Servitization and Operations Management: A Service-Dominant Logic Approach

Abstract

Purpose – The purpose of this paper is to provide further insight into operations management of the Product-Service (P-S) transition, known as servitization, and the resulting Product Service System (PSS) offerings. In exploring the dynamics of product-service transition this paper adopts a Service-Dominant (S-D) 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 five 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 five years of Enterprise Resource Planning (ERP), call centre and contract data.

Findings – The paper identifies 10 generic P-S attributes, which are abstracted 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 it is found that the role and importance of contextual variety increases as the organisation moves through the value propositions. Interdependencies amongst the value propositions and differences in operational design for each value proposition are also found.

Research limitations/implications - The paper investigates PSS through an S-D logic mindset. First, the paper considers 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, a value co-creation system of nested value propositions is illustrated. In so doing the findings have a number of implications for literature on both PSS and S-D Logic. In addition, the research adds 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 firm 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 an S-D 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 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 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 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 than 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 their 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.

1.0 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 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 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 approach 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 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 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.

PSS research within the mainstream management literature has predominantly explored “function-oriented business models” 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 in literature as opportunities for organisations to enhance competitiveness by directly fulfilling customer’s desired results or outcomes (Mont, 2001). One of the more fundamental contributions to arise from PSS management research 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.

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).

Insert Figure 1

1.1 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 (2000) refer to Woodward's (1965) project and small batch production designs. Notably Hobday (2000) explores project-based, organic design structures which have been found to be equally as applicable to the wider PSS context (Salonen, 2011; Turunen, 2011). However, both Salonen (2011) and Hobday (2000) raise the issue of scalability in organic organisational designs, an important issue given that recent 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 in their case organisation 'JetCo', the problem was not merely one of developing effective service, but of actually integrating service and production operations. Moreover, their results challenge the notion that the P-S 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 and such stages are often reflected across the PSS literature (e.g. Oliva & Kallenberg, 2003; Vandermewere & Rada, 1988). Yet, Johnstone et al (2009) find that the situation is more complex and transition is affected by issues of power, politics, constantly shifting organisational priorities, changing customer demands, and a turbulent business environment.

Given these complexities, this paper draws upon the service systems design framework proposed by Buzacott (2000), which incorporates both product and service design principles. A central part of the framework are the attributes of individual jobs (Rolfe, 1990) which has two dimensions:

1. Technical complexity – includes the complexity of the task, the knowledge required to complete it and the range and variety of the tasks;
2. Discretion – includes the workers' element of choice and their ability to exercise judgment in carrying out a task.

Using these dimensions, Buzacott (2000) identifies three different types of task design where there is no discretion i.e. where customer requirements are known by the organisation:

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

Where customer requirements are unknown to the organisation, 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. This can be achieved by two additional types of structure:

1. Bottom-up, where the complexity of the diagnosis increases. For example, in the first, second, third levels of expertise in a call centre
2. Top-down, where the complexity decreases after an initial diagnosis by an expert.

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.

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 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 exchange is not primarily about the exchange of goods, but the exchange of service. In the exchange of service, 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, delivered by 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 utility but 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 and the latter through its realisation of the propositions, be they direct (human activities) or indirect (through product). 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 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, 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 et al., 2009).

3.0 Research Objective and Questions

Thus far we have reviewed extant literature on product-service systems 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 dynamics of 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).

4.0 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, 1998). 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 scheme 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 amends to labeling were made at this point.

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 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 product-service attributes that collectively propose a certain value-in-use to the customer.

Table 1. 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, its potential 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 excerpt 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 and customers realise the value and achieve benefits for themselves with little or no input from the provider.

The Recovery Value Proposition
The attributes which constitute the recovery 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). Value in this case is in the provider's and customer's joint ability to ensure the asset recovers quickly to a usable state. The following excerpt from an interview with an Equipment Programme Manager illustrates this point:

> 'I think (*the customer*) 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'

The Availability Value Proposition
This proposition ensures that equipment is available for customer use. To do so, the firm must consider the proactive replacement of components before the equipment fails *as well as* the customers' life-time maintenance and operation of the equipment to ensure continued reliability and performance in use. This is illustrated in a discussion with an Equipment Manager:

> '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…'

In contrast to the recovery value proposition, the availability value proposition maximises potential usage of the equipment, therefore supporting the customer's use of equipment to achieve their goals. The attributes which constitute this value proposition are 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.

The Outcome Value Proposition
The final value proposition consists of attributes which go beyond availability towards actively facilitating 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. Moreover, they consider how the customer operates the equipment in a use context to achieve those goals, when integrated with other assets and equipment in the customer's use environments. This is illustrated in the following excerpt 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 is therefore an intervention to support a customer's capability to achieve a desirable outcome.

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.

5.2 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; 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 behaviour, equipment knowledge) and/or the physical conditions of the equipment use environment that will create variety. Contextual variety takes its theoretical foundation from state-dependent utility, an economics term commonly used in situations in which the state of the world affects how well individuals are able to enjoy a product's consumption (Cook and Graham, 1977; Karni, 1983; Ng, 2007). State-dependent utility has a considerable following in pricing literature, where traditional concepts of utility are closely related to exchange value. However, state-dependent utility does not merely impact on exchange value (price) but also on value-in-use; ie the context of use might have changes in the state of the world that could disrupt or enhance the customer's valuation of the product (Ng, 2008). For this study, we term the impact of state dependency on value-in-use as *contextual use variety*.

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.

Insert Figure 2

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 affects. 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 in to 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 in to the engineering department. This helps to inform ongoing asset design (please see appendix C for evidence found in the process documentation).

Insert Figure 3

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

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 observe 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 passed for completion by junior staff.

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.

6.0 Implications for theory

In addressing the research questions, a number of findings have been made; the identification of 10 attributes and their consolidation into four nested value propositions, the role and importance of contextual use variety in movement 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) this research finds four value propositions, challenges in the design of the internal operational system to deliver these value propositions and explicitly considers 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, this research advances PSS literature. For example, there are similarities with Tukker's (2004) model, but interactions between the value propositions identified 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, it is shown how a S-D logic approach in PSS 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 two 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 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 SS - service system, where the product is the indirect service provision and service is defined as competencies for competencies (Vargo and Lusch 2004; Vargo and Lusch, 2006). Thus, the design challenge is to achieve the most effective and efficient system of value co-creation 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 servitise, 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.

In considering the implications for operations design, 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 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. 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.

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, 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.

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:

- 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.

The results suggest that in complex product service systems, 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):

- 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 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.

7.0 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 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 in such a dynamic environment requires considerable expertise.

8.0 Conclusions

This 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 the case firm, five research propositions have been identified: 10 attributes can be combined into four value propositions; as firms move through these value propositions, contextual use variety increases; 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, lower level value propositions are more amenable to structured design compared to higher level value propositions.

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.

Of course, 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. 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 etc. 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.

These findings reflect the challenges facing organisations managing complex systems. Complex systems have more interacting elements, which suggests 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 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.	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 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.	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 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.	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. Where capability advice may have 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

Insert Figure 4

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 for completion by junior staff.