# Servitization through outcome-based contract – a systems perspective from the defence industry

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## Abstract

This paper provides a viable systems perspective of an outcome-based service initiative involving major manufacturers in the defence industry. The viable systems perspective allowed a coherent structuration of the complex servitization context involving provider and customer organizations. It also unveiled critical relationship mechanisms that enable synergy and facilitate the achievement of co-capability by the organizations involved. Through a case study approach, the research finds that interventions in the customer system reduce variability in the provider system as well as in the service system as a whole. The systemic interventions are implemented via key provider/customer relationships the study identifies. The relationships deal with the high level of internal variety in outcome-based service systems. A typology for the identified relationships is developed, offering a helpful basis for the purposeful planning and design of interactions aimed at developing co-capability. The paper also offers theoretical propositions defining fundamental features of outcome-based service systems. The unique characteristics of these systems addressed in this paper provide particularly useful insights concerning the implementation of this type of servitization initiative not only in the defence industry, but also in other industrial sectors where servitization initiatives involve complex configurations of provider and customer organizations.

**Keywords:** servitization, outcome-based service, complex services, viable service systems

## 1. Introduction

To remain competitive, manufacturing organizations have increasingly felt the need to provide uninterrupted availability of their equipment through services such as repair, maintenance and overhaul (Baines *et al.,* 2007; Caldwell and Howard, 2011; Neely, McFarlane, and Visnjic, 2011). In a manufacturing context, the provision of services attached to core corporate offerings is commonly referred to as servitization (Vandermerwe and Rada, 1988). Usually, most of the service contracts attached to manufacturers' offerings are equipment-based, where the customer is invoiced for the time and materials involved in equipment repairs, maintenances and overhauls (van Weele, 2002; Lee, Yoo, and Kim, 2016). The performance of such contracts is typically assessed in terms of response time to breakdowns, speed of repairs, price (Crocker and Masten, 1991) and other activities where there is a measurable way to assess the provider's performance (Dehoog, 1990). More recently, servitization has been defined as the implementation of services whose outcome is focused on capabilities delivered by product's performance (Baines et al., 2016).

Of late, there have been a growing number of service contracts attached to equipment outcomes rather than on the traditional activities involved in the service of the equipment. For example, some of Rolls-Royce's service contracts to maintain engines are paid on the basis of how many hours the engine is in the air – a concept known as "Power-by-the-Hour®" (Neely, 2008; Vendrell-Herrero and Wilson, 2016). Such outcomebased contracts focus on achieving required outcomes rather than meeting a set of prescribed service levels (Bramwell, 2003). These forms of service contracts have brought an increased complexity to servitization developments, for achieving outcomes in the customer space places a requirement on the provider to have much closer cooperation and coordination with the customer, resulting in more tightly coupled linkages (Ng and Nudurupati, 2010). Despite the crucial role played by the customer, much of the servitization literature involving outcome-based service has focused upon aspects concerning the provider organization to achieve good service outcomes. There is therefore room for investigating issues concerning the involvement of the customer organization using the equipment.

This paper addresses this gap by considering provider and customer organizations in a more holistic way

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when investigating the implementation of outcome-based service contracts by manufacturing firms. The holistic analysis takes into account relationship issues concerning the provider and the customer organization, rather than simply considering just the provider or the customer. More specifically, we investigate how provider and customer organizations achieve joint capability, i.e. co-capability, in outcome-based service contract initiatives, where tightly coupled interactions between the provider and the customer are critical to achieve service outcomes (Ng, Ding, and Yip, 2013). We argue that such a fundamental change to the value proposition of a service constitutes a major change in the configuration of the service system as a whole.

The paper extends knowledge in servitization by providing a systems perspective of an outcome-based service initiative in the defence industry. We consider a viable systems approach as a theoretical lens to analyze the linkages between processes and functions operationalized within and between provider and customer organizations in order to deliver expected service outcomes. This is based on the notion that a system's viability is determined by its capability to develop harmonic interactions between sub-systems and related supra-systems over time (Barile and Polese, 2010a; Golinelli, 2010; Pels *et al.,* 2013).

The research findings provide valuable insights into the interaction processes through which the harmonic behaviour of provider and customer organizations can be achieved. The findings suggest that intervening in the customer system to ensure structural and systemic stability reduces variability in the provider system and, therefore, in the service system as a whole. Assisting the customer organization to build competency also implies the provider's participation in the customer system. We propose that a systemic development of customer/provider relationships enables the achievement of greater viability and stability of outcome-based service systems. The paper provides a typology of key relationships and their respective roles in this type of servitization.

The paper is organised as follows. In the next section we identify the main research gaps and key theoretical aspects underpinning the study. This is followed by the presentation of the research methodology. In the sequence, we discuss the research findings from a viable systems perspective of outcome-based services and define a typology of critical relationships to counteract variety in the service system. We conclude the paper by pointing out theoretical and practical contributions of the study and related issues for future research.

## 2. Theoretical basis

### *2.1. Outcome-based contracts (OBC)*

Servitization related literature suggest that a product service system (PSS) falls somewhere in a continuum of PSS categories varying from "pure product" to "pure service" systems (Tukker, 2004). On the "pure product" extreme, traditional product oriented service contracts are anchored on billable time and materials, with the cost of spare parts sometimes included in the maintenance, repair or overhaul of equipment, and the customer is billed for the service once the activities have been performed (van Weele, 2002). On the "pure service" extreme, services replace the purchase of a product, i.e. customers purchase not a product with services, but rather they are purchasing a service instead of the product (Cusumano, Kahl, and Suarez, 2015). Oliva and Kallenberg (2003) suggest that the last stage of this service continuum is expanding to relationship-based services, which calls for proper consideration of relationship aspects involving provider and customer organizations. For Bustinza et al. (2015), servitization represents a business-model change that involves organizational transformation from selling goods to selling an integrated combination of goods and services.

The combination of goods and services into service contracts are predominantly result oriented and they are intended to achieve defined outcomes in terms of "availability" of products and related service resources. The service performance is rewarded on the basis of measurable outcomes in terms of timely availability to the customer (Neely, 2008).

Contracting for availability seeks to sustain a service system at an agreed level of readiness over a period of time through partnering arrangements between the provider and the customer (Datta and Rajkumar, 2010). For Smith, Maull and Ng (2014), such partnerships require a mindset change where the customer expectations are carefully considered, particularly in outcome-based contract (OBC) contexts.

OBC has been defined as a "*contracting mechanism that allows the customer to pay only when the firm has delivered outcomes, rather than merely activities and tasks*" (Ng, Maull, and Yip, 2009: 377). By definition, service outcome is the dominant value driver. The "availability" of products and related service resources is a necessary requisite for the achievement of outcomes and, as importantly, outcomes can only be achieved with the

participation of the customer not only in terms of usage, but also in terms of allocating complementary resources (Ng *et al*., 2013). The service outcomes can be specified very broadly in terms of results, i.e. outcomes *resulting from* use, such as paying for every day that is incident-free in the security of a building, or they can be specified *in terms of* use, such as a bank of flying hours of a plane (Ng *et al*., 2009).

