



Service, services and products: rethinking operations strategy

Martin Spring and Luis Araujo

Lancaster University Management School, Lancaster, UK

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Abstract

Purpose – This paper proposes a new approach to operations and supply strategy in the light of recent developments in the analysis of the respective roles of products and services in delivering benefits to customers.

Design/methodology/approach – Reviews and synthesises concepts from operations management (OM), marketing, economics and related areas. Examples of product and service combinations are considered, drawing attention to the ways in which services may be distinguished from products. An institutional basis for defining services is favoured over IHIP. A corollary of this is how services are made tradable: the modularity theory of the firm is used to do this. The paper then outlines, considers and compares various approaches to the combination of products and services: “service-dominant logic”, support services, product-service systems, systems integration, performance-based logistics, bundling and, finally, the notion of “the offering”.

Findings – It is found that the notion of the business model is useful as an integrating concept. This focuses on four areas: network structure, how transactions are made, how revenue models and incentives interact and how capabilities are accessed. Implications for future research in OM are considered.

Research limitations/implications – Hitherto, operations strategy (OS) has concentrated on intra-firm capabilities, which is only part of one of the four areas identified. Therefore, an extensive agenda for research into inter-firm capabilities and the other three areas identified is presented.

Originality/value – This is among the first papers in OM to break completely with IHIP as a basis for service definition and to work through the implications for OS. It is also the first to develop systematically an understanding of how the emerging concept of the business model can inform OM.

Keywords Operations management, Customer service management

Paper type Conceptual paper

Introduction

The respective roles of products and services in delivering benefits to customers has become an increasingly closely studied issue. More specifically, there has been a resurgence of interest in the foundations of services *per se* (Sampson and Froehle, 2006; Corrêa *et al.*, 2007), influenced by the changing practices in erstwhile manufacturing firms (Wise and Baumgartner, 1999), and the promotion of “services science” by IBM (Chesbrough and Spohrer, 2006). The emerging notions of “servitization” (Vandermerwe and Rada, 1988; Neely, 2007) and product-service systems



(PSSs; Baines *et al.*, 2007) have been more specific manifestations of this. In marketing, the strenuous activities, or at least voluminous writings, of Vargo and Lusch (2004a, b, 2008a, b), Lusch *et al.* (2006, 2007) and Michel *et al.* (2008) have propounded the so-called “service dominant logic”.

But the idea that it is not necessary to buy products to access the benefits they provide is nothing new. For example, pineapples were first introduced into Europe in the seventeenth century, and were so exotic that they were seen as a symbol of great status. But they were extremely expensive, so, according to Wilson (2005):

[...] poorer middle-class families would even take to hiring pineapples for occasions when they wished to entertain, in order to appear grand, praying that no one would actually attempt to cut a slice.

Many other, less exotic, examples (Dowd, 2002; Schmenner, 2008) show that although the word may be new, “servitization” and related concepts are not. However, much of operations management (OM) and marketing theory has taken the making and selling of products as their overriding concern. Furthermore, despite the claims typically made in the first chapter of most OM textbooks that most operations actually deliver a “bundle” of product and service elements, there is no coherent picture of how these are combined.

Given this background, the aim of this paper is to examine how product and service elements combine, and what the implications of this may be for OM, operations strategy (OS) and supply networks. The paper begins by outlining some examples of product-service combinations and mutual substitutions. In the following section, alternative approaches to defining and conceptualising services are examined. Then, a relatively brief section examines a recurring theme: how products and services can be made tradable, and hence how the boundaries between economic entities such as firms and consumers might be considered. The next section reviews a number of recent approaches to understanding the management of, and innovation in, product-service combinations. Finally, some emerging implications for OM and OS are set out.

Product-service combinations: some examples

Paint suppliers to automotive original equipment manufacturer (OEMs), instead of selling paint and being paid per litre supplied, are now often engaged to run the OEM’s paint line and be paid per automobile painted. This is a specific example of the more general practice known as chemical management services (CMS) (Stoughton and Votta, 2003). Another example of a service replacing a product-selling approach is that of babies’ nappies (or “diapers”). Some parents choose to pay a weekly charge to use a cotton nappy laundering service rather than buying disposable nappies, partly out of concern for the environment. Two further examples concern the publication of academic journals and the distribution of recorded music. In both instances, a unidirectional distribution of physical goods – hardcopy journals or CDs – has been replaced by online downloading of digital files under a variety of commercial and contractual arrangements (Fisher, 2004), often with considerable data transfer from customer to supplier as well as *vice versa*. Graham *et al.* (2004) describe how this shift radically disrupts music industry supply chains by removing the need for manufacturers, distributors and retailers of the physical media. Finally, car sharing

schemes (Mont, 2004) involve various forms of collective rather than individual ownership of vehicles, and payment according to usage.

These examples, intended to be suggestive rather than exhaustive, involve various combinations of changes in technology and of the organisations involved. They also involve a shift from selling to various forms of leasing, hiring and “paying for the use of”. Many result in a shift to more fixed costs for the provider, and a greater emphasis on variable costs for the customer. Somewhat related to this, the alignment of incentives is altered: for example, under CMS, it is in the interest of the paint manufacturer to use, waste (and therefore manufacture) as little paint as possible, rather than as much (see Snir, 2001, for a detailed account of such incentives).

Such examples have attracted attention because they involve rather radical shifts, often in high-profile sectors. But, as we have seen, the interchangeability between products and services has a long history. It is also rather everyday. Restaurants may increase revenue by opening other branches, possibly by franchising: that is, offering the same service in other locations. But they may also sell products from their service facilities – coffee-shop chains also sell coffee beans – or they may brand products to be sold elsewhere: for example, in the UK, Pizza Express[®]-branded pizzas are sold in supermarkets for home “cooking” and consumption. Services such as student counselling offer one-to-one counselling but also try to deal with predictable peaks in demand for recurring service elements by standardising their service and increasing volume; for example, by running classes on exam technique pre-emptively during the period before exams. They also quite routinely turn their service into products such as leaflets or frequently asked questions on web sites. Hairdressers use “products” such as shampoo and conditioner while carrying out the haircare, but also sell them (often rather forcefully) to increase the profit from a customer’s visit. These are examples of everyday “productising” strategies, which enable services to be scaled up and help management of demand for face-to-face services during peak times, where capacity is rather difficult to change. They also represent ways to generate more revenue from customers, by allowing the self-administered continuation of at least some aspects of the service experience.

This brief exploration draws attention to various combinations of technological and institutional change. These are both cause and effect of shifts in the relationship between product- and service-based approaches to delivering service. Cost structures change, incentives are aligned differently, risks are re-distributed. They are also used to manage capacity and to increase revenue. Existing OM approaches, which tend to polarise products and services on rather simplistic lines, seem ill-equipped to deal with the subtler interplay exemplified here and this hinges in part on the way services are defined. We turn to this next.

Back to basics: the product-service distinction revisited

In the foregoing examples, the terms “product” and “service” have been rather casually used. In all of the examples, “things” are involved – computer servers, bottles of shampoo, ready-made pizzas – and all are means to provide some kind of access to the capabilities of the provider. But the notion of “facilitating goods” in services OM does not capture the complex and often fundamental way in which physical artefacts are implicated in delivering service. Much more is at stake.

The thing about products: services as deficient products and the IHIP characteristics

In both marketing and OM, services have been treated as aberrant departures from the presumed normality of production and product marketing, and are commonly defined in terms of what they are not: they are intangible, non-storable, non-transportable and so on. Sampson and Froehle (2006, p. 329), citing Castells and Aoyoma, have noted the perversity of treating services as “a residual notion embracing everything that is not agriculture, mining, construction, utilities or manufacturing [...] The only feature common to these service activities is what they are not”. The perversity lies in the fact that this “residual” category accounts, at least in developed economies, for the majority of employment and gross domestic product (GDP).

This approach has also been based on the activities that take place and the involvement or otherwise of “things” (Bowen and Ford, 2002). More specifically, Lovelock and Gummesson (2004) trace a sustained utilisation in the service management literature of what they term the “IHIP characteristics” that is:

- intangibility;
- heterogeneity;
- inseparability (simultaneous production and consumption); and
- perishability (hence non-storable or transportable).

As a basis for defining services. A study among OM academics (Nie and Kellogg, 1999) confirmed the widespread use of IHIP, and it is still central to the definition of service operations in a new edition of one of the most widely used textbooks (Fitzsimmons and Fitzsimmons, 2008). There are, however, signs that product-centric views and IHIP are falling out of favour. We now consider some of these alternative views, first from marketing and then from OM.

