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Servitization and Operations Management: A Service-Dominant Logic Approach

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The Service Systems research group at WMG works in collaboration with large organisations such as GlaxoSmithKline, Rolls-Royce, BAE Systems, IBM, Ministry of Defence as well as with SMEs researching into value constellations, new business models and value-creating service systems of people, product, service and technology.

The group conducts research that is capable of solving real problems in practice (ie. how and what do do), while also understanding theoretical abstractions from research (ie. why) so that the knowledge results in high-level publications necessary for its transfer across sector and industry. This approach ensures that the knowledge we create is relevant, impactful and grounded in research.

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- Viable Service Systems and Transformation

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Introduction

Managing organisational performance in sectors such as equipment provision has become increasingly complex as competition has heightened and firms have felt pressure to add value through the provision of services (Baines et al, 2007; Howard and Caldwell, 2011; Neely et al., 2011). This provision is commonly referred to as the servitization of manufacturing (Vandermerwe & Rada, 1988). By extending the traditional offering of equipment to include service activities however, underlying operational delivery systems and processes have become more complex to manage and co-ordinate. No longer are firms simply making and shipping products; they are now engaged in a more complex world of design and delivery (Neely et al., 2011). This study aims to explore servitization from a value perspective through the lens of Service-Dominant (S-D) logic, and to propose its implications for operations management.

Servitization has been generally covered in the manufacturing, mainstream engineering and management literature (Neely, 2008; Baines et al., 2007; Vandermerwe & 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 impact of "servitization" on manufacturing industries (e.g. Neely, 2008). Neely (2008) provides empirical evidence that despite an increase in organisations throughout the world adding services to their core offerings, servitized firms often generate lower net profits as a percentage of revenues compared to pure manufacturing firms. Neely (2008) attributes this to the organisational challenges resulting in inevitable changes to value propositions that servitization entails. This is echoed throughout discussions in literature, which 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). They recognise the need to explore the operations management implications with a customer orientation (Johnstone et al., 2009), with many using the S-D logic (Vargo and Lusch 2004; 2008) as a lens through which to make this exploration (Pawar et al., 2009; Macdonald et al., 2009).

This study aims to address the call from the operations management community for further investigation of the transition from product to service through an S-D logic lens (Pawar et al., 2009). In addressing this call, we take a customer-oriented approach by exploring the change in the firm's core business offering as changes in the value proposed to the customer. We also 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 (PSS) literature with particular focus on the issues of managing operations. Section 2 considers the insight provided by S-D logic and the co-creation of value between producer and customer. Section 3 draws on the PSS work of Pawar et al (2009) and Johnstone et al (2009), further interpreting them work through the S-D logic lens. Through this, we identify two research questions: What PSS value propositions are offered throughout the Product-Service (P-S) transition, and what are the implications of such 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 sections 6 and 7, the implications of these findings for the literature on PSS are discussed.

Product-Service Systems

The servitization phenomenon that has pervaded manufacturing has resulted in organisations offering complex packages of both product and service to generate superior customer exchange value and thus enhance competitive edge. In the PSS literature, servitization is referred to as the Product-Service (P-S) transition and represents the transition between pure product to pure service offerings (e.g. Oliva and Kallenberg, 2003; Pawar et al., 2009; Tukker, 2004). Within this transition exists combinations of products and services known as Product-Service Systems (PSS). PSS studies appear in the literature of several 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 approaches and aims differ. While some researchers refer to PSS as a "value proposition" (Tukker and Tischner 2006), others see it as an "innovation strategy" to remain commercially competitive (Manzini and Vezzoli 2003). 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).

While PSS research evolves from varying perspectives and motivations, there are a few common themes. First is the common understanding that the provision of services plays an important part in GDP growth of most industrialised economies. Traditional manufacturing firms are discovering that their revenues are dominated by their service offerings compared to their 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 could change how firms produce and customers consume. The underlying assumption is that the customer's value of a product could lie in the benefits they attain from the product instead of product ownership, suggesting that the provider could shift focus from the means of achieving such benefits (the product) to the benefits themselves.

One of the contributions arising from management research in PSS is the categorisation of different types of PSS models. Such a classification of PSS falls 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, where ownership of the "material product" is retained by the service provider who sells the "function" of the product to the customer, such as leasing of office equipment; and (c) result-oriented services, where 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) expands on these generalised PSS models by presenting eight sub-categories of PSS within the spectrum of pure product to pure service (see Figure 1). Tukker argues that as the core offering of PSS decreases in its reliance on the product (left to right), the needs of the customer and opportunities for determining the true benefit for the client increases. However, he warns that due to the complexity of PSS types, benefits become more abstract and it is often difficult to translate them 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.