A recent study by Nordin and Kowalkowski (2010) showed that many providers underestimate the relational processes to engage customers. Firms' inattention to these aspects arguably results in dissatisfied customers. They concluded that solution providers would benefit from replacing their product centric view of solutions with a relational process view. This view implies a strong emphasis on service value co-creation processes in which both the provider and the customer mutually align resources towards outcomes (Kale, Dyer, and Singh, 2002). In the OBC context, changing the focus from value capture to value co-creation entails the development of cocapability in provider and customer systems to yield the expected outcomes as opposed to solutions where only the provider is responsible (Ng and Nudurupati, 2010).

The inclusion of customer capabilities for a provider to achieve outcomes creates increased complexity in OBC service systems. Neely, McFarlane and Visnjic (2011) recognise value-in-use and value co-creation as key features of complexity in PSS. They propose that the product-service transition makes the underlying operational delivery systems and processes more complex to manage. Zhang, Gregory and Neely (2016) add that capability building may involve complex patterns of coordination, cooperation and integration between people and other resources. This is particularly the case in OBC systems.

Recent studies on OBC have proposed that there is a need for understanding the different ways a firm is able to manage collaborations (Ng and Nudurupati, 2010; Ng *et al*., 2013), since the capability lies in the way a firm is able to achieve service outcomes collaboratively. This calls for further studies to identify underlying characteristics of provider-customer relationships in an OBC system and the related operational and managerial structure of its complex environment.

From the aspects discussed above, it is possible to identify the following problems:

--- One sided perspectives of service systems such as product-oriented solutions do not provide a suitable theoretical basis for analyzing OBC systems. There is a lack of holistic approaches that capture the complexity of servitization through OBC as well as the integration aspects linking provider and customer organizations.

--- The dynamics between provider and customer relationships in servitized OBC contexts are not sufficiently understood. Since the service delivery capability is achieved in the way a firm is able to achieve customer outcomes collaboratively, there is a need for further studies that investigate the different ways a firm is able to manage collaborations and achieve co-capability. The research objectives were directly derived from these two issues, as follows:

1. To analyze an OBC service system in a more integrative and holistic way, considering insights derived from a viable systems perspective to represent the complex structure of the system as a whole and the integration aspects linking provider and customer organizations.
2. To identify relationship mechanisms that integrate provider and customer organizations and enable the achievement of co-capability in an OBC service system.

### *2.2. Viable systems perspective*

The systems perspective is essentially helpful in understanding the inherent complexities of OBC service systems, for they involve intricate patterns of coordination, cooperation and integration between provider and customer resources and processes. The collaboration and integration between provider and customer to develop the co-capability necessary to achieve agreed service outcomes is ultimately a function of the totality of the parts, rather than just the individual elements. This is a primary notion of systems thinking, i.e. the notion that a system is a set of parts or elements that work with each other to form a whole (von Bertalanffy, 1968).

The totality of the parts is intrinsically related to the boundary of a system and in an OBC system the boundary is extended beyond the firm to include the customer. A particular aspect concerning our research was the "viability" of OBC systems given the complexities involved. From the many models and perspectives one can draw from the systems literature, we have found that the classic Viable Systems Model (VSM) developed by Beer (1984) provided the narrative and the conceptual framework that were particularly useful to address the viability issues concerning the study.

More specifically, the VSM provides a helpful reference for capturing the complex structures and linkages between core elements of a production system. Lowe et al. (2016), for example, have applied VSM as a basis to develop a theoretical framework to represent the functions required for a specific system to be effective in its environment and to provide insights into the processes and capabilities that enable guided interventions in a multi-organizational context. As pointed out by Barile et al. (2016), the multi-organizational perspective of VSM allows analysis beyond dyadic relationships to address the dynamics of systems and related networks involving complex business configurations and interaction patterns. Accordingly, we applied VSM to analyze the multiorganizational configuration and the viability conditions involved in the operational, managerial and governance dimensions of the OBC service system of interest.

Beer (1981; 1984; 1985) has originally introduced the VSM and the principles of viable systems to describe the necessary conditions for viability, which is generally defined as the ability of a system to maintain its existence within a specific environment. We summarise here the key theoretical aspects of viable systems that underline the study.

A first fundamental aspect is that contextual variations coming from the external environment of a system, as well as the multitude of events that may arise within the system itself, confront the system with "variety". Contextual variety as described here is a measure of complexity, for it represents the number of different states in a system (Ashby, 1956).

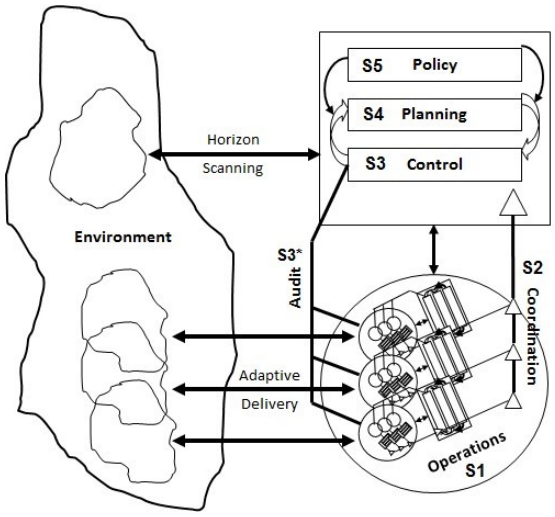
A second fundamental aspect considered in the study addresses the issue: How do organizations cope with variety? The answer builds directly upon Ashby's (1956) law of requisite variety and, as Beer (1984) puts it, managing variety is the very essence of management. A system has requisite variety when it has subsystems or mechanisms to attenuate and amplify variety so that variety in the disturbance can be met with variety in the regulator. More specifically, the viability of a system fundamentally depends on the ability of its parts to attenuate or amplify variety so that the system as a whole can absorb (attenuate) and generate (amplify) as much variety as it receives. While attenuation decreases variety to the number of possible states a system can handle, amplification enhances variety to the number of possible states the system needs to remain fit to its environment (Holten and Rosenkranz, 2011). Both attenuation and amplification can take place between a system and its external environment as well as between the internal subsystems of the system; for example, between operations and management or between management and governance subsystems of a system.

