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Some Fresh Perspectives

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BRIDGING BETWEEN GOODS AND SERVICES SCM: SOME FRESH PERSPECTIVES

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Operations management literature predominantly focuses upon the manufacturing sector although service practice is vastly more dominant in today's economy. This article identifies similarities and differences in goods and services literature to inform a view of constructs (e.g. inventory, capacity, and Bullwhip effect) that are equivalent, and of relevance to the service sector. The authors explicitly present a unifying paradigm and illustrate it by case studies, offering a fresh perspective on services chain management.

Key words: Service operations, supply chain management (SCM), service paradigms, inventory, capacity, immediately usable service (IUS)

Today it is widely recognized that service operations research lags behind its manufacturing counterpart (Heineke and Davis, 2006; Ellram, Tate and Billington, 2007; Metters and Marucheck, 2007). As Chase (2004) poignantly noted, "80% of the United States' economy is in services, but 80% of operations management is still focused heavily on manufacturing." A related concern to the scanty attention paid to services in academic research is that the theoretical foundations and paradigms in service research have all come from the marketing discipline, and operations paradigms are under-represented (Sampson, 2007). Set against this backdrop, this paper focuses on an even less attended subset of service research: services supply chain. A supply chain perspective on service operations is an opportunity to build upon existing knowledge, and meets the needs of a topic fast gaining momentum.

The field of supply chain management (SCM) is rich and gaining momentum because of both practitioners' and researchers' efforts, and offers exciting opportunities to apply goods-SCM concepts to the nascent services supply chain field. This paper attempts to formalize a framework to utilize this opportunity. The academic fields of service operations and SCM have mostly evolved independently, and the novelty of the present paper lies in synthesizing concepts from these two apparently disparate bodies of knowledge and offering an integrative framework. This would provide a new lens for researchers to look at service operations, and offer immense research potential, by facilitating cross fertilization of ideas from a well-established field onto a nascent field. It would also unleash practical insights that can help service managers leapfrog to the current levels of goods-SCM knowledge.

Motivation and Objectives of Research

Anderson and Morrice (2000), abbreviated as A&M 2000, and Akkermans and Vos (2003), abbreviated as A&V 2003, are pioneering works in service SCM modelling, and can have considerable influence on the future research in the field. The impetus for the present article comes from the difficulty in transference of concepts from SCM to service chain contexts in the ibid papers due to lack of clear and consistent constructs. In particular, the section titled "Operationalization of Research Constructs" in A&V 2003, which dwells upon the difficulties, bears testimony to this. The crux of their difficulty lies in finding services-equivalents of the fundamental construct of operations management: *inventory*. This particular issue has not been resolved even after many years after their papers were published. This article re-examines the paradigmatic assumptions of A&V 2003 (and others adopting similar paradigm) and extends knowledge on the topic by reconciling them with competing paradigms. Specifically, the objectives of this article are the following:

1. To examine inconsistencies in the goods-services-equivalents of SCM concepts in literature
2. To reconcile the inconsistencies and propose a logically sound paradigm that would allow cross-fertilization of ideas between goods-SCM and service management.
3. To demonstrate the usefulness and validity of the proposed paradigm, for use by the operations management community.

Research Methodology

The methodology adopted in this research is to first critically examine the existing services supply chain literature. The examination throws up the existence of two schools of thought in previous literature which are mutually incompatible and which need to be reconciled. We address this need by revisiting well-established SCM and service operations/services marketing literature and offering a fresh perspective bridging the two.

The arguments set forth in this article are empirically grounded with case studies. The existence of two schools of thought in previous literature is illustrated with the help of two prominent previously published cases which exemplify the two schools of thought respectively. They are the telecom case study (A&V 2003) which examples the first paradigm and the consumer-lending service centre in a UK bank (Oliva and Sterman, 2001) which exemplifies the second.

To demonstrate empirical support to our constructs that address the incongruence and bridge between goods SCM and service chains, we draw upon two in-depth case studies conducted previously by the present authors. The cases are positioned as "Multiple-Case Design, single unit of analysis" (Type 3) as described in Yin (2003, p. 41). The goods supply chain is represented by the case study of the supply chain dynamics of a market-leading automotive component manufacturer in India (Niranjan, 2008). For the services chain, we draw upon the case study of an outsourced call centre located in India and serving a US-based client (Niranjan and Srivastava, 2008). In addition, to provide variety, we intersperse the discussion with examples drawn from prior literature.

The rest of the article is organized as follows. The section titled *Literature Background* revisits the SCM concepts applied to service chains. It then uncovers two distinct interpretations of Bullwhip and other basic operations management constructs and describes inconsistencies therein. Next, *Unifying Constructs* are proposed from key considerations extracted from the services paradigm debates. *Validation of Proposed Constructs* describes the supporting case studies and examples. *Discussion* draws the implications of this article, its limitations, and finally concludes.

LITERATURE BACKGROUND

While the topic of goods SCM is vast and varied, for the purposes of this paper we start our review with the famous Bullwhip effect. This is because (1) Bullwhip has been synonymous with supply chain dynamics right from Forrester's (1961) seminal work which underpins the body of SCM literature, even though the terms SCM and Bullwhip were introduced decades later, and more importantly, (2) the pioneering works on services supply chains have also used the beer game and Bullwhip concepts to underpin their paradigm of services supply chains. Bullwhip therefore provides a good starting point for our discussion. We then examine how Bullwhip and other fundamental concepts of goods SCM have been used in extant service SCM literature. We bring to the fore the inconsistencies therein, with a view to addressing them in the following section.

Bullwhip Effect

Bullwhip is considered the "first law of supply chain dynamics" (Kouvelis *et al*. 2006). Bullwhip is defined as "upstream order variance amplification". This is the operational definition of the phenomenon observed in supply chains, wherein the variance of output tends to be higher than the variation in input. The classic definition of Bullwhip is attributed to Lee, Padmanabhan and Whang (1997), LPW for short, in their seminal article[1]. As illustrated by the beer game (a popular role-play game), minor variations in end customers demand for beer can get amplified manifold by the time they reach the upstream locations (e.g. the raw material suppliers), and result in alternating cycles of huge inventories and backorders, adversely impacting the supply chain performance, and in particular the raw material suppliers. The underlying coordination issues among the channel members cause this phenomenon. LPW identified four causes of Bullwhip: demand signalling, order batching, fluctuating prices, and shortage gaming. Today there is a rich body of literature focused on reducing the Bullwhip, using a multitude of approaches: behavioural experiments with human players, simulation experiments, system dynamics approach and game-theoretic axiomatic approach.