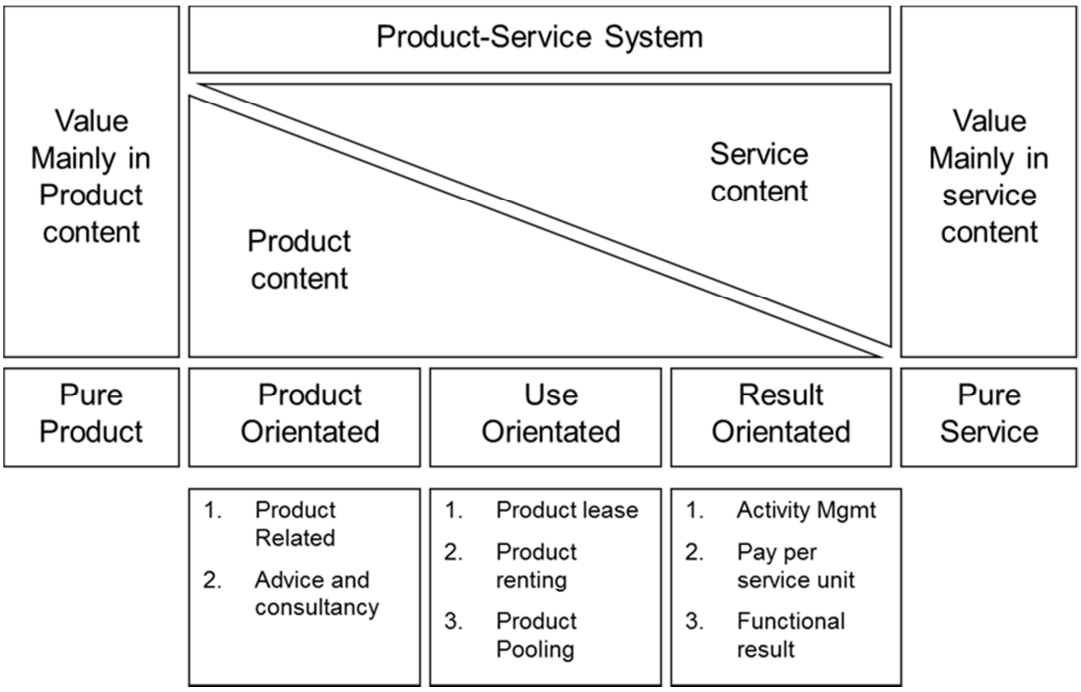

Figure 1: Main and subcategories of PSS, Tukker (2004)

There has been considerable attention given to the increasing complexity inherent in the P-S transition. For example, complex product systems (CoPS) literature considers the complexity involved in high-cost, engineering-intensive products due to high numbers of customised components, the breadth of the knowledge and skills required, and the extent of new knowledge involved in development and production (Acha et al., 2004; Hobday, 1998). Clearly, these complexities are inherent in PSS as well as CoPS. However, Howard and Caldwell (2011) propose that additional complexities are introduced when service is integrated with the product system, which they refer to as complex product service (CPS). Howard and Caldwell (2011) suggest that CoPS is 'a subset of projects concerned with the development, manufacture and delivery of capital goods' (Davies and Hobday, 2005:22), while CPS speaks to whole life issues of complex projects including downstream services, which require co-creation with the customer. In this respect, PSS or CPS offerings extend the CoPS concept by recognising the increased complexity due to the longitudinal nature and requirement for closer collaborative behaviours between buyer and seller in hybrid product service offerings (Howard and Caldwell, 2011). Similarly, Neely et al (2011)

recognise value-in-use, co creation of value and timescale as key features of complexity in PSS and add to the list product extension, capabilities, competition, networks and partnerships, financial flows, contracting, risk, the transformation journey, and technological complexity. They propose that the P-S transition makes the underlying operational delivery systems and processes more complex to manage and co-ordinate (Neely et al., 2011).

Operations Management of PSS

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 into operations management issues related to the transition itself is lacking. In particular, research is needed in the design and delivery of these P-S combinations.

In managing the inherent complexity of CoPS, Acha et al (2004) and Hobday et al (2000) refer to Woodward's (1965) project and small batch production designs, which have been found to be equally as applicable to the wider PSS context (Salonen, 2011; Turunen, 2011). However, both Salonen (2011) and Hobday et al (2000) raise the issue of scalability, an important issue given that production and delivery processes must be efficient as well as effective in PSS (e.g. Salonen, 2011; Ulaga and Reinartz, 2011). As a result, Salonen (2011) identifies three critical challenges; organisational culture, external effectiveness at the customer interfacing 'front office' and achieving internal efficiency of operations at the 'back office'. However, Johnstone et al (2009) note that the problem was not merely one of developing effective service, but of actually integrating service and production operations.

Given these complexities, this paper draws upon the service systems design framework proposed by Buzacott (2000), which incorporates both product and service design principles. Using the framework developed by Rolfe (1990), Buzacott identifies different types of task design, taking into consideration whether the customer requirements are known or unknown. Where requirements are known, designs span the spectrum from one worker performing all tasks through to multiple workers performing differentiated tasks. Where requirements are unknown, he distinguishes between designs which depend on the positioning of the diagnosis phase. Crucially, this work extends beyond description to a theoretical modelling of the criteria under which each design choice would be optimised.

In addition to complexity in operational design, Johnstone et al (2009) recognise that central to transition is the need for a more proactive customer orientation. They acknowledge the challenge of '*seeing value through the eyes of the customer*', and suggest that this orientation presents implications for operations management areas 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 S-D 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.

The above discussion illustrates that PSS aims to rest on a foundation of what a customer values. To this end, Baines et al (2007) define PSS as "*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. Therefore, current academic literature suggests that one of the biggest challenges facing the P-S transition is a change in mindset from the understanding of value as that created in the production and exchange of goods, to one in which value is attained from the use of an offering aimed at achieving customer goals. The following section considers insights from the S-D logic used as a lens through which to examine this change in mindset.

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

Traditionally, creating customer value has focused on customer needs, satisfied predominantly through the manufacturing of products. Over recent years, the concept of P-S transition has increasingly evolved to value created in the function and use of the product provided rather than in its ownership. Whilst PSS recognises that customer value is achieved through use, much of its development has been achieved 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 it 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).

G-D logic views servitization as the phenomenon of manufacturing firms 'adding value' through the provision of service. Yet, the literature often equates the idea of 'adding value' to achieving higher exchange value i.e. the revenue obtained from the exchange of a product. For example, Tukker (2004) suggests that by 'adding' value through service, the client may be willing to pay more. However, exchange value only represents one part of the value creation process in PSS. For example, Lapierre (1997) shows that value created during exchange transactions represent only one level of the service value proposition, while a second level is created after the exchange is complete, that is value-in-use.