Marketing: four “myths” and the rental/access paradigm

As part of their propounding of “service-dominant logic (S-D logic)”, Vargo and Lusch (2004b, p. 324) argue that none of the IHIP characteristics provide a satisfactory basis by which to define services and that they consequently give “inappropriate normative strategies”. Lovelock and Gummesson (2004) also argue against the IHIP characteristics and tentatively propose a “rental/access paradigm” instead. As they acknowledge, the “non-ownership” characteristic is “old but overlooked” (Judd, 1964; Rathmell, 1966). Judd’s (1964, p. 58) definition merits quotation here:

Marketed services: a market transaction by an enterprise or entrepreneur where the object of the market transaction is *other than* the transfer of ownership (and title, if any) of a tangible commodity.

Interestingly, Judd himself notes that this has “the defect of any definition by exclusion in that, from the definition itself, nothing can be learned about what are the essential characteristics of a service”. Also note that, even here, as with IHIP, services are still classified by what they are not: implicitly, ownership (of products) is still “normal”.

The non-ownership characteristic has recently been adopted in one of the leading services management texts (Fitzsimmons and Fitzsimmons, 2008), although it appears “parachuted-in” after a section on IHIP as the “distinctive characteristic of service operations”. It seems from this account that IHIP are seen as distinctive characteristics more important to operations, while “non-ownership” is a concern of marketing.

We suggest below that such a distinction is not helpful, and that the ownership basis is critical to operations as much as to marketing.

Operations management: the unified services theory

In OM, the most sustained divergence from IHIP has been provided by Sampson (2000, 2001) and Sampson and Froehle (2006). He terms this his “Unified Services Theory” (UST), explicitly (and without any apparent irony) emulating Einstein’s unified field theory (Sampson and Froehle, 2006, p. 331). The defining characteristic of service, according to the UST, is:

With service processes, the customer provides significant inputs into the production process (Sampson and Froehle, 2006, p. 331).

In this context, “customer inputs” are of three types: customer self-inputs wherein there is co-production and/or the customer’s body is acted upon (transport, health care and restaurants)[1]; tangible belongings (the customer’s car for repair, say) and customer-provided information (e.g. income data for the preparation of a tax return). These are distinct from “customer involvement”, of which Sampson identifies two types. The first is through market research, whereby groups of customers or potential customers “provide opinions about general products destined for future production”. The second is through “selecting and consuming the output”. Sampson and Froehle claim that the UST explains all other schemes used to characterise services, including IHIP.

Although there are others (Corrêa *et al.*, 2007) Sampson’s UST seems the most radical break with IHIP thinking in OM. But it does not, for example, appear to explain the cause célèbre of servitization, Rolls-Royce’s “Power By The Hour”. Are the challenges of this “shift to service” for Rolls-Royce presented by the fact that their customers, the airlines, provide input (their staff operate the engines on the planes as they fly them)? Or because ownership of the engines is retained by Rolls-Royce rather than transferred to the airlines?[2]. We suggest that the most important issue here is ownership of the engines: in other words, the “rental/access paradigm” has more explanatory power. Furthermore, this seems to be an important facet of many of the examples in the introductory section above. In the following section, therefore, we develop the “rental/access” approach to defining services.

Institutionally based approaches to services

In this section we suggest an alternative approach to defining services, drawing on the work of Hill (1977, 1999) and Gadrey (2000). They are both economists of national accounting and, as such, are concerned with such matters as the way in which the GDP of nation states might be calculated and analysed. Part of this involves breaking total GDP into its constituent parts such as “manufacturing” and “service”. Hence, the basis for distinguishing between products and services is very important to work in this field. It will be seen that the approach adopted is conceptually similar to the “rental/access paradigm” of Lovelock and Gummesson (2004).

Hill (1977, p. 319) holds that:

[...] the production of a service cannot generally be distinguished from that of a good by means of the technology used but by the fact that the producer unit operates directly on goods which already belong to the consumer of the service.

For example, if a worker on a car assembly line fits a tyre to a wheel, it is considered to be a manufacturing operation, because what results is a “thing” – a completed car. If a garage worker fits a new tyre to a car brought in by its owner, it is considered to be a service operation[3]. And yet in terms of most of the IHIP characteristics, there is no difference. What differs is:

- whether there is a direct relationship between the firm doing the work and the end customer; and
- who owns the car when it is being worked on.

A similar argument is applied to services affecting persons, either the customer or those for whom the customer has responsibility, e.g. children. This approach results in the following definition:

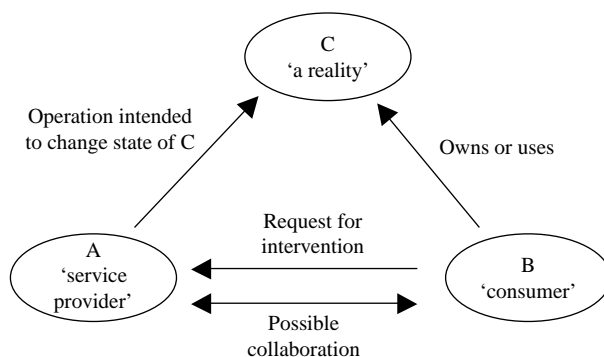
A service may be defined as a change in the condition of a person, or a good belonging to some economic unit, which is brought about as a result of the activity of some other economic unit, with the prior agreement of the former person or economic unit (Hill, 1977, p. 318).

Gadrey (2000, pp. 375-6) takes this definition as a starting-point, but adds some extra precision:

[...] a service activity is an operation intended to bring about a change in state in a reality C that is owned or used by consumer B, the change being effected by the service provider A at the request of B, and in many cases in collaboration with him or her, but without leading to the production of a good that can circulate in the economy independently of medium C.

We will refer to this approach as an institutionally based definition of services (Araujo and Spring, 2006). This does not refer to the “institutional theory” of, say, DiMaggio and Powell (1983), but to the formal institutions governing production and exchange (Coase, 1992). The central feature of the institutional basis for definition is that services are necessarily embodied in relationships between economic entities.

Gadrey suggests, but does not draw, the notion of a “service triangle”. Figure 1 shows one possible interpretation of this, where A-C are used as in the definition just cited (Spring and Araujo, 2005; Araujo and Spring, 2006; Maglio *et al.*, 2006).



Source: After Gadrey (2000)

Figure 1.
The service triangle

Three service logics and a more inclusive definition

The definitions quoted so far only cover one type of service: what Gadrey terms a “request for intervention”, such as a car repair, haircut or surgical operation. They do not, however, deal with services such as using a telephone network, where “what is being purchased is the temporary right to use a technical system (which is maintained for that very purpose)” (Gadrey, 2000). The service provider’s principal activity is the maintenance of the capacity, as when hotel rooms are cleaned and replenished with fresh linen, and such temporary rights are carefully defined, often in terms of a duration of use, as when hiring a car or staying in a hotel. Finally, Gadrey identifies a third category of demand rationale, that of the “performance”, such as takes place in a theatre – effectively the use of a human capacity. This gives rise to the final definition:

Any purchase of services by an economic agent B (whether an individual or organization) would, therefore, be the purchase from organization A of the right to use, generally for a specified period, a technical and human capacity owned or controlled by A in order to produce useful effects on agent B or on goods C owned by agent B or for which he or she is responsible (Gadrey, 2000, pp. 382-3).

The three “service logics” – request for intervention, right to use a capacity, and performance – prove useful, as we see later.

In conclusion, then, it is argued here that, despite its widespread adoption in marketing and OM over 30 years or so, the IHIP basis for defining services can readily be shown to be misleading. Based in part on the introductory examples, we suggest that Sampson’s UST and Lovelock and Gummesson’s “rental/access paradigm” represent useful alternatives. Developing the second of these in particular, we draw on economists of national accounting to provide a more precise and inclusive institutionally based approach to services that involves the purchase of “the right to use [...] a technical or human capacity [...]”. This in turn draws attention to the need, in each instance, to define what that right is, in order that services can be bought and sold. This is the subject of the next section.

Making services (and products) tradable

Gadrey’s definition concerns the purchase of services. As we have seen, service activities do not lead to a good that can “circulate in the economy independently [...]” (Gadrey, 2000) whereas, it seems, production activities do. For instance, I can pay for a haircut but I cannot buy one and sell it on to a third party at a later date. Given our interest at the outset in how products and services are implicated in providing “service” – implicitly to paying customers – we need to examine how the respective elements are made tradable.

