

# Outcome-based Contract Performance and Co-production in B2B Maintenance and Repair Service <sup>1</sup>

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## Abstract

This paper investigates co-production in a B2B Maintenance, Repair and Overhaul (MRO) service contract where the firm is tasked to deliver *outcomes* of MRO service rather than activities directly related to maintenance and repair. Our qualitative findings show that the promise of outcomes has extended the boundary of the firm to include the customer system within its responsibility, resulting in the allowance of customer variety into the firm's system as the consumption of the service is contextual and varied. The ability to deliver the service in such an environment requires the firm's operations process design to be extended beyond supply chain management for material/equipment transformation, but to include information and people transformation as well. Through a quantitative study and Partial Least Squares analysis, the paper shows that outcome-based contract performance is dependent on the co-production alignments of behaviors and information but not material/equipment, with the alignments partially driven by the co-production inputs of complementary competencies and congruence of expectations.

*Key Words: B2B, services, outcome-based contracting, empirical, partial least square analysis*

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## Introduction

Business-to-business (B2B) services have seen an explosion of growth over the last two decades, aided in part by technology and globalization. This growth includes the increasing tendency of firms to outsource their activities to independent providers rather than delivering them in-house (Wilson and Smith, 1996). Many firms have found that specialized companies can now handle their internal services, for example, accounting, legal, recruitment or even R&D, much more effectively than they can do so themselves (Tschetter, 1987). Similarly, the maintenance, repair and overhaul (MRO) service of equipment are now outsourced to specialists that not only provide MRO services but often manage the supply chain, inventory and equipment obsolescence as well. As an indication, the world market for aircraft MRO is forecasted to reach US\$55.2 billion by the year 2015, aided by the expanding Asian aviation market, upcoming airlines in the Middle East region and aircraft purchases by low cost carriers globally<sup>4</sup>. MRO services for other assets such as wind turbines (US\$9 billion)<sup>5</sup>, shipping and other complex engineering equipment are now significant contributors to national economies. Yet, there has been insufficient research into this domain that would typically include both engineering and management perspectives. In particular, the delivery of value in such contexts which include a combination of physical engineered assets, people and processes has been inadequately studied (Maglio and Spohrer 2008; Basole and Rouse, 2008).

Our paper investigates the phenomenon of value co-creation and co-production in a B2B MRO service contract that delivers *outcomes*. Outcome-based contracting (OBC) is a contracting mechanism where the firm is tasked to deliver *outcomes* of an MRO service rather than merely activities and tasks directly related to maintenance and repair. This is the case for Rolls Royce “Power-by-the-hour®” contracting for their aerospace engines, where the continuous maintenance and servicing of the engine is not paid according to the spares, repairs or activities rendered to the customer, but by how many hours the customer gets power from the engine. OBC poses huge challenges to the firm, as outcomes can only be achieved in co-production with the customer which implies that the firm would have to incorporate the customer’s processes and competencies into the firm’s system so that such outcomes could be delivered.

MRO services are traditionally the domain of operations and supply chain management. However, our qualitative findings show that in *outcome-based* MRO services, value is delivered through three forms of transformation – the transformation of material/equipment, transformation of information, and transformation of behaviors

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<sup>4</sup> “Aircraft Maintenance, Repair And Overhaul (MRO): A Global Market Report”, Global Industry Analysts Inc., April 2009

<sup>5</sup> “Growth Opportunities in Wind Maintenance, Repair and Overhaul Services Market 2008-2013”, Lucintel, Jan 2009

(people) and in co-production with the customer, bringing in knowledge from organizational behavior and human resource management (OBHRM), strategy and marketing. The three transformations are value drivers because the delivery of outcomes has extended the boundary of the firm to include the customer system within its responsibility. Such an inclusion results in the allowance of customer variety into the firm's system, as the consumption of the service is contextual and varied. Through the understanding of value in marketing and by mapping value perceived by the customer onto delivery, we found that the ability to deliver the service in a high variety environment requires the firm's operations and delivery process design to be extended beyond mere functional logistic and supply chain processes for material/equipment but to include information and people transformation as well. In addition, the three transformations have to be achieved *in co-production* with the customer. To validate our qualitative study, our paper reports on a quantitative study conducted by applying Partial Least Square (PLS) analysis to investigate the firm-customer relationships in terms of co-production inputs, co-production alignments, intervening variables and contract performance, with confirmatory factor analysis (CFA) to evaluate our scales. The findings show that counter-intuitively, outcome-based MRO contract performance is not dependent on material/equipment process and supply chain alignment with the customer, since the firm is responsible for the outcomes of the equipment from their maintenance and repair activities. However, behavioral and information alignment is essential for contract performance due to the need to manage customer variety. Our results also show that all three alignments are driven by the co-production inputs of complementary competencies and congruence of expectations, and such a relationship is mediated by HR issues of perceived control and empowerment of individuals co-producing the service with the customer. Through this study, our paper contributes towards the understanding of the trans-disciplinary dynamics of delivery in a complex service system of physical assets, people and processes.

This paper is organized as follows. A literature review setting out the study is presented next, to be followed by the research context, design and administration. The qualitative study is then reported and its findings used to develop hypotheses for the quantitative study, supplemented with extant literature. The result of the quantitative study is then reported followed by discussions and conclusions.

## **Literature Review**

Over the past few decades, manufacturing and engineering firms have contributed to growth in services in the form of training, integration with clients' capabilities, consultancy and other services related to the provision of equipment (Ren, 2009). Indeed, for many manufacturers to remain viable, research has recommended that they diversify into the provision of services, focusing on meeting the needs of equipment usage, instead of merely equipment alone (Neely, 2009; Baines et. al. 2007). This has led to an increased need to understand the outcomes achieved by the combination of equipment, people and processes, and the nature of value consumed by the customer within a B2B context.

In understanding the customer, B2B marketing has discussed the nature of business markets (e.g., Fill & Fill, 2005; Ulaga, 2001) and acknowledged it to be generally more geographically concentrated, reliant on the derived demand of the customer's markets and focused on relationships and personal selling (Cannon & Perrault Jr, 1999; Dwyer, Paul, & Oh, 1987; Moller & Aino, 1999). The organizational buying behaviour is more formalized and dependent on key influencers and decision makers (Sheth, 1996; Webster & Wind, 1996). Literature in B2B also discussed channel organization, structure and networks (e.g. John, 1984), factors critical to success (e.g. Eid, Trueman and Ahmed, 2002), and management strategies in B2B environment (e.g. Webb, 2002). Channel management has also been covered in detail in marketing (e.g. Jeuland and Shugan, 1983/2008; Coughlan et.al., 2001), with scholars using transaction cost economics (e.g. Klein, Frazer and Roth, 1990; Heide and John, 1990) and game theory (e.g. Jeuland and Shugan, 1983/2008) to describe cooperation and conflicts between channel members.

From the marketing point of view, B2B research have traditionally focused on pre-purchase choice and buying behavior, a legacy of a goods-based environment where the responsibility of the firm often ends when the customer has purchased the equipment or other industrial products (e.g. Wuyts and Geyskens, 2005) as consumption of the good often does not involve the firm. Most of marketing's focus on post-purchase in goods is therefore on maintaining customer relationships (e.g. Gadde and Snehota, 2000; Gronroos, 2004; Palmatier, 2008), leaving the realization of the firm's value proposition (in the form of consuming the good) to the customer.

However, many B2B contracts are now service contracts such as maintenance, repair and overhaul of equipment or professional services where the consumption of the service would now *include* the firm (Bolton, Lemon and Verhoef, 2008), and relationships are embedded in the processes and interactions of service delivery between the customer and the firm over a length of time. Hence in B2B services, there needs to be a greater concern about post-purchase interactions which would impact on value, customer relationships, future contracts and revenues (Bolton, Lemon and Verhoef, 2008). Vandenbosch and Dawar (2002) demonstrated that managing customer interaction activities is a strong source of value to customers. Yet, current research often relegates the delivery of the firm's value proposition in MRO service to the domain of operations and supply chain management (e.g. Harland et. al., 1999; Shapiro, Singhal and Wagner, 1993) We argue that in the context of B2B MRO service, knowledge in marketing, operations management and logistic/supply chain management must converge to align the firm towards the delivery of value to the customer for better relationships and for contract continuation.

***Customer relationship and co-delivery.*** B2B literature in marketing has had multiple discussions on buyer behavior. It is commonly accepted that the B2B buying decision process would include a buying center and a selling center whereby the buying center includes all those within the customer firm that has an influence over the buying decision e.g. the purchasing manager (who sources for suppliers), the engineer (who proposes the specification), the financial controller (who decides on payment terms).

Conversely, the selling center includes those in the selling firm who assist in the sale e.g. the accounts executive, the technical manager, etc. (Sashi and Kudpi, 2001). In B2B services, due to the separation of purchase and consumption (Ng 2008; Shugan and Xie, 2000), there is not only a buying center but also a consuming center. Similarly, there is not only a selling center but also a delivery center. This implies that service delivery is not merely directed towards one person within a firm, but towards several individuals representing the firm. The consuming community has an influence on the buying center at the contracting stage, but it is a challenge to understand what the *value* is for each member of the consuming community. This issue becomes all-important when a contract comes up for renewal and re-negotiation. Much of marketing literature that deals with customer value has not adequately considered how the consuming/delivery community achieves the value promised, as this is traditionally the domain of operations literature (Karmarkar, 1996; Krishnan and Ulrich, 2001). Similarly, operations and supply chain literature, traditionally a cost center, has not adequately considered the impact of operational delivery/consumption on value perception which would impact on contract renewal (cf. Tan, 2001; Chen and Paulraj, 2004). Recent academic literature has called for integrated perspectives and approaches (Sosa, Eppinger and Rouse, 2004; Menor et. al., 2002).

