The Service Paradox: Supporting Service Supply Chains with Product-oriented ICT

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Abstract—**The dominant models of supply chain management have a strong product orientation, with service supply chain models only starting to appear. The technologies used in existing supply chains generally aim at improving production and logistical operations by increasing their efficiencies and by linking and integrating collaboration between individual supply chain partners. This paper focuses on service supply chains and argues that despite their increasing importance, current information and communication technologies (ICTs) fail to fully support the specific needs of service co-production. The paper reviews current technology use from a service perspective and concludes that even the most advanced technologies that have huge potential to support services (such as RFID) remain product-oriented. It argues that such technologies should be deployed in ways that can support the service logic and identifies the danger that unreflected ICT use may pose for the pragmatic utility of ICT use in service-supply**

Index Terms—**ICT, RFID, service supply chains**

I. Introduction

The dominant models of supply chain management have a strong product orientation, with service supply chain models only starting to appear. The technologies used in existing supply chains generally aim at improving production and logistical operations by increasing their efficiencies and by linking and integrating collaboration between individual supply chain partners. This paper focuses on service supply chains and argues that despite their increasing importance, current information and communication technologies (ICTs) fail to fully support the specific needs of service co-production. The paper reviews current technology use from a service perspective and concludes that even the most advanced technologies that have huge potential to support services (such as RFID) remain product-oriented. It identifies two main challenges with deploying RFID for services, namely the danger of cementing a product logic through unreflected technology use, and the difficulty of managing the enormous amounts of data made available from ubiquitous RFID use. It argues that such technologies should be deployed in ways that can support the service logic.

II. Literature Review

A. A focus on the service supply chain

Supply chain management has four main orientations: The traditional logistics school, the modern logistics school, the integrated process redesign school, and the industrial organization school, with most research focused on the first two (Cogolini et al., 2004). All of these orientations adopt a product oriented logic in which operational effectiveness and efficiency within and across individual supply chain partners is the main objective. Thus, these schools reflect different developments of operations and supply chain management thinking dating back to origins in the Fordist era.

The service supply chain of today has developed through incremental changes to traditional, mostly product oriented practices and as such has remained inefficient, ineffective, and insufficient as a guiding model for service supply chains that can successfully address contemporary requirements while fully availing of current technological and other opportunities. For most services, elements of both product and service oriented operations need to be included. Advanced ICT must be designed and deployed to enable and support service supply and delivery in ways that the iterative adaptation of centralised legacy systems decades past their sell-by date cannot achieve. Efficiency-oriented contemporary service supply chains treat the customer as simply being the final receiver of a quasi-product. An alternative view that recognizes the central role of the customer in service design, provision and delivery would require that understanding and addressing customer requirements must be central to the design and operation of service supply chains.

The majority of global supply chain models are product-based models (e.g., the HP, SCOR and GSCF models). This focus belies the fact that services are fast overtaking products as the basis of the economic model for companies and countries. The service sector has outpaced product and manufacturing oriented

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sectors and replaced them as the motor of economic growth. Services account for 75% of the GDP in the United States and 70% of the aggregate production and employment in OECD nations (OECD, 2005). According to the WTO, the services sector accounts globally for $1.6 trillion of world trade.

Service science is seen as the next frontier discipline after computer and information science (Berry et al., 2006). Vargo and Lusch (2004) recognise the importance of service provision as the basis for economic exchange and argue that despite limited empirical support academics have traditionally viewed service as a subset of product. They challenge this traditional paradigm that treats service marketing as a special case of product marketing. From a global supply chain perspective, Ellram et al. (2004) suggest that service supply chains have been overlooked in favour of product based supply chains even though the former will grow in importance along with rising spend on the management of service, growing service outsourcing, and the increasing economic importance of service supply chains. As more and more traditionally product based companies like IBM, Pitney Bowes and Fujitsu garner increasing proportions of their revenues from services (Neu and Brown, 2000) it is time to refocus on how we conceptualise and study services, and on how customers avail of services in this global networked economy.

