vargo and Lusch (2004; 2008) in their empirical research of the implications of PSS, in which they identify three challenges in PSS;

(1) defining the value proposition that will satisfy the customer;
(2) designing the operational system to deliver the value proposition;

(3) delivering the value through a network of partners.

Whilst recognising value in use and its potential implications for operations management, Pawar et al (2009) have not fully captured the essence of S-D Logic, particularly in the conceptulisation of their PSO model. Most notably, the model implies that value is defined by the producer, in that their framework is a process to define, design and *deliver value to customers.* This is resonant of the G-D Logic view that *the customer is the recipient of the goods* and *value is determined by the producer (Vargo & Lusch, 2004 p7.)* Through SDLogic, a firm can only offer a value proposition, the realisation of it can only be through co-creation with the customer. Therefore a firm cannot 'satisfy' a customer they can only collaboratively support value co-creation.

3.0 Research Objective and Questions

Thus far this paper has reviewed extant literature on product-service systems and the subsequent research calls from operations management scholars to (a) explore the implications of PSS for operations management and (b) explore the resulting implications of a customer orientation. In light of this call for a customer orientation, we have considered the prevailing G-D Logic and its limitations as a perspective from which to examine PSS and have drawn on S-D Logic as an alternative lens through which to explore PSS.

Within this review, research into the implications of the P-S transition for operations management is found to be in the early stages of exploration. Moreover, much of the existing mainstream PSS literature is deemed to be normative and prescriptive, focusing upon motivations of P-S transition but offering little insight into how it is managed (Johnstone et al, 2009; Pawar et al, 2009; MacDonald et al, 2009). As a result, this paper seeks to provide further insight into operations management of the P-S transition and the resulting PSS offerings.

This paper specifically draws on the previous descriptive-exploratory work of Johnstone et al (2009) and Pawar et al (2009) in which important challenges of PSS for operations management were introduced. Firstly, we extend on the formative work of Pawar et al (2009) by empirically investigating their first two challenges of PSS through a Service-Dominant Logic perspective. We do not directly attempt to translate Pawar et al's (2009) challenges in to research questions but instead use them as a frame through which to explore the implications of PSS for operations management. Thus, our first research question looks to address Pawar et al's (2009) first challenge centred on the definition of value propositions in PSS:

Research Question 1: What PSS value propositions are offered in the P-S transition?

The second research question examines Pawar et al's (2009) second challenge around the design of operations for PSS value propositions:

Research Question 2: What are the implications of PSS value propositions for operations design?

By framing our research questions on Pawar et al's (2009) challenges we also respond to the work of Johnstone et al (2009) who call for a customer orientation in operations management of PSS. In our exploration of the dynamics of the product-service transition we adopt an S-D logic view of value creation, using it as a lens through which to explore value propositions and their operations design in PSS. The overarching objective of this research is to extend and explore through the development of research propositions (Eisenhart, 1989).

4.0 Research Methodology

Much of the existing empirical PSS research has adopted a case design, detailing a contemporary phenomenon in its real-life context (Yin 1984). The focus of these investigations has been on the production of detailed examples from practice of 'why' firms adopt a PSS strategy and 'how' the PSS transition can be characterised. Our research seeks to further investigate an exemplar of the P-S transition for a more nuanced examination of 'how' the P-S transition affects the value

proposition and 'how' the firm is organised to deliver on the proposition. Case study research is found to be particularly useful when the aim of research is to answer "how" and "why" questions (Yin, 2003). Moreover, whilst a number of authors have raised the need to explore the question of 'how' PSS offerings are delivered, no previous study has fully addressed the implications of a 'customer orientation' and included interviews and data directly from customers. Given that the phenomenon under investigation is in the developmental stages of research, we use an in-depth exploratory case to point out factors that may be of importance, proposing a number of propositions for future research.

4.1 The Case

Central to case study research is the selection of suitable cases (Eisenhardt, 1989). We use a degree of "purposeful sampling" to select a case organisation considered to be an exemplar in that in that it is a firm with a successful P-S strategy, Over the last five years the case firm's corporate strategy has evolved to include use-orientated and result-orientated P-S contracts and in so doing have grown service revenues by over 50%. Moreover, the extent to which the case firm has transitioned from pure product offerings to those designed for use and result orientated PSS also presents an ideal opportunity from which to investigate value propositions and operations design of those value propositions present in the P-S transition. As such the case organisation under study should be considered an "extreme" or "deviant" case (Patton, 2002).

The case company is a prominent UK Original Equipment Manufacturer (OEM) supplying durable capital equipment and service on a global market. The nature of capital equipment presents an ideal opportunity for packaging product and service as part of its core offering as it is characterised by large, high value, low volume production outputs. Furthermore, durable manufactured goods yield utility over time and require services as they advance through their life cycle (acquisition, installation, operation, upgrades, decommission, etc.), they also have an associated cost of ownership beyond the original purchase price (spare parts, consumables, maintenance, etc.) (Oliva & Kallenberg, 2003)

The corporate success of the case firm has been founded on manufacturing excellence and high quality products, however, over the last ten-fifteen years attention has switched to equipment support services and this now represents over 50% of the company's revenue. Historically, the focus has been on product-orientated service offerings including repair and maintenance but in the last five years the company have expanded their P-S offering by introducing a number of use-orientated PSS solutions. These solutions are characterised by the following:

- *Whole-life support of the asset,* supporting the economical acquisition, repair, maintenance and disposal of equipment from the time it is delivered to the customer, until it reaches end of life.
- *Working availability of assets as a performance indicator*, the company maintains and is measured on a volume of equipment ready for use at any one time.
- *Pricing based on a cost-per-unit of equipment use*, a customer pays per unit of use, generally speaking the unit could be time, distance, depth, volume etc depending on which measurement unit applies to the equipment and its usefulness.
- *A range of ownership options including full and partial and non- ownership*, a customer can choose whether they retain ownership of the equipment as capital assets, whether they rent/lease equipment for certain periods of time or indeed if they do not have any ownership rights over the equipment.