Gadrey’s definition also makes specific mention of the need, with services, to specify in some detail the right to use the capacity. Such matters do not detain us in relation to everyday products – we “just know” what it is to buy a newspaper, a bar of chocolate or a toaster. On some views (Demsetz, 1993) products-as-things “act as a means of separating production from exchange and delimiting user-producer interaction” (Araujo and Spring, 2006, p. 800). But is it necessarily a matter of common sense where that separation takes place? Is it straightforward to define what is being sold, even with products? Baldwin and Clark (2006) (see also Baldwin, 2008, for a reduced treatment) draw attention to the “mundane transaction costs (MTC)” – i.e. implicitly, the work involved – in defining where in the totality of a chain of activities

a transaction between economic entities may take place. MTCs consist of the costs of standardising what is to be sold, counting the units to be sold, and compensating the provider (Baldwin and Clark, 2006, pp. 13-5). In their terms, products represent the encapsulation of knowledge and material transfers into a good that can be sold; products are not self-evidently bounded, and work has to be done to define what they are. Baldwin and Clark's main point is that these "pinch-points" – the points in the total chain of activities where transactions between economic entities take place – occur where the MTCs are lowest.

Baldwin and Clark, taking an engineering design view, concentrate on production chains. But in the same way, services may also be made tradable (for we know they are bought and sold) by such processes of standardizing, counting, and compensating. However, as the offering moves further away from one encapsulated neatly in a physical artefact, more work is required to stabilise and qualify what the service is and to make it tradable (Callon *et al.*, 2002). For example, a supplier of fasteners such as nuts and bolts to a customer assembling, say, trucks may begin to provide vendor-managed inventory and lineside delivery. Definition of what is being traded shifts from various "things", defined by engineering drawings and international standards, to a much less "obvious" and taken-for-granted service offering which is designed in terms of service level agreements, stock-turns, measures of availability and the like, and whereby ownership of the "things" is transferred at some point after use, rather than upon arrival at the customer's facility. Such services require considerable effort on the part of the supplier and the customer to define and measure performance to a service-level agreement, which is inevitably specified, in the end, in terms of a written document. This banal but important point is not lost on Callon (2002), who also points to the important role for writing in defining offerings through documents such as service process files and contracts. As Shakespeare puts it:

[...] the poet's pen, Turns them to shapes and gives to airy nothing, A local habitation and a name (Theseus from *A Midsummer Night's Dream*, Act 5, Scene 1).

This implies that there is no "natural" role for any physical embodiments as the boundary of what is sold: given suitable qualification, any combination of things, interventions, rights to access and performance can be sold.

Baldwin and Clark's analysis offers some powerful insights and establishes the idea of MTCs. However, it is fundamentally a static view, taking the total set of activities to be performed, and their respective MTCs, as stable phenomena. Langlois (2006) has drawn our attention to the "secret life" of MTCs, pointing out that technological and other changes alter what activities need to be performed, and even change the MTCs. For example, Zipkin (2006) shows how radio frequency identification greatly reduces the cost of standardising and counting activities in operations processes, making it possible to introduce transactions where none previously existed because they were too hard to define and monitor. Also, as once-novel practices (e.g. lineside delivery of fasteners) become institutionalised, MTCs are lowered and it becomes easier for other customers to buy these services.

The previous section argued for an institutional approach to defining services, part of which was the need to specify the terms of the customer's right to access the capacity of the supplier. In turn, this section has examined this process of specification more closely, suggesting that MTCs play a significant role in determining where in

a total system of activities those activities may be specified to an extent sufficient to allow an economic exchange to take place. Furthermore, institutionalisation and technological change mean that these points, and the form of what is bought and sold, also change. This perspective informs the next section, which examines alternative approaches to product-service combinations, all of which are concerned with why, how, where (in a supply chain) and in what form a combination of artefacts and activities are brought together into a tradable good.

Service, and the role of products in delivering it

Having examined some competing approaches to distinguishing between products and services, we now return to their combination and mutual substitution. First, the role of products within the “service dominant” logic is briefly discussed. Then, alternative treatments of product-service combinations in the OM and marketing literatures are examined, namely: support services, PSS, systems integration, performance-based logistics, bundling and finally, the notion of the “offering”.

“Service-dominant logic”

The so-called “S-D logic” propounded by Vargo and Lusch (2004a) has been extremely influential. They argue that the focus of marketing should be on the provision of service, that manufactured products are merely incidental mechanisms or “appliances” for the provision of service, and that marketing thought has been too pre-occupied with the “goods-dominant logic” derived from manufacturing, including the IHIP characteristics (Vargo and Lusch, 2004b). In many ways, this is not a new insight: in 1972, Levitt suggested that “we’re all in services now” (Levitt, 1972); Grönroos claims that “every business is a service business” (Grönroos, 2000) and that “the product [...] becomes just one element in the *total, ongoing service offering*” (Grönroos, 2000, emphasis in original)[4]. However, S-D logic does serve to remind us that there is no natural or inevitable role for products and that alternative configurations, embodiments and combinations of elements should be considered. We return to this later. These sentiments also remind us that most of what follows is heavily indebted to the insights of Penrose (1959), in that we are concerned with the infinitely reconfigurable nature of organizations’ resources into alternative means of providing customers with access to capabilities.

Support services

A convenient starting-point – a kind of “base case” – for services associated with products is what are termed “support services” (Goffin and New, 2001), “after-sales service” (Armistead and Clark, 1991) or “supplementary services” (Anderson and Narus, 1995). Some analyses specifically relate the services provided to the timing of purchase of the related product. For example, Frambach *et al.* (1997) and Samli *et al.* (1992) both identify the services provided before product sale (e.g. demonstration), during (e.g. finance) and after (e.g. maintenance), but see them as additional to the product and sold as separate, optional elements. Boyt and Harvey (1997), in contrast, classify industrial services according to complexity, ranging from elementary to intermediate to “intricate”.

Managerial prescription for such services touches on a number of issues. In OM, the focus has been on the service process strategy. Armistead and Clark (1991) relate the

process design for after-sales service to competitive strategy and the product life-cycle stage of the equipment to be supported. Marketing analyses have drawn attention to the sometimes workaday question of how to identify and charge for business-to-business (B2B) services. As Mathieu (2001) notes, “one easy solution consists in [*sic*] not charging the client”. Anderson and Narus (1995) argue that firms do not give enough attention to the management of “supplementary” services: they do not know which services customers want, how much they cost to provide, which to offer as standard, which as options, or how to price them. Anderson and Narus’ approach is akin to mass-customisation, i.e. have a platform offering (a “naked” service) and then sell supplementary services, appropriately priced, according to the requirements of each customer or market segment, and based on a clear definition and costing of each service element (Spring, 1997). Potts (1988) emphasises the profitability of post-sale service compared to the sale of the product. A further question from a marketing point-of-view is then whether to make the pricing of each element transparent – the “menu of options” approach – or not – the “tailored-value package” (Mathieu, 2001). Alternatives to this are discussed below in relation to bundling and performance-based logistics.

PSS and the industrial ecology perspective

The PSS approach has its roots in industrial ecology and is centred on “selling performance instead of selling goods” (Stahel, 1998), with the aim of reducing the consumption of materials. A PSS is conceived as “a marketable set of products and services, jointly capable of fulfilling a client’s need” (Goedkoop *et al.*, 1999). As Mont (2002) notes, PSSs often involve changes in ownership structure, i.e. replacing “selling” with other forms of access to physical artefacts, e.g. leasing and rental approaches. Recently, the applicability of the PSS concept beyond situations primarily concerned with reduction of environmental impact has been discussed by Baines *et al.* (2007), for whom a PSS “is an integrated combination of products and services”; similarly: Manzini and Vezolli (2003, p. 851) hold that (a PSS is):

[...] an innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands.

The “systems” part of the PSS analysis is mainly concerned with calculating the total environmental impact. For example, Reichart and Hirsch (2002) compare alternative means of distributing the news. Baines *et al.* (2007), adopting the concept for more general purposes, explicitly introduce the notion of integration and, even more recently (Baines *et al.*, 2008), have focussed on the transition of firms from product- to service-based strategies, which has also concerned Oliva and Kallenberg (2003) and, in a business-to-consumer context, Mont (2004). PSS analysis has, then, progressed from principles and definitions, through evaluation, to implementation. It remains to be seen whether it takes hold as a general unifying conceptual framework or remains for the most part a concern of industrial ecologists.