Adopting a service perspective cannot be done by simply transferring product and manufacturing knowledge and models (Ellram et al., 2004; Sengupta, Heiser, & Cook, 2006). Existing approaches to service provision need to be extended to more fully reflect service-driven global supply chain models. More research is needed on the actual transferability of our knowledge of the manufacturing supply chain to the service sector. While factors such as information sharing, distribution network systems, and reliance on multiple suppliers support both types of supply chains, other factors have significantly different impacts in these different settings (Sengupta et al., 2006).

Some challenges to traditional supply chain conceptions have emerged. Initial formal conceptions of service supply chains have been offered (e.g., Ellram et al., 2004; Baltacioglu, Ada, Kaplan, Yurt & Kaplan, 2007). These model attempt to be sensitive to specific issues in service design and provision, and reflect attempts to move towards an understanding of supply chain models that goes beyond product oriented views. Similarly, Christopher (2004) argues that a more holistic view of supply chains that goes beyond an accumulation of dyadic interactions and linkages of individual supply chain partners would reflect a more useful conception of supply chains. Both approaches offer useful departures from the traditional views and inform our review of the use of ICT for service supply chains below.

B. The ICT Imperative; The Co-creation deployment of service based ICT

In tandem with the growth in services there has been a phenomenal rise in the adoption of ICT by a wide variety of companies within both product and service domains. To many ICT is viewed as the norm of business practice. Given that services by their nature process large amount of information, they can benefit from the appropriate deployment of a supporting ICT infrastructure. Many services beyond the spheres of traditional service activities such as banking, insurance and travel are also becoming heavily reliant on ICT. Overall, the dominant users of ICT can be found in the service sector (Meyronin, 2004). How can the ICT component of services be delivered? What are the challenges for this from a management perspective? If service organizations fully embrace this service logic, what are the implications for the ICT currently in use in their customer offerings, and how can ICT most usefully be deployed in ways that delivers efficient as well as customer centric operations?

A review of IT in supply chain management will usually provide us with a list of technologies or the techniques supported by these technologies or the objective of the tools. For example, Cigolini et al., (2004) refer to information tools, co-ordination and control tools and organizational tools. Auramo et al., (2005) refer to ERP; EDI, EML (system to system integration); Internet, extranet, electronic B2B marketplaces (web portals; and third-party transaction hubs that provide B2B integration services (services providers). Simchi-Levi et al., (2003) suggests that IT provides information availability and visibility; enabling a single point of contact for data; allowing decisions based on total supply chain information and enabling collaboration with supply chain partners.

Auramo et al., (2005) in a recent study of IT along the supply chain found that most of the ICT projects are individualistic, dyadic and that the main view of ICT is primarily from an operational perspective. Much of the systems install are basic and proprietary and do not achieve higher level business impacts. These tailor made solutions are difficult to copy. They found that 'in order to achieve real competitive advantage it is important to focus on improving those processes that are most critical for customer services. Successful companies have been able to improve service levels and effectiveness simultaneously (Auramo et al., 2005: 96).

Much ICT was designed for operational efficiencies aligned to supply chains and for the ability to track product and material orders and financial flows together with EDI as the traditional system in use. EDI, the most common form of electronic commerce, is the replacement of the paper documents, for financial transactions, by an electronic message, structured to an agreed standard and passed from one computer to another, without manual intervention. EDI is typically defined as a set of protocols used in electronic commerce that encompasses the exchange of business information in a standardized electronic form. It is a subset of electronic commerce that defines the structure for business data such as purchase orders, invoices

and shipping notices. One visible form of inter organizational IT based interactions, are EDI systems. Firm specific IT applications like EDI, reflect the development of a common electronic infrastructure between companies.

Naude and Holland's (1997) study, focused on the potential of EDI to alter marketing practices, through increased customer relations, economic and value creation. They found that it was used mainly for purchasing, selling and fund transfer, with a slow rate of maturity of systems. Reekers and Smithson, (1996) in case based research within the automotive industry and utilising transaction cost theory, resource theory, and the network perspective, found that the use of EDI enables both parties to rationalise their operations, but that manufactures optimise their production at the expense of their suppliers, which may have a long-term impact on the supplier/manufacture relationship. In research into the assimilation of EDI and the Internet for ecommerce within the supply chain, the Shell experience highlighted the use of IT to take the business into the *'realm of truly cooperative relationships between suppliers and customers'* (Chan and Swatman, 2000:81). They observed that EDI was the first stage of the implementation of ecommerce and confirmed that the driving forces for EDI and ecommerce developments changed significantly over time, from technical issues to management issues and business issues. Overall, however, the ICT use in supply chain management has been automational in nature.