A third aspect of particular relevance to the research refers to the constituent parts of a viable system as proposed by Beer (1984) or, more specifically, the VSM structure. This is a particularly useful conceptual basis to structure our analysis around operational, managerial and governance elements of OBC service systems. The VSM describes the necessary organizational structure for a system to survive in a constantly changing environment (Holten and Rosenkranz, 2011). To be viable, an organization should have five core components (core systems) necessary to ensure viability. These five systems are also related to fundamental functions within organizations, as summarised below:

- *System 1 (S1) – Operations*: It comprises the organizational units that carry out the operations activities. Each operational unit is responsible for conducting specific operations activities within the wider system being analyzed.
- *System 2 (S2) – Coordination*: It is the system responsible for creating stability and resolving conflicts between the operational units. It comprises important supporting functions such as finance, human resources and information systems for the operations in S1, serving to restrain oscillations and disruptions that may occur between the units at operational level.
- *System 3 (S3) – Control*: It is the system responsible for optimization, internal regulation, and generation of synergy between the operational units. S3 supervises the operational activities of S1 from a higher point of view, adjusting the allocation of resources to the operational units. In addition, a specific control system termed System 3* (S3*) is responsible for regularly checking the use of the assigned resources through an audit channel that informs System 3 about the state of affairs at the operational level. While S3 focuses more on controlling the allocation of resources, S3* mainly focuses on controlling the usage of the resources allocated.
- *System 4 (S4) – Planning*: It is the system responsible for defining strategies and long-term forward planning that lead to adaptation to future trends in the external environment.
- *System 5 (S5) – Policy*: It comprises the ultimate authority and ground rules for the system as a whole, establishing supreme values, policies and norms that apply to the whole system.

As shown in Fig. 1, these core systems are connected via information channels that work as two-way communication loops of variety attenuators and amplifiers. Moreover, they recur within various instances of an organization, comprising critical organizational functions. For example, some systems focus on operational activities and decisions concerned with the internal environment (the “inside and now”), other systems focus on strategic decisions and actions concerning long-term adaptation to the external environment (the “outside and then”), and others focus on normative decisions and actions concerning the governance of the system as a whole.

**Fig. 1. The Viable Systems Model – VSM** (Adapted from Beer, 1984)




Barile and Polese (2010a) have considered the survival capacity of viable systems in a constantly changing environment. Due to its coordination and control mechanisms, a viable system has the capacity to dynamically adjust its structure and behaviour to achieve consonance with its context and thus preserve its stability. In essence this represents the homeostasis property of systems (von Bertalanffy, 1968), which refers to a system’s capability to adapt to external and internal disturbances (contextual variety) and restore its point of equilibrium in order to maintain stability and viability (Ashby, 1956). From a business perspective, homeostasis refers to a company’s ability to maintain its state of equilibrium by counteracting internal and external turbulences through adaptation, i.e. attenuation or amplification, of contextual variety (Beer, 1981). For instance, collaborative homeostats that ensure the continued viability of a system involve an organization’s ability to align its operations with its customer’s environment as well as the organization’s ability to achieve stability in terms of managing the present with focus on the future (Ng *et al*., 2012). Practical perspectives of this are, for example, the cooperative approach that some companies adopt to assure their competitiveness in the market (Vendrell-Herrero *et al*., 2016) or the introduction of new digital products that change providercustomer relationships and allow the provider to gather data and learn from the client (Coreynen *et al*., 2016).

Finally, a further theoretical aspect the study takes into account is derived from the work of Barile and Polese (2010a, 2010b). According to them, the management of a viable firm requires transformation of static structural relationships into dynamic interactions between sub- and supra-systems. They argue that “*the ability to organize relationships demonstrates top management efficiency and is a main characteristic of viable systems*” in business terms. These relationships enable what Barile and Polese (2010a) term as “*consonant*” (i.e. compatibility between the actors of a system) and “*resonant*” (i.e. harmonic interactions between actors) behaviours that reinforce the viability of the system as a whole.

This can be linked with a particularly relevant aspect of OBC systems, which refers to the dynamic interactions between the provider and the customer to guarantee that the resources the system needs to achieve expected outcomes are properly integrated and allocated over time. Ng *et al*. (2013) recognize the critical importance of relationships in complex service systems. They argue that the building of co-capability in OBC systems requires all stakeholders to invest in relational assets that are both value-driven and partnershipfocused. Relational

governance assets comprising inter-organizational exchanges complemented by social relationships are particularly significant for consolidating cooperation, reducing costs, and enabling flexibility to facilitate adaptation to environmental changes.

The theoretical aspects presented above provide the underlying principles, concepts and frameworks that guided the analysis conducted in the study. Specifically, the unity of analysis in the study is an OBC service system being implemented in the UK defence sector. It comprises, on one hand, large manufacturing organizations providing outcome-based services and, on the other hand, a customer organization involving different government departments and institutions. This complex structure involving provider and customer organizations is analyzed from a VSM perspective, where the system-in-focus comprises resources and processes of the provider firms and the supra-systems represent the customer controlled systems where the providers' resources are integrated with the customer's resources, within the customer's space, to achieve the expected outcomes.

The VSM Systems S1 to S5 comprise the different operational, managerial and governance levels of the OBC system as a whole where provider and customer systems entwine, to a higher or lower degree, to achieve service outcomes collaboratively. Variety can be seen as the changing external and internal environmental circumstances faced by provider and customer organizations, and thus faced by the OBC system as a whole. Finally, the homeostatic elements in the system represent the mechanisms that enable transformational adjustments (i.e. attenuations and amplifications) implemented to face variety and therefore preserve the stability of the OBC system as a whole.

## 3. Research methodology

A case study approach was taken to develop the study. Qualitative research methods were used to derive insights from a specific OBC service system, including structures, processes, personnel and interactions involving provider and customer organizations. In conformity with qualitative research strategies (Bryman, 2012), we employed a variety of techniques such as observation, analysis of texts and documents, interviews, and recording/transcribing to extract data for the purpose of understanding and analysis. The logic behind using multiple methods is to achieve an in-depth understanding of the dynamics arising from service delivery through OBC (the phenomenon in question) and related operational and managerial contexts.

The provider and customer organizations in the case were selected according to theoretical sampling of single cases (Yin, 1994), where the organizations were purposefully targeted because they featured comprehensive examples of OBC implementation initiatives and provided ample opportunity for research access (Eisenhardt and Graebner, 2007). The organizations in the case were also involved in an unprecedented servitization initiative through an OBC comprising two large manufacturing corporations and the British Ministry of Defence (see Section 3.1). This created a timely phenomenal opportunity for scientific investigation of the subject in the defence industry. Given the scale and the complexity of the operations and organizational structures involved, the VSM represented a suitable framework to address viability issues concerning the systems perspective of the phenomenon.

In the case, the OBC service contracted was fully operational by 2012. Primary data was collected from semi-structured interviews in that period. 50 managers from provider and customer organizations were interviewed in face-to-face sessions that lasted two hours in average. The interviews were audio-recorded and subsequently transcribed, coded and categorised with the support of the software QSR NVivo 10. The participants were highly knowledgeable managers selected in a balanced way (similar numbers) from provider and customer organizations and from key departments and hierarchical levels linked to operations, strategic management and governance activities. The themes developed in the interviews referred to the circumstances in which services are required, the operational implementation of services, the joint allocation of resources to achieve service outcomes, relationship aspects, and how decisions and strategies are made and communicated within and between organizations.