The concept of customer value has recently been considered using a relationship marketing perspective (Eggert, Ulaga & Schultz, 2006; Flint, Woodruff, and Gardial, 1997; Liu, Leach & Bernhardt 2005; Payne & Holt, 2001; Gronroos, 2004). This view accentuates value creation within a relationship, as opposed to transaction-based exchanges. Such thinking has evolved into current ideas around the co-creation of value where resources (i.e. "people, systems, infrastructures and information" (Gronroos 2004) work together through processes to achieve the optimum benefit for the consumer. While much has been said about customer relationship management and relationship marketing within B2B, marketing researchers have been reluctant to include service delivery within that domain. Since the relationship between the firm and the customer occurs at all levels of buying/selling and consuming/delivering, relationships are therefore not merely developed by customer relationship management systems, sales people or top management, but by every employee who interacts with the employees in the customer firm. The value of the contract, and the relationship with the customer, is therefore embedded within a complex system of delivery and use (cf. Normann & Ramirez, 1993).

***Value co-creation and co-production.*** Academic literature surrounding service delivery and consumption centers around the notion of *service encounter* for consumer services (Czepiel, Solomon and Surprenant 1985; Bitner et. al., 1990). The service encounter is defined as all activities involved in the service delivery process (Bitner, 1990; Bitner, Booms & Mohr, 1994). Managers and service researchers describe this as the "moment of truth" to indicate the defining period when the interaction between the firm and buyer is of crucial importance to determine customer satisfaction (Bitner, Booms and Tetreault, 1990; Churchill & Surprenant, 1982; Anderson & Sullivan, 1993). The service encounter also embodies the co-creation of value, where the value is no longer *value-in-exchange* (i.e. a tangible product solely created within the firm and

exchanged with the customer), but *value-in-use*, i.e. jointly co-created between the customer and the firm for benefits (Payne, Kaj, & Pennie, 2008; Prahalad & Ramaswamy, 2003). The concept of value co-creation subsumes previous service research in operations and strategy that have emphasized the role of the customer within a service system such as the customer contact model (Chase & Apte, 2007; Chase & Tansik, 1983), customer interactions (Johnson, Manyika, & Yee, 2005) and value co-production with the customer (Ramirez, 1999). In marketing literature, Bitner et al. (1997) claims that in co-creating value, customers could be partial employees, contributors to their own satisfaction and quality of the service and if customers choose to produce the service by themselves, they can become competitors to firms. Within such thinking, recent researchers have proposed that firms do not really provide value, but merely value propositions (Vargo and Lusch, 2004) and it is the customer that determines value and co-creates it with the firm. Hence, a firm's product offering is merely value unrealized until the customer realizes it through co-creation and gains the benefit. This has also been suggested by Woodruff and Flint (2006) when they proposed that mutual satisfaction is dependent on *bidirectionality*. Gummesson (2008) suggested the term *balanced centrality* to illustrate this concept. Woodruff and Flint suggested that customers have an obligation to assess the needs of the provider and to assess resources to deliver these needs as part of the co-creation of value. In doing so, there is a need to understand the role of the customer in the firm's processes and systems, and the role of the firm in customer's processes and systems. Extending this logic, this implies that it is not merely what resources and activities are contributed by each party but how both are aligned to achieve desirable outcomes and second, it isn't merely good relationships between sales persons and top management of both firms that needs to be developed but also the appropriate behaviors and relationships between employees of both firms. Finally, if the delivery of a contract is consultancy, business processing, or MRO, the processes and system must be in place to deliver the core activities as well. All this implies that value co-creation and co-production in B2B MRO service contracts is a combination of processes, behaviors, information and equipment acted upon by both customer and firm employees in achieving contract outcomes. This is in contrast to the selling of tangible goods where production is without intervention of the customer and value-in-use realized by the customer is without any intervention of the firm.

Our paper investigates the phenomenon of value co-creation and co-production in a B2B MRO service contract. MRO services is traditionally the domain of purchasing and supply chain management. The increasing importance of supply chain collaboration in corporate strategy is related to the belief that competitive advantage is a function of supply chain efficiency and effectiveness (Harland et al., 1999). The more a firm can capitalize on its network of suppliers and customers, the greater the chance it may gain a sustainable competitive advantage (Jarillo, 1993). Harland et al (1999) define the concept of supply strategy as a 'holistic approach to managing operations within collaborative inter-organisational networks, allowing the formulation and implementation of rationale strategies for creating, stimulating, capturing and satisfying end-customer demand through innovation of products, services, supply network structures and infrastructures, in a global dynamic environment'.

Supply chain management scholars have investigated various aspects of strategic, operational and outcomes issues in managing inter-organizational supply relationships. For instance, buyer-supplier partnerships (Lamming, 1993), strategic supplier alliances (Monczka et al, 1999), strategic outsourcing or make-or-buy decision (Holcomb and Hitt, 2007), supply base management (Cousins, 1999), supplier integration and knowledge sharing (Dyer and Hatch, 2006). However, these studies tend to focus on supply chain relationships in manufacturing rather than services, with a greater emphasis on equipment, rather than people. In terms of supply management in services, effective management of service-oriented supply chain relationships is under-researched. Existing service-related supply research examine service sourcing and buyer-supplier interaction in service (Wynstra et al, 2006), nature of service and goods and service distinction (Araujo and Spring, 2006), buying complex performance (Lewis and Roehrich, 2007) and product-service systems and environmental sustainability (Tukker, 2004). Araujo and Spring (2006) call for better understanding of how to categorize service from a business perspective and how to find new ways to connect sets of capabilities within and across suppliers and customers' boundaries'.

One emerging practice that has been increasingly employed in MRO is contracting on outcomes (Ng, Williams and Neely, 2009), as we explain below.

**Outcome-Based Contracts** Traditional MRO contracts are contracted under a MRO service level agreement where the cost of spares could be excluded or included in the price (Van Weele, 2002). The contractor could also provide the customer with a cost-plus contract with detailed costs structures (inclusive of a schedule of cost of spares) to ascertain reimbursement with a profit percentage that has been pre-determined (Kim, Cohen, & Netessine, 2007). Of late, there have been a growing number of MRO contracts that focus on outcomes of equipment rather than the tasks involved in the provision of the equipment. For example, in the case of Rolls Royce, the service provided to maintain engines is being remunerated on the basis of how many hours the engine is in the air – a concept known as 'power by the hour®'. Such outcome-based contracts focus on achieving required outcomes rather than being a contract for the supply of a set of prescribed specifications (Bramwell, 2003). In short, the buyer purchases the result of the product used (utilization of service or performance outcomes) and not ownership of the product. It has been argued that under these circumstances and in the long term, suppliers may find it in their interest to invest in designing more reliable products and more efficient repair and logistics capabilities to increase profitability (Martin, 2003). This implies that contracting on outcomes has an ability to elicit desired behaviors arising from the incentives within the contract, thus reducing the cost of MRO over the longer term for the customer. Overall, it has been acknowledged that there is more equitably aligned risks and incentives between suppliers and customers in OBC than in traditional contracting (Kim, et al., 2007). As such, we are beginning to find more B2B services contracts moving towards outcome-based incentives with hopes of witnessing significant decreases in costs, significant increases in customer satisfaction and the reduction of financial audits. Despite this growing interest in OBC from both the public and private sectors in terms of application,

little research has been established to examine fundamental theoretical issues underpinning the dynamic relationship between the firm and the customer under an outcome-based contract where value is co-produced. Narrower versions of outcome-based contracts have been called performance based contracts, a term that originated from performance-based logistics (e.g. Kim et. al., 2007). Due to the legacy of the term, performance-based contracts often denotes performance of activities and tasks such as procurement in service-level agreements (SLAs) or the performance of supply chains (e.g. Berkowitz et. al., 2004) all of which tends to give the term an 'inside-out' focus, with a strong provider focus. The term outcome-based contract, which we use in this paper, denotes a more 'outside-in' approach without explicitly stating the responsibility for the outcomes which could be attributable to both provider and customer performances.

In this paper, we argue that the need to jointly deliver outcomes of a contract *would* compel co-creation. OBC therefore meets the criteria for co-creation previously set out in literature such as dialogue, mutual access, risk sharing and transparency (Prahalad and Ramaswamy, 2003), the emphasis on the development of customer-supplier relationships through interaction and dialog (Payne, Storbacka and Frow 2008), balanced centricity (Gummesson, 2008) and bidirectionality (Woodruff and Flint, 2002). Outcome-based contracts are also consistent with the service-dominant logic (Vargo and Lusch 2004, 2008) where goods and activities are combined to achieve value-in-use (outcomes).