Much of the growth in services, particularly in those internationally traded, has been ICT induced. Given the increased coordination cost associated with the scale necessary for global service provision, it is not clear if purely transactional advantages arising from global service offerings provide enough value for such service firms. To fully exploit global service offerings, they need to maximize the value co-constructed with their customers as well as capture a sufficient part of this value. The more value the service encounter creates the more value can be retained by the firm, which suggests that both transactional and relational opportunities inherent in service encounters need to be vigorously pursued.

As an example, the growth in self-service technologies and co-production of services heralds new and interesting developments at the customer interface (Howard and Worboys, 2003; Meuter et al., 1998, 2000). Academics have observed the growing popularity of self-service technologies and have commented on both the positive and negative consumer perception of same (Howard and Worboys, 2003). Meuter and her colleagues' (2000) empirical study confirm that self-service technology is accepted and growing in popularity particularly when handled as a customer support rather than a cost saving initiative. She did note that only 5% of customers wanted self-service through all the stages of the decision making process but that they would use self-service as long as a human element was available if needed. It appears that the scope for deploying ICTs that support such self-service based customer interfaces is tremendous. The obvious attraction for service providers is the potential for technology-based efficiency and resulting cost savings. An important challenge for service firms, however, is to not prioritize the technological or economical aspects to the detriment of the value ultimately delivered to their customers. In this context, a range of challenges arise for global service providers. They need to develop and deploy technological enhanced self-service interfaces that are either universally deployable or easily customizable to specific local requirements to exploit the efficiencies inherent in such interface solutions. Initial capital investment into the development of such interfaces can be large, and specific technological, organizational or managerial knowledge is required for the successful use of such interfaces. None of the above are easy or cheap to develop.

The efficiency logic employed by many global service providers makes it important to consider if the quest for economic and productivity gains through automated service interfaces is useful. Is there a loss of value with a rise in ICT, a loss of the interpersonal relationship with the customer? Within business–to-business relationships a recent study showed that the use of internet-based systems decreases the nature and quality of information shared by the participants and reduces the frequency of their interactions. (Schultz and Orlikowski, 2004) Meyronin (2004) suggest that automation contributes to the building of an informational wall. He asks whether the productivity gains from automation compensate for the losses in terms of value and differentiation so often inherent in the deployment of automating technologies. How can ICT based services be distinguished in the eyes of the customer? Does electronic anonymity (Meyronin, 2004) support the service environment?

Service innovation through ICT has often seen the service moved to a transactional rather than a relational focus. For example, a relational dominant marketing practice like book selling can be transformed by placing an ICT-based interface between the customer and the supplier. Now the relational aspects that previously may have been a central part of the customer experience have been incorporated in a transactionally orientated interaction and the relationship is IT mediated. Service provision becomes skewed towards what the ICT can deliver. As ICT does not deliver the relational as much as the transactional, part of the value of the service can be lost as a result. ICT's electronic mediation 'tends to impoverish service relations, insomuch as the technological interface can by no means replace the wealth of human interactions on which the creation of value and the differentiation of services are based'. (Meyronin, 2004:216)

The logic of how ICT is assimilated into organizations follows Nolan's (1973) Stage Theory through stages of data processing, personal computing and network, or in Zuboff's (1988) terms automation, information and transformation. Thus the fact that the first wave of ICT assimilations has produced efficiency gains rather than relational improvements is accepted but highlights our need to move towards what Nolan called the network era. Aligned to this is the continuing move to ubiquitous computing, Weiser's (1993) 3rd stage of computing. Much of IT along the supply chain is

predominantly automational in focus, i.e., it is used to automate previously manual tasks and was only slowly resulting in more effectiveness with little evidence of ICT transforming practice (Auramo, 2005).