Inductive coding was used as the constant comparison analysis method (Leech and Onwuegbuzie, 2007) applied to identify codes emerging from the entire dataset. This method is commonly used when a researcher is interested in utilizing an entire dataset to identify underlying themes emerging from the data (Miles and Huberman, 1994). The emerged themes were systematically matched to theoretical aspects concerning systems variety, adaptations (from the perspective of attenuations and amplifications) and relationships.

Guba's (1981) credibility qualities of trustworthiness in qualitative research were observed by the study. Accordingly, (1) trackable variability was ascribed to sources in which variability stem from the range of experience rather than the average experience; (2) data was collected from, and peer examined by, persons who

are familiar with the phenomenon being studied; and (3) triangulation of data source also involved persistent observation on service sites. As suggested by Lincoln and Guba (1985), the latter activity included prolonged engagement, i.e. adequate submersion in the research settings to enable recurrent patterns to be identified and verified. The investigators were responsive and adaptable to changing circumstances, with professional immediacy, sensitivity and ability for clarification and summarization.

### *3.1. The context of the Study*

In the study, a major outcome-based service contract system involving the UK MoD - Ministry of Defence (the customer organization), and two major manufacturers (the providers) in the defence industry was investigated. The provider organizations are two prime manufacturers of fast jet aircraft and engines in the military aviation and defence industry. The service contract specifies expected outcomes in terms of availability of aircrafts and related engines and mission systems. The companies support the British fleet of Tornado military aircraft and their engines, as well as the new Typhoon military aircraft fleet, which is set to gradually replace the Tornado fleet over the years.

Typical of OBC, the service performance is rewarded on the basis of measurable outcomes in terms of the timely availability to the RAF (Royal Air Force) of aircraft (available flying hours) and engines, spares, trained maintenance personnel, and technical advice. The service contract was described by all parties as “partnered support contracts”, which involves a degree of co-location of customer and supplier at either the customer’s or the supplier’s premises, and were facilitated by the supplier’s day-to-day use of “Government Furnished Assets” (jargon termed “GFx”) including personnel, facilities, spares, services and data provided by the MoD. The OBC service system operates under complex relationships between providers and customer entities, since the service delivery requires both parties (providers and customers) to focus on achieving outcomes. That is, the customer co-produces with the providers to achieve the expected outcomes.

### *3.2. Applying the VSM framework onto the OBC service context*

To facilitate understanding of the complex service system being studied, the VSM provided the theoretical framework for investigation of interactive processes between key personnel, main activities, organizational structures and the ability of both the provider and the customer to co-create activities to achieve expected outcomes. Homeostatic aspects in the system represented the adjustment mechanisms implemented by both provider and customer to achieve co-capability.

As mentioned, the system-in-focus comprises the providers’ system of equipment provision and availability, and the supra-systems are where the providers’ equipment and various other resources are integrated within the customer’s space for use in combination with customer’s resources to achieve the expected outcomes. The supra-systems are controlled by the customer at a recursion level above the system-in-focus. Understanding the supra-system that is controlled by the customer therefore allows an understanding of the variety faced by the system-in-focus.

In practice, the VSM helped to depict the structure of the OBC service system in a holistic way, including main operational and managerial components as well as the information and communication channels between the key components of the system involving the providers and customers. The framework was essentially useful for making organizational structures and links visible and comparable in terms of operational, managerial and governance processes.

## 4. Research findings

An initial examination of the OBC origins and background in the subject context revealed that the MoD reached towards “partnering” with its major industry suppliers as a contractual philosophy through intuition and an extension of practice and precedent rather than from any robust theoretical foundation. The rationale for OBC adoption was simply that traditional maintenance, repair and overhaul contract models were demonstrably wasteful and leading inexorably towards an unaffordable future. In fact, a recent study by Lee, Yoo and Kim (2016) revealed that servitization is a more cost-efficient strategy when the goods involved require a high level of service, which is the case of the RAF defence fleets. Moreover, at least for the Tornado fleet, which have been in operation for a number of years, there would be a reliance on both customer manpower and equipment resources, i.e. GFx that was best managed jointly. In terms of manpower, there were severe doubts that the

industry providers could resource all of the necessary trained maintenance technicians from the local economy at a reasonable price.

From the perspective of the OBC system, the high degree of contextual variety is represented by an increase in the heterogeneity of the contexts that deviate from the most likely contexts of use for which the service was originally designed. For instance, investigation of contextual variety in the operational systems showed that modern warfare is expeditionary in nature, requiring aircrafts to be deployed to varying locations where they and their supporting cast of aircrew and ground-crew may be put in harm's way. Also, fast jet aircrafts are complex engineering systems, densely packed with mechanical, electro-mechanical, electric, hydraulic, and electronic equipment that are required to operate at the top of their performance range in a far from benign environment in terms of temperature and vibration. As a consequence, they develop faults far more frequently than their civilian equivalents operated in far more sedate environments. Furthermore, to ease the maintainability of so densely packed products, a philosophy of repair by replacement of "line replaceable items" (LRIs), i.e. items consisting of a cluster of parts that can be taken out when component parts are faulty, has evolved. This approach creates a modular boundary for changing systemic components that was a tradeoff between what is efficient for the maintainer and effective, in terms of time, for the customer. This also resolved the tension between squadron operations and off-aircraft repair sites, and a potential cost resulting from "information hiding" regarding the LRI's usage and its fault history. For example, it is not uncommon for an LRI to be removed from an aircraft only to be diagnosed as "no fault found" when tested in the repair bay. It is not unreasonable for this LRI to be returned to service in this case, as it has been removed by mistake through erroneous front-line diagnosis. However, from a customer perspective, it would be unreasonable for the same LRI to cycle back and forth to the repair bay without some alternative intervention. A contractor paid by a fixed amount per "repair" may see it otherwise.

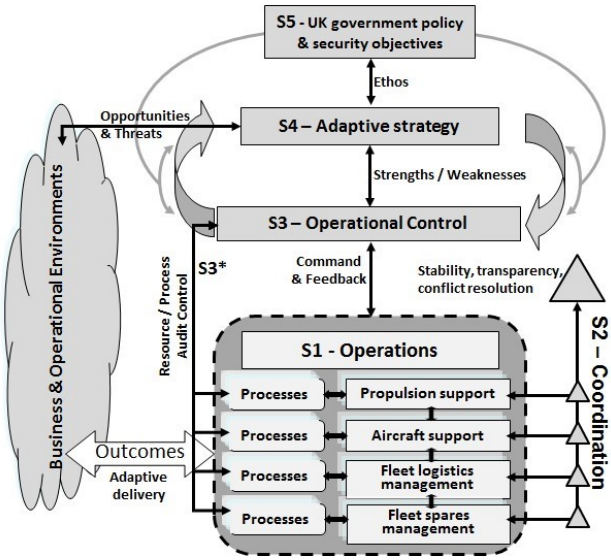
These findings confirm that contextual variety threatens the stability of the system and challenges cocreation for outcome achievement. This calls for a more in-depth analysis of operational elements and homeostatic processes developed to keep the viability of the system. As mentioned, we have applied the VSM to support such analysis.