Seminal papers on S-D logic by Vargo and Lusch (2004, 2008) propose that value is achieved from the integration of skills and knowledge, termed as operant resources, that operate on each other or on operand resources (such as a product) to achieve value-in-use. Consequently, whether benefits to customers are attained through tangible products or human activities, a customer-focused orientation would focus on value-in-use from the outcomes enabled by product or service activities.

Recent research into PSS has seen a step towards adopting an S-D logic perspective. Notably, Pawar et al (2009) 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, we argue that Pawar et al (2009) have not fully captured the essence of S-D logic, particularly in the conceptualisation 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.) S-D logic proposes that a firm can only offer value propositions, and its realisation can only be through co-creation with the customer. Therefore a firm cannot 'satisfy' a customer; they can only collaboratively support value co-creation.

The foundations of PSS recognise the concept of utility, but we argue that they do not fully comprehend the conceptual difference between utility and value-in-use. Utility is seen as a G-D 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 be they direct (human activities) or indirect (through product) and the latter through its realisation of the propositions. So a firm's offering is merely value unrealised i.e. a 'store of potential value', until the customer realises it in use through co-creation and gains the benefit (Ng and Smith, 2012). Value-in-use, as evaluated by customers, must therefore include themselves as active participants in the process and by logical argument, an evaluation of their own performance in the realisation of the value. In manufacturing terms, customers must learn to use, maintain, repair, and adapt the appliance to their unique needs, usage situation, and behaviours within their variety of contexts. Thus, value co-creation implies that customer resources to realise the value are also central to achieving end goals or benefits. For co-creation to be understood in the fullest sense, the customer's role in attaining benefits cannot be ignored, and researchers have to face the challenge of understanding customer consumption processes (Ballantyne and Varey, 2006; Ng and Smith, 2012).

Research Objective and Questions

Thus far we have reviewed extant literature on PSS and the subsequent research calls from operations management scholars to explore the implications of PSS for operations management through a customer-oriented approach. With the limitation of G-D logic, we propose the use of S-D logic as an alternative lens through which to explore PSS.

Research into the implications of the P-S transition for operations management seems 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). 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. First, the work of Pawar et al (2009) is extended by empirically investigating their first two challenges of PSS through an S-D logic perspective. Whilst Pawar et al's (2009) challenges are not directly translated into research questions, they are used as a frame through which to explore the implications of PSS for operations management. Thus, the 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?

In framing the research questions on Pawar et al's (2009) challenges, we therefore respond to Johnstone et al's (2009) call for a customer orientation in operations management of PSS. In exploring the P-S transition, an S-D logic view of value creation is adopted, providing 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 (Eisenhardt, 1989).

Research Method

Given that the phenomenon under investigation is in the developmental stages of research, and that case study is an appropriate research method for improving the understanding of operational issues (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Meredith, 1998), an in-depth exploratory case is used to point out factors that may be important in the P-S transition. The case study approach is also used to propose a number of propositions for future research (Eisenhardt and Graebner, 2007; Roth et al., 2008).

A degree of "purposeful sampling" (Patton, 1990) was employed to select a case organisation considered to be an exemplar in terms of P-S strategy. The case firm selected is a prominent UK Original Equipment Manufacturer (OEM) supplying durable capital equipment and service to a global market. Over the last five years, the firm's corporate strategy has evolved from excellence in manufacturing to include leading-edge use-orientated and result-orientated P-S contracts, and this has seen its service revenues grow by over 50% in the period. The organisation's use-orientated solutions include whole-life

support of equipment, performance indicators based on working availability of equipment, pricing based on equipment use and partial and non-ownership options. The firm is also moving towards solutions packages that offer an operational capability, more akin to a result-orientated PSS package. In these solutions, the firm contracts are based on operational capability rather than on specific availability of a piece of equipment. The extent to which the case firm has transitioned from pure product offerings to those designed for use and result-orientated PSS presents an ideal opportunity from which to investigate value propositions and operations design of those value propositions present in the P-S transition. Given these conditions, the case organisation should be considered an "extreme" or "deviant" case (Patton, 2002). As discussed, very few studies provide any empirical evidence in relation to the operational realities of P-S transition, and the case firm provides a rich setting in which to address the research questions.

A multi-method research design, often referred to as triangulation, is used to study the case organisation. Qualitative interviews, analysis of texts, documents and secondary data, as well as recording and transcribing of interviews and meetings are used (Dooley, 2001) 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. As such, key informants were identified with the help of a 'Project Champion' within the case organisation, and selected based on their ability to provide insight into the value offering and organisational structures and processes of service delivery. 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 services were also selected. Multiple respondents were sought to avoid subjectivity and bias as this technique allows the cross-checking of responses and the resolution of conflicting or inconsistent information (Eisenhardt and Graebner, 2007). The Project Champion introduced the researcher to most informants in person, and 28 in-depth interviews were conducted, each lasting between one and two hours. Each interview was audio-taped and verbatim transcribed.

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 problem types, date/time of query, departments involved in dealing with queries and times of work begun and completed in each department. Five years of detailed call centre data on employee grades answering queries and associated labour rates were also provided. Access to a complete set of process maps was also obtained, and through a series of interviews these maps were challenged and amended. For three of the attributes where there was no existing map, we had to develop and validate process maps.