In addition to contracting for availability of equipment use, for certain customers the company are also moving towards solutions packages that offer an operational capability; this would be more akin to a result-orientated PSS package. In these solutions the company contracts on the basis of an operational capability rather than on specific availability of a piece of equipment.

In line with a conscious move from product to product-service, service revenue across the organisation has grown by almost three times in the last decade and over 50% in the last five years that these new PSS offerings have been in operation. As we have discussed, very few studies provide any empirical evidence in relation to the operational realities of P-S transition and the case company provides a rich setting in which to address the research questions.

4.2 Research Design

We employ a multi-method research design, which is often referred to as triangulation. In our method we use qualitative interviews, analysis of texts, documents and secondary data as well as recording and transcribing of interviews and meetings (Dooley 2001). The logic behind using multiple methods is to provide a rich web of information to illuminate the PSS value propositions and how the firm is organised to deliver on these propositions.

The selection of key informants is critical to the process of identifying and describing the phenomenon under study. Employees involved in the delivery of equipment based services were selected, primarily from asset/equipment management and customer facing support roles. A number of customers of equipment based service were also selected. Such individuals are the best placed to provide insight into the value offering and organisational structures and processes of service delivery. A total of 28 in-depth interviews with employees and customers were conducted.

The interviews lasted approximately one to two hours. Each interview was audio taped and verbatim transcribed. The analysis of the data was driven by three explicit goals: First, to understand the product and service attributes that constitute the complete company offering. Second, to understand the value those attributes propose to the customer; and third, to understand and document the implemented operations design and processes and the roles that different actors took within the process. The validity of the present research findings was assessed by applying the techniques of triangulation and informant feedback (Miles and Huberman 1994). Firstly, the data was analysed by three researchers. Secondly, results of all three researchers were compared to identify areas of disagreement. To resolve any inconsistency the researchers conducted a participant workshop to gather informant feedback. The study's methodology and findings were presented during a workshop with four interviewees. Participants received a description of the results and were asked to comment on how well they reflected their experience and practice.

The interviews were supplemented with extensive reviews of archival data covering the last five years. This data included contract data, five years ERP data which provided data on for example, problem types, date/time of query, departments involved in dealing with queries and times of work begun and completed in each department. We were also provided with five years of detailed call centre data on employee grades answering the query and associated labour rates etc. In addition, we were provided with the customer's complete set of process maps and through a series of interviews we were able to challenge and amend these maps. For 3 of the attributes, where there was no existing map we had to develop and validate process maps.

5.0 Findings

5.1 Findings: 'What' are the value propositions offered by PSS strategies

Goedkoop et al (1999) break down the concept of PSS by defining *Product* as a tangible commodity, manufactured to be sold; *Service* as an activity, (work) done for others with an economic value; and *System* as a collection of elements. Thus, the value proposed is constituted by bundles of product and service elements. In other words product, service or supplier characteristics that the customer values (Woodruff and Flint 2003). Essentially, the customer wants those characteristics, termed as attributes, that in a particular use situation, brings consequences that are consistent with the goals and purposes he or she pursues (Lapierre et al., 2008; Woodruff, 1997), regardless of whether these attributes are delivered through a tangible component or human activity

Few PSS studies have sought to identify the attribute content of PSS offerings (for a notable exception see Oliva & Kallenberg, 2003). More often the offering is referred to along a continuum from pure product, to pure service without a breakdown of the composition. In addressing the first research question we set out to conceptualise attributes of PSS in the case organisation.

To identify attributes of the PSS offering verbatim interview transcripts from employee and customer interviews were cross coded with company documentation by three researchers. The analysis aimed to categorise and reduce the data to generic PSS attributes which constituted the complete offering of the case organisation. The researcher's results were compared and 17 attributes were identified. To validate these attributes and to ensure conceptual independence of attributes, informant feedback was sought. As a consequence, changes were made to labelling and

classification, the result was a consolidated set of 10 PSS attributes. The attributes are shown in table 1.