### *4.1. VSM Analysis*

Many previous studies have applied the VSM to analyze, describe, explain, and understand organization structures and related structural relationships (Holten and Rosenkranz, 2011; Jackson, 2000; Kawalek and Wastell, 1999; Vidgen, 1998). In this study, we used the VSM to investigate functions, structures, and links (relationships) involving both the provider and the customer organizations in the OBC service systems examined. The model was used to depict the structural design and relational links involving the system-in-focus and related supra-systems at different recursive levels for the Tornado and the Typhoon OBC.

The technologies of the aircrafts and related engines/avionics (electronic equipment fitted in the aircraft) for the Tornado and the Typhoon fleet present different features. Despite the technological differences, the general operational, managerial and governance structures deployed to deliver the OBC service for both fleets are similar. It is possible thus to describe the service system configuration for both fleets analogously, with basis on the classic VSM model. Fig. 2 shows the VSM structure for the major operational and related managerial/governance systems of the OBC system studied.

**Fig. 2. The VSM for the OBC system studied**




A key aspect of the system shown in Fig. 2 is that, despite having clear objectives, the component systems (S1 to S5) are not implemented by the provider or the customer exclusively. They all involve a degree of resources jointly allocated by the provider and the customer organisations. For instance, at S1 system level equipment availability is mainly operationalized through the propulsion and aircraft support processes as well as logistics and spares management processes. These processes are predominantly led by the provider, but they also require personnel, premises and data from the customer organisation. By their turn, governance processes at S5 level are predominantly led by the customer, but they also require personnel and data from the provider.

*4.1.1. Systems S1 to S5 in the OBC Studied*

In the model, S1 comprises the main operations that deliver the OBC outcomes. According to Beer (1981), S1 operations justify the existence of the system as a whole. It includes the management of the operations, but excludes senior management, which is comprised by other systems in the VSM. In the context of the OBC studied, S1 encompasses operations such as maintenance of aircrafts and related engines/avionics to guarantee equipment availability. It also includes management of the capability of repair bays in order to ensure rapid turnaround of LRIs, as well as logistics and inventory management of part spares to ensure that they are available for repair activities and the operations do not suffer from shortages. One respondent summarized S1 operations as:

> "*…in terms of repair solutions, they involve the engineers that drive these reliability improvement programs as we move forward... They're the, sort of, key areas, engineering, inventory and maintenance. So, that's really my value stream, effectively.*" (Operations Manager, provider)

System S2 coordinates resources and processes between the various operations and recursions in S1. It works as a regulatory centre for each of the S1 components and it also comprises an overseeing regulatory centre at senior management level that links the internal coordination of S1 with the higher managerial instances. This gives S2 the ability and authority to handle resolution of conflicts between the various activities taking place in S1, toning down disruptions and ensuring that interactions are kept stable. In the OBC context studied, S2 conducts relevant service support functions for S1, such as information systems and IT services, finance, human resources, engineering authority, and supply chain functions from provider and customer organizations. An example of S2 level management process is:

> "*I do manage the distribution of resources through the operational units according to their planned demand and mission priority. Unexpected missions may require quick changes that conflict with previously planned resource allocations. By managing resources at a level slightly above the operational units we are able to deal with these conflicts.*" (Inventory Manager, provider)

By its turn, System S3 has an executive function, supervising the coordination activities of S2, as well as controlling and auditing resources and processes in S1. It is the key controlling bridge between the activities in S1 and S2 and the top management activities in S4 and S5. The audit channel S3* allows S3 to obtain more elaborated audit information, rather than relying on information provided by operational divisions only. By

comprising activities such as accounting, production planning and control, and audit rules, resources and rights, S3 supervises all internal operational activities from a higher point of view of the total system. It leads resource bargaining and lobbying, which includes negotiation of resource allocation to the operations, and regular checking of the use of resources. This is illustrated by the comments below from a respondent in S3:

> "*…if we decide that we should spend less money on engineers and more money on supply chain people, for instance, we can make that choice and I'm the ultimate approver and authoriser that can move that money from one place to the next…I'm balancing cost and performance, so I'm the person who's actually, if you like, putting the brakes on for people who want to spend any amount of money to achieve any amount of performance. I'm the person saying no, no, no, we only need to provide 17 aircraft this month. There's no reason to provide 18, don't spend the money*". (Finance Director, provider)

System S4 is concerned with the external environment of the system. It can be seen as the "external eye" of the system as whole, being responsible for monitoring the external environment, assessing threats and opportunities, and making plans to ensure that the system can adapt to a changing environment. It comprises strategy and marketing functions, which give S4 the ability to scan the environment, forecast a future and plan for it. The close link with S3 allows S4 to have a clear view of the current state of affairs in the system and to plan its future state, including definition of future resources and development of new service offerings. The intelligence processes in S4 address eventualities, perspectives and responsibilities that are beyond the sight of managers in other systems. As an S4 level manager puts it,

> "W*e do all the forecasting and planning for the avionics value stream, which means we try to pull together the whole end-to-end service for avionics, so from, you know, the support of the equipment off-base to spares, planning for its management of the brought out budget and then just for a delivery of the avionics availability.*" (Director, provider)

Finally, System S5 applies established policy and ethos to ensure a balanced interaction between S3 and S4 and that the system as a whole function within policy guidelines. Ultimately, the strategic governance of the entire OBC service system sits within S5, where board of directors' activities take place. In the OBC studied, the board comprised members from the MoD linked to the higher echelon of military institutions, and from the contractors linked to the higher echelons of their company. An example of S5 level role is:

> *"We are looking for as much synergies as we can between Tornado and Typhoon… the key challenges that I've got is (a) operating across different stakeholder groups; and (b) trying to find ways of standardising two very distinctly different products…So, the approach at the moment is to*

*try to come up with a single business, multi-product way of operating."* (Government Officer, customer)

### *4.1.2. Boundary Fuzziness*

When analyzing the creation of co-capabilities in the service system, we have observed a peculiar feature of the OBC system concerning its boundaries. Usually, the essential activities from S1 to S5 involve integration of processes and resources from the provider and the customer organizations. Such integration enables the achievement of outcomes by the OBC system as a whole, rather than by one single organization. An OBC system can therefore be seen as a service system interlinking provider and customer systems whose boundaries overlap in order to achieve the expected OBC outcomes. In this sense, the classic systems' perspective of organizations whose system boundary places customer resources in an environment external to the system-in-focus (Katz and Khan, 1966) does not necessarily apply in an OBC setting where the boundaries of distinct organizations (provider and customer) entwine in a fuzzy way to form a broader complex service system of collaborative outcomes.