Data analysis was driven by three explicit goals; to understand the product and service attributes that constitute the complete firm offering, to understand the value those attributes propose to the customer, and 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). To identify distinctive product and service attributes, grounded theory coding was used (see Strauss and Corbin, 1990). This began with three researchers independently undertaking

open coding to identify attributes mentioned within the transcripts. The results of the first step were then compiled and compared and a preliminary coding plan was jointly developed. The plan detailed 17 product-service attributes including labels, descriptions and examples. To validate the inclusion of attributes in the plan, three key criteria similar to those used by Tuli et al (2007) were employed: (1) Is the attribute applicable beyond a very specific context?, (2) Did multiple participants mention the attribute?, and (3) Does the attribute go beyond the obvious to provide interesting and useful conclusions? Through this step, researchers reduced and combined attributes to reveal 10 distinctive P-S attributes. In the third step, axial coding laid out the properties and dimensions of each of the 10 attributes, as well as the relationships between the attributes in terms of value proposed to the customer. This resulted in a refined coding plan that grouped the 10 P-S attributes into four categories of value proposition. In a final coding stage, the selective coding step, an overall framework was developed. Researchers reviewed the value proposition framework for internal consistency and refined the wording of the definitions and the selected examples. To resolve any inconsistency and to improve content validity, the researchers conducted a participant workshop to gather informant feedback. The study's methodology, 10 product-service attributes and four value propositions were presented during this workshop with four interviewees. Participants received a description of the results and were asked to comment on how well this reflected their experience and practice. Only minor amendments to labeling were made at this point.

Findings

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 features that are collectively valued because they achieve customers' goals in a particular use situation (Lapierre et al., 2008; Woodruff, 1997; Woodruff and Flint 2003). 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 composition. In addressing the first research question, attributes of PSS in the case organisation were identified (see Table 1). Although the attributes are context dependent, they do provide the basis upon which operational design for delivery can be explored. Qualitative analysis of these attributes, their properties and relationships revealed four distinct propositions of value offered by the case organisation. Each of these propositions represents a group of P-S attributes that collectively propose a certain value-in-use to the customer.

Table 1. The Four Value Propositions

Attributes	**Value Proposition**	**Potential value-in-use**	**Example Quote**
Equipment Performance	Asset	Value proposed by the product itself, specifically, its potential performance in any given use situation. Generally customers realise the value and achieve benefits for themselves with little or no input from the provider.	'For the (*equipment operators*) satisfaction means an (*asset*) which produces the best level of performance in whatever circumstance they're trying to (*operate*) in' (Client Account Manager)
Technical Query Resolution Technical Variance Equipment Repair Service	Recovery	Value proposed follows 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). Value is the provider's and customer's joint ability to ensure the asset recovers quickly to a usable state.	'I think (*customers*) value the performance of the (*asset*) when it's running. They don't value the service when it's broken, it's expensive to them, it takes too long' (Equipment Programme Manager)
Equipment Maintenance Service Component Forecasting & Provisioning Through-Life and Obsolescence Forecasting & Planning Recommendations	Availability	This proposition maximises potential usage of the equipment, therefore supporting the customer's use of equipment to achieve their goals. Often part of an availability contract, where contract performance is dependent on equipment availability for use, rather than on the performance of activities or tasks.	'There's 300 people that work in Services who can be tasked to develop these proactive approaches to keep (*assets in use*)… There's a number of ways you can keep an (*asset*) (*operating*) longer, you can look at the parts, engineering services assessment, changes to maintenance routines…'

Capability Forecasting & Planning Recommendations Equipment Operating Advice			(Equipment Manager)
Equipment Configuration Advice for Operational and Contextual Capability	Outcome	This proposition facilitates the customer's effective use of the equipment, supporting the customer in achieving their own goals. The customer uses the equipment to achieve goals in coordination with the firm that provides the service, taking into consideration the customer's need for the equipment and the way it is used towards the operational goal.	'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' (Asset Manager)

Based on these findings, the following research proposition is presented. For an illustrative example of the four value propositions, please refer to Appendix A.

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.**

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

In addressing the second research question, the implications of these four value propositions for operations design are considered. In doing so, it is important to recognise that whilst the service mindset driving P-S transition enables firms to gain deeper insights into 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 customer and firm practices that support the product's or service's use. Given that value is created in the use encounter, situational or contextual conditions of that encounter could affect the co-creation of value (Beverland et al, 2004; Flint et al, 2002; Lemon et al, 2002; Lapierre et al., 2008). Palmetier (2008) states that contextual variables may stem from multiple levels, such as the physical environment, industry and/or 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 behaviour, equipment knowledge) and/or the physical conditions of the equipment use environment that will create variety. From an S-D logic perspective, users of equipment act as resources integrators to achieve benefits in context. Chandler and Vargo (2011) define context as a set of unique actors or entities with unique reciprocal links among them, and suggest that "context heterogeneity affects how resources can be drawn upon for service" (Chandler and Vargo, 2011:p. 6). We consider such context heterogeneity as contextual variety, and define it as the degree of heterogeneity or variability in the set of contexts within which the individual faces in co-creating value through use of equipment (Ng et al, 2012). For example, the use of aircraft on scheduled civilian flights would exhibit a lower contextual variety from creating value-in-use of the aircraft when compared with the aircraft being used for military purposes. Contextual variety therefore defines the heterogeneity of resources that could be leveraged or accessed to achieve the same outcome continually over time in equipment use. Such heterogeneity of resources can come about due to environmental conditions or the individual's personal conditions (Ng and Briscoe, 2012). In other words, context is not defined by the entities, but by the linkages and interactions between them.

Traditionally, in an asset or recovery value proposition characterised by product-sale or after-sale support contracts, variety in the context of the customer's use of the equipment was not a consideration of the firm; it was the customer's 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 found evidence that as the case firm transitioned from a traditional repairs contract to an availability contract,

contextual use variety became increasingly important. In the following excerpt from an interview with an Equipment Programme Manager, it is evident that the firm 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'*

This suggests that when equipment use is the unit by which a firm contracts, as is the case in an availability contract, customer use of the equipment and the context in which they use it is a factor in the contract's achievement. Therefore, the firm requires a greater understanding of the customer's use environment.