### **Research Context, Design and Administration**

In this study, the delivery of two MRO outcome-based service contracts between two defence contractors and the UK Ministry of Defence (MoD) are investigated. The outcomes concerned were the outcome of *availability* of two types of equipment; a fighter jet and a missile system. The first, the ATTAC<sup>6</sup> contract with BAE Systems for the Tornado (fastjet) availability is an outcome-based contract with the UK MoD for which the primary outcome is to maintain a defined level of available mission-ready flying hours (flying hour bank) across the UK fleet of some 220 Tornado aircraft. The Tornado ATTAC support service has been a successful<sup>7</sup> response to the UK's imperative to significantly cut the cost of operational flying for Tornado aircraft. The contractor is paid and incentivized for performance against outcome-based "key performance indicators". The second, MBDA's ADAPT program provides partnered support for the British Army's Rapier mobile air defence missile system. The service contract is operated as a collaboration between the MoD and industry with MBDA leading the industrial support, and is managed through a joint project team. The contractor is paid and incentivized for performance against "contract performance

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<sup>6</sup> ATTAC - Availability Transformation: Tornado Aircraft Contract of £947m with the UK MoD <http://www.theengineer.co.uk/news/attach-contract-for-bae-systems/297588.article>

<sup>7</sup> National Audit Office report 17 July 2007: "Transforming logistics support for fast jets", [http://www.nao.org.uk/publications/0607/transforming\\_logistics\\_support.aspx](http://www.nao.org.uk/publications/0607/transforming_logistics_support.aspx)

indicators” for which the primary outcome is to maintain a defined level of percentage availability of the missile system.

The total value of each contract exceeded USD\$400 million per annum and had approximately 1500 people delivering the outcomes of the contract from both the customer and the supplier firms. Since the contract is outcome-based, the customer has to commit to being responsible and abiding by the level of use stipulated in the contract, and the firm is obliged to deliver the outcome of a set number of flying hours on the fighter jet and a fixed percentage availability over a certain period of time (e.g. 95% availability) for the missile system for the agreed usage. While the MRO service is outsourced, the MoD had a big role in the partnership which is to provide Government Furnished Materials (GFX) including supplying physical facilities, material, data, IT and manpower to facilitate the company in achieving its outcomes.

The delivery of these contracts serves as an exemplar for value co-created and co-produced where both parties are focused on achieving outcomes. The study was carried out in two parts as a component of the research conducted by work package 3 of the S4T project,<sup>8</sup> a research program involving 10 universities and 37 researchers.

### ***Study 1: Qualitative Study - Discovering the Value Offering***

A qualitative study was conducted to discover what the customer considers to be the firm’s value offering. The data was collected in four ways. First, defence contracts tend to be riddled with jargon, so meetings and interviews were held to provide researchers with an understanding of the service rendered under the contracts. The explanations of the contracts and the jargon in itself provided invaluable sets of qualitative data as employees used their understanding of their world to convey their interpretation of the service delivered and the role they (and the customer) played within the system. Second, in-depth interviews to solicit a deeper understanding of their world and their role in the social construction of the environment provided further insights. A total of 32 in-depth interviews with employees from the firm and the customer firm were conducted over six months. Third, with the customer and firm’s permission, we also accompanied key employees in walking around the bases and the sites, observing, taking notes and recording their audio interactions with one another. Finally, minutes of meetings between the employees of both sides were collected and analyzed, together with an analysis of presentations, reports and other text-based documents such as maintenance logs. In analysis, the data was coded and categorized by three researchers and triangulated through discussion between the three. The coding and categorization centered on distilling and reducing the data to generic value transformations.

## **Findings**

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<sup>8</sup> The S4T project is a £2 million grant programme on Service Support solutions: Strategy and Transition, funded by the UK government through the Engineering and Physical Science Research Council and BAE Systems

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The research found that, in the delivery of outcome-based contracts, value is co-produced with the customer as a combination of three generic transformations. Table 1 showed the mapping of contextual value offerings onto generic value transformations.

**Table 1: Mapping contextual value offerings onto value transformation from the qualitative study**

Value Offerings	Description	Transformation
Professional Assessment of Serviceability of Spares	The firm is responsible for serviceable spares provision	Transform materials/equipment
Assurance	Activities that ensure equipment availability, providing security to customer	Transform people Transform information
Competency	The capability at firm level to pool expertise from within BAE as a wider corporate body+ability to communicate that capability	Transform people Transform information
Continuity and Stability	Permanent full-time postings that ensure service consistency+ability to communicate that capability	Transform people Transform information
Coordinate both User and Contractor	Management expertise	Transform people Transform information
Expertise	Technical expertise on equipment and usage+ability to communicate that expertise	Transform people Transform information
Higher Availability & Readiness	Activities that provide better equipment performance	Transform materials/equipment
Instruction and Training	The provision of onsite training by the firm to the customer	Transform people
Knowledge that is Valuable	Knowledge transfer from the firm to the customer	Transform people Transform information
Obsolescence Management	The provision of through life capability management	Transform materials/equipment Transform information
Pre-emptive in Maintenance	The firm is proactive in equipment maintenance	Transform materials/equipment Transform information
Protecting Troops	Activities that are able to protect the army during war time	Transform materials/equipment Transform people Transform information
Re-design if not Suitable for Use	Activities that improve the equipment design	Transform materials/equipment
Reliability of Equipment	The firm is motivated to provide consistent availability	Transform materials/equipment
Speed	Activities that provide quicker support service	Transform information

Tailor the Equipment for How it would be Used	Being the design authority, the firm provides expertise on how the equipment could be used more effectively	Transform materials/equipment Transform people Transform information
Taking away the Stress of MRO	Activities that remove operational risks from the MoD	Transform people

The three generic transformations are explained below:

- (a) Transform materials and equipment (i.e. manufacturing and production, store, move, repair, install, discard materials and equipment through supply chain, repairs, obsolescence management, predictive maintenance etc.)
- (b) Transform information (i.e. design, store, move, analyse, change information through knowledge management, information, communication and technological strategies, data strategies in equipment management etc.)
- (c) Transform people (i.e. train use, change use, build trust through education, influence, build relationships, change mindsets, achieve mental states etc.)

Our study found that the firm predominantly designed its processes around the transformation of materials/equipment, considered to be the primary transformation of MRO service. However, we found that in *outcome-based* MRO service, information and people transformation became crucial to ensure that outcomes were achieved. This is because delivery to outcomes extended the boundary of performance towards *use*, which introduced a dynamic *customer variety of use* into the firm's delivery space (cf. Lee and Tang, 1998). By delivering to an outcome, the firm is committed to the same outcomes even when the context of usage changes. Thus, both the customer and the firm may not know the contingency nature of the context that could change how the service is delivered or co-produced at that point in time. For example, it may not be possible to predict when the airforce is in need of a few additional sorties (thus increasing the need for flying hours) at a particular day. Thus, delivering to a context dependent value in use suggests that the firm has to be prepared and capable to absorb customer variety and still deliver satisfaction when committed to delivering outcomes. In this case, the transformation of people and information become an integral part of the value delivered. People transformation allowed the firm to plan and control for the customer's irregular usage patterns while information transformation allowed for better bilateral communication to manage customer variety. One surprising result is that people transformation was not confined to usage alone. The need to change the way the customer use the equipment is one facet of it as this would result in greater reliability and durability of the asset, which in turns translate to lower costs to the provider. Yet, the transformation of people is more than changing use. It is about the customer coming to a belief that the service rendered is satisfactory. Yet, although both people and information transformations were delivered by the firm, they were mostly tacitly delivered through the interactions of employees and customer, and through ways that both sides manage individually. Finally, the three transformations interacted with

one another. For example, the transformation of customers' perceptions and usage of equipment had an impact on the supply chain (material/equipment transformation) and constantly changed the nature of how information was communicated both ways (information transformation). In addition, our findings also suggested that the transformations were not executed by the firm alone, but jointly with the customer.

Figure 1 illustrates value co-creation with the customer to achieve outcomes that introduces variety and 'push-back' into the firm, impacting on the costs and the delivery of core transformation processes to achieve the outcomes.

<Take in Figure 1>

Our qualitative study also found that contract performance is dependent not only on the core transformations, but how the transformations (behavioral (people), material & equipment and information) are *aligned* with the customer processes. Through some of the coded data, we find that the alignments are driven by three factors; that of congruence of expectations of the firm by both parties, congruence of expectations of the customer by both parties and complementary competencies between the employees of the firm. In addition, two further variables could intervene in the relationship – that of perceived control and degree of empowerment of the firm's employees. To validate these qualitative observations, we present the hypotheses development for our quantitative study below.

## **Hypothesis development**

### **Core Transformations Co-production alignments**

For the firm to be able to co-produce and co-create value with the customer in a context where customer variety pushes back into the system, we argue that both customer and firm systems must somehow be aligned. Alignment would then facilitate a symmetric transfer of resources, information and all that is necessary to ameliorate problems that may arise from the highly uncertain environmental factors that impact on co-production to achieve outcomes. Such an alignment must therefore exist within the core value transformations.

In the transformation of people, the data suggests an attribute that corresponds with the behavior of both the firm and the customer. Through the coded data, both parties discussed ideas of "building relationships", "having a good relationship" and "getting along" as essential in their business partnerships. The data also detected conversations of parties having to behave "sensibly" and "responsibly" in order for the services to be performed and rendered effectively. As such, it is important that both the firm and the customer understand that their behaviors are aligned to ensure effective and efficient value co-production and co-creation.

*H1: Behavioral alignment is positively related to contract performance*

The qualitative study also highlighted that interactions at the customer interface (alignment) between the customer's value creating processes and supplier's service delivery processes are important in value co-production and co-creation. The development of linkages and shared ways of operating between suppliers and customers would ensure both parties to work smoothly together consistent with Kanter (1994). Both partners should work together towards improving processes and products, showing their commitment to shared benefits (Evans et al 2000). The benefits are that the companies can mobilize their resources for an increase in productivity by tightening the linkages (Magrath et al 1994). Such linkages would include information transfer between both parties. Thus, in the context of process alignment between suppliers and customers, information alignment is the *gathering, moving and storing of information* between partners.