We have found that the fuzzy boundaries of provider and customer systems embraced by an OBC service system are a source of ownership problems as there is no central control. As some respondents put it:

- *"The [contract] doesn't have a strong tree [sic] which is in a system perspective; there is no ownership of the availability system."* (Operations manager, provider, S2 level)
- *"…the ownership [of the system] is not at an enterprise level… at multiple levels there has been a dilution in terms of ownership and accountability."* (Engineer authority, customer, S5 level)

In fact, in an OBC system the provider and the customer systems are intertwined in many circumstances. Considering customer resources as being in an external system makes no sense in an OBC context, where GFx (Government Furnished resources) including personnel, facilities, spares, services and data are jointly managed by the provider and customer on a daily basis. Hence, in OBC systems the boundaries of the systemin-focus extend to include that of the customer and, as organizational boundaries become fuzzy, considering the scope of the system in terms of its overall purpose rather than its organizational borders holds together the many processes and resources from both organizations within a rational space.

The boundary fuzziness is however less characteristic at S5 level of an OBC service system. More specifically, despite involving provider resources (i.e. top executives of contractors' higher echelons) S5 is a governance system that predominantly consists of customer resources and processes. This reflects what was found during the research: The co-located provider and customer delivery teams were generally quite closecoupled, but their respective higher management echelons were less coupled. For this reason, the organizational boundaries are more visible in S5 compared to the organizational boundaries of the other systems. Nonetheless, the purpose of the system is still a crucial aspect to be considered in all instances, as without a purpose it is impossible to define a system boundary (Richardson and Pugh, 1981).

## *4.2. Variety Aspects*

Further findings from the study relate to the high level of internal variety in the system not in terms of requisite variety implemented, but in terms of variety internally generated by distinct organizations (provider and customer) acting together in the OBC service system. This can be explained by the fact that OBC service systems typically have a substantial number of processes which are carried out jointly by the provider and the customer in different functions and recursive levels. As mentioned before, the ownership of such processes is in several circumstances unclear for the organizations involved and this is likely to be hindering consistency of resources across functions, convergence of assumptions and expectations, control and coordination of processes, and negotiation of priorities. Moreover, there is also performance variability in terms of the way the contract is measured (i.e. contract performance), as evidenced by the respondents' comments below:

- *"We do suffer quite a lot of disruption... sometimes the [contract] picture isn't particularly clear and sometimes it's very, very clear, but we do suffer from quite a lot of disruption but it comes from a variety of sources because we have multiple stakeholders."* (Engineer, provider, S2 level)
- *"…the contract doesn't stay the same, it's constantly being changed… so more and more things are coming into the contract and… so the baseline changes constantly as we move forward."* (Account Manager, provider, S3 level)

As a consequence of this variety, many different KPIs (Key Performance Indicators) are applied to measure equipment availability, including spares delivered at different recursion levels involving different stakeholders. For instance, in terms of delivery of spares, the variability of KPIs is driven by the thousands of parts and related components in LRIs necessary to guarantee availability of aircraft fleet. The overall performance of the contract is therefore affected by this wide variety of components and units to be repaired or maintained at operational level. This contributes to an increase in the level of internal variety faced by both the provider and the customer. This aspect is evidenced by a number of managers who were interviewed in the study. We highlight below some of the opinions that corroborate this potential problem in OBC systems:

- "*decisions are not rational… we have real issues and that's where a considerable amount of the disruption comes from*" (Finance Manager, customer, S3 level)
- "*I think we get the best information that's available, but there's so much uncertainty within government*" (IT Manager, provider, S2 level)
- "*the way they're structured is not aligned to the advance in technology and it's not aligned to the world politics*" (Marketing Manager, provider, S4 level)
- "*you'll have people that have very strong political or business views that will heavily influence the systems at different levels and in fact, possibly even, at all levels*" (Senior Government Officer, customer, S5 level)

Further analysis of individual agents and their interactions across managerial functions at different recursion levels of the OBC service system for Tornado and Typhoon revealed that to deal with the high level of internal variety in particular, as well as the variety coming from the external environment, managers from the provider and customer organizations interact on a regular basis through formal and informal relationships instances. These interactions proved to be a crucial mechanism to sustain the viability of the system as a whole. This interesting aspect of an OBC system is also a good example of how human resources are used to "attenuate" the impact of variety in the system. For example, by monitoring and engaging with the customer on a regular basis the provider creates opportunities to attenuate internal contextual variety. Our study expands on this aspect by specifying a typology of key relationships in OBC contexts, as discussed next.

### *4.3. Critical Relationships in OBC Systems*

Mechanisms to deal with the law of requisite variety as well as the design of structural sub-systems and related communication channels are central to VSM applications (Vidgen, 1998). The communication channels deal with internal variety between sub-systems in homeostatic loops aimed at balancing interactions. These interactions are manifested through relationships between individual agents from different managerial functions and levels of the system.

Our research findings confirmed that OBC systems involve complex relationships between customers and service providers that rely heavily on tangible (equipment) and intangible (knowledge and experiences) resources as well as information-based relational assets to achieve the outcomes of the contract. The findings point out key relationships that fundamentally determine the performance of the contract, acting as mechanisms that allow the provider to intervene in the customer-controlled supra-system in order to ensure structural and systemic stability, therefore reducing variety not only in the system-in-focus, but also in the supra-system.

Moreover, the key relationships identified in the study allow strategic and operational alignment between the firm and the customer systems in order to achieve OBC outcomes. From a systems perspective, the relationships between the firm and the customer can be seen as homeostat mechanisms that ensure the continued viability of the system. They absorb variety by allowing the firm to align its tangible (e.g. material and manpower) and intangible (e.g. expertise) resources with complementary resources provided by the customer.

Specifically, the relationships identified seem to be an efficient way to guarantee the availability of resources in the OBC system. They reinforce the coordination and harmonization between the system-in-focus and the customer-controlled supra-system, maximizing co-capability achievements. They are practical examples of how a system can create consonant (creation of compatibility between provider and customer) and resonant (development of harmonic interactions between provider and customer) behaviours that sustain the viability of the system as a whole (Barile and Polese, 2010a; Golinelli, 2010).

Table 1 provides a typology for the critical relationships we have identified in the study. In general, these relationships influence the congruence of expectations between the parties involved, the consistency of resources

allocated, their complementary competencies, the convergence of assumptions and expectations, the control and coordination of processes, and the negotiation of priorities.