However, it must be observed that order amplification manifests itself at two distinct levels: (i) product sold and (ii) capacity. Bullwhip literature refers to the product-level dynamics; research on the capacity-level dynamics is almost non-existent. Both dimensions of Bullwhip, however, are important, and more so for the purposes of this article. A notable

[1] This is among the ten most influential articles in the fifty years of *Management Science* journal.

work on the capacity-level dynamics in manufacturing context is Anderson, Fine and Parker's (2000, p. 240) study of a capital equipment supply chain:

> *"This [capacity-level Bullwhip] effect, known in macroeconomics as the investment accelerator (see, e.g., Samuelson 1939), dominates because a small percentage change in product demand (automobiles, washing machines, computers, etc.) creates a dramatic change in orders for the equipment necessary to produce those products. For example, suppose that an automobile tire-maker is operating at full capacity and replaces its capital equipment (tire-making machines) at the rate of 10% per year. If the tire-maker sees a sustained 5% increase in demand, it will place an order with the machine-maker to increase capacity by 5%. This order comes on top of the normal orders that flow from equipment replacement and increases the orders from the tire-maker to the tire-making machine manufacturer by 50%. Conversely, if there is a sustained 5% drop in the demand for tires, the tire manufacturer may choose to order less equipment in that year, and orders to the tire-machine-maker could fall by 50%."*

The present work reviews how these and other basic concepts of operations management and SCM can be applied to both goods as well as services, and how some inconsistencies in established literature on service chains can be an impediment to smooth transfer of this knowledge.

Goods SCM Concepts Applied to Services Chains

While goods SCM has been around for considerable time, recently it has been acknowledged that little work has been done towards understanding and managing services supply chains (Baltacioglu *et al*., 2007; Ellram *et al*., 2004, 2007; Sampson, 2007). A&V 2003 note that service operations managers frequently look for guidance to manufacturing supply chains, "which is understandable because knowledge in SCM has accumulated over several decades, and is now well established" (p. 221). "The rationale for applying well-established models from the manufacturing sector to services sector is that the issues are the same: How can we design and manage a supply chain, controlling its assets and uncertainties, to best meet the needs of the customers in a cost-effective manner" (Ellram *et al*., 2004, p 21).

However, getting ready-to-use guidance might not be easy because although "root causes and promising countermeasures [of Bullwhip] are known and tested (in product supply chains), to what extent these apply to services chains is not immediately evident" (A&V 2003, p. 222). A&V 2003 claim some limitations of applying SCM concepts to services chains. For example, they argue that amplification effects in services do not manifest themselves in inventory levels, but rather in order backlog and workload levels. They also

assert that some of the known countermeasures of Bullwhip (e.g. reduction of order batching) do not apply to services chains.

We concur with the viewpoint that several concepts from traditional SCM can, and should, be gainfully applied to services supply chain. However, although A&M 2000 and A&V 2003 make some pioneering and valuable modelling attempts in this direction, their constructs and key findings (e.g. their finding that some of the known countermeasures do not apply to services chains) have some limitations. We argue that firstly, some of the salient findings of their studies are simply a direct outcome of their own choices of constructs, and therefore open to question, and further, the constructs are themselves sometimes logically inconsistent. According to the A&M 2000 – A&V 2003 framework, it is not possible to smoothly transfer goods SCM concepts to services, and therefore there is a need to reinterpret the building blocks of OM/SCM: inventory and capacity. We will show how this is not so: the framework proposed in this paper blends easily into the commonly understood building blocks of the OM/SCM literature. To achieve our objectives, we first identify and then bridge two distinct ways in which services supply chain literature has interpreted the building blocks of OM/SCM: inventory and capacity. In fact, literature has *not* been explicit on what the service equivalents of inventory are, and has not dealt adequately on what the service equivalent of capacity is. This article attempts to address this gap as well.

Service Capacity as Equivalent to Inventory

This viewpoint can be attributed to Ellram *et al*. (2004) who seem to be the first ones in academic literature to apply goods SCM concepts to service SCM context. Ellram *et al*. (2004) developed a framework appropriate for services supply chain by comparing and contrasting the applicability of important goods-based SCM models. They argue that buying a service represents a transfer of the service supplier's capacity to its customer in the form of a service. "Capacity in the services sector takes the place of goods in the manufacturing sector. *Capacity is a services supply chain replacement for inventory* (emphasis added) in that it allows a supply chain to increase its level of production to respond to customer demands" (p. 25). This is consistent with Chopra and Lariviere's (2005) view of *service inventory*. Somewhat similarly, Vargo and Lusch (2004a) use the term 'operant' resources to include all resource inputs that work *on* the operand resources to create value, so in a way, the operant resources are analogous to capacity.

	Inventory	Capacity
Goods supply chains	Goods	Machines/people/resources used to produce the goods
Services chains	Capacity to produce the service offering	

Figure 1: Service capacity as inventory-equivalent*

* Kimes (1989, 2003), Ellram *et al*. (2004, 2007), Chopra and Lariviere (2005), Lovelock and Gummesson (2004), Vargo and Lusch (2004a, 2004b)

The framework proposed in this article falls in the "*Service Capacity as Equivalent to Inventory*" school of thought. However, if service capacity is service-counterpart of goods-inventory, what then is the service-counterpart of *capacity* in goods context? We note that in services context, the distinction between inventory and capacity is subtle and Ellram *et al*. (2004) do not distinguish between the two. From an operations perspective it is very important to make this distinction (Schroeder, 1993). Therefore, later in this article, we explicate the construct 'capacity' as used by Ellram *et al*., in order to distinguish the two constructs.

Order Backlog as Equivalent to Inventory

A&V 2003 and A&M 2000 take a different position. For these authors, *backlog* is the services-equivalent of goods inventory. A&M 2000 is the first paper to mathematically model a services supply chain. Considering the importance of the concept of Bullwhip effect to the industry, and given its familiarity to operations management researchers, and its amenability to research, they adopt the beer game for their study. To "address the limitations of the traditional Beer Game for teaching the bullwhip effect (LPW 1997) in services chain contexts" and "to overcome difficulties in extrapolating these concepts to services, and to further the understanding of the topic" they develop a mathematical simulation model of a services supply chain. They consider a financial services chain comprising four levels of processing. The prime motivation for their work is to offer a model to simulate chains having no finished goods inventories. They liken the work backlog faced by each stage to the inventories; and manpower hiring orders to product orders. This paradigm can be summarized, see figure 2.

	Inventory	Orders for product	Capacity
Goods supply chains	Goods	Orders for goods	Machines/people/resources used to produce the goods
Services chains	Backlog (outstanding demand)	Manpower hiring orders	Workforce i.e. People/resources used to produce the service

Figure 2: Backorders as inventory-equivalent**

**A&M 2000, A&V 2003, Sampson and Froehle, 2006, Sampson 2007

A&V 2003 draw upon this work and adopt a similar position: that order backlogs are the service-equivalents of inventory. Their modelling work, based on their paradigm proves that: "Amplification effects also occur in service supply chains, but they manifest themselves in variances in order backlogs and workloads." (Proposition 1, ibid). A corollary to this framework is the *bidirectional service chains notion.*

Historically, Sampson (2000) was the first to offer a service SCM paradigm. Central to Sampson's framework is the notion of bidirectional supply chains or customer-supplier duality. According to this view, customers are also a sort of suppliers in that they supply their minds and bodies as raw material for the service provider to work on. E.g. a dental patient-customer is also a supplier of the raw material (teeth) to the dentist-service provider. The patients waiting at the clinic are viewed as repositories of raw materials (teeth) and hence an inventory. This forms the cornerstone of academic treatment of service SCM in academic literature on service operations (e.g.: Fitzsimmons and Fitzsimmons, 2006; Sampson and Froehle, 2006). Bidirectionality is clearly captured in Sampson and Froehle (2006, p. 335).