*H2: Information alignment is positively related to contract performance*

According to Guimaraes et al (1996), determining set-up details, tooling, scheduling, maintenance, storage, replenishment for materials and equipment is a success factor in MRO service. Thus, logistics and the supply chain are particularly relevant and both the firm and the customer should achieve material/equipment process alignment, i.e. synchronizing both the parties' processes. Synchronizing would enable the value creation and transfer process, right from the supplier to the end customer, to operate as a seamless chain along which equipment and physical assets flow (Gunasekaran et al 2002).

*H3: Material/Equipment alignment is positively related to contract performance*

### **Co-Production inputs**

Co-production inputs act as a driver to facilitate co-production alignments. Our qualitative study found "competencies" as an important attribute. The study found broad agreements from both the firm and the customer that employing the "right people" with the right competencies and appropriate "judgment of environment state" was crucial to the day-to-day operations of the ATTAC/ADAPT contracts and ultimately in building the business relationship. Hence, it is important to ensure that the skill sets presented in the relationship between the firm and the customer complement each other. According to Cox et al (1997), where the supplier competencies are not core or complementary to the customers' business processes then a weak relationship of no value exists. Yusuf et al (2004) proposes that the resource competencies required are often difficult to mobilize and retain by single companies. It is therefore imperative for companies to cooperate and leverage complementary competencies for enhanced competitive advantage. Huge firms such as aerospace companies are now teaming up with different competencies to respond to projects that are too large for any one firm to manage (Crouse, 1991).

*H4: Complementary competency is positively associated with co-production alignments of behavioral (A), information (B), and material/equipment (C)*

Our qualitative study also found that a key attribute for a successful relationship is the congruence of expectations, i.e. supplier should know the role of customer and customer should know the role of supplier in the value creation process (Woodruff and Flint, 2006). This is consistent with Kambil et al (1999) who argue that while co-creating value, both partners should be clear about rights and expectations. Customers need to trust the suppliers not to misuse the information provided by them and similarly, suppliers need to actively manage customer expectations.

Parasuraman et al (1988) also argued that customers evaluate quality by comparing their expectations with their perceptions of the service performance. Thus, in co-creating value, the firm's expectation of customers' roles is just as important. Hence, both parties have to be congruent in the expectations of each other's roles in value-co creation.

*H5: Congruence of expectations of self (the firm) is positively associated with co-production alignments of behavioral (A), information (B), and material/equipment (C)*

*H6: Congruence of expectations of other (the customer) is positively associated with co-production alignments of behavioral (A), information (B), and material/equipment (C)*

### **Intervening Variables**

Parts of our qualitative study found that the link between co-production inputs and co-production alignments may not be as straightforward. Two factors seemed to have played an intervention role.

First, perceived control, as a psychological construct, has emerged from qualitative coded data to be an important factor. Indeed, perceived control over job-related activities is a frequently used construct in organizational behavior research (Smith et al 1997). This is because humans have an essential need to control their work environment, and the desire for control arises because it is associated with positive outcome (White 1959, Rodin et al 1980). This is also reflected in the study where the interviews reflected the importance of perceived control in the day-to-day operations of the contract delivery.

*H7: Perceived Control mediates the relationship between co-production inputs and co-production alignments*

In our qualitative study, we also found that empowerment to effect change was a key issue from both the firm's and the customer's perspectives. Both parties appear to recognize that in order for effective co-production to take place, there must be willingness and a sense of empowerment for the individual to identify and effect changes especially with the customer operating in a high state-dependent context and environmental uncertainty.

Most literature on “empowerment” agree that psychological empowerment in the workplace is useful for organizations in understanding the quality of their service delivery (Conger & Kanungo, 1988; Schulz, B.A.Israel, M.A.Zimmerman, & B.N.Checkoway, 1995; Spreitzer, 1995).

*H8: Empowerment for behavioral change mediates the relationship between co-production inputs and co-production alignments*

### ***Study 2: Quantitative Study – Testing the Relationship between Co-production inputs, Co-production alignments and Contract performance***

The relationships between theoretical variables are represented in Figure 2. We suggest that the set of inputs (complementary competency, congruence of expectations of self (the firm), and congruence of expectations of other (the customer)) influence co-production alignments at behavioral, information, and material/equipment levels, which in turn influence contract performance. In addition, the expected causal relationship between inputs and alignments may also be mediated by the intervening variables of perceived control and empowerment. All the hypothesized directions of causal relationships are assumed to be positive in this study.

<Take in Figure 2 here>

### **Research Methodology**

In conducting the quantitative study, we decided to operationalize the constructs into perceptual measures i.e. the constructs of which measures were developed were constructs from the perceptions of the attributes by individuals delivering the contract, as previous research has shown that individual level relationships drive value (Bolton, Lemon and Verhoef, 2008). We felt this was necessary as it continued to allow us to take a strategic approach in understanding co-production. In case there were gaps in operationalizing and measuring these constructs, we proposed modification or construction of new scales for the purpose of measuring the constructs. Because of the adaptations and modifications in items scales, one of our objectives was to perform content face validity of the items and scales with the experts in this field (Gatignon et al, 2002, Nunnally and Bernstein, 1994). These items were submitted to five academics and five industrialists working in the field of service research with particular expertise on availability-based contracts, to validate the content face of the items. We provided each expert with a detailed definition of each item and asked them to either accept or reject the premise that each particular item reflected the construct (or attribute). When a majority of the experts responded that an item did not reflect the construct, we removed the item. Similarly we included a few items based on expert’s comments (Gatignon et al, 2002). Some measures (questions) were worded to be positively slanted while others were negatively worded to reduce the possibility that the respondents would simply agree or disagree with all the measures without providing adequate attention to reading and comprehending the questions (Venkatraman 1989). The measures developed are presented in Table 2.

**Table 2: Construct Measures**

Construct	Measures on a Likert Scale of 1-5 with 1= strongly disagree and 5 strongly agree
<b>CO-PRODUCTION INPUTS</b>	
Complementary Competencies (Sheridan et al 2001, Wong et al 1999, Yusuf et al 2004, Hanna 2007, Zhu et al. 2004, Stratman et al 2002)	Q97. Myself and the personnel I interact with on the customer/company side have complementary skill sets to get the work done Q98. Myself and the personnel I interact with on the customer/company side have complementary roles (i.e. job title and description) to get the work done Q99. Myself and the personnel I interact with on the customer/company side are able to access resources necessary to get the work done Q100. Myself and the personnel I interact with on the customer/company side are able to access the technology necessary to get the work done
Congruence of Expectations of self (Dean et al 2004, Zeithmal et al, 1993, Parasuraman et al 1994, Leventhal 2008)	Q64. I believe the personnel I interact with on the company/customer side knows what I am doing under the contract Q145. I believe the personnel I interact with on the company/customer side knows HOW I am doing the job under the contract Q65. I believe the personnel I interact with on the company/customer side knows what I WILL DO under the contract Q66. I believe the personnel I interact with on the company/customer side knows what I SHOULD DO under the contract Q146. I believe the personnel I interact with on the company/customer side knows HOW I SHOULD DO my job under the contract Q67. I believe the personnel I interact with on the company/customer side knows what I WANT TO DO under the contract
Congruence of Expectations of other (Dean et al 2004, Zeithmal et al, 1993, Parasuraman et al 1994, Leventhal 2008)	Q60. I am clear on what the personnel I interact with on the company/customer side is doing under the contract Q142. I am clear on HOW the personnel I interact with on the company/customer side is doing his/her job under the contract Q61. I am clear on what the personnel I interact with on the company/customer side WILL DO under the contract Q62. I am clear on what the personnel I interact with on the company/customer side SHOULD DO under the contract Q143. I am clear on HOW the personnel I interact with on the company/customer side SHOULD DO his/her job under the contract Q63. I am clear on what the personnel I interact with on the company/customer side WANT TO DO under the contract
<b>CO-PRODUCTION ALIGNMENTS</b>	
Information Alignment (Hung et al 2007, Guimaraes et al 1996, Evans et al 2000, Gunasekaran et al 2002, Yusuf et al 2004)	Q71. The company's processes of GATHERING information is aligned with the customer's processes to enable the gathering of information Q72. The company's processes of GIVING information is aligned with the customer's processes to receive the information Q73. The company's processes of STORING information is aligned with the customer's processes to enable the storage of information Q74. The company's processes of MOVING the information is aligned with the customer's processes to enable the movement of information