Oliva and Kallenberg (2003) discuss this variety in terms of increased operating risk for the firm, suggesting that in the product-to-service transition, the "pure service organisation" assumes risk incurred by taking entire responsibility for the end-user's process. They argue that this move is largely uninvestigated. In the following interview excerpt, a Company Service Manager discusses a shift from availability contracts to capability contracts which propose outcome value, and acknowledges the increase in business risk. This increased risk is also equated 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).'*

In the case organisation, it was found that a shift from repair to availability contracts introduced increased variety into the firm's system from the context in which equipment was being used by the customer. A further P-S shift from an availability value proposition to an outcome value proposition also incurred additional variety due to the complexity of equipment use to achieve customer goals. As such, the following research propositions are put forward:

Research Proposition 2a: **As a firm transitions from product to P-S, contextual use variety increases.**

Research Proposition 2b: **Resources to absorb or attenuate contextual use variety in P-S consist of both customer's and firm's human resources.**

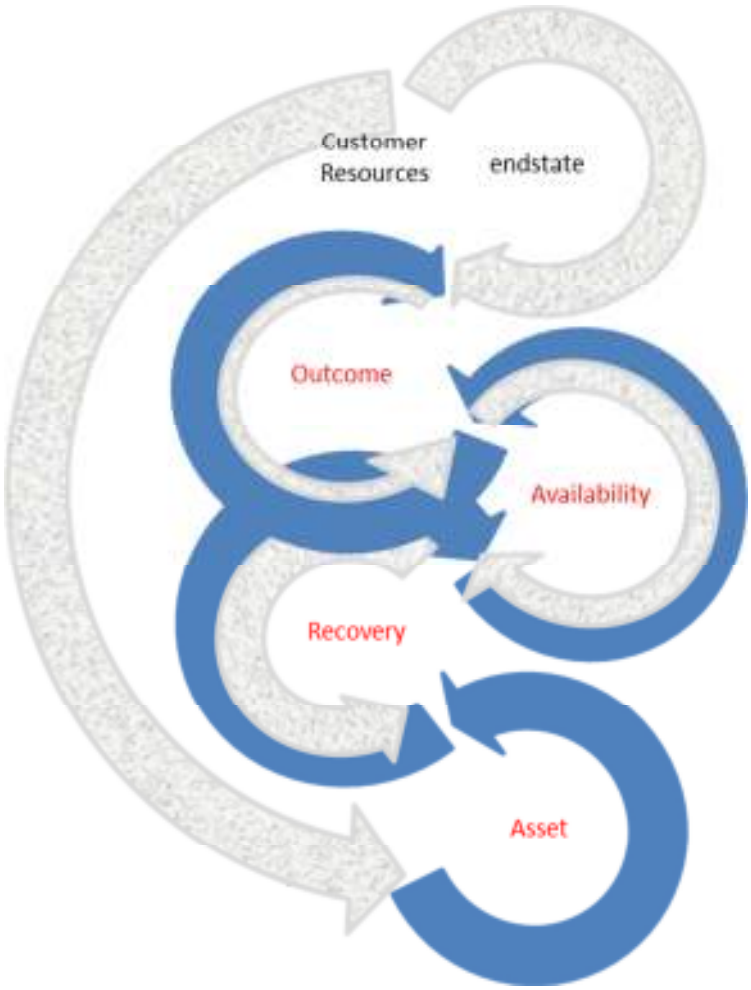

Figure 2: The four value propositions as interactive cycles

As the case organisation transitioned from product to P-S and as a consequence of exposure to variety in the customer's equipment use context, the study 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, he suggests that the customer and firm 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 organisation requires customer information to co-produce availability value propositions. The following interview excerpt 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 firm and customer to co-produce the availability value propositions, there was also evidence that the firm was managing customer behaviours. When an Equipment Programme Manager was asked if the firm manages 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).'

Thus, we found that the case organisation requires customer materials and customer information to co-produce availability value propositions, even while the customer co-creates the equipment value-in-use. We also found that variety in the customer's environment and use of equipment requires the firm to manage operating and maintenance behaviours in both the co-production (of the firm's value propositions) and co-creation (of value). These findings led to the following research proposition:

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

Further analysis of the archival data and employee interviews found that the value propositions are interdependent. Specifically within the case organisation, interactions were observed between each of the four value propositions (see Figure 3). Notably, as the case organisation transitioned from an asset value proposition based on a pure product offering, to an outcome value proposition based on capability contracts, there were interactive effects. For example, when the case organisation offered outcome value propositions to customers, there were two resulting effects. The first interaction occurred between the outcome value proposition and the availability value proposition (interaction 3 in Figure 3). Here, contextual use variety was found to have 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 interview excerpt from an Asset Manager illustrates how knowledge of customer goals and the necessary use of equipment to support these goals impacts 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 in Figure 3). The outcome value proposition requires an understanding of customer's equipment use to achieve their goals. When asked whether the firm 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.'

It is notable that, where possible, the interactions between value propositions were built into the design of task processes. This was found to be the case particularly in the interactions between the recovery value proposition and the asset value proposition (interaction 1, figure 3). For example, when the firm issues a concession of technical variance to an equipment specification in the recovery value proposition, the concession is fed back to the engineering department. This helps to inform ongoing asset design (please see Appendix C for evidence found in the process documentation).

These interactive affects were found throughout transition. Supporting evidence for each of the interactions is provided in Appendix B. In light of these findings, the following research proposition is suggested and the four value propositions are conceptualised as interactive cycles in Figure 2.