> *"With service processes, we cannot produce before demand due to the reliance on customer inputs. However, there can still be delays in the system if customer inputs arrive in excess of available capacity. In such cases, the customer inputs are in "inventory" either until sufficient server capacity becomes available or until the customer decides to withdraw his or her inputs from the process (Sampson 2001, p. 90). This "customer inventory" is commonly called a "queue" or a "waiting line," and it experiences a "holding cost" much more time sensitive than traditional manufacturing inventories."*

In summary, the school of thought comprising leading works such as A&M 2000, A&V 2003, Sampson (2000, 2007) and Sampson and Froehle (2006) adopt the *order backlogs as inventory* paradigm.

Reconciliation of Different Constructs

From Sampson and Froehle's (2006) quote above, it is clear that there exist two distinct schools of thought: "backlog as the equivalent of inventory" and "capacity as inventory", which are obviously distinct and inconsistent because backlog and capacity are not the same. In attempting to reconcile this, the present article adopts the lens of operand and operant resources proposed by Vargo and Lusch (2004a): the product that flows through the chain (*operand* resources) and the resource used to create that product (*operant* resources). Leaving aside the existence of two schools of thought, this article rests on the premise that backlog/inventory pertains to the *product* flowing through the chain i.e. *operand resource*, and clearly distinct from *capacity* which is the *operant* resource. The conventional view in operations management is that inventory is something produced *prior* to orders being received. When this view is applied in the service context, it may be seen that the queue of customers waiting to be served connotes *backorder* cost, quite opposite to *inventory holding cost* as interpreted by Sampson and Froehle (2006).

We identify other logical inconsistencies within the "order backlog as equivalent to inventory paradigm. A&V 2003 observe "order backlog is very much the mirror image of inventories" in services (p. 209). Centred on this questionable assumption, they model amplification (Bullwhip effect) in a telecom services chain using system dynamics. The assumption is questionable because backlog is actually the opposite of inventory in operations management terminology, and can be mirror images in that sense i.e. being opposite, rather than equivalent as interpreted by A&V 2003. A&V 2003 draw support from A&M 2000 to argue that "while other indicators such as hiring/firing rates and capacity utilization can also serve as indicators, amplification manifests itself most clearly in order backlogs and workloads", so order backlogs are the appropriate service-equivalent of inventory. By this logic, any other variable that exhibits high variance could become the service equivalents E.g. if price volatility exhibits increasing upstream volatility then price could also become the service equivalent of inventory. Using amplification, rather than conceptual consistency, as the basis of assigning service equivalence, seems unjustifiable. That the 'order backlog as equivalent to inventory' framework is also at odds with existing OM constructs is another concern.

A&V 2003's main justification for their choice of constructs is the purported consistency with LPW 1997. In a bid to demonstrate that consistency, and show how it is superior, they (incorrectly) reference to LPW's (1997) use of order quantity rather than physical units for measuring Bullwhip (LPW did of course use orders instead of physical units to measure variance ratio, but the subsequent interpretation that LPW used orders as rate variables in patently wrong. Foot note 3 clarifies). We will show that there are differences between the original constructs used by LPW (1997), and those used by A&M 2000 and A&V 2003. They are three-fold:

- LPW adopt units at the *product* level (which is the entity demanded/sold) as the unit for measuring variance amplification. The latter authors use the level of *capacity* (an entity that is used to produce the product), and not the unit of product, to measure amplification. The two (product and capacity to produce) are not equivalent, and hence the latter authors' paradigm is inconsistent with the accepted notion of Bullwhip[2]. Again, note that the latter authors use the construct at the logical level of capacity, and A&M 2000's mortgage service game is all about capacity decisions, however, A&M 2000 and A&V 2003 position their works at the level of product and insist the decisions are at the level, and hence, the same decisions are analogous to inventory decisions in goods supply chains.
- Amplification could either be measured in physical units held at, or orders placed by, an echelon. LPW chose orders because bullwhip is a variable to measure information distortion, and orders are closer to information than physical units are. See footnote 3.
- More seriously, if we sidestep the dichotomy existing at the product vs. capacity level bullwhip, and instead focus on the signage of the constructs, A&M and A&V's interpretations of backorders as the equivalent of inventory seems to be at odds with the fundamental notions of inventory as understood in operations literature. That is because inventory, traditionally, means work/output produced ahead of demand, whereas backorders occur when work/output lags behind demand.
- In their paper, LPW of course, do discuss in terms of orders for units rather than physical units, as suited to the objective of their paper. LPW refer to amplification of orders i.e. a *decision/action* that a player takes and is a cause. The latter authors study

[2] Note that merely being at odds with the accepted notion of bullwhip does not necessarily undermine A&M's paradigm; in fact, their reinterpretation of bullwhip has the potential to set off research on bullwhip in a new direction. That however does not mean conceptual clarity and reconciliation is not needed.

amplification of backlog, which is an *outcome* or effect of past capacity decisions[3], not a *decision* or action in the present time.

These can possibly be reconciled by noting that the latter authors refer to the *capacity-Bullwhip* (as studied by Anderson *et al*. 2000), and not the traditional *product-level* Bullwhip. Although at some places they allude to bullwhip as ratio of order backlogs, they essentially work of capacity decisions of the echelons, and hence distinct from bullwhip literature. Note that it is not implied here that capacity Bullwhip is any less important than product bullwhip. The contentions are merely on logic and construct validity of the paradigm under critique.

Further, while A&V 2003's prime motive was to study amplification, it appears that other concepts of goods SCM cannot be transferred to services as easily using their construct 'order backlogs'. Their approach poses some additional conceptual difficulties, which translate into modelling difficulties. For example, in their model, the service-equivalent of inventory, i.e. backlogs is a variable that can take both positive and negative values, with negative backlog implying overstocking (e.g. employees sitting idle in a call centre when manning-level temporarily exceeds calls arrival). However, the original construct (orders) for Bullwhip was always non-negative and therefore much simpler to handle. In fact, A&V 2003 (p. 214) themselves admit to the "sometimes confusing relation between backlog and workload, two concepts often used interchangeably in this context." Such a lack of a consistently used unifying structure that defines what the service-goods paradigms are, makes it difficult to achieve coherence within the field and can create a barrier to discovering the managerial and operational implications.

A&V 2003 suggest that since services supply chain literature is in a nascent stage, there is some freedom on how to use terms (e.g. whether to use order backlogs or hiring rates), and use this to justify the introduction of their paradigm. The present research, however asserts that, while it is agreeable that services chain management research is in a nascent stage, it is imperative that early researchers use this opportunity to build sound base for future research to avoid problems later, and the "freedom to use terms" must be weighed against this imperative. Otherwise this freedom can lead to some logical inconsistencies and questionable findings gaining acceptance in extant knowledge. For example, consider one of the main findings of A&V 2003 on bullwhip in services: that some of the known causes of

[3] A&V 2003 devote an entire section to claim that their chosen construct, backlog, a stock variable, is superior to orders, "a rate variable" as purportedly used by LPW. However, they miss the point that LPW (1997) also used orders as a stock variable; they never used orders as a rate (author's personal correspondence with Hau L. Lee, Jan 2006). By this, the main justification for A&V 2003 choosing backlog stands in question!