Systems integration

The PSS literature takes a systems view in so far as it assesses environmental impact at the systemic level. Other systemic issues are, however, neglected. Recent analyses of systems integration (Davies, 2003, 2004) do go further. Systems integrators, on this

account, deliver complex products and systems such as flight simulation or mobile telephone networks and involve four sets of capabilities in the provider firms: systems integration, operational services, business consultancy and financial services (Davies, 2003). Davies (2003) suggests that forward vertical integration is a central element – in some cases combined with backward integration. This echoes Wise and Baumgartner (1999), who identify four “downstream business models”[5]:

- (1) *Embedded services*. Information technology-enabled monitoring and control built into capital equipment.
- (2) *Comprehensive services*. For example, financing and managing a wide range of related but not closely connected activities involving the manufactured goods.
- (3) *Integrated solutions*. Providing related product and service elements that are closely inter-related.
- (4) *Distribution control*. Forward integration into distribution.

An important systemic effect of such moves, argues Davies (2004), is that experience of activities such as maintenance can be more effectively fed back into future (improved) designs. Similarly, Goffin and New (2001) argue that involvement in customer support means that “design for supportability” is then more systematically taken into account.

Although recent analyses have focussed on large, complex systems, these are but particular forms of the more general phenomenon discussed by the prescient Mattsson (1973). “Systems selling” is the provision of a combination of “hardware components” (products) and a “software” component – “technological and market know-how”. Systems selling helps the purchaser and makes it more likely that they will buy more of, and perhaps a wider range of, “hardware” components, with consequences for volume and predictability of sales of these; crucially, it also provides extra value through the novel combination, and hence differentiation and possible greater margins compared to simple component selling. As Langlois and Cosgel (1998) and Araujo *et al.* (2003) point out, buyers, in consumer or business markets, require capabilities in order to buy. Systems selling reduces – or at least alters – the capabilities they need to be successful buyers.

So, as might be expected, systems integration and systems selling both emphasise the genuinely systemic, emergent properties of combinations of artefacts and activities, of products and services. Systems integration tends to concentrate on design and operations aspects, whereas systems selling links these to competitive positioning. Another aspect of some of the cases studied by Davies (2004) is a shift to some form of performance-based payment. This aspect is given very limited treatment, however, and seems casually conflated with forward vertical integration. We turn to this next.

“Power-by-the hour” and performance-based logistics

The widely noted “classic” case of servitization, Rolls-Royce’s “Power by the Hour”, does not, contra Wise and Baumgartner (1999), involve Rolls-Royce in taking over “downstream” service activities that had hitherto been the preserve of its customers or, at least, this is not the distinctive change that is of current interest. Rather, the change is to the basis for payment and ownership of physical assets. The approach is gaining in popularity in a variety of contexts, but is most fully developed as

“performance-based logistics” (PBL) in defence procurement (Doerr *et al.*, 2005). Broadly, this involves the supplier retaining ownership of the capital asset, and being paid according to usage, whilst incurring the costs of maintenance and provision of spares. PBL is intended to align incentives (Snir, 2001) and to encourage the supplier to manage the asset and associated spares and services so as to maximise performance and minimize costs, rather than depend on (separate) high-margin spares sales for its profits. It has been adopted in defence and commercial contexts (Kim *et al.*, 2006). Although such examples may also involve changes in the extent of vertical integration of the provider, e.g. taking over maintenance activities previously conducted by the customer’s staff, this is distinct from the question of ownership of the capital asset.

Systems integration analysis has emphasised the relationships between the systems integrators and their upstream suppliers. In contrast, PBL focuses attention on the shift in incentives and re-allocation of risk between the supplier and the customer. It presents considerable challenges in defining the “performance” required, and then measuring it accordingly (Doerr *et al.*, 2005): in other words, it generates significant MTCs.

Bundling

In many OM texts, the term “bundle” is used rather loosely to refer to any combination of products and services. But it has a more specific meaning than that. Bundling is “the practice of combining multiple products or components at a set price” (Johnson *et al.*, 1999); the individual elements may not be available individually, or the total price of the elements bought individually may be significantly greater. Systems selling (Mattsson, 1973), PBL (Kim *et al.*, 2006; Doerr *et al.*, 2005) and, indeed, Mathieu’s (2001) “tailored-value package” all involve bundling in this stricter sense of the term. From the provider’s perspective, bundling simplifies the range of offerings and can give economies of scale in operations; from the buyer’s perspective, bundling simplifies choice, but may result in paying for elements that are not required.

Eppen *et al.* (1991) and Mathieu (2001) suggest that buyers value the simplification that bundling provides in less mature markets but, as the market matures, they learn to discriminate among the elements, are better able to value them individually and are less willing to pay for bundles[6]. Recent interest in bundling has concerned information goods, where marginal production costs are effectively zero (Hayes, 2002): Bakos and Brynjolfsson (1999) find that very large bundles of such products “can be surprisingly profitable”. From a marketing perspective:

The key intuition behind the power of bundling is that consumer’s [*sic*] valuation for a collection of goods typically has a probability distribution with a lower variance per good compared to the valuations for the individual goods (Bakos and Brynjolfsson, 1999, p. 1614).

So, as “uncertainty about consumer valuations is the enemy of effective pricing and efficient transactions” (Myerson and Satterthwaite paraphrased in Bakos and Brynjolfsson, 1999), bundling can serve to make transactions viable (Baldwin and Clark, 2006; Langlois, 2006) where previously none were.

More complex combinations of elements may increase information asymmetry (Akerlof, 1970) in favour of the seller. Furthermore, this could be analysed as a version of the multitask principal-agent problem (Holmstrom and Milgrom, 1991). In this, the supplier is required to perform a number of tasks, only some of which can be observed

by the customer: the corollary of this is, where incentives exist, the supplier will put effort into the elements that can be observed, at the expense of others. This approach has recently been applied in OM to study PBL contracts (Kim *et al.*, 2006). More specifically, where problem diagnosis by an expert and provision of the “cure” are combined, under certain regimes of payment and reward, there may be strong incentives for the supplier to behave fraudulently, i.e. carry out (or pretend to carry out) and charge for unnecessary “repair” services (Darby and Karni, 1973; Emons, 1997). Although this discussion is necessarily brief, it should be enough to suggest that servitization, systems selling and bundling may have as much to do with selling low-cost elements at high margins as with offering “value-added services”.

The “offering”

Much of the discussion in forgoing sections, in one way or another, hinges on the boundary between the service provider and the customer – who does what, who understands what, what is paid for. What is the role of the customer in all this? According to Sampson’s UST (Sampson and Froehle, 2006), the customer, by definition, “provides significant input”. As we have seen, this is distinct from customer involvement. But it seems from those illustrations of “customer involvement” he provides – evidently from consumer markets – that Sampson has a limited notion of the customer’s role, reflecting what Ramirez (1999) calls the “industrial view” of value creation, in which “consumers destroy the value created by producers” or, as Normann (2001) puts it, seeing the customer as a “sink” at the end of the supply chain. This almost entirely passive conception of the customer’s role in product/service design and “consumption” is criticised by Langlois and Cosgel (1998, p. 107):

In neoclassical economics [...] the consumer is important but inactive. Pareto is supposed to have said that we do not need the consumer at all so long as he leaves us a snapshot of his preferences.

And is at odds with the frequently rich interaction that takes place in B2B markets (Spring and Dalrymple, 2000). Normann advocates a shift from seeing the customer as a “sink”, to a “source” then to a “co-producer” – in consumer markets as well as B2B.

In contrast with Sampson, Normann (2001, p. 114) suggests the “offering” as a key concept, as follows:

Offerings are artefacts designed to more effectively enable and organise co-production.

For Normann, a physical product is “frozen knowledge” – the knowledge being that of the designers, technologists, producers and previous users who have given rise to it in its stabilised form – and a platform on which economic actors of the present can link with others in the present, the past and the future. Offerings are not just physical products: for example, IKEA’s offering should be seen “as a process configuration – not as furniture” (Normann, 2001, p. 117). As Langlois and Cosgel (1998, pp. 112, 114) put it:

Understanding the institutional structure of production and consumption thus requires more than just relaxing the assumption that productive knowledge is given. It requires also relaxing the assumption that the structure of production and transaction is given [...] The economic problem of production becomes a coordination problem: discovering – or, rather, helping to create – an interpersonally shared structure of transaction.