Research Proposition 4: **P-S value propositions are interdependent**

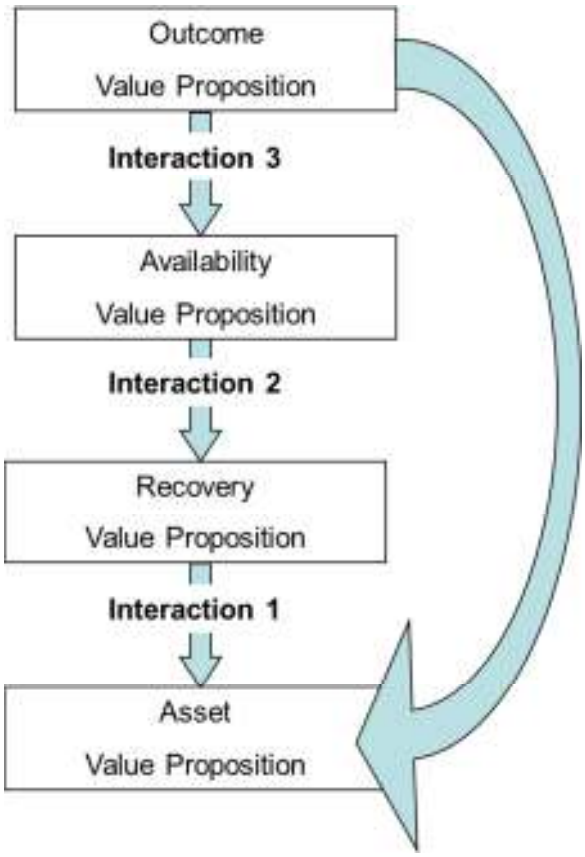

Figure 3: Evidenced interactions between the four value propositions

To explore the implications of each of the value propositions on operations design, we draw upon the service systems framework proposed by Buzacott (2000) [See Appendix D for a more detailed analysis of archival case data by this model]. Notably, it was observed that the degree of task discretion and therefore task design differed by value proposition. The case firm indicated that in the transition from the asset value proposition through to the outcome value proposition, the process design became more orientated around individual expertise and less amenable to a structured, or mechanistic, design. Take for example, technical query resolution, a recovery value attribute. In terms of task discretion, evidence shows some technical queries are dealt with relatively easily because they are repeats of queries from previous customers. Other technical queries are more complex, requiring 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. From process models and ERP data we notice a bottom-up design where four grades of workers are observed to spend time on the task. Initially the query is handled by a lower grade 4 worker, accounting for over 57% of the total recorded time spent by employees on query resolution. This worker then filters out calls so that the next higher grade only receives more complex queries, accounting for 42.5% of the total time spent on the attribute. Any queries of increasing complexity are then passed on to grade 2 and grade 1 workers, accounting for only 0.1% and 0.2% of time respectively. In contrast, other attributes are addressed through a series design such as planned and scheduled maintenance or through a top-down unplanned design. Top-down design is found to predominate

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 who then passes on specific requirements to specialist supply chain planners. Two grades of staff performed tasks associated with this attribute; 82% of the total time recorded for component forecasting was carried out by higher grade staff and 18% by back office support staff. This evidence supports the conclusion that the vast majority of the activity was carried out initially by senior staff and then handed over to junior staff for completion.

Research Proposition 5: **Service process design varies according to the PSS value proposition(s). Lower level value propositions have a more structured process design than higher level propositions.**

Implications for Theory

Drawing 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, this paper has sought to provide further insight into operations management of the P-S transition and the resulting PSS offerings, through a customer-oriented approach. In so doing, it contributes to PSS research in the operations management domain.

In responding to the first challenge presented by Pawar et al (2009), which centred on the definition of value propositions in PSS, this research finds four value propositions presented by PSS. While there are similarities with Tukker's (2004) model, interactions between the value propositions identified suggest that Tukker's (2004) model may only be valid in cases where there are simple, loosely coupled interactions between activities and assets. This is often not the case in complex equipment provision. The model in this paper differs significantly from the existing PSS literature as it challenges the view that each of the main categories and subcategories of PSS represents a separate evolutionary state. In this respect, the call from Johnstone et al (2009) for more research on how the transition from product to service 'plays out in practice' is addressed. Results presented here 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 PSS literature. Our case firm has the challenge of simultaneously delivering across four value propositions that are inextricably linked; this is a highly complex system with many interactions.

In responding to Pawar et al's (2009) second challenge around the design of operations for PSS value propositions, this paper adds to PSS literature by identifying and considering the concept of contextual use variety, which 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 use 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 customers 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. As such, contextual use variety represents an additional dimension of complexity to those identified by Howard and Caldwell (2011) when service is integrated with the product system.

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, the more appropriate is the 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 provide evidence that numerous task designs exist simultaneously in complex equipment, or product, services. Specifically, the case provides evidence of a mix of parallel design, bottom-up, top-down and complex mixes of service delivery.

The results suggest that in complex PSS, many customer inputs are unknown and the key phase is diagnosis of the customer requirement. Therefore, an extension of Buzacott's (2000) binary distinction between knowing and not knowing customer requirements may be necessary. Where customer requirements can be divided into four categories based on Parnaby's (1988) runners, repeaters, strangers framework, crucially a fourth category of 'unknowns' can be added, as proposed by Godsiff and Maull (2009), where customer requirements are diagnosed and are completely unknown and the process to meet these requirements is unknown, but they are feasible. This provides a more complete categorisation of types of customer input faced by our case firm. 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.

In addition, it is shown how a S-D logic approach in PSS generally is able to liberate the domain from a G-D logic encumbered with goods-laden frameworks that are less effective in understanding service. The model adopted in this paper takes a S-D logic approach in three ways that progress the PSS literature. First, it considers value propositions not according to 'product' or 'service' but in terms of how resources (both material and non-material) are optimally configured within the value propositions to co-create value with the customer. Thus, 'product' is taken as an indirect service provision (S-D Logic FP3) and potential resources are aligned 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, both are considered equally to achieve a more effective value proposition.

Second, a value co-creation system of nested value propositions is illustrated which, if not provided by the firm, would still require customer resources for value to be created. These are depicted by the grey arrows in Figure 2, which 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, the combinative and substitutability of both firm and customer resources to achieve the outcome is illustrated. We consider such a framework more meaningful for the business community, as it provides 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 greater customer orientation.