<p>Material/Equipment Alignment (Hung et al 2007, Guimaraes et al 1996, Evans et al 2000, Gunasekaran et al 2002, Yusuf et al 2004)</p>	<p>Q75. The company's processes of COLLECTING the material and equipment is aligned with the customer's processes to enable the collection of material and equipment  Q76. The company's processes of STORING the material and equipment is aligned with the customer's processes to enable the storage of the material and equipment  Q77. The company's processes of MOVING the material and equipment is aligned with the customer's processes to enable the movement of the material and equipment  Q141. The company's processes of REPAIRING the material and equipment is aligned with the customer's processes to enable the movement of the material and equipment  Q96. The company's processes of INSTALLING the material and equipment is aligned with the customer's processes to enable the installation of the material and equipment</p>
<p>Behavioral Alignment (Leuthesser et al 1995, Reich et al 2000, Reich et al 1996)</p>	<p>Q35. Myself and the personnel I interact with on the customer/company side give each other a clear picture of what goes on behind the scenes in our organization that may impact our work  Q36. Myself and the personnel I interact with on the customer/company side give each other ample notice of planned changes that might impact our operations  Q37. Myself and the personnel I interact with on the customer/company side do a good job of notifying each other in advance of any schedule changes  Q38. Myself and the personnel I interact with on the customer/company side would discuss any plans that might change the nature of the work we are doing  Q39. Myself and the personnel I interact with on the customer/company side take the time needed to discuss new ideas  Q40. Myself and the personnel I interact with on the customer/company side co-operate in order to APPLY new ideas  Q41. Myself and the personnel I interact with on the customer/company side share (reasonable) resources to help in our day to day operations</p>
<b>INTERVENING VARIABLES</b>	
<p>Perceived Control (Smith et al 1997, White 1959, Rodin et al 1980, Karsek 1979, Ganster 1989, Dwyer and Ganster 1991)</p>	<p>Q24. I feel that I have control over the decisions that affect my work  Q25. I feel that I have control over the VARIETY OF METHODS I employ in completing my work  Q26. I feel that I can choose among a VARIETY OF TASKS to do  Q27. I feel that I have total control over the quality of the work I'm delivering  Q28. I feel that I can dictate how quickly or slowly I have to work  Q29. I feel that I am able to decide when to schedule my rest breaks  Q32. I feel that I have influence over the policies and procedures of my work unit</p>
<p>Empowerment (Conger et al 1988, Schulz et al 1995, Spreitzer 1995, Thomas et al 1990)</p>	<p>Q48. When interacting with personnel from the customer/company side, I am good at turning problems into opportunities  Q49. When interacting with personnel from the customer/company side, I feel I can use my personal judgment to ensure good contract performance  Q50. When interacting with personnel from the customer/company side, I feel that my line manager supports me even when I go beyond the normal call of duty  Q57. When interacting with personnel from the customer/company side, I feel I can use tactics that would ensure good contract performance  Q51. When interacting with personnel from the customer/company side, I feel I can do more than what my job specifies to ensure good contract performance  Q52. When interacting with personnel from the customer/company side, I feel I have significant autonomy in that interaction</p>
<p>Contract</p>	<p>For the contract you are involved in, how do you think it's going so far?</p>

Performance	Q16a.The contract is performing well overall Q16b.The contract is doing well on the company side Q16c.The contract is doing well on the customer side
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The measures were entered into a web-based survey and sent out to all 1500 individuals managing, delivering, and supporting outcome-based contracts in 2009. The web-based survey also prevented the users from referring back to the responses they had given to earlier questions. This reduces possible common variance problems that could result in inflated reliability measures (Stanton 1998). Out of 1500, 116 responses were received from the survey. After eliminating incomplete responses, the survey yielded 96 usable responses which were then used for further analysis. To ensure that we captured the 'web'-like nature of the service and its interactions, we received responses from across the firm and at all levels from management to support (administrative) to the actual technical and physical delivery of the service (see Figure 3). All respondents have been involved in contracts during the year of 2008-2009, with 52% working as professionals and 25% working as executives. A total of 82.3% of the sample work for the ATTAC contract, while the rest work for the ADAPT contract, while 78.5% of the sample are male and about 66.7% of the subjects are between 35 and 54 years old. Also, 65.7% of the subjects have at least some college education, and 71% report a household income of between £20,000 and £50,000.

<Take in Figure 3>

We control for demographic features such as age, gender, education, income, marital status, and race to ensure these variables would not be relevant as factors that influence co-production performance and contract outcome. We also controlled for the individual's degree of interaction with the customer.

### **Measurement Model Analysis and Testing**

We first perform a principal component analysis with direct Oblimin rotation and a confirmatory factor analysis (CFA) to evaluate our scales (Gerbing & Anderson, 1988). We follow the two-step approach suggested by Gerbing & Anderson (1988) for our measurement model construction and eliminate measured variables or latent factors that do not fit well in the initial CFA model. We next perform a separate CFA for each construct to assess whether any structural model exhibits an acceptable goodness-of-fit level. As a result, we remove two measurement items for the control construct and one measurement item for the empowerment construct that do not load properly. We then fit the structural model to the purified measured variables retained from the first step.

In Table 3, we display the estimates of item loadings and reliability for the investigated constructs in an unconstrained analysis. To examine the psychometric properties of the measurement model, we analyze the indicators and constructs for reliability, convergent validity, and discriminant validity. Each investigated construct provides a Cronbach's alpha value and composite reliability greater than .7, in support

of the satisfactory reliability of our scales (Fornell & Larker, 1981; Nunnally, 1978). We assess the convergent validity of our scales at both item and construct levels by examining the item loadings and average variance extracted (AVE) (Fornell & Larker, 1981). An individual item loading greater than .7 suggests an indicator shares more variance with the construct it measures than with error variances (Gefen, Straub, & Boudreau, 2000). An AVE greater than .5 manifests a construct that shares more variance with its indicators than with error variances (Fornell & Larker, 1981). As we show in Table 3, most items load highly on the constructs they measure with item loadings of .7 or greater, except for three indicators. Our measurement items also converge properly on their intended constructs. The items exhibit good convergent validity, as suggested by the AVE greater than .5 for each investigated construct.

**Table 3: Item Loadings**

Construct	SL	CR	AVE	Items
Complementary Competencies ( $\xi_1$ )		.81	.61	Myself and the personnel I interact with on the customer/company side have
	.78			..... complementary skill sets to get the work done
	.74			..... complementary roles to get the work done
	.79			..... are able to access resources necessary to get the work done
	.81			..... are able to access the technology to get the work done
Congruence of Expectations of self ( $\xi_2$ )		.91	.61	I believe the personnel I interact with on the company/customer side
	.68			know what I am doing under the contract
	.82			..... how I am doing the job under the contract
	.78			..... what I will do under the contract
	.82			..... what I should do under the contract
	.83			..... how I should do my job under the contract
Congruence of Expectations of other ( $\xi_3$ )		.87	.54	I am clear on what the personnel I interact with on the company/customer side
	.78			..... is doing under the contract
	.84			..... is doing his/her job under the contract
	.83			..... will do under the contract
	.63			..... should do under the contract
	.67			..... should do his/her job under the contract
Behavioral Alignment ( $\eta_1$ )		.87	.54	Myself and the personnel I interact with on the customer/company side
	.64			..... give each other a clear picture of what goes on behind the scenes in our organization that may impact our work
	.75			..... give each other ample notice of planned changes that might impact our operations
	.77			..... do a good job of notifying each other in advance of any schedule changes
	.63			..... would discuss any plans that might change the nature of the work we are doing
	.77			..... take the time needed to discuss new ideas

	.81		..... co-operate in order to APPLY new idea
Information Alignment ( $\eta_2$ )	.81	.52	The company's processes of
	.78		..... gathering information is aligned with the customer's processes to enable the gathering of information
	.76		..... giving information is aligned with the customer's processes to receive the information
	.61		..... storing information is aligned with the customer's processes to enable the storage of information
	.73		..... moving the information is aligned with the customer's processes to enable the movement of information
Material Alignment ( $\eta_3$ )	.87	.58	The company's processes of
	.85		..... collecting the material & equipment is aligned with the customer's processes
	.76		..... storing the material & equipment is aligned with the customer's processes
	.86		..... moving the material & equipment is aligned with the customer's processes
	.78		..... repairing the material & equipment is aligned with the customer's processes
	.53		..... installing the material & equipment is aligned with the customer's processes
Perceived Control ( $\eta_4$ )	.84	.52	I feel that
	.74		..... I have control over the decisions that affect my work
	.80		..... I have control over the variety of methods in completing work
	.68		..... I can choose among a variety of tasks to do
	.73		..... I have total control over the quality of the work I'm delivering
	.63		..... I can dictate how quickly or slowly I have to work
Empowerment ( $\eta_5$ )	.83	.52	When interacting with personnel from the customer/company side
	.74		..... I am good at turning problems into opportunities
	.80		..... I feel I can use personal judgment to ensure contract performance
	.68		..... I feel I can use tactics that would ensure good contract performance
	.73		..... I feel I can do more than job specifies to ensure performance
	.63		..... I feel I have significant autonomy in that interaction
Contract Performance ( $\eta_6$ )	.91	.77	For the contract you are involved in, how do you think it's going so far
	.87		..... The contract is performing well overall
	.90		..... The contract is doing well on the company side
	.86		..... The contract is doing well on the customer side

Note: *SL* = standardized loadings; *CR* = composite reliability; *AVE* = average variance extracted. Items are measured on seven-point scales, where 1 represents strongly agree, 4 is the neutral point, and 7 is strongly disagree.

Finally, we examine discriminant validity by comparing the correlations among constructs and the AVE values (Fornell & Larker, 1981). In general, the square root of the AVE for a construct should be greater than the correlations between that construct and all other constructs. As shown in Table 4, the square roots of the AVE are greater than any of the corresponding correlations. Hence, our scales exhibit appropriate discriminant validity. We seek additional support for discriminant validity by comparing item loadings and cross-loadings in Table 3. All the items load substantially higher on intended construct than on other constructs, thus further suggesting our scales possessed adequate discriminant validity (Fornell, 1992).