**Table 1. Critical Relationships in OBC Systems**

| Relationship type | Purpose |
|---|---|
| *Check resource consistency* | To check internally whether there is consistency in resources (e.g. manpower, budget, materials, etc.) that need to be available for yielding an expected outcome. This is important because in the military context of the OBC studied, customer personnel can be redeployed for different missions. Since outcome achievement is co-resourced (i.e. manpower from the customer is used), this relationship asset ensures that the necessary manpower was consistently available so that outcomes are not compromised. |
| *Check assumptions* | To ensure that the provider and the customer have the same assumptions about the future, the missions and the outcomes to be achieved. |
| *Negotiate priorities* | To establish clear priorities of actions. In times when resources may need to be redistributed, especially when mission capabilities require resource peaks, this relationship asset keeps the communication channel open so that priorities could be negotiated or renegotiated to lower the cost of resource use variety (e.g. peak time may require more resources which are costly). |
| *Develop harmony* | To set proper expectations, i.e. calm people down. This relationship asset tries to synchronise views and perspectives around specific outcomes to be achieved. |
| *Lag control* | To manage expectations concerning lead time. This relationship asset makes teams aware of the time necessary to deliver specific tasks and potential delays ahead. |
| *Gather intelligence* | To specify future implications and consequences of current actions and situations. It is also related to lag control because if you have more intelligence about delivery times, you can anticipate and lower the cost of lag. |

It is important to mention that these relationships are mainly tacit initiatives developed through formal and social interactions between provider and customer members of staff at the management level, i.e. coordination (S2), control (S3), planning (S4), and policy (S5) levels. They represent homeostatic loops that enable the development of co-capability in the OBC system. The manager's comment below provides an illustration of this aspect.

> *"I've built strong relationships, obviously, in the maintenance world, in the inventory world and in the engineering world… those relationships are very important to me. They're working relationships that are being [developed] effectively… I already had relationships with these people, but what's happening now is, because of the value stream, we're going to look at colocation, which is a very important move, as far as I'm concerned, to get the integrated working that we need…"* (Project Manager, provider, S2 level)

Another important point to consider is the balance between competition and cooperation across the organizations involved in the OBC service system. Previous studies have found that trust is more likely to be sustained in geographically concentrated networks, in the sense that firms within networks benefit from the reciprocal exchange of information and the benefits of collaboration can overcome the negative externalities of competition (Newlands, 2003). In the context of the OBC system studied, providers and customers are geographically collocated in many operational instances of the service and the achievement of co-capability is an inherent concern of the management teams. The many operational and managerial networks involved in the OBC system very likely favor the development of the relationships above described.

## 5. Conclusions

### *5.1. Theoretical contributions*

This research makes important contributions to the servitization theory to explain service implementation by manufacturing firms through OBC. A first important point is that servitization through OBC requires a mindset change towards service value co-creation. Nordin and Kowalkowski (2010) argue that solution providers would benefit from replacing their product centric view of solutions with a relational process view. We agree with their view and add that viewing OBCs as product-oriented solutions is too "reductionistic" in assuming that the gradual aggregation of service steps in the offered solution makes the whole. What this view fails to take into account is the complex interactions that result from adding service components. For example, in the case of moving from selling surveillance cameras to offering 24-hour security, the provider will certainly want extremely low failure rates in the camera, probably more secure communication and to train security staff on how to monitor for suspicious activity. All of this requires a complete reconfiguration of product design that will also include discussing with the customer the location of cameras and staff. From these aspects, we derived the following proposition.

> **Proposition 1**: *Servitization through OBC requires a shift from a product-centric view of solutions to a relational-process view of solutions.*

In other words, the product-centric view of service does not fit servitization through OBC, which requires a relational-process view of solutions where co-capability is a fundamental requisite. This reinforces evidence of previous research suggesting that customers prefer solutions that include provider-customer relationship processes to facilitate the definition of customer requirements, customization of services and post deployment support (Tuli *et al*., 2007). Moreover, the relational-process view fits the advanced manufacturer's service category suggested by Baines et al. (2013), in which the range of service activities stretches beyond production competences to take on activities that are internal to the customer. Indeed, in the OBC service system we analyzed many of the provider's servitized operations shown in Fig. 2 take place at RAF facilities and are implemented with the support of RAF staff.

Another important contribution of the research sheds light on how major manufacturers in the defence industry are developing servitization initiatives through OBC systems. The implementation of OBC in this sector is a response to market demand for more cost effective service systems. It represents a distinctive servitization format that fits Cusumano, Kahl and Suarez's (2015) view that the way firms servitize is contingent on industry evolution and characteristics. We agree with this point of view and add that, due to their expeditionary nature, OBC service systems in the defence sector is also contingent on short term variations in the environmental circumstances faced by the system.

Such contingent variety brings increased complexity to OBC service systems, where variations may arise from changes not only in the external environment, but also in the internal environment. The internal variations originate either from the provider or from the customer themselves, as suggested in previous studies (Palmatier, 2008). In this sense, variations from the customer sphere do not necessarily represent external variety faced by the system. Considering that (1) the study shows high level of internal variety in OBC service systems and (2) in OBC systems the customer is an important active element jointly delivering the service, we derive a second proposition as follows.

> **Proposition 2**: *In servitization initiatives through OBC systems, variety arising from the customer organization is mainly an issue of internal variety, rather than variety originated from the external environment.*

Following from this proposition, a further important outcome of the research refers to the critical relationships that can purposefully deal with the high level of internal variety in OBC systems. Previous studies have acknowledged the importance of relationships in servitized contexts (Oliva and Kallenberg, 2003; Coreynen *et al*., 2016; Vendrell-Herrero *et al*., 2016). For instance, the development of provider-customer relationships is essential to cooperative approaches in servitization initiatives (Vendrell-Herrero *et al*. 2016). Bastl et al. (2012) have found that buyer-supplier relationships allow more open exchange of information between the parties and strengthen operational linkages. For Kastalli and Van Looy (2013), servitization requires greater provider-customer interactions, which lead to more detailed knowledge of customer needs as well as improved service development and engineering work. By their turn, Sacanni, Visintin, and Rapaccini (2014) have found that the technical information needed by a supplier should be coupled with an increasing degree of knowledge of customers and their processes. This can be illustrated by the digital integrations that some providers develop with the purpose of improving their learning capabilities regarding customer needs and preferences (Coreynen

*et al*., 2016). The aspects above entail an increase in the amount of information exchanged between provider and customer, as well as the establishment of relationship-specific adaptations. We add to these studies by emphasizing the 'purposefulness' and the 'criticality' of such relationships, which we elaborate in the following proposition.

> **Proposition 3**: *The development of purposeful relationships between the firm and the customer are critical to guarantee the viability of servitization initiatives through OBC.*

Furthermore, the study specifies critical relationships (Table 1) through which attenuation and amplification adjustments in a service system can be continuously planned and designed, enabling co-capability and organizational flexibility for adaptive delivery of equipment availability in more cost-efficient ways. This links to Holten and Rosenkranz's (2011) argument that attenuators and amplifiers need to be designed. When they are not designed, they will occur because Ashby's law asserts itself (Beer, 1981); however, in this case variety is balanced at a greater cost.