Third, from a S-D logic lexicon perspective, and when given the implied exogeneity of product design within PSS, it could be suggested that the term PSS should be changed to service systems, specifically, *value creating* service system, where the product is the indirect service provision and service is defined as the entities applying their own competencies within the system to co-create value (Vargo and Lusch 2004; Vargo and Lusch, 2006). Thus, the design challenge is to achieve the most effective and efficient value-creating service system using both the firm's and the customer's material and non-material competencies for outcomes. This 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 servitize, the interdependency of the various value propositions suggest that such a failure could be attributed to (a) the configuration of human activities (the 'service'), as was implied; but also to (b) how the asset itself was designed and manufactured to support the human activities; (c) how the combination of asset and activities enable (or not) co-creation by the customer; and (d) the failure to understand hyper-variety contextual outcomes by the customer that threatens the original asset and activity design.

Implications for Management

This research has indicated the complexity of the transition from product to service. Specifically, through the identification of the four value propositions, we show that even organisations that have been transitioning for some time cannot simply see service as a bolt-on extra to their product offerings. For those firms new to servitizing or who are still developing their offering, our findings indicate the extent of the challenge they face. Crucially, as the value proposed to the customer changes, this modifies the core offering and firms need to consider the implications for their resources and their staff's competences in relation to the specific skills that they bring in delivering the value propositions. These are not the same competencies and knowledge of a manufacturer, but will have to reflect different knowledge bases and the softer skills associated with customer contact.

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, and to recognise that changing delivery of one value proposition can have unintended consequences on another value proposition. Delivering higher order value

propositions is dependent on the performance of lower order value propositions; indeed these lower order propositions may become order qualifiers. However, their performance cannot be ignored or assumed to be routine, else the customer will not contract for higher order value propositions.

Finally, the implications of contextual use 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 suggests 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 in such a dynamic environment requires considerable expertise.

Conclusions

From the analysis of findings from the case firm, a number of research propositions reflecting implications for operations management of PSS have been identified. This study identifies four nested value propositions for the phenomenon of 'servitization' that serve to enable the co-creation of value with the customer. These propositions are found to have a number of substantial implications for operations management of the P-S transition.

The findings emphasise the impact of contextual use variety, as organisations move through the value propositions with increased complexity created by the interdependencies amongst the value propositions, and the differences in operational design for each value proposition. It is proposed 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. Taking an S-D logic approach, this paper considers the value propositions not according to 'product' or 'service' but in terms of how resources (both material and human) are optimally 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.

The study is not without limitations. In exploring the P-S transition, the focus of analysis in this paper is the identification of value propositions in a servitized firm and the structural patterns associated with these value propositions. These structural patterns are identified but the paper does not explore why they exist or how they are developed. In particular, it does not explore the process by which the case company transitioned from a pure product offering to also offering product-, use- and result-orientated PSS. Furthermore, in defining the value propositions of PSS, the study is first limited to the value proposed by the provider to the customer and not vice versa and second, it only identifies propositions of functional value. Other value propositions are likely to exist that may propose other forms of value such as social or hedonic value. Finally, the study explores the operations management implications of the value propositions to the provider; it does not explore the customer processes of realisation of the value propositions. The research conducted

in this paper is exploratory and therefore future research should not only seek to address these limitations but should be conducted to test the five research propositions through further case research into complex PSS. Future work to test the propositions would be suited to a methodology including multiple cases of both literal and theoretical replication, whereby each case should be selected so that it either predicts similar results (a literal replication), or produces contrary results to those found in this paper but for predictable reasons (a theoretical replication)" (Yin 1984, pp. 48-49). Multiple cases would also help to augment external validity.

The findings of this paper reflect the challenges facing organisations managing complex systems. Complex systems have more interacting elements, which 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; put 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 by manufacturers of the future to compete in the service economy.

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Appendix A

An illustrative example of how the four value propositions might apply to PSS centred on police riot vehicles:

	Asset	Recovery	Availability	Outcome
Attributes	Equipment Performance	Technical Query Resolution Technical Variance Equipment Repair Service	Equipment Maintenance Service Component Forecasting & Provisioning Through-Life and Obsolescence Forecasting & Planning Capability Forecasting & Planning Equipment Operating Advice	Equipment Configuration Advice for Operational and Contextual Capability
Proposed value-in-use	There is a potential use value proposed to the police force by the asset itself. For example, the vehicle may have height, width, and weight characteristics that have the potential in use for agility and manoeuvrability in multiple policing	Service attributes such as those associated with traditional support services propose a value-in-use of minimal disruption at the point of vehicle failure. For example, if a riot vehicle is required for, or is on active deployment and a warning	The above service activities offer a potential value-in-use to the police force through facilitating a maximum available number of working vehicles for deployment at any one time. Attributes such as preventative maintenance may also ensure continued	Proposed value-in-use in the outcome value proposition is about use of the equipment for a specific operational goal. Take for example, an unprecedented and unexpected event like the 2011 London Riots. Here capability advice may have

	environments. Furthermore its armaments, material and appearance characteristics may have the potential to protect against attack and/or have a discrete appearance so as not to create panic if it seen on the streets.	light is flashing on the dashboard. Technical variance services may release that vehicle as safe to continue to operate on deployment for a specified amount of miles or hours. This would allow the police to continue using the vehicle for the issue in hand. Therefore, not compromising vehicle numbers or requiring extra resources to organise a replacement.	reliability and performance in use. For example, advice on how best to drive the vehicle to reduce damage and increase longevity of parts will help the police to maximise the operability of the vehicle.	been of value so as to help the police to restore order. For example, advice on the potential vehicle uses for the situation at hand, how the vehicle could be adapted to protect against new threats like missiles or fire or how it may be teamed with other police resources to form the most effective line of defence against the threat.