And:

The producer's design problem involves not just figuring out what consumers want but also what consumers know how to do (or would be willing and able to learn how to do).

Hence, we are, to reiterate, a long way from Sampson's notion of the consumer whose role is to "select and consume the output".

Sampson also sees customers as one of the firm's main competitors – in that, for example, one might prepare one's own food rather than buy a ready meal (Hill, 1979); but it is important not to construe the problem in terms of a Porter-esque value-chain involving a given, static set and sequence of activities, the only question being who does which activity. Normann discusses this in terms of the "freezing" of the offering, arguing that it is no longer a matter of the producer freezing the offering in advance and the consumer choosing it (or not), in the way that Sampson sees it. Rather, the offering should provide the wherewithal, in terms of product and service elements, linkages and opportunities for learning, for customers to co-produce value in the future. Normann (2001, p. 122) suggests that a critical question is when the offering is frozen and by whom. This is especially so in some domains: e.g. offerings employing user-generated content such as Wikipedia (Tapscott and Williams, 2006); really do consist of creating "an interpersonally shared structure of transaction", as Langlois and Cosgel put it, and leaving the "end product" perpetually postponed and "unfrozen".

Discussion, conclusions and OS implications

What are the operations issues that arise from this exploration of service, services and products? Product-service combination and mutual substitution are, as discussed, commonplace and not new. But it seems that there are many contemporary examples involving profound shifts in cost structures as a result of the use of information communication technology (ICT), widespread adoption of the "rental/access" approach to service provision and the novel use of co-production, peering and inter-organisational networks. As such, we are a long way from the empirical roots of the operations and manufacturing strategy founding fathers (Skinner, 1969; Hayes and Wheelwright, 1984). At the risk of oversimplifying that body of work, we attempt to summarise: the unit of analysis was typically the plant or facility; the problem was essentially one of designing an intra-firm facility – its structure and infrastructure – to serve a segment of a market characterised by its competitive priorities. More recently, this process of "reading-off" the design of a facility from the market or segment it is to serve has been tempered by the influence of the resource-based view (Spring and Boaden, 1997; Pandza *et al.*, 2003; Mills *et al.*, 2003), but the aim is still the alignment of facilities with markets.

Hayes tackled some of these issues in his 2002 paper on "the new economy", in other words "the combination of globalization and high technology" (Hayes, 2002, p. 21). He argued that this meant leaving behind some basic OM assumptions, namely:

- The unit of analysis is an intra-firm operating unit.
- OM is concerned with stable "products" and "processes".
- Primary task of the operations manager is to control the flow of materials (or information) through a sequence of process steps.

- A major concern is reduction of variable cost.
- Competitors are enemies.

Our argument agrees with this perspective to the extent that the issues we identify come about because of “new economy” phenomena – principally the growth in ICT capabilities. But that is not the whole story: both empirically and theoretically, our discussion identifies some long-standing OM blind spots hinging on the fundamentally institutional nature of services and the way in which external capabilities are accessed. Hayes (2008) has subsequently re-emphasised the importance of the inter-organizational dimension in his call for a re-energising of OM by studying the “Coordination of Operations Across Multiple Organizations”.

One potentially fruitful approach is emerging – the notion of business models. These ideas started in internet-based businesses (Timmers, 1999; Weill and Vitale, 2001) but are now being applied to all sectors and ages of firm (Chesbrough and Rosenbloom, 2002). As such, there is a certain symmetry with Hayes’ “new economy” arguments: just as the internet drew attention to issues that, in our view, have long been neglected in OM, so the basis for analysis and the form of prescription that grew out of internet entrepreneurialism offers a framework for thinking about all kinds of sectors and operations, “old” and “new” alike. Indeed, one of the leading business model writers, Chesbrough, is also involved with IBM’s “services science” initiative (Chesbrough and Spohrer, 2006). Although there is not space here to review the business model literature, common themes include a concern with network structure; a focus on how transactions are made; revenue models and incentives and how providers’ capabilities are transferred or accessed – through products, services or combinations thereof (Chesbrough and Rosenbloom, 2002; Zott and Amit, 2008).

In this final section, we use this business model framework to draw together key issues from the preceding discussion. We also link them to Hayes’ recent comments on the development of OM, and offer some prescription and an agenda for research into a possible new form of OS thinking, one that is institutionally malleable and sophisticated. Broadly speaking, the message of OS was consistency: that design and control in each decision area should be consistent with each other and with the competitive and marketing strategy of the business unit. The business model approach suggests a more fluid gestalt, one that is more than the sum of its parts by having mutually reinforcing virtuous circles between its elements but is simultaneously robust, self-regulating and self-adjusting. The business model approach begins not with a facility, or even a product, but a set of capabilities, possibly distributed among several firms, and a potentially profitable offering. The four areas of the business model framework are now used to draw the discussion together.

Network structure

The business model literature is inter-organizational from the outset. It takes seriously “relaxing the assumption that the structure of production and transaction is given [...]” (Langlois and Cosgel, 1998, p. 112). Rather than putting the firm and its operations centre-stage, adding suppliers and the supply chain as subsidiary issues, then trying to insert new products and services into this network, the BM approach starts with the essence of some potentially valuable offering and then configures a network to deliver it. As such, the goal of OM is to “develop ongoing relationships with

customers, suppliers and complementors” such that they “jointly prosper through collaboration” (Hayes, 2002, p. 28).

Hence, analyses of “vertical integration” found in OM (Hayes and Wheelwright, 1984), based on rough comparisons of the benefits of direct control versus flexibility, or on transaction costs arguments (Williamson, 1985), neglect the “MTC” of setting up transactional interfaces between economic entities. These are always an issue, but become more so when what is being traded is a novel “right to use” a capacity, rather than a clearly bounded physical product. The boundaries of the firm are more multi-dimensional than many analyses would admit: who owns what, who does what for whom, where they do it (i.e. on whose site) and who knows what, are all contestable and separate dimensions of boundary definitions. It is no simple matter of “make or buy”. What is more, the boundaries are not only multiple, but also dynamic: individual firms-as-buyers develop their capabilities as buyers and this may make possible transactions where none previously existed, and will have an effect on the attractiveness or otherwise of buying systems or bundles, as defined above. Finally, it is evident that network structure should not be considered as a process of slicing up a pre-defined set and sequence of value-adding tasks between economic actors, but also potentially as a process of re-thinking what these activities are, how they can be recombined and of genuinely embracing the opportunities for co-production. This leads to the first possible element of a new OS:

To develop techniques for analysing alternative network structures, the capabilities of possible complementor organisations, and the mundane transaction costs of making relationships work, operationally and commercially.

How transactions are made

Networks between economic entities require transactions as well as relationships. MTCs help explain network structure, but in OM we need a translation of this into specific organisational activities. After Langlois and Cosgel (1998), we might contend that the OS task “becomes a coordination problem: discovering – or, rather, helping to create – an interpersonally shared structure of transaction”. Hayes suggests that OM tools in the “new economy” include “project management, negotiating, building consensus, designing incentives, etc.” (Hayes, 2002, p. 28). All of these are relevant, but we suggest, much more concretely, that OM practitioners need to be virtuosi in designing, managing and being managed within inter-organisational performance management systems as well as contracts and contracting, service level agreements and, given the international nature of so much OM, the way in which international standards and different legal regimes impinge on these issues.

Transaction making is technological as well as organisational and institutional. Most discussions of process technology in OM concern the customer-, material- or information-processing technologies that operations own and run, which will always be important. But the example of online music distribution and the theoretical aspects of making services tradable point to an important but neglected role for transaction-making technology (Zipkin, 2006 is instructive here). If, as we argue, MTCs are significant, then it would be in keeping with OM principles to use process technology – automation – as appropriate, to reduce them. E-procurement tools

(Croom, 2005) do this to some extent, but these are only a tiny part of the whole apparatus of qualification and transaction-making. Hence, the second aspect of a new OS:

To develop techniques for identifying, understanding and modelling the effects of institutional and technological mechanisms for making transactions between firms possible.