Table 1. Observed attributes of the case PSS offerings

	Product-Service Features	**Product-Service Feature Definitions**
1	Equipment Performance	The alignment of the equipment specification to the customer's desired level of economy, durability or other use-related performance measure.
2	Technical Query Resolution	The speed with which a technical query is resolved. .
3	Technical Variance	The issue of a technical variance to the original design specification of a piece part or a repair process to allow continued usage or repair of the equipment.
4	Equipment Repair Service	The fixing of a piece of equipment should it become out of order or broken
5	Equipment Maintenance Service	Performing scheduled or preventative maintenance.
6	Component Forecasting & Provisioning	Forecasting spares requirement to support a particular group of equipment and allow for timely provision of necessary parts.
7	Through-Life and Obsolescence Forecasting & Planning Recommendations	Forecasting and planning recommendations to maximise the potential usage at minimum cost over the equipment's life time. This would include the recommendation of solutions to minimise disruption at equipment end of life.
8	Capability Forecasting & Planning Recommendations	Advice on the optimal configuration of a group of equipment to ensure maximum equipment availability at minimum cost.
9	Equipment Operating Advice	Advisory service on how to operate the equipment to maximise performance and longevity.
10	Equipment Configuration Advice for Operational and contextual Capability	Advice on the optimal configuration of a group of assets for example, specific operational requirement in a specific context to achieve a specific task.

Whilst recognizing that identifying attributes of PSS is context dependent, they do provide insight into the composition of the PSS offering and its value proposition to the customer. They also provide the basis upon which operational design for delivery of the attributes can be explored.

S-D Logic proposes that the company cannot deliver value, but only offer value propositions for co-creation with the customer (Vargo and Lusch, 2008). Superior value propositions therefore should be relevant to the company's target customers and if accepted by the customer, should result in greater opportunity for the co-creation of benefits that facilitate a customer's desired end goal. In order to understand the value proposed to the customer through the offering of these 10 PSS attributes a second level of analysis was conducted to uncover the theoretical abstractions of the 10 attributes

To identify the value proposed to customers through the PSS attributes, verbatim interview transcripts from employee interviews were cross coded with customer interviews again by the three researchers. The data was abstracted to generic sets of categories, which were crucial in describing the value proposed to the customer. The researchers' brief was to code and categorize for the purpose of theory building and knowledge transferability. The content validity of the characterization of the value propositions was addressed through triangulation and informant feedback (Miles and Huberman 1994). First, results of all three researchers were compared to identify areas of disagreement. All three researchers consistently identified four cycles of value delivery. However, differences existed in terms of (1) the labeling of each cycle and (2) the categorization of service attributes within the value cycles. Second, to resolve any inconsistency in labeling and the correct assignment of service attributes to the three value cycles the researchers conducted a participant workshop to gather informant feedback. The findings were presented during a workshop with four interviewees. Participants received a description of the value results and were asked to comment on how well they reflected their experience and whether they recommended changes. Minor amendments to the labels were made. Each of the four value propositions identified (see table 2) represents a group of product-service attributes that collectively propose value to the customer.

Table 2. The four Value Propositions

Value Proposition	**Attribute**
Asset	Equipment Performance
Recovery	Technical Query Resolution
	Technical Variance
	Equipment Repair Service
Availability	Equipment Maintenance Service
	Component Forecasting & Provisioning
	Through-Life and Obsolescence Forecasting & Planning Recommendations
	Capability Forecasting & Planning Recommendations
	Equipment Operating Advice
Outcome	Equipment Configuration Advice for Operational and contextual Capability

The Asset Value Proposition

The first value proposition is offered by the product itself, specifically, the value of the product is in its performance in any given use situation. Different performance parameters are valued by customers for their ability to facilitate certain consequences in use situations that help them achieve their goals. The following passage taken from an interview with a client account manager illustrates this point:

> 'For the (*equipment operators*) satisfaction means an (*asset*) which produces the best level of performance in whatever circumstance they're trying to (*operate*) in'

The asset value proposition is essentially the pure product offering. Traditionally the value offered by equipment manufacturers' has been in the tangible good that is the equipment was offered to the market for customers to realise their own value. Thus, benefits are achieved by the customer with little or no input from the provider. As a consequence, the customer values the potential performance of the asset that will be experienced in use and will facilitate achievement of their end goal.

The Recovery Value Proposition

The second value proposition is the recovery value proposition. The attributes which constitute this value proposition follow the traditional equipment support model and would normally be offered as part of a Repairs, Spares or Post-Design Services contract (Hockley et al, 2010). Like the asset value proposition, here the use of equipment is carried out by the customer independently from the firm that manufactured it.. Value is co-created in the provider's ability to recover the asset quickly to a serviceable state. The following passage from an interview with an Equipment Programme Manager illustrates this point:

> 'We get a lot (*of requests*) in on the basis of the (*equipment*) being (*inoperable*). So they're (*the Customer*) in a critical position. "Can you turn this around in a very short time frame?" When we do that, the response you get is, is very, very positive ... because, you know, without that piece of advice they can't (*use*) the (*asset*). So it becomes critical to, to their (*operational*) success.'

The Availability Value Proposition

The third value proposition is the availability value proposition. This ensures equipment is serviceable and available for customer use. To do so, the firm must consider the customers life-time maintenance and operation of the equipment. This is illustrated in a discussion with a Client Account Manager on the difference between traditional equipment support models, for example repair only contracts, and the way in which practices to support availability contracts have changed practice:

> 'You can control the quality of (*the asset*) as it leaves the factory gates, you couldn't control the quality of it as it was in service. So, to an extent, we've actually got more control now than we previously had because when you're in the situation when you deliver a product… it goes into the customer's organisation and the gates swing shut and we're not allowed in, the quality of that product in operation is, or was to an extent, dependent on the customer's maintenance and management of it.'