This suggests that ICT in the service domain is replacing the human interface and automating that relationship, thus often turning the customer into a self-service customer and mediating the relationship through ICT. There are obvious effects on the relationship as the buyer/seller roles become blurred and the understanding of each other is ICT mediated and is therefore often more limited. Prahalad and Ramaswamy (2004:7) suggest that in a service era defined by co-creation 'we need to challenge the traditional, distinct roles of both the consumer and the company and examine the impact of a convergence of the roles of production and consumption'. They suggest that the current system of value creation, even when shared with the customer through self-service, is product centric, service centric and company centric rather than customer centric. If we wish to move away from a predominantly technology oriented view then a co-creation view may offer a solution. Prahalad and Ramaswamy (2004) offer dialogue, transparency, access and risk benefits as building blocks of interactions for the co-creation of value. Many of these are driven by ubiquitous connectivity. Much of co-creation has had a company focus, even when the customer is seen to drive innovation or mass customization. These often suit financial or other objectives of the company rather than a real customer centric focus on co-creation.

In summary, the use of ICT in service operations promises significant improvements in information availability that aids customer-oriented decision making and relevant operations. In practice, however, ICT deployment has only furthered the efficiency oriented automation in such supply chains. Examples of ICT deployment that directly improves customers' service experiences or that increases customer value are very rare.

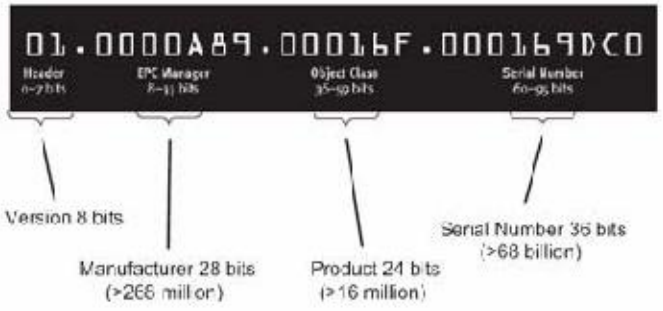
III RFID: FORWARD THINKING

What do leading edge technologies like RFID offer for service supply chains? Imburgia (2006; 1050) suggests that RFID could '*with a seemingly infinite supply of data.... have the ability to forecast demand and manage inventory of countless products at a level of accuracy that is practically scientific ... all in real time'*. RFID has been heralded as the technology which will allow for transparency and speed along global supply chains. RFID provides the ability to management and monitor among various parties, data and inventory movement.

RFID is the generic name for a type of auto-identification technology that uses radio waves or wireless communication to identify objects. RFID tags have both a microchip and an antenna. The microchip is used to store object information such as a unique serial number. The antenna enables the microchip to transmit object information from the RFID tag, which transforms the information into a format understandable by computers (Angeles, 2005). Although RFID tags are not dramatically different from the existing capabilities of barcodes, RFID is considered a significant improvement as tags do not need to be 'seen', as tags can be read remotely, and the amount of information that can be stored is much higher. RFID tags are also read in real-time, allowing the information gathered to be extremely accurate.

Could this automated data capture technology provide the integrator of the services element, a customer centric approach, the mapping of the financial flows and be the technology that binds. Current technology is focused at the inputs level of the supply chain with co-ordination between buyers and sellers of materials with some matched to order replenishment and overcoming the bull whip effect. If the supply chain focused on the customer from the start would the system be different? Could we redesign the supply chain to be customer centric and could RFID be the solution.

RFID is a product focused technology and as such is focused on solutions within the product domain. The dominant use of this technology could consolidate the product focused nature of much of technology. The standards for RFID are called Electronic Product Code (EPC) which developed from the MIT Auto-ID centre and now are based at EPC Global. The predefined algorithms produce a unique Uniform Resource Locator (URL) which provides the 'map' to retrieve a host of product related data. This data is based at the manufacturer's data source which then provides product data in the form of PML – See table below.



Could this be used for service related data too? What are the technology challenges for services which cannot be supported by RFID?