### **Examining Common Method Bias Analysis**

Because each respondent answers question items pertaining to both independent and dependent variables, we must assess potential common method bias, though the specificity of the measurement items and our use of adequate anchors for different scales should reduce this bias. We first perform Harmon's single-factor test using exploratory factor analysis to determine if a single factor emerges or a general factor accounts for the majority of the covariance. Our results indicate that none of the nine factor accounts for the majority of the variances. We also examine the common method bias by adding a latent variable that presents common method (Podsakoff, MacKenzie, & Podsakoff, 2003). Our results reveal that when adding a latent variable that represents common method, model fit improved ( $\chi^2$  difference = 8.65,  $df = 492$ ,  $p < .01$ ) but the variance accounted for by the common method latent variable was only 5.9% of the total variance. Together, these results suggest that common method bias is not a serious threat to our analysis (Calson & Perrewew, 1999; Williams, Cote, & Buckley, 1989).

### **Analysis Method**

To test the set of hypotheses, we apply the Partial Least Square (PLS) method to investigate the proposed relationships among co-production inputs, co-production alignments, intervening variables, and contract performance. Based on component construct concept, PLS is ideally suited to the early stage of theory building and testing and especially appropriate when the researcher is primarily concerned with prediction of the dependent variable (Fornell & Bookstein, 1982). Compared with two-stage least squares, PLS considers all path coefficients simultaneously and allow direct, indirect, and spurious relationships and estimates the individual item weightings in the context of the theoretical model rather than in isolation (Birkinshaw, Morrison, & Hulland, 1995). Compared with other multivariate analysis such as LISREL and Mplus program which are better suited for theory testing, PLS is better suited for explaining complex relationships (Fornell & Bookstein, 1982). In addition, PLS procedure has been gaining interest and has been increasingly used in business research because of its ability to model latent constructs under conditions of non-normality and small to medium sample sizes (Chin, Marcolin, & Newsted, 2003).

**Table 4: Descriptive Statistics, Reliability, Correlations, and Discriminant Validity**

Construct	Construct																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
1. Age	<i>M</i>	5.17																
	<i>S.D.</i>	0.84	1.19	1.00														
2. Education		4.54	3.10	1.58	0.41	1.00												
3. Gender		1.50	1.67	1.06	0.27	0.39	1.00											
4. Income		1.29	0.60	1.94	0.45	0.48	0.34	1.00										
5. Marital		3.44	1.64	1.72	0.34	0.39	0.54	0.36	1.00									
6. Race		4.45	1.75	1.12	0.48	0.53	0.44	0.46	0.61	1.00								
7. Interaction		3.25	1.40	1.13	-0.18	-0.15	0.00	-0.18	-0.17	-0.17	1.00							
8. Complementary competencies		2.41	0.77	0.34	-0.11	0.00	-0.09	0.00	-0.04	-0.05	0.24	0.67						
9. Congruency of expectation of self		2.59	0.71	0.42	-0.21	-0.05	0.06	-0.02	-0.01	-0.11	0.41	0.42	0.67					
10. Congruency of expectation of others		2.47	0.60	0.06	-0.13	-0.05	-0.05	-0.02	-0.08	-0.08	0.28	0.50	0.49	0.54				
11. Behavioral Alignment		2.66	0.67	0.44	-0.19	-0.09	-0.03	-0.06	-0.05	-0.15	0.25	0.54	0.58	0.61	0.54			
12. Information Alignment		2.95	0.60	-0.19	-0.10	-0.05	-0.15	0.06	-0.04	0.06	0.10	0.50	0.31	0.37	0.43	0.52		
13. Material & Equipment Alignment		2.65	0.64	-0.38	-0.12	-0.25	-0.16	-0.12	-0.19	-0.24	0.25	0.49	0.34	0.35	0.44	0.57	0.58	
14. Perceived Control		2.69	0.75	0.59	-0.02	-0.11	0.05	-0.05	-0.03	-0.05	0.33	0.50	0.40	0.40	0.48	0.46	0.35	
15. Empowerment		2.47	0.57	0.13	-0.02	-0.04	-0.07	-0.11	-0.19	-0.05	0.30	0.50	0.43	0.44	0.54	0.44	0.40	
16. Contract Performance		2.35	0.86	0.89	-0.14	-0.08	0.06	-0.08	-0.09	0.00	0.21	0.36	0.34	0.43	0.46	0.30	0.25	
																	0.57	
																		0.77

Notes: *M* = mean construct score (unweighted); *SD* = standard deviation; *SK* = skewness;

\*. Numbers on the diagonal (in *italic*) represent the square root of the *AVE*. Off-diagonal numbers represent the correlations among constructs. |

The structural equations in PLS are specified as follows:  $E(\eta | \eta, \xi) = \beta^* \times \eta + \Gamma \times \xi$ ,  $\eta = \eta(\eta_1, \eta_2, \dots, \eta_m)$  and  $\xi = (\xi_1, \xi_2, \dots, \xi_m)$  are vectors of unobserved criterion and explanatory latent variables.  $\beta^*(m \times m)$  is a matrix of coefficient parameters (with zeros in the diagonal) for  $\eta$ ; and  $\Gamma(m \times m)$  is a matrix of coefficient parameters for  $\xi$ .

PLS estimation proceeds in two stages. First, the latent variables are estimated in an iterative manner by finding successive approximations. The PLS algorithm involves alternations between the measurement and structural model where parameter estimates in either part of the model are treated as fixed as the parameters in the other part are estimated. Second, upon convergence, the measurement and structural relations are estimated by OLS regressions using the latent variables estimated in the first stage. Alternatively, the latent variables partial least-squares model is essentially a path analytic model with latent variables.

The PLS estimates and associated p values of the structural model are reported in Table 5. The sequence of reported results follows the discussion of the model developed earlier and is represented in Figure 3. The overall fit of the structural model can be evaluated by the incidence of significant relationships among the constructs on the one hand, and by the explained variance of the endogenous latent variables on the other. Table 5 shows that several individual relationships do not pass the .05 significance hurdle. Further, the R squares of behavioral alignment, information alignment, material and equipment alignment, and contract performance are .55, .35 .29, and .22 respectively. Given that alignments and contract performance are the central focuses of the model, it can be concluded that a satisfactory fit is obtained. Empirical results are reported below. The 'direct' relations among constructs are discussed first. Thereafter, 'mediating' effects will be considered and contrasted with the 'direct' effects.

< Take in Figure 4 Here >

## **Direct Effect**

### *Alignments and contract performance*

It was hypothesized that the alignments between customer and firm systems facilitate a symmetric transfer of resources, information and all that is necessary to deliver outcomes. The results in Table 5 and Figure 4 suggest that both behavioral and information alignments provide significant explanatory power on contract performance, yet the material and equipment alignment does not have a significant effect on contract performance ( $\beta_{61} = .40^{***}$ ,  $\beta_{62} = .13^*$ ,  $\beta_{63} = .00$ ). Judging from the size of the path-coefficients, one can conclude that in the context of the outcome-based contract, the direct effect of behavioral alignment and information alignment are quite important in co-production to achieve desired outcomes. However, material and equipment alignment does not have a significant effect on contract performance. Therefore, while *H1* and *H2* are supported, *H3* is not.

**Table 5: Partial Least Square (PLS) Estimation Results for Direct Effects**

Structural paths	Hypothesis	PLS estimate	Standard deviation
Behavioral alignment → Contract performance	H1	0.40***	0.11
Information alignment → Contract performance	H2	0.13*	0.09
Material & equipment alignment → Contract performance	H3	-0.00	0.07
Complementary competencies → Behavioral alignment	H4a	0.23***	0.09
Complementary competencies → Information alignment	H4b	0.42***	0.10
Complementary competencies → Material & equipment alignment	H4c	0.39***	0.10
Congruency of expectation of self → Behavioral alignment	H5a	0.32***	0.09
Congruency of expectation of self → Information alignment	H5b	0.10	0.09
Congruency of expectation of self → Material & equipment alignment	H5c	0.14*	0.10
Congruency of expectation of other → Behavioral alignment	H6a	0.34***	0.09
Congruency of expectation of other → Information alignment	H6b	0.14*	0.09
Congruency of expectation of other → Material & equipment alignment	H6c	0.09	0.10

\*\*\*: Significant at .001 significance level (two-tailed); \*\*: significant at .01 significance level (two-tailed); \*: significant at .05 significance level (two-tailed).

□

### *Co-production inputs and alignments*

The results from hypotheses *H4* through *H6* in Table 5 shed light on the relation between co-production inputs and alignments. It was hypothesized that co-production inputs serve as a driver to facilitate co-production alignments. Our data suggests that the complementary skills and competencies between the firm and customers greatly contribute to symmetric transfer of resources including behavior ( $\gamma_{11} = .23^{***}$ ), information ( $\gamma_{21} = .42^{***}$ ), and materials & equipment ( $\gamma_{31} = .39^{***}$ ) during the co-production of the service. In addition, the positive relation between congruencies of expectation and co-production alignments add further insights to the question of whether pre-existing expectations drive the alignments in value co-production. Congruencies of expectations for both self and other positively affect behavioral alignment at  $\gamma_{12} = .32^{***}$  and  $\gamma_{13} = .34^{***}$ , respectively. Yet, the congruency of expectation of self has a direct effect on material & equipment alignment ( $\gamma_{32} = .14^*$ ) while the congruency of expectation of other has a direct effect on information alignment ( $\gamma_{23} = .14^*$ ). Therefore, *H4* is supported while *H5* and *H6* are partially supported.