In the recovery value proposition the use of equipment is conducted by the customer completely independently of the manufacturer. In contrast, the availability value proposition maximizes potential usage of the equipment, therefore supporting the customer's use of equipment for achievement of their goals. The attributes which constitute this value proposition are often part of an availability contract, where customers pay only when the equipment is in use.

The Outcome Value Proposition

In addition to offering recovery and availability value propositions, analysis found attributes which go beyond availability to facilitate effective use of the equipment, supporting the customer in achieving their own goals. The use of equipment to achieve goals is conducted by the customer in coordination with the firm that manufactured it. Thus, the firm is taking into consideration the customers need for their equipment and the way it is used to deliver to an operational goal. Moreover, they consider how the customer operates the equipment in a use context to achieve those goals. This is illustrated in the passage below, taken from an interview with an Asset Manager:

> 'You can say "right, the serviceable assets – I could take that assembly, that assembly and that assembly and build an (*asset*) good for *(a certain performance)* and send it to (*achieve this goal*). It probably will get to (*the performance level*) but not much further. So you can start doing selective builds and selective usage of the assets'

The outcome value proposition as a result is intervening to support a customer's capability to achieve a desirable outcome:

> 'The intention (*is*) that what the (*provider*) delivers is either zero failure in terms of (*operational*) outcome or minimising the impact on (*operational*) outcome. And that's a consequence of having the best products at delivery and the best service, such that you manage the volatility.'

Based on our findings we offer the following research proposition.

> ***Research Proposition 1:*** P-S transitions include a transition to a combination of four core value propositions to the customer; asset value proposition; recovery value proposition; availability value proposition; outcome value proposition.

5.2 Findings: 'What' are the implications of PSS value propositions for operations design?

In addressing the second research question, we focus on the implications of these four value propositions for operations design. In doing so it is important to recognise that whilst the service mindset driving P-S transition enables firms to gain deeper insights in to what customers' value (Tukker, 2004), customer value creation is co-created in use. In other words, it is the consumption experience that defines what is valuable to a customer.

Payne et al (2008) discuss forms of encounter, or consumption experience, such as usage encounters which facilitate value co-creation. Here, a usage encounter refers to those customer and company practices that support use of the product or service. Given that value is created in the use

encounter, situational or contextual conditions of that encounter could affect the co-creation of value (for literature on situational and contextual value see Beverland et al, 2004; Flint et al, 2002; Lemon et al, 2002; Lapierre et al., 2008). Palmetier (2008) state that contextual variables may stem from multiple levels for example from the physical environment, from industry and/or from the customer themselves. In an equipment usage encounter there are a number of contextual factors affecting value creation, for example, factors relating to the provider, the customer (e.g. customer goals, user behavior, equipment knowledge etc) and/or the physical conditions of the equipment use environment etc that will create variety. Contextual variety takes its theoretical foundation from state dependent utility. State dependent utility is a term in economics commonly used in situation in which the state of the world affects how well individuals are able to enjoy the consumption of a product (Cook and Graham, 1977; Karni, 1983; Ng, 2007). State dependent utility has had a huge following in pricing literature, where traditional concepts of utility were closely related to exchange value. However, state dependent utility does not merely impact on exchange value (price) it also has an impact on value in use in so far as the context of use might have changes in the state of the world that could disrupt or enhance the individual's valuation of the product (Ng, 2008). The impact of state dependence on value in use we term here as contextual use variety.

The product to P-S transition is often characterized by a move from a pure product offering, where firms are paid for the asset, to a function orientated offering where firms are being paid directly for achievement of results or customer goals. As a result, the customer's use activities and indeed the context within which the equipment is being used is stipulated within the contract. Traditionally, in an asset or recovery value proposition, characterized by product support contracts, variety in the context of the customer's use of the equipment was not a consideration of the firm, it is the customers concern. However, as firms make the P-S transition variety from the contextual conditions of equipment use becomes a factor in achieving the outputs of the contact. We have found evidence that as the case firm transitioned from the a traditional repairs contract, to an availability contract, contextual use variety becomes of increasing importance. In the following passage taken from an interview with an Equipment Programme Manager it is evident that the company is now incentivised by the contract to work with the customer to understand their use of equipment:

> '(*in availability contracts*) the customer tends to be located here with ourselves; we're working together… we go in and say "right, I don't want that (*asset*) coming (*inoperable*). What are the top ten reliability items that are going to break in that (*asset*)? What are we going to do about them? How can we as (*the provider*) invest in them to make sure they don't happen?" … Because I don't want that to happen – I want an (*asset) (in use*) as long as I can because every (*unit of use*) I get paid for'

What this suggests is that when equipment use is the unit by which a firm contract, as is the case in an availability contract, customer use of the equipment and the context in which they use the equipment is a factor in the achievement of the contract. As a result, the firm requires a greater understanding of the customers use environment.