RFID uses are starting to develop, and some successful services make use of them at the customer interface. EZPASS is a good example of a service provision monitored and managed through RFID and acceptable to the customer. Smart shelves in retailing is another RFID-based innovation that has positive implications for consumers. However, both of these examples are service propositions that have been derived from service supply chain partners' drive towards efficiency rather than from their understanding of distinct, and novel, customer needs and demands. Their use could be integrated with the existing information processing capabilities in the service organizations. Ultimately, one can argue that they were deployed because the use of RFID could be matched with legacy systems within organizations

There are two fundamental problems with deploying RFID to holistically support service operations. First, unreflected use of technologies such as RFID can cement the efficiency-oriented product logic of traditional supply chain thinking. Imburgia (2006) for example suggests that linking EDI and RFID will provide a powerful suite of tools: pipeline management, synchronization of parties through RFID/EDI/XML; Visibility of Opportunities, Accurate forecasting, Bottom Line Reduction and Flexibility and Responsiveness. Notably there is no mention of how such integration of RFID and EDI legacy systems will make operations more responsive to potentially changing customer needs and preferences.

Second, RFID presents the pragmatic difficulty of data management in a data-saturated situation. The price of ubiquitous use of RFID data is excess information. Bearing in mind that many companies struggle with the current level of data that they possess, it is likely that any additional information produced by advanced technologies will be met with considerable confusion. In the case of RFID, Levinson (2003) points out, *"RFID technology is going to generate mountains of data about the location of pallets, cases and cartons. It is going to produce oceans of information about when and where merchandise is manufactured, picked, packed and shipped. It is going to create rivers of numbers,... which will have to be stored, transmitted in real-time and shared with warehouse management and others"* (2003:1). In spite of the wealth of information available to them, retailers admit to using only a fraction of the data they already have stored in their data warehouses (Jones et al., 2004). RFID technology has the potential to become *"the mother lode of personally identifiable data collection for commercial enterprises"(* Kelly and Erickson, 2005: 707),. Jones et al. (2004:168) affirm that RFID systems will gather a "*massive and continuous stream of real time data*", but that "*the storage and transmission of these data will place severe strains on many retailers' current ICT infrastructure*". How can we manage the data from the RFID when the data management from current systems is so hard to manage? There are estimates for trillions of network requests as each item is in real time, for mountains of data and unmanageable floods of requests. Data sharing is the core focus of this system – with whom and why. This is even more crucial when it is financial information. Whether this sheer volume of data is capable of being managed effectively is doubtful as many companies privately admit to utilizing so little of it already. So, if organizations are not using the data they have at the moment, the crucial question is how will they use all this additional information in the future? A survey by O'Connor (2004), found that more than half of the respondents expressed concern with the quality and synchronisation of the data generated by RFID devices. Jones et al. (2004) support this view, finding that a significant amount of noise and dirty data are generated from an RFID-based system. The effective use of the massive amount of data captured by RFID systems throughout the supply chain is a real challenge (Li et al., 2006). Data management will require "*major increases in bandwidth, access and storage*" (Jones et al., 2005: 400) and new ITs along with comprehensive training to allow employees to use the new systems.

In its current deployment RFID is an automation tool. It is instructive to ask if by viewing it differently it could move away from process automation and towards real innovation in services. Currently, most RFID applications are within narrow closed loop systems rather than an open networked system.

Christopher (2004) suggests that all supply chains should be operated in such a way that customers are serviced at higher levels yet at lower costs. Yet the reality is different: Service issues abound and much of the systems are inefficient and ineffectual at judging demand and supply. Both manufacturing and service sectors need to equip themselves with tools to detect changes in their supply chain and be prepared to counteract any undesirable consequences. While in theory RFID gives such real time ability, the pragmatic technical solutions and the overarching conception of how RFID's capabilities can beneficially be used for service operations remain open.

III. CONCLUSIONS

Supply Chain Management is one of the most costly and difficult parts of a business to manage. Effective management of complex global supply chains is a competitive requirement for all organizations. Much of technology within supply chains has been aligned with the automation of this process and is product focused. With the advancing RFID technology this paper suggests that RFID may be the same type of technology but could be designed with a business case to support service orientated organizations if the technological solutions of handling the resulting data for the benefit of both customers and service providers can be developed and successfully implemented.

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