### **Mediating Effect**

#### *Perceived control and empowerment as the mediators of co-production alignments*

Building on organizational behavior research (Smith et al, 1997; Spreitzer 1995), we hypothesize that co-production inputs affect co-production alignments through their effects on perceived control and empowerment (*H7* & *H8*). The mediation hypotheses require the test of the following equations: (1) the effects of co-production inputs on co-production alignments; (2) the combined effects of perceived control & empowerment and co-production inputs on co-production alignments; and (3) the effects of co-production inputs on perceived control and empowerment. As suggested by Baron and Kenny (1986), all of these effects must be significant, but the significance of the associations between co-production inputs and co-production alignments must be reduced by adding control and empowerment to the model.

The positive effects of co-production inputs on corresponding alignments are shown in Table 6 (Models 1, 3, and 5). The direct effects of co-production inputs on co-production alignments have been confirmed in *H4-H6*, which suggest that complementary competencies and congruency of expectations significantly improve alignments. When control and empowerment are added into each model for corresponding alignment, the effects of co-production inputs on alignments are reduced. While empowerment is associated with significant improvement of behavioral alignment (0.22,  $p < .01$ ) and information alignment (0.13,  $p < .05$ ), control is associated with significant improvements of information alignment (0.24,  $p < .01$ ) and material & equipment alignment (0.13,  $p < .05$ ).

**Table 6 Partial Least Square (PLS) Estimation Results for Mediating Effects of Control and Empowerment**

Variable	Behavioral Alignment				Information Alignment				Material & Equipment Alignment			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>
Complementary competencies	0.26***	0.09	0.16**	0.10	0.40***	0.10	0.27***	0.11	0.41***	0.09	0.37***	0.12
Congruency of expectation 1	0.31***	0.09	0.25***	0.11	0.14**	0.09	0.05	0.07	0.10*	0.08	0.08	0.09
Congruency of expectation 2	0.34***	0.10	0.30***	0.11	0.13**	0.09	0.08	0.10	0.07	0.08	0.05	0.09
Age	-0.03	0.06	-0.07	0.07	-0.09*	0.07	-0.15*	0.09	0.13*	0.09	0.11*	0.09
Education	-0.03	0.05	-0.02	0.05	-0.10	0.08	-0.07	0.06	-0.22**	0.09	-0.20**	0.10
Gender	0.03	0.05	0.01	0.05	-0.18**	0.10	-0.21**	0.10	0.00	0.06	-0.02	0.08
Income	-0.03	0.05	0.02	0.06	0.11	0.09	0.14*	0.09	0.02	0.07	0.02	0.07
Marital status	0.05	0.07	0.11	0.09	-0.04	0.08	-0.01	0.08	-0.05	0.07	-0.05	0.09
Race	-0.09	0.09	-0.12	0.11	0.24**	0.10	0.22**	0.10	-0.10	0.10	-0.10	0.11
Interaction	-0.06	0.06	-0.07	0.06	-0.09*	0.09	-0.11*	0.08	0.12*	0.10	0.11*	0.10
Control			0.06	0.07			0.24**	0.10			0.13*	0.11
Empowerment			0.22**	0.09			0.13*	0.14			-0.03	0.12
$R^2$	0.52		0.57		0.34		0.41		0.35		0.37	
$\Delta R^2$			0.05				0.07				0.02	

\*\*\*: Significant at .001 significance level (two-tailed); \*\*: significant at .01 significance level (two-tailed); \*: significant at .05 significance level (two-tailed).

To complete the mediation hypotheses, it is important to show that co-production inputs are associated with increased levels of control and empowerment for each of the alignment context. As shown in Table 7, complementary competencies and congruency of expectations are associated with a higher level of control and empowerment across all three co-production alignments. To further test the mediation effects, we use the Sobel test or the product-of-coefficients approach to compute the ratio of  $ab$  ( $a$ : path coefficient between the independent variable and the mediator;  $b$ : path coefficient between the mediator and the dependent variable) and its estimated standard error (Sobel, 1986). We compute the  $p$  value for this ratio in reference to the standard normal distribution, and use the significance level to test the hypotheses of mediation. The Sobel test suggests that empowerment positively and significantly mediates the relationship between co-production inputs and behavioral alignment at  $z=2.07$ ,  $p < .05$  level, while perceived control positively and significantly mediates the relationship between co-production inputs and information alignment at  $z = 2.04$ ,  $p < .05$  level. Based on the above tests,  $H7$  and  $H8$  are partially supported.

## Discussion

Our qualitative findings are consistent with the three generic types of operations often used to distinguish between organization types in operations management literature. Operations management categorize organization type on the basis of their transformation process such as 'material-processing operations', 'information processing operations', and 'people-processing operations' – and literature have discussed the various managerial challenges which differ across the three archetypes (Morris & Johnston, 1987; Ponsignon, Smart and Maull, 2007). Yet, operations literature has usually considered one type of transformation to be dominant (e.g. Slack et al., 2004). Hence, hotels are about transforming people, manufacturing and production are about transforming materials and equipment, and media and information services such as Reuters and CNN are about transforming information. Our findings show that in outcome-based MRO services, value is delivered through all three forms of transformation, through a value constellation (Normann and Ramirez, 1993), in co-production with the customer. Through the understanding of value in marketing, and by mapping value perceived by the customer onto delivery, we find that the firm's operations and delivery process design has to be extended beyond mere functional processes for material/equipment but to include information and people transformation as well and to do so in co-production with the customer. In addition, we find that transforming the customer means transforming a customer's 'mental state' that is perceptual as well. This is consistent with literature that study socio-technical systems which has proposed that disciplines such as operations, supply chain management and systems engineering has to move beyond functional aspects and incorporate the management and transformation of the receiver mental states as part of its responsibility to achieve customer satisfaction; such a transformation typically achieved through social activity, relationships and shared mental models (e.g. Ng et. al., 2010; Woods and Tasker, 2010).

**Table 7 Effects of Co-production Inputs on Control and Empowerment**

<i>Variable</i>	Behavioral Alignment			Information Alignment			Material & equipment Alignment					
	Control		Empowerment	Control		Empowerment	Control		Empowerment			
	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>	<i>b</i>	<i>s.e.</i>		
Complementary competencies	0.35***	0.09	0.33***	0.12	0.35***	0.10	0.32***	0.12	0.35***	0.09	0.31***	0.12
Congruency of expectation of self	0.19**	0.09	0.20**	0.11	0.19**	0.09	0.22***	0.10	0.19**	0.09	0.22**	0.12
Congruency of expectation of other	0.14*	0.09	0.18**	0.10	0.14*	0.09	0.17**	0.11	0.15*	0.10	0.18**	0.11

\*\*\*: Significant at 0.001 significance level, \*\*: significant at 0.01 significance level, \*: significant at 0.05 significance level.

Our quantitative findings provide an insight into the heterogeneity of service co-production towards outcomes. Hypotheses 1 and 2 show that contract performance is dependent on both behavioral and information alignments. This supports our thesis that such an alignment allows more effective delivery to the customer while absorbing customer variety that could change the way the service is delivered. That material & equipment alignment isn't related to contractual performance is at first surprising for an MRO service but on reflection, is intuitively plausible since outcome-based MRO essentially puts the entire supply chain and its installation of parts and equipment into the hands of the firm to deliver the outcome of *use* of the equipment by the customer. Thus, *alignment* of material/equipment processes with the customer's processes may not be as relevant to contract performance, even though such processes may still be crucial to the value delivered. Hypothesis 4 shows that complementary competencies drive all co-production alignments as we have proposed, emphasizing the importance of the complementarity of resources, skills, assets and knowledge in co-production. In the case of hypotheses 5 and 6, congruence of expectations drive behavioral alignment but congruency of expectations of self is not related to information alignment whilst congruency of expectations of other is not related to material/equipment alignment. The latter point is consistent with the unsupported hypothesis 3, since if material/equipment alignment is inconsequential to contract performance, expectations of the other by self may then not be deemed to be essential to material/equipment alignment. With regard to congruency of expectations of the self by the other being unrelated to information alignment, we can only surmise that sharing of information transcends the customer's knowledge of his/her counterpart, throwing light on the heterogeneity of co-production dynamics.

The mediating effects Hypotheses 7 and 8 add a further layer of insight. Control and empowerment clearly mediates the relationship between all the co-production inputs with behavioral alignment, which is expected since all variables embody strong HR issues. Yet, control and empowerment also mediates the relationship between the co-production inputs of complementary competencies and expectations of self by other. Co-production alignments of material/equipment and information suggest that for outcome-based contracts, HR issues have wider and bigger impact on co-production than merely behavioral elements, affecting operational processes and supply chains as well, possibly due to reactions to customer variety. The mediating effects have a further implication. Even if there is complementary competencies and congruence of expectations between the firm and its customer, a lack of perceived control and empowerment of employees involved in co-production would result in less effective co-production alignments, causing lower contract performance. The findings clearly show the interaction between HR, marketing, operations and supply chain issues in achieving contract performance within a B2B MRO service context.