Oliva & Kallenberg (2003) discuss this variety in terms of increased operating risk for the firm. They suggest that in the product to service transition, the "pure service organization" assumes risk incurred by taking entire responsibility for the end-user's process. This move they argue is a largely uncharted territory. In the following passage a Company Service Manager discusses a shift from availability contracts to capability contracts, which propose outcome value. In this discussion they acknowledge the increase in business risk; they also equate this increased risk to variety in customer goals:

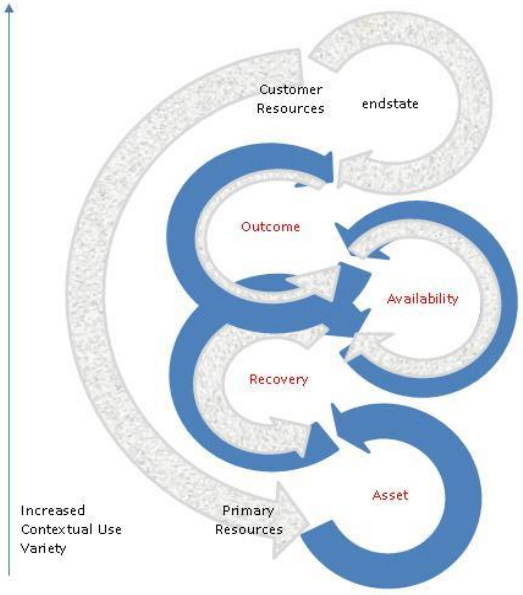
> '(*Capability contracts*) includes a lot more than any of the (*repair contracts*) or (*availability contracts*) do. It takes a lot more of the risk from the customer; it takes on a lot more things that the customer used to do. (*Our equipment market*) is considered to have a wide range of operating types for a (*product*).'

We find that in the case organisation a shift from repair to availability contracts introduced increased variety in to the company's system from the context in which equipment was being used by the customer. We also found that in a further P-S shift from an availability value proposition to an outcome value proposition incurred additional variety due to the complexity of equipment use for the achievement of customer goals. As such we put forward the following research propositions:

Research Proposition 2a:
As a firm transitions from product to product-service contextual use variety increases.

Research Proposition 2b:
Resources to absorb or attenuate contextual use variety in P-S are both customer and firm human resources

Figure 2. The Closed Coil Value Co-creation Service System with firms' value propositions



As the case organisations transitioned from product to product-service and as a consequence of exposure to variety in the customer's equipment use context we found evidence of the increasing use of the customer as a resource in the delivery of outcome and availability value propositions. For example, in offering an availability contract based on equipment use, the case firm is required to maintain a volume of equipment ready for use at any one time. In a discussion with an Asset Manager on maintaining this equipment level, the Asset Manager suggests that the customer and company share material resources:

> 'Sometimes we're using his assets as well. So if he's got assets in store then we request that we have those parts to use in his (*assets*). We've also asked for our customers whether we can buy some of his stock.'

Furthermore, it is evident that the case company requires customer information in order to co-create availability value propositions. The following passage taken from an Asset Manager discussing a potential move from a repair contract to an availability contract, illustrates how vital customer information is:

> 'At the moment, I don't know what (*the potential customer*) is doing in terms of (*equipment use*). I don't know where they're going and what they're doing with it; whether it's a (*difficult physical*) environment or whatever. So, for me to take the risk, I'd have to know what they're doing with it. How many hours they're (*operating*) it and what their plans are for it longer-term and also some records of the history of each of the (*assets*).'

In addition to the sharing of materials and information between company and customer in order to co-create availability value there was also evidence that the company was managing customer behaviours. When an Equipment Programme Manager was asked if they manage the way customers use their equipment, the response was:

> 'there's much more of a proactive approach… we've now changed … it's in our interests for nothing to break, so we are much more proactive in terms of making sure that nothing breaks and keeping things (*operable*).'

We find that the case organisation requires customer materials and customer information to co-create availability value propositions. We also find that variety in the customer's environment and use of equipment requires the company to manage operating and maintenance behaviours. As a result of these findings we suggest the following research proposition:

***Research Proposition 3**:*
Delivery of availability and outcome value propositions requires customer resource integration.

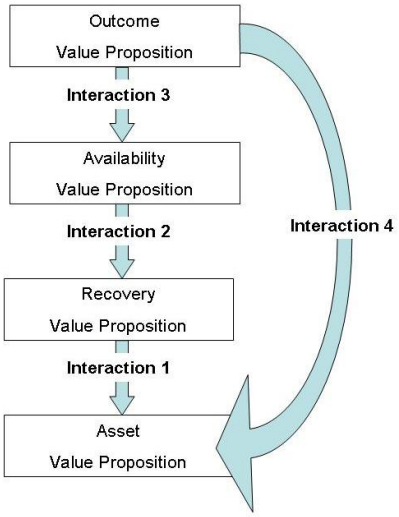
In further analysis of the archival data and employee interviews we found evidence that the value propositions are interdependent. Specifically, within the case organisation we observed interactions between each of the four value propositions (see figure 3). Notably, as the case organisation transitioned from asset value proposition based on a pure product offering, to an outcome value proposition based on capability contracts, there were interactive affects. For example, when the case organisation offered outcome value propositions to customers, there were two resulting affects. The first interaction occurred between the outcome value proposition and the availability value proposition (interaction 3, figure 3). Here, we found that contextual use variety had an impact on predetermined spares and asset levels. Use variety towards customer goals increased the risk of asset availability since it was not clear if predetermined spares and component levels were adequate for the new contextual states. The following passage taken from an Asset Manager illustrates how knowledge of customer goals and the necessary use of equipment to support these goals has an impact on the working asset level needed to maintain a certain level of equipment ready for use at any given time:

> 'Working Asset Level is how many (*assets*) you need to cover that (*asset*) rejection level. Because there's always a rejection level, combined with how many you need for (*operating goals*)? So, (*the equipment*) go abroad on the back of a ship for two months; that ship is completely unreplenishable so, whereas you might need, say, four (*assets*) to support your (*equipment group*) – actually you need six – because those two need to be on the ship for two months.'