Revenue models and incentives

Many of the classic OS decisions areas – for example, facilities, layout, process technology, job design – boil down to striking the best balance between fixed and variable costs for a given demand environment. “New economy” operations involving digital information products result in higher fixed costs and low or even negligible variable costs for the operation (Hayes, 2002, pp. 23-4). Many of the principles and empirical examples we discuss concern such shifts in fixed and variable costs and revenues – by no means in relation only to information products. In OM terms, many of the empirical examples involve a type of risk-pooling. This is a familiar concept in the management of inventory in extended supply chains (Eppen, 1979), suggesting that centralizing inventory reduces holding costs, as the stochastic behaviours of demand at each downstream demand point (e.g. retail outlet) tend to cancel one another out. Similar principles apply to files available for downloading on the central server of, say, a distributor of recorded music; alternatively, on a peer-to-peer basis rather than along a “supply chain”, car-sharing works precisely because of the risk-pooling effect. Bundling applies similar principles – indeed, one of the theorists of bundling, Eppen, also wrote the seminal paper on risk pooling cited above.

A key challenge for the provider, then, is to design the right combination of risk-pooling capacity and contracts with customers. For example, academic journal publishers incur greater fixed cost in hosting large quantities of files in accessible form on servers; they mitigate their risk through the design of alternative forms of “right to use” the capacity: long-term contracts, contracts for access to whole suites of journals (i.e. bundles) and so forth. In some instances this may be a matter between one provider and its customers; in others, there may be a “supply chain” of service providers, and the risk pooling question then becomes one not only of where to position capacity in relation to the user, but also of how to use chains of revenue models and contracts to distribute risk among the complementors in an inter-firm network. This suggests a third area of concern for a new OS:

Understanding the interplay of alternative cost and revenue models within and between all the firms in a network, especially in the way they affect the distribution of risk among the firms, and the way in which this can be mitigated through contracts and performance management.

Assessing providers’ (and customers’) capabilities

This brings us back to the main theme of our research question – how do products and services combine to provide service to customers? In Hayes’ “new economy” the domain of OM has become “systems of complementary products provided through networks by different organizations” (Hayes, 2002, p. 28); this echoes the prominence in our own analysis of systems approaches such as PSS and systems integration. Of course, there is no single trend: while some customers want no part in the detailed specification or co-provision of services and are content to pay for bundles and

pre-integrated “solutions”, others want offerings that provide platforms for them to become deeply involved in specification, design and delivery of their own services. It is dependent on a host of factors: the respective capabilities of various actors, the maturity or otherwise of the technological and institutional apparatus that make it possible to shape tradable goods, the volatility or otherwise of demand levels, to name a few. However, strong irreversible trends are shaping this terrain. Costs of transmitting voice and data internationally are falling rapidly, and the capacity of the infrastructure is growing equally fast (Metters and Verma, 2008). Developed economies are doing less and less commodity-like manufacturing and are increasingly off-shoring services (Lewin and Peeters, 2006) and some argue that there is irreversible commoditization of business processes (Davenport, 2005). This all reduces MTCs and increases the likelihood that services – even PBL-type “solutions” – will be provided by inter-connected networks of complementary providers, rather than by single firms.

On the customer side, Normann’s concept of the “offering” has many implications for operations design. This is the “customer as employee” writ large: not some superficial cost-saving “relieving” activity such as clearing the plates away in a fast-food restaurant, but profound and idiosyncratic co-creation of value[7]. “Enabling” offerings, those that “empower [. . .] [the customer] with more capabilities and assets that [it] did not have access to” (Normann, 2001, pp. 35-6), require that operations have highly developed understanding of their own direct capabilities, but also advanced indirect capabilities, i.e. the ability to understand what they can help customers to do for themselves. This applies equally to supplier and complementor relationships – indeed it could be argued that is the *raison d’être* (and the basis of profitability) for “systems integrators”.

At a tactical level, changing the timing and form of “freezing” the offering can be used to manage capacity. The supposed “unstorability” of services requires a “chase” strategy (Armistead and Clark, 1994): but our simple example of student counselling suggests that, in fact, operations routinely substitute products and services for one another so as to build an inventory of “services” for subsequent use by customers. Taking this further, the example suggests a full range of “service logics” (Gadrey, 2000) at work: “request for intervention” – an individual counselling session; “access to a socio-technical capacity” – reading standard advice on a web site; “performance” – a large-group, standardised lecture on, say, exam technique (a possible cause of concern for a potential counselling client). These can be seen to offer different types and levels of quality, under different volume/variety of demand, to deal with an underlying seasonality or variation in demand. These are all basic parameters determining process design in OM (Slack *et al.*, 2007), and yet their suggested relationship with the “service logics” has not been explicitly discussed.

Finally, it seems that modularity is an important aspect of the design of offerings and the processes (and organisations) by which they are delivered. For example, the much-discussed and emulated open-source writing of software code depends, as Benckler (2002) points out, on the fine-grained modularity of the software, so that each contributor can write her part of the code without interaction with other contributors. Hence, the important issue is the design and definition of interfaces that allow customers to deploy their own capabilities in co-creation of value. A complementary research issue for OM, then, is to improve on the present very poor understanding of modularity in services (Sundbo, 1994). More broadly, as part of the new OS:

The development of techniques for understanding direct and indirect capabilities to support the design and delivery of “offerings” allowing the flexible combination and extension of socio-technical capacities to be accessed, products to be bought, and services to be delivered, so as to provide value to customers under idiosyncratic and volatile demand conditions.

Notes

1. In this regard, the customer-self input seems to confuse and conflate the notions of customer as object of the service and the customer as employee.
2. Sampson might argue that there is customer input as the customer has to provide their planes at a certain place and time so that Rolls-Royce or their agents can carry out maintenance services. However, this would not be a service according to the UST as that which is being acted upon – the engines – is not the property of the customer, it just happens to be attached to something that information systems – the plane. Rolls-Royce maintenance staff are simply carrying out maintenance on their own capital equipment, much as a fitter might carry out routine maintenance on a machine tool in a car factory.
3. Sampson and Froehle use a very similar example to argue against the “tangibility” characteristic as a basis for service definition, but somewhat overlook the wider implications (Sampson and Froehle, 2006).
4. It is notable that, in the 2000 edition of his text, Gronroos is to be found producing an IHIP-based tabulation of the “differences between services and physical goods” (Grönroos, 2000) in the edition 2007, the table has disappeared.
5. The use of the term “business model” is in itself interesting (Section 6).
6. See also Langlois (2006). As buyers learn, they reduce their costs for effecting transactions.
7. The treatment of “the customer as employee” in Bowen (1986) has been an extension of the “industrial view” of value creation: giving customers a carefully-defined role in a predetermined value-chain, for which they are to be recruited, trained and rewarded.

References

- Akerlof, G.A. (1970), “The market for ‘Lemons’ – quality uncertainty and the market mechanism”, *Quarterly Journal of Economics*, Vol. 84 No. 3, pp. 488-500.
- Anderson, J.C. and Narus, J.A. (1995), “Capturing the value of supplementary services”, *Harvard Business Review*, Vol. 73 No. 1, pp. 75-83.
- Araujo, L. and Spring, M. (2006), “Products, services and the institutional structure of production”, *Industrial Marketing Management*, Vol. 35 No. 7, pp. 797-805.
- Araujo, L., Dubois, A. and Gadde, L.-E. (2003), “The multiple boundaries of the firm”, *Journal of Management Studies*, Vol. 40 No. 5, pp. 1255-77.
- Armistead, C. and Clark, G. (1991), “A framework for formulating after-sales support strategy”, *International Journal of Operations & Production Management*, Vol. 11 No. 3, pp. 111-24.
- Armistead, C. and Clark, G. (1994), “The ‘coping’ capacity management strategy in services and the influence on quality performance”, *International Journal of Service Industry Management*, Vol. 5 No. 2, pp. 5-22.
- Baines, T.S., Lightfoot, H.W., Peppard, J., Johnson, M., Tiwari, A. and Shehab, E. (2008), “Operations framework for servitized manufacture”, paper presented at 15th International Annual EurOMA Conference, Groningen.
- Baines, T.S., Lightfoot, H.W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J.R., Angus, J.P., Bastl, M., Cousens, A., Irving, P.,