Our study contributes to continuing scholarly work on value co-production and co-creation and sheds light on the complexity of delivering to outcomes in MRO service and the challenge it poses to service operations. It also contributes to the evolving conversations on service science and service dominant logic (Ng, Maull and Yip, 2009; Vargo, Maglio and Akaka, 2008). A system is deemed complex when it is composed of

interconnected parts that exhibit one or more properties as a whole which is not obvious from the properties of the individual parts (Anderson, 1999). Our study proposes that operations management/supply chain management research in service for outcomes has to adopt a systems view. In addition, unconventional techniques and tools for perceptual transformation of people contributing to an overall integrated and effective socio-technical system warrants further research.

Our study also contributes to the literature in B2B and relationship marketing and its role in operations management. Relationship marketing has long discussed networks, alliances and customer relationship management (e.g. Gronroos, 2004). Our study suggests that relationship management is embedded within service delivery and one has to consider the building of relationships as *part* of the firm's delivery processes and not separated from it. In other words, it is not much of a point to have great communication and network when the fundamental core service delivery and transformations (which the customer has purchased) is not incorporated into the relationship management system, a point echoed by past research where scholars have described the relational process as a social exchange arising from transactions (Narayandas and Rangan, 2004; Bolton, Lemon and Verhoef, 2008).

The limitations of our study lies in the context we selected to test our hypotheses. We have decided to select the population of individuals delivering to two outcome-based contracts where the customer is primarily a government body. Such a context may be unique and could limit the external validity which we sacrificed in the interest of internal validity in understanding the delivery of outcome-based MRO contracts, in itself a new phenomenon. Future research could survey individuals delivering across a wider set of outcome-based contracts and towards a more diverse customer set. A further limitation of our study is that we chose to investigate co-production between a single prime contractor and a customer. Modern supply chains are often multi-organizational networks with various stakeholders responsible for different components of the total value offering. Further research should extend the current study towards network co-production and alignments to achieve core transformations.

## **Conclusion**

Our study provides evidence that achieving outcomes in MRO service through the transformation of material/equipment, behavioral and information result in a *complex service system*, where the three core value transformations form part of the firm's value proposition, through a delivery constellation in co-production with the customer. With outcomes as an emerging property of the system, co-production inputs and alignments become crucial in the firm's design to achieve superior service capability. Yet, the inputs and alignments can only be effective if HR issues such as perceived control and empowerment are included within the design of that capability. If successfully designed and applied, competitive advantage may be gained through such a capability that would allow the firm to continuously adapt and co-evolve within the complex environments created, embedding a system capable of undergoing continuous metamorphosis in order to respond to a dynamic delivery landscape (Lewin, Long, & Carroll, 1999).

Marion and Bacon (2000) found that traditional organizations firms with a closed system approach of complexity limit their organization's firm's ability to adapt to its environment resulting in loss of control on business. This will lead to organizational firm's failure due to inertia inability to adapt. The firm's service capability is in part defined by how it can adapt and discover opportunities from managing customer variety (Neu and Brown 2005, Galunic and Eisenhardt 1996).

Finally, outcome-based MRO service capability can potentially be a significant contribution to the sustainability agenda as the longer engines are kept flying, turbines kept working, and equipment kept operational, the less there is the need for production and consumption of new equipment, cutting carbon emissions overall (cf. Mullens and William, 2004). However, such a capability drives the need for research in marketing, OB/HRM, strategy and operations management to be brought to bear on the management and delivery of complex service systems in terms of the configuration design of people, physical assets and processes, as well as in the design of the enterprise tasked to achieve it. Compartmentalizing the knowledge into individual disciplines may have been useful for the manufacturing and production of goods, where many processes are linear and with low intervention of the customer, but would be less useful in the delivery of complex service systems towards achieving outcomes.

Complex service systems exist not merely in outcome-based MRO services but in many integrated value outcomes such as airport services, city transportation service, and healthcare, all of which integrate various processes, people, physical assets for multiple stakeholders and where the system includes the consumption system of various stakeholders and customers. Our paper suggests the need for not merely multi-disciplinary perspectives, but trans-disciplinary integration and approaches to advance knowledge in this domain.

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Figure 1: Complex Service System of Core Transformations and Value Co-creation with State-dependent Outcomes

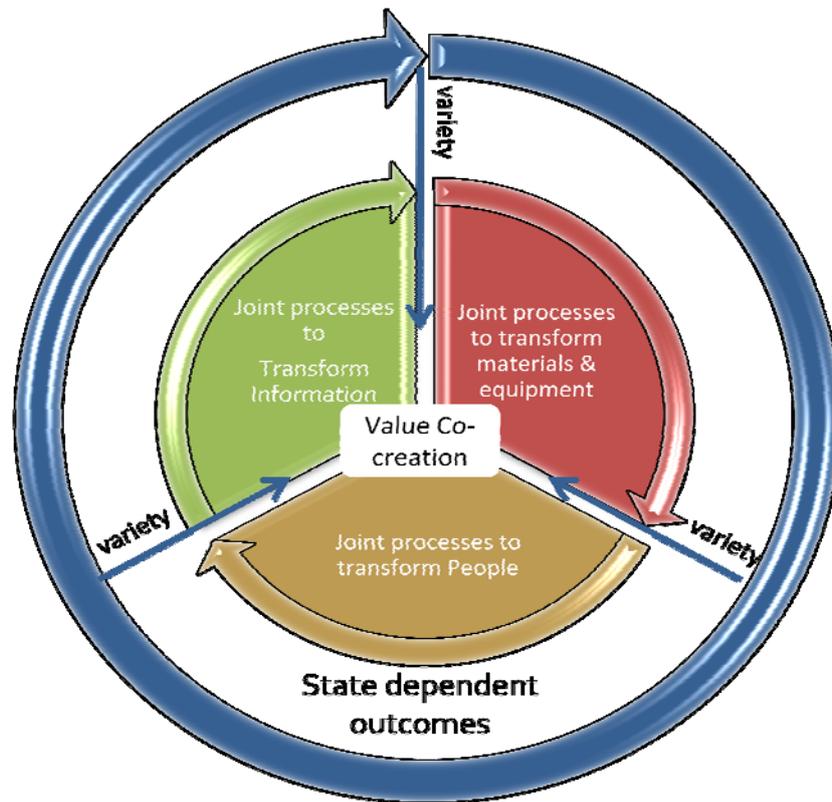


Figure 2: A Model of Contract Performance in Outcome-based B2B MRO Service

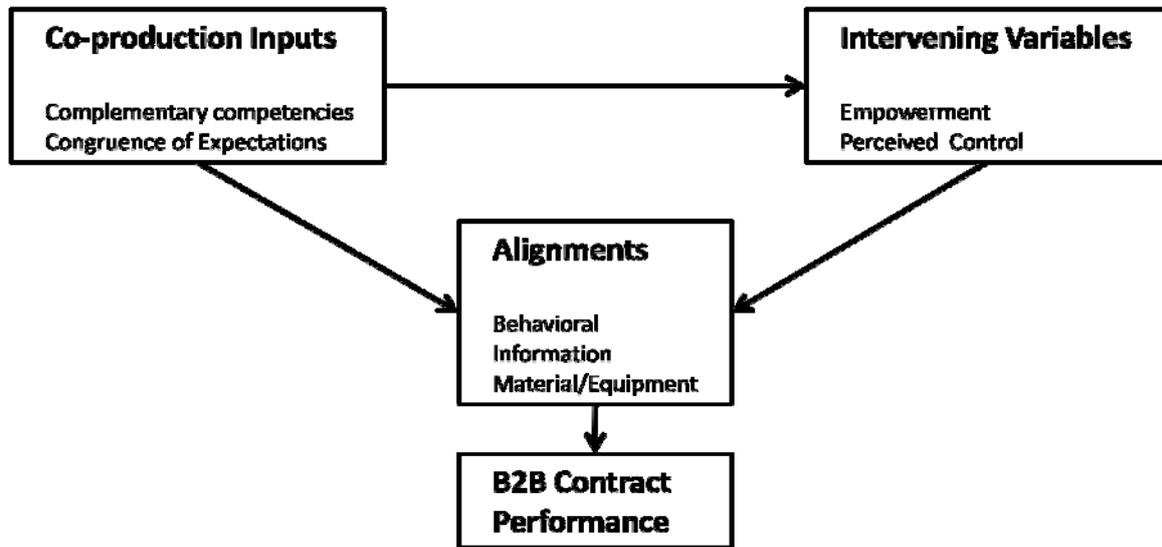


Figure 3: Distribution of responses by employees of the firm managing, supporting and delivering the contract

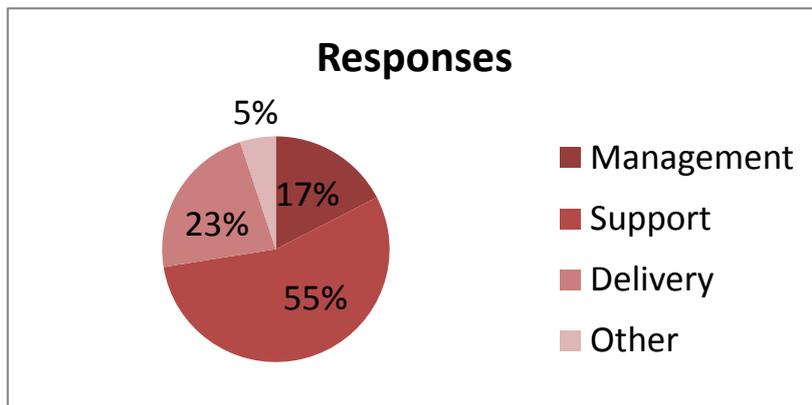


Figure 4 Structural Model of Contract Performance in B2B MRO Service