Bullwhip do not apply in service chains. We contend that it is *by their own choice of construct definition* that A&V 2003 preclude two of the generic root causes of amplification (LPW 1997): order batching and shortages gaming, from their model. It would be therefore be inappropriate to claim, as A&V 2003 claim, that some causes of Bullwhip are absent in services chains! We shall later show that all causes identified by LPW are applicable to services chains as well, through proposed paradigm. Further, A&V 2003 and A&M 2000 choose 'order backlog' as the services-equivalent of inventory. Their choice is based on two crucial assumptions, both of which, we argue, are questionable:

(i) "Services cannot be inventoried": This notion is based on the IHIP paradigm which several contemporary authors (e.g. Gummesson, 2000; Vargo and Lusch, 2004b) dismiss in their well-publicized works. In light of this, the assertion that services cannot be inventoried stands in question.

(ii) "Amplification manifests itself most clearly with backlog": I.e. A&V 2003 choose backlogs primarily because it gets amplified in their case study. We feel that merely manifesting more prominently does not justify the use of a particular variable as the services-equivalent. Either the services-equivalent must be logically consistent with conventions, or conventions must be proven wrong, and A&V 2003 and A&M 2000 do neither. Further, they overlook other variables, such as capacity, that can also display amplification. It is mathematically much simpler to handle capacity than backlog (a fact that those authors have noted). Further, justification (ii) above can be refuted by arguing that amplification does clearly manifest in capacity too; influential papers have alluded to capacity variance getting amplified in services. For example, in a study of high contact services (which matches the 'pure services' nature of A&V's 2003 case study), Oliva and Sterman (2001) find that amplification prominently manifests in work intensity and time per order as well as in long-term capacity (total number of employees on payroll).

From this discussion, it is evident that the constructs used in some pioneering work (A&M 2000; A&V 2003) rest on unfounded logic, and that their sophisticated system dynamics model notwithstanding, they are needlessly complex and inconsistent with the extant operations/SCM literature, and transference of knowledge has been rendered difficult. It is therefore important to work towards a commonly accepted language, especially when the field is in nascence. Not doing so would result in continued tension rooted in faulty constructs, and result in research effort being directed at less fruitful inter-paradigmatic debates, rather than actual research contributions within the paradigms. Lest we face similar

quandary as faced by services marketing, that until now, rested on goods-dominant logic (Lovelock and Gummesson 2004).

UNIFYING CONSTRUCTS

The importance of paradigms for progress in any scientific field, and in service management in particular, has been extensively discussed in previous studies of this nature (e.g. Lovelock and Gummesson, 2004; Vargo and Lusch, 2004a, 2004b; Correa *et al*., 2007 and Sampson, 2007). The contribution of the present article is to adapt and apply these 'goods-services' discourses to derive useful insights for its subset, services chains. The main objective of the present article is to arrive at a unifying framework: to offer service-equivalent constructs to enable easy transference of learning from goods chains to services chain.

What are Services?

We anchor our discussion around the paradigm of services proposed by Vargo and Lusch (2004b) and Lovelock and Gummesson (2004). This is chosen to underpin the arguments in this article because it has a clear and sound logical basis. Vargo and Lusch (2004b) and Lovelock and Gummesson (2004) debunk the notion of IHIP as being features exclusive to services. From a view that transcends goods and services, they argue that it is these very traits which are common to both services and goods; they are the meeting points where goods and services concepts can be applied from one to another.

Vargo and Lusch (2004b) define services as "the application of specialized competences (skills and knowledge), through deeds, processes, and performances for the benefit of another entity". They call for an integrative view that collapses goods and services as non-mutually exclusive subsets of a common domain, that is, products. This viewpoint is consistent with the view that "activities render services; goods render services" and goods are merely vehicles of delivering services (e.g. Gummesson, 1995; Kotler, 1997). Riddle (1986) points that goods have little value in themselves; they are important only to the extent that they serve as the equipment for the service production processes. Kotler (2003) defines value proposition as a set of benefits companies offer to customers to satisfy their needs. "The intangible value proposition is made physical by an offering which can be a combination of products, services, information, and experiences." As an illustration consider a customer who needs coffee. One of the ways of meeting this need is by providing an automated coffee dispenser and ensuring adequate quantity of ingredients. Another way is by providing an employee who is readily available to prepare and serve the coffee. In both cases, the coffee-ingredients and the automatic dispenser/human server are important only to the extent that

they facilitate meeting the needs. Prahalad and Hamel (1990) characterize products (goods) as merely the physical embodiments of one or more competencies. In other words, it is the *organizational competencies* that are common inputs to both services and goods production. This key point forms the basis for our unified framework for identifying equivalent of services and goods supply chain constructs. Please note that our unified paradigm is for services *and* goods, as against Sampson and Froehle (2006) who propose a unified theory for all services, to distinguish services *from* goods.

We shall now propose our services-equivalents of goods inventory and production capacity. For this, we first need to refine the term capacity used by Ellram, Tate, and Billington (2004) and operant resources as used by Vargo and Lusch (2004a) because they use the term in a broad sense, inadequate for the purposes of this article. We make a distinction between capacity actually deployed and ready to use at a given point in time, vs. the long-term (maximum possible) capacity. This distinction is especially important in the services chain context. The distinction is along three orthogonal dimensions:

1. Time bucket: This captures how quickly the capacity level can be varied and convertible into readily usable (and saleable) resource.
2. Cost: How cost effectively/easily the resource level can be varied and made readily usable.
3. Perishability: perishable capacity, in that capacity without corresponding demand cannot be utilized to meet future demand.

It may be noted that these dimensions are not dichotomous; values for different services lie on a continuum between two extremes.

Immediately Usable Service (IUS) = Inventory

We begin this section by revisiting the basic concept of inventory in operations management (primarily in manufacturing context). In a widely used textbook, Ritzman and Krajewski (2003) defined inventory as: “inventory is created when the receipt of materials, parts, or finished goods exceeds their disbursement; it is depleted when their disbursement exceeds receipts.” Inventory management is about balancing the costs of excess vs. shortages. The first, called the inventory holding cost is the variable cost of keeping items on hand, including interest or opportunity cost, handling cost, insurance and shrinkage. The second, called backorder is a customer order that cannot be filled when promised or demanded but is filled later; and when the customer chooses not to wait, it results in lost sales.

It is evident that the *backorder as inventory paradigm* is at odds with this basic premise of operations management. This is because they view the waiting customers as

inventory rather than as backorders. Therefore, in the dichotomy between the two schools of thought: *backorder* vs. *capacity* as the services-equivalent of inventory, we take a position on the side of the latter i.e. *capacity* as the services-equivalent of inventory.

Schroeder (1993) defines inventory as "a stock of materials used to facilitate production or to satisfy customer demands." However he also notes a wider definition of inventory as an idle resource of any kind which has potential economic value e.g. equipment and idle workers and stresses that it is important to distinguish between inventory and capacity. We adopt the wider definition to capture the concept of inventory, applicable for both goods and services. If goods-dominance had not preceded the subsequent services-reawakening, and if were to start from back-to-basics, this is the likely definition we would have adopted. We name the construct as "immediately usable service" or IUS. Note that waiting customers are not part of this resource; just as outstanding orders for a car under make-to-stock situation implies backorders, waiting customers are backorders, a variable to be reduced by the actions of the service provider by deploying resources suitably.