-
- Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I.M. and Wilson, H. (2007), "State-of-the-art in product-service systems", *Proceedings of the Institution of Mechanical Engineers Part B – Journal of Engineering Manufacture*, Vol. 221 No. 10, pp. 1543-52.
- Bakos, Y. and Brynjolfsson, E. (1999), "Bundling information goods: pricing, profits and efficiency", *Management Science*, Vol. 45 No. 12, pp. 1613-30.
- Baldwin, C.Y. (2008), "Where do transactions come from? Modularity, transactions, and the boundaries of firms", *Industrial and Corporate Change*, Vol. 17 No. 1, pp. 155-95.
- Baldwin, C. and Clark, K.B. (2006), "Where do transactions come from? A network design perspective on the theory of the firm", Harvard Business School Working Paper 901790, Harvard University, Boston, MA, p. 53.
- Benkler, Y. (2002), "Coase's penguin, or, Linux and the nature of the firm", *Yale Law Journal*, Vol. 112 No. 3, pp. 369-446.
- Bowen, D. (1986), "Managing customers as human resources in service organizations", *Human Resource Management*, Vol. 25 No. 3, pp. 371-83.
- Bowen, J. and Ford, R. (2002), "Managing service organizations: does having a 'Thing' make a difference?", *Journal of Management*, Vol. 28 No. 3, pp. 447-69.
- Boyt, T. and Harvey, M. (1997), "Classification of industrial services – a model with strategic implications", *Industrial Marketing Management*, Vol. 26 No. 4, pp. 291-300.
- Callon, M. (2002), "Writing and (re)writing devices as tools for managing complexity", in Law, J. and Mol, A. (Eds), *Complexities: Social Studies of Knowledge Practices*, Duke University Press, Durham, NC.
- Callon, M., Meadel, C. and Rabeharisoa, V. (2002), "The economy of qualities", *Economy and Society*, Vol. 2 No. 31, pp. 194-217.
- Chesbrough, H. and Rosenbloom, R. (2002), "The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies", *Industrial and Corporate Change*, Vol. 11 No. 3, pp. 529-55.
- Chesbrough, H. and Spohrer, J. (2006), "A research manifesto for services science", *Communications of the ACM*, Vol. 49 No. 7, pp. 35-40.
- Coase, R. (1992), "The institutional structure of production", *American Economic Review*, Vol. 82 No. 4, pp. 713-9.
- Corrêa, H.L., Ellram, L.M., Scavarda, A.J. and Cooper, M.C. (2007), "An operations management view of the services and goods offering mix", *International Journal of Operations & Production Management*, Vol. 27 No. 5, p. 444.
- Croom, S.R. (2005), "The impact of e-business on supply chain management – an empirical study of key developments", *International Journal of Operations & Production Management*, Vol. 25 No. 1, pp. 55-73.
- Darby, M. and Karni, E. (1973), "Free competition and the optimal amount of fraud", *Journal of Law and Economics*, Vol. 16, pp. 67-88.
- Davenport, T.H. (2005), "The coming commoditization of processes", *Harvard Business Review*, Vol. 83 No. 6, pp. 100-8.
- Davies, A. (2003), "Integrated solutions: the changing business of systems integration", in Davies, A., Hobday, M. and Prencipe, A. (Eds), *The Business of Systems Integration*, Oxford University Press, Oxford, pp. 333-73.
- Davies, A. (2004), "Moving base into high-value integrated solutions: a value stream approach", *Industrial and Corporate Change*, Vol. 13 No. 5, pp. 727-56.

- Demsetz, H. (1993), "The theory of the firm revisited", in Williamson, O.E. and Winter, S.G. (Eds), *The Nature of the Firm. Origins, Evolution and Development*, Oxford University Press, New York, NY.
- DiMaggio, P. and Powell, W. (1983), "The iron cage revisited: institutional isomorphism and collective rationality in organizational fields", *American Sociological Review*, Vol. 48 No. 2, pp. 147-60.
- Doerr, K., Lewis, I. and Eaton, D.R. (2005), "Measurement issues in performance-based logistics", *Journal of Public Procurement*, Vol. 5 No. 2, p. 164.
- Dowd, T. (2002), "Culture and commodification: technology and structural power in the early us recording industry", *International Journal of Sociology and Social Policy*, Vol. 22 Nos 1/3, pp. 106-40.
- Emons, W. (1997), "Credence goods and fraudulent experts", *Rand Journal of Economics*, Vol. 28 No. 1, pp. 107-19.
- Eppen, G.D. (1979), "Effects of centralization on expected costs in a multi-location newsboy problem", *Management Science*, Vol. 25 No. 5, pp. 498-501.
- Eppen, G.D., Hanson, W.A. and Martin, R.K. (1991), "Bundling new products, new markets, low-risk", *Sloan Management Review*, Vol. 32 No. 4, pp. 7-14.
- Fisher, W.W. (2004), *Promises to Keep: Technology, Law, and the Future of Entertainment*, Stanford Law and Politics, Stanford, CA.
- Fitzsimmons, J.A. and Fitzsimmons, M.J. (2008), *Service Management: Operations, Strategy, Information Technology*, McGraw-Hill, New York, NY.
- Frambach, R.T., Welsliss, I. and Gundlach, A. (1997), "Proactive product service strategies – an application in the european health market", *Industrial Marketing Management*, Vol. 26 No. 4, pp. 341-52.
- Gadrey, J. (2000), "The characterisation of goods and services: an alternative approach", *Review of Income and Wealth*, Vol. 46 No. 3, pp. 369-87.
- Goedkoop, M., van Halen, C., Te Riele, H. and Rommens, P. (1999), *Product Service Systems: Ecological and Economic Basics*, PriceWaterhouse Coopers/Vrom, The Hague.
- Goffin, K. and New, C. (2001), "Customer support and new product development – an exploratory study", *International Journal of Operations & Production Management*, Vol. 21 No. 3, pp. 275-301.
- Graham, G., Burnes, B., Lewis, G.J. and Langer, J. (2004), "The transformation of the music industry supply chain – a major label perspective", *International Journal of Operations & Production Management*, Vol. 24 Nos 11/12, pp. 1087-103.
- Grönroos, C. (2000), *Service Management and Marketing*, Wiley, Chichester.
- Hayes, R.H. (2002), "Challenges posed to operations management by the "new economy", *Production and Operations Management*, Vol. 11 No. 1, pp. 21-32.
- Hayes, R.H. (2008), "Operations management's next source of galvanizing energy?", *Production and Operations Management*, Vol. 17 No. 6, pp. 567-72.
- Hayes, R.H. and Wheelwright, S.C. (1984), *Restoring Our Competitive Edge: Competing Through Manufacturing*, Wiley, New York, NY.
- Hill, T.P. (1977), "On goods and services", *Review of Income and Wealth*, Vol. 23 No. 4, pp. 315-38.
- Hill, T.P. (1979), "Do-it-yourself and gdp", *Review of Income and Wealth*, Vol. 25 No. 1, pp. 31-9.
- Hill, T.P. (1999), "Tangibles, intangibles and services: a new taxonomy for the classification of output", *Canadian Journal of Economics*, Vol. 32 No. 2, pp. 426-47.