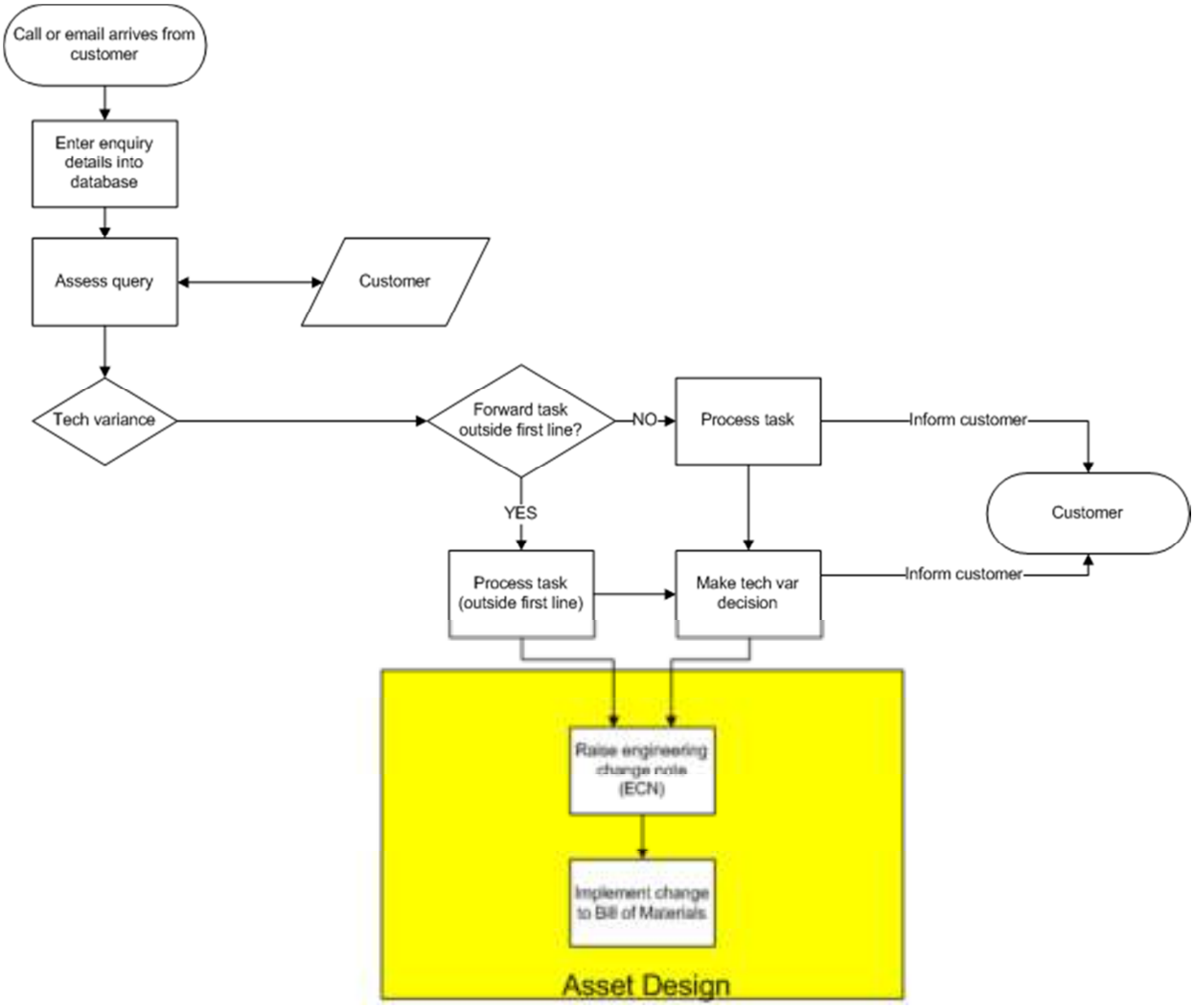
Appendix B

Case Evidence of Interactions between Value Propositions

Interaction	Nature of Interaction	Supporting Evidence
1	Recovery Value Proposition → Asset Value Proposition	An Asset Manager refers to the process by which customer technical queries into the call centre as part of asset recovery are fed back into the engineering design process: "You also have problems that can't be defined or solved within the Service Delivery function and they have to go into the Core Engineering function… Core Engineering is development and design of new solutions… (*for example*) it could be a Safety issue which we have to redesign the (*asset*), or …it would be … a hardware change."
2	Availability Value Proposition → Recovery Value Proposition	In discussion of asset management practices (availability attributes), an Asset Manager illustrates that improvements for equipment availability reduce asset failure and therefore reduce inputs into the call centre: 'We kicked in a whole process of work to the point where on one of the (*parts*), we actually (*reduced returns*) by 40%. So by reworking (*techniques*) in the (*customer workshop*) we got them back as serviceable.'
3	Outcome Value Proposition → Availability Value Proposition	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.'
4	Outcome Value Proposition → Asset Value Proposition	An Equipment Programme Manager discusses how customer goals and use conditions link 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.'

Appendix C: Process map detailing how a concession of technical variance in the recovery value proposition informs ongoing asset design



Appendix D

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[*1]	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 Forecasting & Provisioning[*2]	Top-Down	Customer requirements are negotiated 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.

[*1] There were 23,933 instances of this attribute in a 56-month period which totalled 31,142 hours of work. There were four staff grades that performed tasks associated with this attribute; 57.2% at the lowest grade (4), 42.5% at grade 3, 0.1% at grade 2 and 0.2% at grade 1.

[*2] There were 1406 instances of this attribute in a 56-month period which totalled 2375 hours of work. There were two grades of staff that performed tasks associated with this attribute; 1947 of these hours were carried out by higher grade staff (82%) and 428 hrs (18%) by back office support staff. This evidence supports the conclusion that the vast majority of the activity was carried out initially by senior staff and then passed on to junior staff for completion.