Some examples of IUS are effective workforce available at a given point of time in a call centre, quantity of dough for making pizzas in a restaurant, etc. To build intuition behind this term, consider how the well-known newsvendor problem can be addressed using this term. These examples are used here to illustrate some basic OM concepts and thus strengthen the base for further discussion. In case of a goods inventory problem, cost is incurred up to the point of building inventory (e.g. how many newspapers to procure). Beyond this point, how many units are actually demanded and purchased by the consumer is uncertain; usually beyond managerial control. The key operational decision in the short-term is to balance the stock-out cost and holding cost, and decide how many newspapers to keep *readily saleable.* The term IUS implies an inventory of not just the newspapers, but the whole bundle of resources essential for successful exchange: sufficient human-sellers or kiosks, availability of loose change, availability of sufficient parking space at the shop without which customers cannot access the servers etc. In fact, in the 'services context', Sampson and Froehle (2006) and Fitzsimmons and Fitzsimmons (2006) realize this and use the term facilitating goods to describe items which although peripheral, are indispensable for the service to be successfully delivered. The term IUS captures both facilitating goods in services-context, and service offerings (around the core goods) in goods-contexts.

Applying the analogy of newsvendor problem to the call centre case study (Niranjan and Srivastava, 2008), the key short-term operational decision is the manning levels in each shift, to best match the uncertain demand. The inflow of call receiving agents into each of the

10-12 work-shifts constituting each workday is regulated to match the demand as closely as possible. The manning decision is taken by trading off the cost of extra (idle) manpower (and of course, occupying work-consoles, and lunch and beverages) against the costs of reduced service level, subject to manpower availability. When calls arrive, the agents receive them and immediately deliver the service if it is of routine nature using templates. More complicated queries require longer processing time. When demand arrival exceeds the forecasts, the situation is akin to stock-outs: customers on hold (akin to backordering) are dissatisfied, and the more impatient ones hang up (akin to lost sales). When manning-levels are higher than desirable, the deployed service potential (and staff time) goes waste, akin to salvage price being zero (100% perishable). It may be noted that just as goods are merely the distribution vehicle or channel for service provision (Vargo and Lusch, 2004a) we argue that the IUS is the distribution vehicle of the goods-services bundle.

Our view of IUS, while new to service chain literature, is held many earlier authors. In the service operations management domain, Chopra and Lariviere (2005) argue that "In service businesses as in others, work can be performed and stored in anticipation of demand". The placement of the push-pull boundary defines the portion of the work that has been performed and stored before the customer arrives. This, they call this work "service inventory", essentially same as our IUS. This is a managerial decision variable and "by wisely choosing what kind of inventory to hold, companies can improve quality, response times, customization and pricing." (Chopra and Lariviere 2005, p. 56)

Kerin *et al.* (2003) also use the word inventory, rather than perishability to characterize services: "With services, inventory carrying costs are related to idle production capacity" (p. 325). While discussing yield management, Kimes (1989) used hotels as an example and distinguished between perishable inventory (the availability of ready-to-use vacant rooms) and fixed capacity (number of rooms). Once a hotel or an aircraft has been bought, it is rather difficult/non-instantaneous to increase the (long-term) capacity. This makes hotels and airlines ideal candidates for yield management techniques which temporarily match the demand to the availability: room-inventory management and pricing so that demand is met profitably within the constraints. IUS refers to the perishable inventory. In the hotel example, it refers to a particular set of offerings (rooms with certain characteristics which can be easily modified within available room capacity e.g. whether to offer room service, replacing a single bed with a double-bed and converting to twin-sharing, adding a bed and making it multiple-sharing, changing number of staff available per room etc.). A customer is not concerned about the number of cars that the car-rental owns, or the actual

number of rooms in a hotel; she is only interested in the options readily available for her to choose from, at the time she needs the service. Lovelock and Gummesson (2004) use the term preproduction inventory to refer to this.

The key points of the foregoing discussions are that (i) far from saying inventory is not relevant for services i.e. *IHIP* paradigm, inventory is the meeting point of services and goods and (ii) "Perishability of productive capacity is as relevant to the manager of a factory producing beds as is it is to a hotel manager worried about unrented rooms" (Lovelock and Gummesson, 2004, p. 30). And this constitutes the foundation for our unifying paradigm.

IUS is the effective capacity or service creation potential available for *immediate* use, as and when the demand occurs. The subtle distinction is between physical resources owned/leased vs. the service-creation potential of that resource for immediate use, and IUS refers to the latter. This notion relates to prior literature in the following manner. As Hunt (2002) points out, "resources can be viewed as bundles of potential services" (p. 270) and "...it is never resources themselves that are inputs to the production process but only the services the resources can render" (Penrose, 1959). In the call centre example, it is the call handling ability that is the input. This is analogous to stocking a certain level of physical inventory. Call handling ability would be a function of not only the number of people deployed in the shift, but also of their productivity, working hours, prior preparations where applicable etc. Such a definition would accommodate the peculiarities of people-intensive services inventory: an 'inventory' that feels, emotes, and tires! For example, merely increasing working hours may not constitute increasing the IUS, as such a practice may lower individual performance and reduce productivity as found by Oliva and Sterman (2001).

Equivalent of Capacity

Capacity is the maximum rate of output and capacity planning refers to long-term planning, over one or two year horizons (Ritzman and Krajewski, 2003 p. 157). Capacity of a service firm is "the highest quantity of output possible in a given time period with a predefined level of staffing, facilities and equipment" (Lovelock, 1992, p. 26). Our notion of capacity (i.e. total employee strength on the payroll; number of consoles and other physical infrastructure in a call centre; number of rooms in the hotel) is consistent with Lovelock's definition and it is analogous to production capacity of goods supply chains, and therefore encompasses product bundles comprising services and goods. Just as a manufacturing unit is constrained by its capacity as to how fast it can build-up inventory, so also, the effective strength on rolls (including those on leave, off duty, etc.) determines how quickly IUS can be ramped up, and maintained at a sustainable level. E.g. a call centre would have people working round the

clock, and the total number on payroll (capacity) defines the quickness by which a certain number of employees can be put behind the desk to take calls (IUS).

Our services-equivalent of 'capacity increase' is the hiring (of human resources for services such as professional services which are mostly human expertise based) just as physical property acquisitions are, for goods. Similarly, just as surplus capacity is disposed of by selling or loaning out, surplus employee capacity is disposed of by firing. Normal attrition (e.g. retirements) is akin to depreciation of plant (Anderson *et al*., 2000); long spells of overwork with lack of exercise and rest causes short-term productivity gain at the expense of long-term capacity; just as it does in case of ill-maintained machines.

ILLUSTRATION OF THE PROPOSED PARADIGM

The validity and usefulness of the proposed paradigm, and its superiority to earlier ones (e.g. Sampson and Froehle, 2006 A&V 2003) is now demonstrated with the help of case studies, one each for the services (see figure 3) and goods supply chain (see figure 4). For the services chain, in view of the "changing face of the economy where globalization and purchasing/outsourcing of professional services are becoming increasingly important", (Parasuraman, 1998, Ellram *et al*., 2007), we choose the case study of a typical outsourced call centre for our purpose. A more detailed treatment of the case study is available in Niranjan and Srivastava (2008). The call centre services the client's (a large US-based communications network equipment manufacturer) consumers' calls relating to troubleshooting and enquiries.