The second interaction was found to exist between the outcome value proposition and the asset value proposition (interaction 4, figure 4). The outcome value proposition requires an understanding of customers equipment use for the achievement of their goals. When answering a question on whether the company would completely change the specification of an asset to suit a customer's operational goals, an Equipment Programme Manager discusses customer goals and use conditions and links them back to asset design:

> 'I think it depends on what you're trying to do with your (*equipment*). So, in certain conditions (*piece of equipment X*) will do what you need to do. If you want to (*achieve a goal*) in very treacherous conditions like (*environment Y*), then it's going to be very difficult to (*operate*) that (*asset*)…because the (*asset*) is limited to what it can do…. (*Its*) expensive concept because things like that have got fairly rigorous testing procedures, which don't come cheap. You can't just have an idea tomorrow and just introduce it because you don't standardise it across the (group of assets), you've got to understand the impact it's going to have; to the way the (asset) works…I think we do elements of that but perhaps not to the grandest scale... we add additions … and I think some of the things we've done to (asset a) over the last four or five years have given it extra life but there's a limit to how far you can take it.'

Figure 3. Value Proposition Interactions



These interactive affects were found throughout transition. Supporting evidence for each of the interactions is provided in table 3. In light of these findings we suggest the following research proposition and conceptualise the four value propositions as interactive cycles in figure 2.

Research Proposition 4:
P-S value propositions are interdependent

To explore the implications of each of the value propositions on operations design we have used the service systems framework proposed by Buzacott (2000). A central part of the Buzacott work is the attributes of individual jobs (Rolfe, 1990) which has two dimensions;

- Technical complexity, this includes the complexity of the task, the knowledge required to do the task and the range and variety of the tasks
- Discretion, this includes the workers element of choice and their ability to exercise judgment in carrying out a task.

Using these dimensions Buzacott (2000) identified three different types of task design where there is no discretion i.e. where customer requirements are known by the organization;

1. Parallel, where the worker is able to do all the tasks required by the customer
2. Series, multiple workers perform separate tasks
3. Specialization, this is where the customer chooses from a menu item and there are different workers for different menu items.

Where customer requirements are unknown by the organization this could be met by either parallel (one worker does all) or series (the customer's information is passed between workers) or in a simplification of the process design it can be achieved by an additional 2 types of structure;

4. Bottom –up, where the complexity of the diagnosis increases, as for example in first, second, third levels of expertise in a call centre
5. Top-down, where the complexity decreases after an initial diagnosis by an expert.

In our case we observed different degrees of task discretion based on the value proposition. For example, some technical queries are dealt with relatively easily because they are repeats of queries from previous customers. However, other technical queries are more complex, require additional calculations and are dealt with by on-site maintenance engineers. Others are even more challenging and require new knowledge; these are passed to specialist functions. Conceptually, there are strong echoes here of Parnaby's (1988) well known framework of runners, repeaters, strangers.

Using the analysis of archival data including process models of the companies service delivery process models we apply Buzacott's (2000) model to our data and develop the following table used to summarise our findings:

Table 3

Value Proposition	**Attribute**	**Process Design**	**Explanation**
Asset	Equipment Performance	Series,	Equipment is produced to a customer specification agreed in advance with the customer, multiple workers perform separate tasks.
Recovery	Technical Query Resolution	Bottom-up,	Customer requirements are unknown the complexity of the diagnosis increases.
	Technical Variance	Bottom-up	Customer requirements are unknown and complexity increases
	Equipment Repair Service	Parallel or Series	Customer requirements are unknown and equipment might pass between various workers all be repaired by a single worker.
Availability	Equipment Maintenance Service	Series	Customer requirements are known in different workers perform separate tasks.
	Component	Top Down	Customer requirements are negotiated

	Forecasting & Provisioning		with senior staff and complexity decreases as it passes down the organisation hierarchy.
	Through-Life and Obsolescence Forecasting	Top Down	(As per component forecasting)
	Capability Forecasting & Planning Recommendations	Top Down	(As per component forecasting)
	Equipment Operating Advice	Top Down	(As per component forecasting)
Outcome	Equipment Configuration Advice for Operational and contextual Capability	Top Down	Customer requirements are negotiated with senior staff and complexity decreases as it passes down the organisation hierarchy.

We can observe that as we progress through the value propositions the process design becomes more orientated around individual expertise and less amenable to structured design. It is noticeable that Buzacott (2000) suggest that it is *necessary* (our italics) for the bottom-up structure to be designed prior to the customer's input into the system, whereas top down structures can be modified after each initial expert assessment. It was evident from our interviews that initially technical query resolution and technical variance were ad-hoc in design. Queries came in to account managers who identified suitable 'experts' as the situation demanded. This was often done on the basis of personal contacts and owned little to formal design. Subsequently, the ad-hoc nature of this process has been addressed. The current situation has queries handled by a team of first line experts who have a clear process routing for subsequent expertise. The customer query is initially handled by a worker who filters out calls so that the second and third level only receives complex queries. This has necessitated the development of a set of knowledge management databases which are structured in such a way that 'like queries' can be quickly identified and solutions provided. This formalisation has significantly lowered the cost of query handling. In the following passage an Account Manager discusses the change in structure and the resulting change in customer relationship from personal one-to-one to a call centre structure:

> 'I think the (*call*) centre does what it does well… more and more requests are being put through the (*call*) centre which … a question comes into the (*call*) centre, can they answer it quickly within their remit, within their scope? Yes or No? Yes, then it stays within there and then they'll raise whatever paperwork that's needed. It goes to the Specialist areas, gets signed and comes back out within 24 hours to three days, depending on the complexity'

Other attributes continue to be addressed through a series design as in planned and scheduled maintenance or in a top down unplanned design. Top down design predominates because of the nature of the task. For example, component forecasting is an attribute required by the customer but is often unique to that customer. This is initially handled by an expert who discusses the customer's needs and then passes on specific requirement to specialist supply chain planners.

Research Proposition 5

Service process design varies according to the PSS value proposition(s). Lower level propositions have a more structured process design than higher level propositions.

6.0 Implications for theory

In addressing our research questions, we have made a number of findings; the identification of 10 attributes and their consolidation into four nested value propositions, the role and importance of contextual variety as we move through the value propositions, the interdependencies amongst the value propositions and the differences in operational design for each value proposition.

Specifically, in responding to the challenges presented by Pawar et al (2009), we have defined four value propositions, identified in more detail some of the challenges in the design of the internal

operational system to deliver these value propositions and explicitly considered the customer as part of the network of partners necessary to co-create and realise the value proposition in use.

In characterising the value propositions our research advances PSS literature. For example, there are similarities with Tukker's (2004) model however, we have uncovered interactions between the value propositions that suggest that Tukker's (2004) model may be only valid in cases where there are simple loosely coupled interactions between activities and assets. This is often not the case in complex equipment provision. In addition, we show how a service dominant logic approach in PSS is able to liberate the domain from a G-D Logic, that is encumbered with goods-laden frameworks that are less effective in understanding service.

Our model takes on a Service Dominant Logic approach in two ways that progresses the PSS literature. First, we consider the value propositions not according to 'product' or 'service' but in terms of how resources (both material and human) are optimally designed, 'manufactured', or configured within the value propositions to co-create value with the customer. Thus, we take 'product' as an indirect service provision (S-D Logic FP3) and align the resources for the product as well as the human activities towards value propositions that are better able to co-create value with the customer. Within this perspective, tangible products and intangible activities have an equal role. Rather than activities being viewed as 'supporting' an asset, this study has shown that the asset itself could require redesign for more scalable and efficient activities.

Second, we illustrate a value co-creation system of nested value propositions which, if not provided by the firm, would still require customer resources to achieve. These are depicted by the grey arrows in figure 2. The arrows show that the provision of an asset value proposition would require the realisation of the proposition through the customer's own resources to achieve the same contextual outcomes. In doing so we illustrate the combinative and substitutability of both firm and customer resources to achieve the outcome. We consider that such a framework is more meaningful for the business community to provide insights into where innovation and business models of the future might sit. This framework is also a response to the call from Johnstone et al (2009) for a greater customer orientation.

Finally from a S-D Logic lexicon perspective, and given the implied exogeneity of product design within P-S-S, we would suggest the abbreviation of the PSS term to SS - service system where the product is the indirect service provision and service is defined as competencies for competencies (Vargo and Lusch 2004; Lusch and Vargo, 2006c, p. 410). Our study also contributes to S-D Logic literature to show that customer resources and contextual outcomes would interact directly with the design and resource requirement in manufacturing the asset itself. Returning to Neely (2008) and the failure of some firms to servitise, our study that shows the interdependency of the various value propositions implies that such a failure could be attributed to (a) configuration of human activities (the 'service'), as was implied but also (b) how the asset itself was designed and manufactured to support the human activities and (c) how the combination of asset and activities enabled co-creation by the customer and (d) failure to understand hyper-variety contextual outcomes by the customer that threatens the original asset and activity design.

In considering the implications for operations design we add to the PSS literature through the identification and consideration of the concept of contextual use variety. Contextual use variety recognises the different conditions under which the equipment may be used. This has a significant impact on the operational system as the firm transitions through the value propositions. Variability into the service induced from the customer input has been analysed by Frei (2006). We suggest that contextual variety has not been adequately addressed in her five categories of variability; arrival, request, capability, effort and subjective preference variability. The concept of contextual use variability extends request variability (range of customer's inputs) through the recognition that not only might the range of customer's vary but the *same customer* 's requirements might vary and therefore the amount of variety to be dealt with by the producer systems is even greater than that envisaged by Frei (2006). Such *customer heterogeneity* implies that contextual use variety pervades through the co-creation system, challenging the boundaries of 'product' and 'service' in the resource configuration.

Where our model differs significantly from the existing PSS literature, it challenges the view that each of the main categories and subcategories of PSS represents a separate evolutionary state. In this we have addressed the call from Johnstone et al (2009) for more research on how the transition from product to service 'plays out in practice'. Our results provide a strong empirical example of an organisation that is simultaneously providing four different value propositions for the same product.

This contradicts the notion that an organisation moves through stages of PSS that is so prevalent in the PSS literature. Our case company has the challenge, of simultaneously delivering across 4 value propositions that are inextricably linked, this is a highly complex systems with many interactions.