A final important outcome of the research is the identification of potential process ownership problems related to organizational boundary fuzziness. The phenomenon of boundary fuzziness is a consequence of the substantial number of processes flowing across different functional areas requiring co-capability and colocation of tangible and intangible assets (e.g. materials, infra-structure, people, information and knowledge) from the provider and customer organizations in order to achieve expected service outcomes. Not uncommonly, the ownership of many processes in the system becomes unclear because of the complex configuration of the joint activities, interactions and structures involving the provider and the customer in several operational and managerial instances of the OBC system.

To deal with this problem, it is essentially important, particularly in OBC systems, to consider the notion of system purpose as proposed by Forrester (1968). He argued that a fundamental basis for identifying and organizing a system structure is to have a proper and sharp definition of the purpose of the system. With basis on this premise, we derive the following proposition.

> **Proposition 4**: *Organizational boundary fuzziness is an inherent feature of OBC service systems, in which the operational, managerial and governance functions should be primarily determined by the systems' purpose and not limited by organizational boundaries.*

### *5.2. Managerial contributions*

In order to shed light on the systems features of OBC services, the study develops a VSM structuration of the phenomenon, revealing the operational, managerial and governance structures necessary to preserve the functional viability of the system. By doing so the study provides a pioneering VSM perspective of OBC systems being deployed as major servitization initiatives taking place in the defence area.

The outcomes from the VSM analysis provide useful managerial insights. For instance, one general outcome identifies the functionalities of critical component systems (S1 to S5) in the OBC, which can be used as a valuable reference in the management of future servitization initiatives, where similar operational, control and governance structures can be replicated. We have found the model particularly helpful to represent the complex structure of the large scope of the OBC system being implemented in the defence sector, where systems S1 to S5 can be more clearly represented. However, in servitization initiatives of reduced scope implemented by SMEs for example, S2 to S5 systems are usually merged into more general management structures. In this case, the component systems would not be clearly identified through the VSM framework.

The research has also shown that when an organization is contracting for outcomes, relationships are a key factor in the performance of the contract. The typology of key relationships specified in the study provides a helpful reference for provider and customer organizations involved in OBC systems to develop vital interactions in a more purposeful fashion, rather than on an ad hoc basis. The relationships can potentially act as practical mechanisms that allow the provider to engage with the customer-controlled supra-system, creating intervention opportunities for the firm and, this way, absorbing the variety faced by the service system. Consequently the viability of the system as a whole is reinforced. The relationships can also be seen as the means through which the provider can assist the customer organization to adjust resources and materials necessary to achieve contract outcomes. Such systemic interactions build co-capability competence in terms of equipment use by customer and provider, allowing therefore the achievement of greater viability and stability for long-term equipment outcomes. Following from these aspects, we can conclude that to guarantee availability of resources in an OBC system, the management should reinforce the coordination and harmonization of the relationships across

different functions and levels of the system in order to maximize the contributions made by both the provider and the customer.

Process ownership is a potential problem that should be dealt with appropriately. Problems concerning process ownership in manufacturing companies have been identified in previous research (Kohlbacher and Gruenwald, 2011), where empirical evidence suggests that managers should develop efforts to establish process owners. Yet, the issue remains to be further explored in the servitization context. Because cocapability is fundamentally required in OBC service systems, we imply (Proposition 4) that organizational boundary fuzziness is an inherent feature of OBC systems and related process ownership problems should be dealt with through a purposeful definition of the functional systems and the development of relationship mechanisms that enable dynamic adjustments of joint capabilities. Because they support contingent adjustments, we argue (Proposition 3) that these relationship mechanisms are critical to the implementation of OBC service operations.

Moreover, a peculiar aspect of the issues concerning process ownership and the implementation of relationship mechanisms in OBC service systems is that they involve the customer organization. As the customer in this context is an internal element of the system, the issues relate to internal variety (Proposition 2). By being internal, the problem allows a higher degree of managerial control when compared with external elements of the system.

### *5.3. Limitations and further research*

The research here reported is not exempt from limitations. For instance, generalizations from case studies are context dependent. In this respect our findings are context specific and might not reflect the majority of outcome-based contracts. Specifically, the OBC system we analyzed comprises a service contract involving the UK Ministry of Defence and two major manufacturers in the defence industry. This represents a market configuration close to a monopsony with a duopoly scenario, where the competition level is most likely low. Conventional economic theory states that competition is a state characterized by the absence or minimization of monopoly rents and, conversely, when there are few buyers and providers they may collaborate in order to avoid external competition (Kurz, 2016). Our findings provide evidence of inter-organizational collaborations being developed with the intrinsic objective of achieving co-capability to deliver the service contracted. However, the market context of the organizations may also influence the motivations for the collaboration initiatives taking place in the phenomenon analyzed. A different perspective of this issue is that while collaboration provides opportunities for firms to pull resources together, the overriding imperative of their motivations remains that of being competitive in the market (Newlands, 2003). In this sense, the decision to develop closer relationships with others might involve a trade-off between the benefits of mutual collaboration and the potential loss of competitive advantage. Research exploring the tensions between collaboration and competition in servitization initiatives through OBC would be valuable.

Overall, the methodology and outcomes of this study provide insightful basis for the development of future research that could apply a similar approach. Although external generalizability cannot be claimed for this study, our investigation contributes to analytic generalization, i.e. our abstractions and findings contribute to the theory of the phenomenon being studied, a theory that may have much wider applicability than the particular case studied (Maxwell, 2005; Yin, 2003). In practical terms, the unique characteristics of OBC service systems which are addressed in this paper provides particularly useful insights concerning the implementation of this type of servitization initiative not only in the defence industry, but also in other industrial sectors where servitization initiatives involve complex configurations of provider and customer organizations.

The VSM analysis here developed has widespread applicability, for it can be applied to facilitate the understanding of service systems with high level of complexity. As Beer (1985) stated, the unit of analysis might be a firm, a consortium or even a national economy. This gives rise to a consideration of the VSM framework across a networked organizational structure in further research on servitization through OBC. In this paper it is not our intention to argue that VSM provides a better theoretical basis to explain servitization through OBC phenomena. We aim to provide a VSM perspective that is original per se and to offer the academic and practitioner community a supplementary perspective to explain a complex servitization phenomenon. We do acknowledge that other theoretical backgrounds such as strategic alliances/partnerships and relational contracts can also provide relevant explanations for the phenomenon of OBC in servitization. Further research building upon these theoretical lenses would be welcomed.

Finally, the typology of key relationships specified in this study can be used as a reference for further research to examine the dynamics of firm-customer relationships in complex servitized systems in other contexts, refining this way the initial classification here developed and expanding on issues concerning cocapability coordination

and alignment. Further studies could also consider relationships initiatives between firms with focus on trust development and analysis of the degree of criticality of each relationship. The investment in value-driven relational initiatives can potentially determine co-capability and, ultimately, the performance of the service system as a whole.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