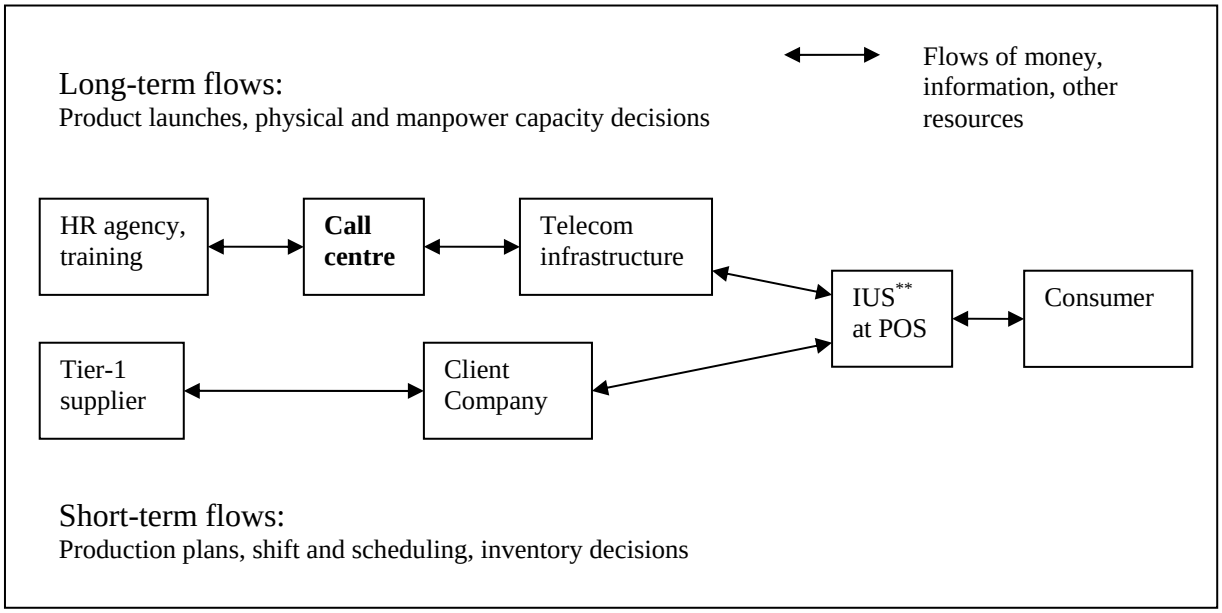

Figure 3: Call centre case study*

*Simplified diagram. The actual chain has several entities at each echelon

**IUS at POS: Immediately usable service at point of sale or "moment of truth". At the moment of the call, IUS pertains to the availability of space in the call-handling infrastructure: queue capacity, 1st stage automated call distributor, as well as the human server who finally receives the call.

The goods chain case study is drawn from the ongoing doctoral dissertation work on the supply dynamics of an Indian automotive chain (Niranjan, 2008). The focal firm is a Tier-1 supplier of car steering system assemblies to over 12 car makers.

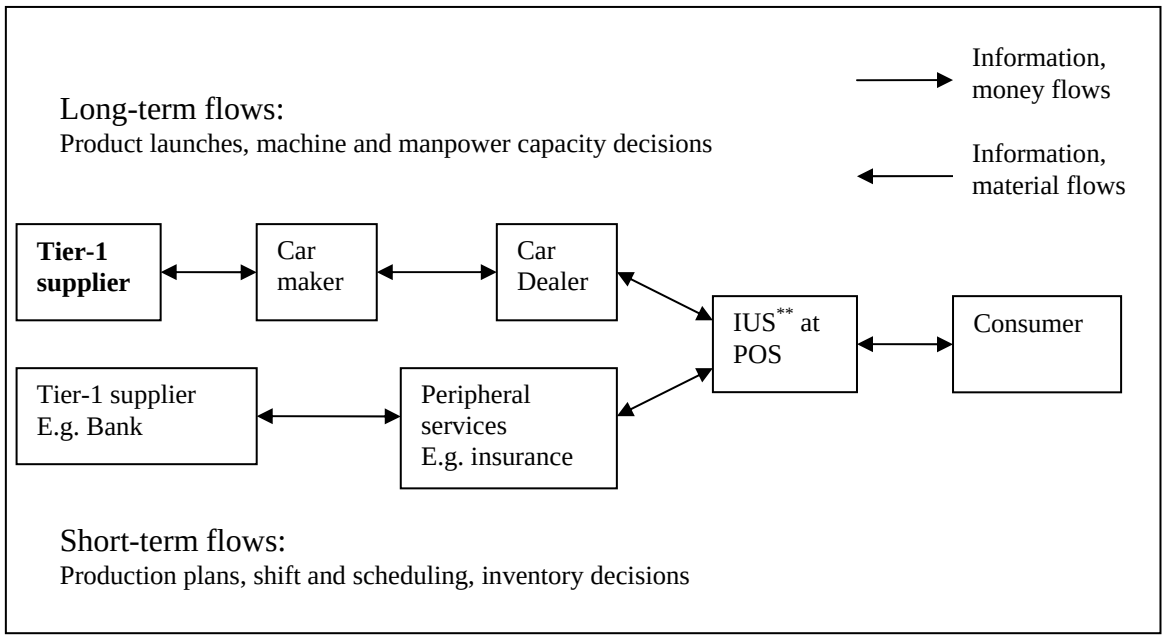

Figure 4: Automotive supply chain*

*Simplified diagram. The actual chain has several entities at each echelon

**IUS at POS: Immediately usable service at point of sale

The way the following goods-SCM concepts are applicable to services, also serves as themes for future research in service chain management.

- *Forecasting and planning:* Uncertainty of customer demand is a basic problem of any chain, which managers need to grapple with. In the auto chain, long-term (over 1-year horizon) forecasting and planning is aimed at managing the capacities: negotiating with customers for price and service levels, purchase of land and plant infrastructure, vendor search and drawing up of supply contracts etc. In the call centre, the corresponding activities are drawing up of service levels (see Niranjan, Bharadwaj and Saxena, 2007 for a discussion of the centrality of service level agreements (SLAs) in business process outsourcing), location, buildings, negotiations with the human resource consultancies for recruitment of staff, acquisitions etc. In the short-term (less than a week's horizon), forecasting is for the expected demand for the next few days, intra-shift production uncertainties and supply delays, monitoring and rectifying mini-max levels inventories. In the call centre, short-term forecasting refers to forecasting the call rate, and from it, calculating how much effective manpower to place on duty

in a shift. This is analogous to forecasting demand and calculating how much to stock in a goods supply chain (IUS).