-
- Holmstrom, B. and Milgrom, P. (1991), "Multitask principal-agent analyses: incentive contracts, asset ownership, and job design", *Journal of Law, Economics and Organization*, Vol. 7, pp. 24-52 (special issue).
- Johnson, M.D., Herrmann, A. and Bauer, H.H. (1999), "The effects of price bundling on consumer evaluations of product offerings", *International Journal of Research in Marketing*, Vol. 16 No. 2, pp. 129-42.
- Judd, R.C. (1964), "The case for redefining services", *Journal of Marketing*, Vol. 28 No. 1, pp. 58-9.
- Kim, S.-H., Cohen, M.A. and Netessine, S. (2006), *Performance Contracting in After-sales Service Supply Chains*, The Wharton School, Philadelphia, PA.
- Langlois, R.N. (2006), "The secret life of mundane transaction costs", *Organization Studies*, Vol. 27 No. 9, pp. 1389-410.
- Langlois, R.N. and Cosgel, M.M. (1998), "The organization of consumption", in Bianchi, M. (Ed.), *The Active Consumer: Novelty and Surprise in Consumer Choice*, Routledge, London.
- Levitt, T. (1972), "Production-line approach to service", *Harvard Business Review*, Vol. 5 No. 5, pp. 41-52.
- Lewin, A.Y. and Peeters, C. (2006), "Offshoring work: business hype or the onset of fundamental transformation?", *Long Range Planning*, Vol. 39 No. 3, pp. 221-39.
- Lovelock, C. and Gummesson, E. (2004), "Whither services marketing: in search of a new paradigm and fresh perspectives", *Journal of Service Research*, Vol. 7 No. 1, pp. 20-41.
- Lusch, R.F., Vargo, S.L. and Malter, A.J. (2006), "Marketing as service-exchange: taking a leadership role in global marketing management", *Organizational Dynamics*, Vol. 35 No. 3, pp. 264-78.
- Lusch, R.F., Vargo, S.L. and O'Brien, M. (2007), "Competing through service: insights from service-dominant logic", *Journal of Retailing*, Vol. 83 No. 1, pp. 5-18.
- Maglio, P.P., Srinivasan, S., Kreulen, J.T. and Spohrer, J. (2006), "Service systems, service scientists, SSME, and innovation", *Communications of the ACM*, Vol. 49 No. 7, pp. 81-5.
- Manzini, E. and Vezzoli, C. (2003), "A strategic design approach to develop sustainable product service systems: examples taken from the 'environmentally friendly innovation' Italian prize", *Journal of Cleaner Production*, Vol. 11 No. 8, pp. 851-7.
- Mathieu, V. (2001), "Service strategies within the manufacturing sector: benefits, costs and partnership", *International Journal of Service Industry Management*, Vol. 12 No. 5, pp. 451-75.
- Mattsson, L.G. (1973), "Systems selling as a strategy on industrial markets", *Industrial Marketing Management*, Vol. 3 No. 2, pp. 107-20.
- Metters, R. and Verma, R. (2008), "History of offshoring knowledge services", *Journal of Operations Management*, Vol. 26 No. 2, pp. 141-7.
- Michel, S., Vargo, S.L. and Lusch, R.F. (2008), "Reconfiguration of the conceptual landscape: a tribute to the service logic of Richard Norman", *Journal of the Academy of Marketing Science*, Vol. 36 No. 1, pp. 152-5.
- Mills, J., Platts, K. and Bourne, M. (2003), "Applying resource-based theory: methods, outcomes and utility for managers", *International Journal of Operations & Production Management*, Vol. 23 No. 2, pp. 148-66.
- Mont, O. (2002), "Clarifying the concept of product-service system", *Journal of Cleaner Production*, Vol. 10, pp. 237-45.
- Mont, O. (2004), "Institutionalisation of sustainable consumption patterns based on shared use", *Ecological Economics*, Vol. 50 Nos 1/2, pp. 135-53.

- Neely, A. (2007), "The servitization of manufacturing: an analysis of global trends", paper presented at European Operations Management Conference, Ankara.
- Nie, W. and Kellogg, D. (1999), "How professors of operations management view service operations", *Production and Operations Management*, Vol. 8 No. 3, pp. 339-53.
- Normann, R. (2001), *Reframing Business: When the Map Changes the Landscape*, Wiley, Chichester.
- Oliva, R. and Kallenberg, R. (2003), "Managing the transition from products to services", *International Journal of Service Industry Management*, Vol. 14 No. 2, pp. 160-72.
- Pandza, K., Horsburgh, S., Gorton, K. and Polajnar, A. (2003), "A real options approach to managing resources and capabilities", *International Journal of Operations & Production Management*, Vol. 23 No. 9, pp. 1010-32.
- Penrose, E.T. (1959), *The Theory of the Growth of the Firm*, Basil Blackwell, Oxford.
- Potts, G.W. (1988), "Exploit your product's service life-cycle", *Harvard Business Review*, Vol. 66 No. 5, pp. 32-6.
- Ramirez, R. (1999), "Value co-production: intellectual origins and implications for practice and research", *Strategic Management Journal*, Vol. 20 No. 1, pp. 49-65.
- Rathmell, J.M. (1966), "What is meant by services?", *Journal of Marketing*, Vol. 30 No. 4, pp. 32-6.
- Reichart, I. and Hischier, R. (2002), "The environmental impact of getting the news: a comparison of on-line, television, and newspaper information delivery", *Journal of Industrial Ecology*, Vol. 6 Nos 3/4, p. 185.
- Samli, A.C., Jacobs, L.W. and Wills, J. (1992), "What presale and postsale services do you need to be competitive", *Industrial Marketing Management*, Vol. 21 No. 1, pp. 33-41.
- Sampson, S.E. (2000), "Customer-supplier duality and bidirectional supply chains in service organisations", *International Journal of Service Industry Management*, Vol. 11 No. 4, pp. 348-64.
- Sampson, S.E. (2001), *Understanding Service Businesses*, Wiley, New York, NY.
- Sampson, S.E. and Froehle, C.M. (2006), "Foundations and implications of a proposed unified services theory", *Production and Operations Management*, Vol. 15 No. 2, pp. 329-43.
- Schmenner, R.W. (2008), "Manufacturing, service, and their integration: some history and theory", paper presented at 15th International Annual EurOMA Conference, Groningen.
- Skinner, W. (1969), "Manufacturing – missing link in corporate strategy", *Harvard Business Review*, Vol. 47, pp. 136-45.
- Slack, N., Chambers, S. and Johnston, R. (2007), *Operations Management*, Prentice-Hall, Englewood Cliffs, NJ.
- Snir, E. (2001), "Liability as a catalyst for product stewardship", *Production and Operations Management*, Vol. 10 No. 2, pp. 190-206.
- Spring, M. (1997), "Product customization as a service operation", in Ribera, J. and Prats, J. (Eds), *4th International Conference of the European Operations Management Association Managing Service Operations*, IESE, Barcelona.
- Spring, M. and Araujo, L. (2005), "Revisiting the product-service distinction", paper presented at 12th International EurOMA Conference on Operational and Global Competitiveness, Budapest.
- Spring, M. and Boaden, R. (1997), "One more time: how do you win orders? A critical reappraisal of the terry hill manufacturing strategy framework", *International Journal of Operations & Production Management*, Vol. 17 No. 8, pp. 757-79.

-
- Spring, M. and Dalrymple, J.F. (2000), "Product customization and manufacturing strategy", *International Journal of Operations & Production Management*, Vol. 20 No. 4, pp. 441-67.
- Stahel, W. (1998), "From products to services: selling performance instead of goods", *The IPTS Report*, Institute for Prospective Technological Studies, Seville.
- Stoughton, M. and Votta, T. (2003), "Implementing service-based chemical procurement: lessons and results", *Journal of Cleaner Production*, Vol. 11, pp. 839-49.
- Sundbo, J. (1994), "Modulization of service production and a thesis of convergence between service and manufacturing organizations", *Scandinavian Journal of Management*, Vol. 10 No. 3, pp. 245-66.
- Tapscott, D. and Williams, A.D. (2006), *Wikinomics: How Mass Collaboration Changes Everything*, Portfolio, New York, NY.
- Timmers, P. (1999), *Electronic Commerce*, Wiley, Chichester.
- Vandermerwe, S. and Rada, J. (1988), "Servitization of business: adding value by adding services", *European Management Journal*, Vol. 6 No. 4, pp. 314-24.
- Vargo, S.L. and Lusch, R.F. (2004a), "Evolving to a new dominant logic for marketing", *Journal of Marketing*, Vol. 68 No. 1, pp. 1-17.
- Vargo, S.L. and Lusch, R.F. (2004b), "The four service marketing myths: remnants of a goods-based, manufacturing model", *Journal of Service Research*, Vol. 6 No. 4, pp. 324-35.
- Vargo, S.L. and Lusch, R.F. (2008a), "Service-dominant logic: continuing the evolution", *Journal of the Academy of Marketing Science*, Vol. 36 No. 1, pp. 1-10.
- Vargo, S.L. and Lusch, R.F. (2008b), "Why 'Service'?", *Journal of the Academy of Marketing Science*, Vol. 36 No. 1, pp. 25-38.
- Weill, P. and Vitale, M.R. (2001), *Place to Space: Migrating to Ebusiness Models*, Harvard Business School, Boston, MA.
- Williamson, O.E. (1985), *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, The Free Press, New York, NY.
- Wilson, B. (2005), "Canned truth", *Times Literary Supplement*, Times Publishing, London.
- Wise, R. and Baumgartner, P. (1999), "Go downstream – the new profit imperative in manufacturing", *Harvard Business Review*, Vol. 77 No. 5, pp. 133-41.
- Zipkin, P. (2006), "The best things in life were free: on the technology of transactions", *Manufacturing & Service Operations Management*, Vol. 8 No. 4, pp. 321-9.
- Zott, C. and Amit, R. (2008), "The fit between product market strategy and business model: implications for firm performance", *Strategic Management Journal*, Vol. 29 No. 1, pp. 1-26.

Corresponding author

Martin Spring can be contacted at: m.spring@lancaster.ac.uk