Finally, our work extends that of Buzacott's (2000) modelling work by considering the determinants of service system design in services with high contextual variety. In his modelling of appropriate service designs Buzacott (2000) uses the arrival rate and co-efficient of variation between arrivals as determinants and his performance measure is average service time. In the situation where there is high complexity of diagnosis and service times (the majority of our attributes) he concludes that bottom up is desirable where one test can diagnose the problem, however the more complex that diagnosis becomes then the more appropriate is top down design. For example, he claims that equipment repair is often 'bottom up' in situations where sources of failure are easy to identify. However, our results indicate that equipment repair in the case company shows evidence of

- parallel design, where the problem is unknown, easily diagnosed and carried out by an expert in situ, it is noticeable that Buzacott (2000) does not include the notion of multiple server locations
- bottom up, where the problem is unknown and runs through a structured diagnostic processes which are more complex at successive stages
- top down, where the problem is unknown, an initial complex diagnosis is conducted by an expert who identifies the problem and passes it to the relevant workers.
- complex mixes of service delivery where an expert carries out the diagnosis and hands off to other experts e.g. controls, this is some 78% of our cases.

Our results suggest that in complex product service systems many customer inputs are unknown and the key phase is diagnosis of the customer requirement. We propose an extension of Buzacott's (2000) binary distinction between knowing and not knowing customer requirements. We consider that customer requirements can be divided into 4 categories based on the runners, repeaters, strangers framework of Parnaby (1988) and crucially adding a fourth category of 'unknowns' proposed by Godsiff (2009)

- Runners, where customer requirements are swiftly diagnosed and we know how to process them
- Repeaters, where customer requirements are diagnosed and have to be assessed prior to processing them
- Strangers, where customer requirements are diagnosed and assessed and some consultations (between experts) have to take place on how to process them
- Unknowns, where customer requirements are diagnosed and are completely unknown and the process to meet these requirements is unknown, but they are feasible.

This classification into 4 categories provides a more complete categorisation of types of customer input faced by our case company. It recognises that the determinant of appropriate service design in complex service systems may not be arrival variability but request variability (Frei, 2006) and recognises the much greater degree of unknowns in complex service systems where the process of diagnosis is of such critical importance.

7.0 Implications for management

Our research has indicated the complexity of the transition from product to service. Specifically, through the identification of the 4 value propositions we have provided evidence that even organisations that have been transitioning for some while cannot simply see service as a bolt on extra to their product offering. For those firms that are new to servitizing or who are still developing their offering, our findings indicate the extent of the challenge that faces them. Crucially, as the value proposed to the customer changes, this changes the core offering and firms need to consider the implications for their resources and the competences of their staff in relation to the specific skills that they bring in delivering the value propositions. These are not going to be just the traditional competencies and knowledge that underpinned the development of the organisation as a goods producer, these will reflect different knowledge bases (eg in our case supply chain optimisation and modelling) and the softer skills associated with customer contact including the environment of the service encounter.

Also, because the different value propositions are interactive they cannot be optimised discretely. This calls for managers to take a systems perspective on their value propositions, recognising that changing delivery of one value proposition can have unintended consequences in another value proposition. Delivering higher order value propositions is dependent on performance on lower order value propositions, indeed these lower order propositions may become order qualifiers, however performance on them cannot be ignored or assumed to be routine else the customer will not contract for higher order value propositions.

Finally, the implications of contextual variety will impact on service delivery. For example, higher levels of variety will need to be matched in the delivery system with considerable implications for resource flexibility Our case evidence suggest that some of this contextual use variety might be mitigated through consideration of the customer as employee. However, where this is not possible the processes of delivery will need to be flexible with the implications of higher cost of delivery as flexibility often includes some degree of redundancy. Designing the delivery system for the requisite amount of variety is such dynamic environment requires considerable expertise.

8.0 Conclusions

Our study identified 10 attributes in four nested value propositions for the phenomenon of 'servitization' that serve to enable the co-creation of value with the customer. From the analysis of findings from our case company we have we have identified 5 research propositions; that the 10 attributes can be combined into 4 value propositions, that as forms move through these value propositions contextual variety increases, that the resources necessary to absorb this contextual variety can be based in the firm or the customer but higher level value propositions require some integration of customer resources and finally that lower level value propositions are more amenable to structured design than higher level value propositions.

Our findings emphasise the impact of contextual use variety as we move through the value propositions, the interdependencies amongst the value propositions and the differences in operational design for each value proposition. We propose that contextual use variety poses a challenge to the firm in terms of delivering the value propositions and integrating customer resources and even to the extent of prompting a redesign of the asset. Through a service dominant logic approach, we consider the value propositions not according to 'product' or 'service' but in terms of how resources (both material and human) are optimally designed, 'manufactured', or configured within the value propositions to co-create value with the customer. Our findings suggest an alternative approach towards 'servitization' as value propositions are manifestly interdependent.

These findings reflect the challenges facing organisations managing complex systems. Complex systems by definition have more interacting elements and we suggest that they have to simultaneously provide for the customer, use, recovery, availability and outcome. Each of these value propositions if managed separately would already be a challenge; together they call for systems level management methods with an emphasis on variety management. The route from design and manufacture to a full service organisation requires a theoretical understanding of the phenomenon to inform its practice. Our study aims to contribute to the knowledge needed for manufacturers of the future to compete in the service economy.

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