- *Manufacturing lead times (MLT):* MLT, in the auto chain, is the time it takes to convert the raw material into finished assemblies and to deliver them to the customer. In a call centre, the analogous activity is to convert the latent capacity into agents ready to receive the calls at their computer terminals. The delay is due to transportation (from their residences to the office, a task managed by the company because of the critical nature of time) and seat allotment delays, and time taken to switch-on the system and log on to it. This conception of MLT applied to services, appears straightforward compared to A&V's 2003 conception.
- *Capacity build-up lead times:* Lead time of acquisition of plant and machinery, in the auto chain. Hiring/training lead times in the call centre.
- *Bullwhip (product-level):* While this phenomenon is well-known in goods supply chains, it is also relevant but far less prevalent in services chains. The reason is special nature of the human component of the services inventory i.e. employees deployed in a particular shift, is highly flexible. The employees are able to cushion a significant part of the demand oscillations in real time (this however has long-term detrimental effects) unlike a finished good e.g. a toy which cannot grow bigger or multiply to meet extra demand. This human-cushioning can be achieved by the first two of three modes identified by Oliva and Sterman (2001) as the structural determinants of service response flexibility: varying (i) Time per order and (ii) Work intensity (working harder and/or longer). The third one, Service capacity (this essentially pertains to long-term capacity; what we called fixed capacity) is applicable in the next point.
- *Bullwhip (capacity-level):* In services chains, amplification primarily occurs primarily on the capacity side, rather than on the product (output) side. It is manifested in hiring rates and firing rates which can be more volatile than the volatility of calls arrival. Amplification occurs due to long training/procurement lead times (See Oliva and Sterman 2001 for a detailed study along these lines). Interestingly, the same mechanism of huge cyclicality of manpower is observed in Anderson *et al*'s (2000) study in a sector thought to be predominantly goods, and this reaffirms the goods-services commonalities.

- *Risk-pooling:* Several components and worker skills are common across several finished assemblies, resulting in reduction in inventory and manning required for a given service level. Its equivalent in a call centre is server-pooling i.e. cross-training manpower so that they can be moved from a queue with low demand, to a queue facing high demand, in almost real time by shifting the employees across desks.
- *Order-batching:* The well-known concept of production lot-sizes to reduce wastages of set-up times. In the call centre, grouping new hires for training in call centre. It is not economical to train them individually; often, a few more than requirement are taken in because of economies of scale. Batching is also done in transportation: with a few people often being picked up prior to expected requirement in order to minimize empty vehicle movements and utilize the sift managers better. This provides an alternate explanation to one of A&V's 2003 main findings that order batching *cannot be* a relevant cause of amplification effects in service chains.
- *Supply chain coordination:* There is a rich body of literature on supply chain contracting in the goods B2B context (see for example, a review by Cachon 2003). It covers issues including pricing, service levels (e.g. fill rate) and process-metrics (capacity investments, quality measures). Interesting parallels can be drawn from studies of service levels in goods context (Taylor *et al*.-forthcoming) with those in outsourced business services (Niranjan *et al*., 2007). Central to the SLAs are the performance metrics e.g. how quickly call must be handled and process-metrics i.e., and the total manning-levels, hiring processes & training to be imparted (Niranjan and Srivastava, 2008). It is easy to visualize the IUS as the unifying construct to capture inventory. It also distinguishes inventory and capacity far more readily than A&V's 2003 *order backlogs* does.
- *Postponement:* This is a well-known SCM strategy by which the resources are used in such a way that the final product is differentiated at the last moment possible in order to match the changing demand as closely as possible. Its counterpart in the services case is to train call-employees with the most general skills in the beginning (e.g. voice and accent training module in Niranjan and Srivastava, 2008), so that towards the end of training period, they can be imparted the particular product skill (exclusive to a particular client's products) to match the updated demand forecast. This concept of postponement is consistent with moving the push-pull boundary closer to the customer in services context (Chopra and Lariviere, 2005).

Our paradigm of unifying constructs is consistent with that of several marketing authors as well. For example Gummesson (2000) argues that "The claim that services cannot be stored is nonsense. Services are stored in systems, buildings, machines, knowledge and people." Vargo and Lusch (2004b, p. 331) note that "airline and theatre seats are routinely inventoried for a period of time prior to 'production', purchase, or consumption; they just are not inventoried after production." This, we note, is akin to raw material inventory and work-in-progress inventory i.e. pre-production inventory. We note, however, the above two 'marketing' authors do not distinguish between inventory and capacity. Therefore, from an operations management perspective, we refined their notion of what is stored, into two temporally separated concepts: inventory (the service capability readily available) and capacity (long-term service capability/potential, not yet deployed for ready use). In Gummesson's (2000) quote above, we identify the knowledge and people actually on duty as IUS; and buildings and machines and total people on payrolls as fixed capacity. Similarly, in Vargo and Lusch's (2004b) example of airlines, we identify the available seats (and effective staff on duty) as equivalent of inventory of product being sold; the total number of seats in the aircraft (and total workforce) refers to the maximum capacity.

DISCUSSION

Having established the literature linkages and empirical support of our proposed paradigm, we will now discuss the implications. We first revisit the view that *backlogs are the equivalent of inventory*, a view held by A&V 2003, A&M 2000, Sampson (2000), Sampson and Froehle (2006) and Sampson (2007), and implicitly by Fitzsimmons and Fitzsimmons (2006) and demonstrate their fallacies. To provide variety, our position is explained with reference to Sampson's (2000) original examples which were mostly in the B2C context. Consider the examples of dental service and the education service. To these authors, the patients in queue to be examined, and the students waiting for lectures (or planning to enrol for an educational program), are raw material-inventory. The supplier-customer duality theory of service chains rests on this premise. That this theory does not help in smooth transference of SCM concepts to services was demonstrated in foregoing discussions. In fact Sampson and Froehle (2006, p. 337) admit "But applying SCM to 'pure services' like consulting and psychology can seem forced and unclear."

In contrast, according to the paradigm proposed here, inventory means the doctor and professor's prior preparations (physical: gloves, course materials etc. as well as intellectual: the doctor going through patients' case histories and lab reports in advance, the professor's prior reading of literature and preparations for the lectures etc.) in the same way that Chopra

and Lariviere mean ‘service inventory’. The waiting or anticipated customers i.e. patients and students, are just forms build-to-stock (BTS) or build-to-order (BTO) customer orders depending on how much of the service creation potential is actually expended before/after orders receipt (Chopra and Lariviere, 2005). The same reasoning can be applied to each of their examples (Sampson, 2000, Figure 1, p. 352). While to them, a car owner with his broken car, and the student, are *supplier*-customers, to us they are just *co-producing* customers: the clarity of description of the car’s fault, and the student’s intellectual calibre and engagement can all loosely be said to impact upon the quality of car repair or teaching service.

We draw upon the clear distinction made between the terms *supplier*-customers and *co-producing* customers by Sampson (2007, p. 23). Our views are consistent with the concept of *co-producing customers*: quality of customers’ *co-production* inputs (communication, knowledge etc.) can impact quality. We, however, disagree with the *supplier*-customer concept. To us, customers’ teeth, hair and minds are the ‘objects’ upon which service is applied, rather than raw materials themselves.

Sampson’s (2000) view of raw material quality and “garbage in, garbage out” (p. 359) can be shown to have peculiar implications: for example, a cosmetic surgeon seeking to ensure the highest quality of output should turn away a highly ungainly individual, and a paramedic should turn away severe cases of trauma because ‘the raw material is in bad shape’; a hairstylist should turn away a balding client for similar reasons. Surely, none of this happens in real life. Sampson (2000) circumvents this limitation of the duality paradigm by arguing that “supplier selection is usually not an issue under customer-supplier duality, since it is the customers who choose to be input-suppliers to the service provider, not the service provider who chooses the customers” (p. 359). To us this appears as a case of redefining common language in order to justify the validity of a paradigm, rather that their paradigm falling in place with commonly observed reality.

Further, their claimed solution to improve service quality, emerging through their paradigm, is for the service buyer and seller to communicate their mutual expectations better. It may be noted that this is a well-known concept in service quality literature, and applies everywhere independently of the customer duality paradigm. In other words, our notion of *co-producing* customers (described by Sampson 2007 as a distinguishing feature of services) is an equally important perspective for manufacturing as well. For example, the well-known car manufacturer Toyota is a customer of components. Its quality of communication with vendors, vendor development efforts, sharing of forecasts and plans, specification of design

etc. can all significantly affect the quality of the supplies, a fact well-known in goods SCM literature and not unique to services.

A related limitation of the duality paradigm is that essentially all offerings (including those previously understood as goods) can fall under their description of services, instead of identifying unique features of services, which is one of the purposes of that paradigm. For example, just as a patient is a supplier of raw material (spoilt teeth), so can be a car owner who brings in a dilapidated car for repainting (because the paint needs a surface for it to be applied on; and the final "quality" depends on the surface finish and properties of the object as well as the paint (the paint, paint*er* and the 'paint*ee*'!). Therefore, in their scheme of things, a car is a raw material for the paint. For similar reasons they categorize garments as raw materials for the dry cleaner. It is not clear how the garments and the dry-cleaning solvents can be treated under a common term inventory. These are the problems that ill-founded constructs can lead to. Clearly, there is space for a superior construct definition; a space that this article hopes to fill.

Limitations

We now list some limitations of this work. Due to the legacy of A&M 2000 and A&M 2003, the arguments in this article were rooted in prior supply chain literature, which, we admit, is predominantly of a linear chain structure. This is a gross simplification even for goods chains, l*et al*one service chains. Although researchers and practitioners agree that a network or 'spaghetti' (Chopra and Meindl, 2004) is more representative of real supply chains, academic research is mostly restricted to the linear chain view of business, perhaps for modelling ease and other reasons. To what extent the concepts such as Bullwhip, grown out of linear supply chain thinking, apply to modern business environment, is a moot question. As Fitzsimmons and Fitzsimmons (2006, p. 483) have already noted, "Service supply chain relationships are hubs, not chains". Further, rather it being a discriminating feature of services, it is a feature that services share with goods. And this is another justification for us to unify goods and service constructs and take an expansive view of the service chain (e.g. the newsvendor problem discussed earlier in this article). If services supply chain is emerging as a new sub-domain of service research we would caution against over-reliance of ideas , and instead adopt more holistic approaches based on systems-thinking and "arborescent supply chain" model (Giménez, Pérez and González, 2005, Sodhi, 2006) or "service ecology", while retaining the theoretical underpinnings of operations management, such as inventory and capacity.

A notable limitation of our case examples is that they are in B2B service context and this may limit wider suitability of this study. However it may also be noted that several authors have acknowledged the meteoric rise of B2B services, and that service literature rooted in B2C contexts has generally been generally slow to catch up (e.g. Parasuraman 1998). More recently, Johnston (2005, p. 1302) observed that "Ninety per cent of my students are involved in business-to-business (B2B) services, with either internal and/or external clients/customers. As a result, over the last few years the content of my courses, the cases and examples used, has shifted to contain around 80 per cent business services." Viewed in this light, our choice of cases and discussions in B2B context seems well-justified.

Conclusions

In this article we explored the application of extant knowledge in SCM to services chains. We briefly reviewed the distinction between amplification of orders for inventory and of orders for capacity in manufacturing supply chains. We highlighted some of the ambiguity existing in literature about what their services-equivalents, and the importance of developing a common language/paradigm when the field is in a nascent stage. We identified some fallacies in the *backorders as equivalent to inventory* and the *bi-directional service chain* paradigms.

We proposed the IUS (i.e. service inventory) and clarified its distinction with capacity. Vargo and Lusch (2004b) convincingly show how integrated services and goods are; and how futile it is to delineate them. Our article is in the same spirit in proposing unifying constructs for inventory and capacity. We drew upon previous works (e.g. Oliva and Sterman, 2001) to argue that in services chains, responses to demand volatility (a.k.a. Bullwhip) may be both at the level of IUS (e.g. working hours) as well as long-term capacity (hiring). This is analogous to amplification in inventory and capacity in goods chains. We built upon the different constructs used in previous literature, to offer a simplified and consistent framework with wider applicability. The implications for researchers are that our proposed constructs help in modelling of service delivery by smooth transference of goods-SCM concepts, opening a gateway of new research avenues.

	Goods supply chain	Two distinct Service chain paradigms in prior literature		Proposed Unified framework
Representative papers	Lee *et al*. (1997)	A&V 2003; A&M 2000	Ellram *et al*. (2004)	Present work
Inventory:	Units stocked (finished goods, w.i.p)	hiring/firing rates; order backlogs; Capacity size	Capacity	IUS (e.g. effective manpower per shift; finished goods)
Capacity:	Capacity to produce	Workforce	Capacity? (not explicitly addressed)	Long-term capacity (Workforce on rolls)
Production Lead times:	Time to procure and convert inputs into output ready for sale	processing time per *consumer order*	Not addressed (NA) explicitly	Time to readjust shift manning-level (e.g. to assign more people for a shift)
Lead time: (capacity level)	Time to re-adjust capacity (Author's inference of Lee *et al*.)	NA		Time to hire and train people; buy/hire and install new machines to process the orders.
What gets amplified: (inventory & capacity Bullwhip)	1. Orders for units; 2. Orders for capacity	backlogs and work intensity;	NA	1. IUS = inventory; 2. Hiring rates and machine acquisitions as capacity
What, if left unsold, is perishable:	unsold units	NA	NA	IUS (e.g. value of deployed, but unutilized employees)
Raw material:	Self explanatory	1. People's hair (saloon service), teeth (dental service); students minds (education) 2. Consulting clients' business problems	NA	1. Tools/ hair designs/ dentistry tools and prior mental preparations and availability of service provider 2. Intellectual resources such as trade analyses, template reports

Figure 5: Summary of concepts

Our constructs also contribute by transcending the now discredited goods-services dichotomy upon which Sampson and Froehle's (2006) unified service theory rests. Viewing the offering (goods-service bundle) as an outcome of the interaction between people and physical resources, forces the manager to take a more holistic look than a linear chain view at every level. For example, selling a car (seemingly a 'good') includes a host of peripheral services which Lovelock (1994) poetically describes as forming the petals of the "flower of service". Such a view would help in designing seamless service delivery. As several of the above cited authors note, the distinction between services and goods was made by academics, and are artificial and unjustifiable. Our paradigm is a timely contribution as it integrates and responds to the somewhat disparate calls for research e.g. the call for a "service-dominant

logic for marketing" (Vargo and Lusch, 2004a, 2004b), "service-goods bundle of offering" (Correa *et al*., 2007) and an "operations paradigm to services" (Sampson, 2007).

To conclude, like Lovelock and Gummesson (2004, p. 38) "We make no claim that the proposed new paradigm offers a panacea with necessarily general properties." Rather, we have built upon prior studies to propose a goods-services-equivalent constructs to achieve the modest goals of this article: smooth transference of SCM concepts which were predominantly goods-oriented, to service chains.

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