

The servitization of manufacturing: A systematic literature review of interdependent trends

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1 Introduction

Competing strategically through service provision is becoming a distinctive feature of innovative manufacturing firms (Spring and Araujo, 2009). Integrated product-service offerings can be a means of differentiation and provide a robust market defence to competition from lower cost economies, particularly in the manufacturing sectors where there is a high installed product base (Wise and Baumgartner, 1999). Consequently, there is a growing amount of research interest in the role of services in sustaining the competitiveness of manufacturers. The term “servitization” was coined by Vandermerwe and Rada (1988) to describe this phenomenon and subsequently become known as the “servitization of manufacturing”.

As a field of research the servitization of manufacturing is being studied from a broad range of academic traditions. Researchers are working within their distinct research communities and providing unique and complementary perspectives on the rationale, design and delivery of servitization (Oliva and Kallenberg, 2003; Slack, 2005; Malleret, 2006). Issues that have received particular attention include service business growth (Martin and Horne, 1992; Wise and Baumgartner, 1999; Gebauer et al., 2008), solutions provision (Galbraith, 2002; Miller and Hartwick, 2002; Windahl and Lakemond, 2006; Davies et al., 2006), after-sale marketing (Cohen et al., 2006), service profitability (Samli et al., 1992; Anderson and Narus, 1995; Neely, 2009) and new business models (Edvardsson et al., 2008; Lindahl et al., 2009). This proliferation is testimony to the increasing recognition of the importance of services to manufacturers, and given the multi-disciplinary and applied nature of the issues being addressed platforms for improving researcher engagement should be actively sought.

Servitization within manufacturing is evidently a diverse and complex field with contributions arising across a range of research communities that are interdependent. Improved awareness and cohesion across these communities will help to improve the quality and rate of knowledge production, and establish important future research challenges. This is the motivation underpinning the research reported in this paper. Our aim is to provide an integrative and organising lens for viewing the various contributions to knowledge production from those research communities addressing concerns associated with the servitization of manufacturing. We are particularly interested in better understanding what research has been published in academic and scholarly journals (i.e. the knowledge stocks) and which scientific fields of study are underpinning and influencing its evolution (i.e. the knowledge flows). To achieve this we address the following research questions, namely:

RQ1. Where are the knowledge stocks and flows amongst the research communities?

RQ2. What generic research concerns are being addressed by the research communities?

In doing so, we aspire to move the body of knowledge on servitization forwards and progress both within-community and cross-community understanding.

We have addressed these questions through an evidenced based investigation. This research has been guided by the process of systematic review (Tranfield et al., 2003) and studied its application in other scholarly works (Lesure et al., 2004; Thorpe et al., 2005; Bakker, 2010; Meier, 2011), which has allowed us to appreciate the subtle variations in adoption practices by academics. This approach takes principles originating from the medical sciences and applies them to management and organisation theory. Through this process we have performed a descriptive and thematic analysis of 148 academic and scholarly papers from 68 international peer-reviewed journals.

The outcomes of this review are an understanding of where knowledge resides across research communities, where interactions and communications are stronger and where the common areas of inquiry are located. In this way, this work both confirms and expands previous research (Baines et al., 2009b) that indicates that the principal research communities are services marketing, service management, operations management, product-service systems (PSS) and service science (Baines et al., 2009a). Our work indicates that each of the communities is actively contributing to knowledge production. There are, however, significant variations in engagement and interaction amongst the communities. Nevertheless, there is shared interest in the conceptualizing product-service differentiation, competitive strategy, customer value, customer relationships and product-service configuration.

This paper describes our investigation of the various contributions to the production of knowledge in the field of servitization. It is structured to first introduce the research communities that are actively engaged with researching the topic of servitization, their origins and generic interests. An overview of our research methodology is then provided. The subsequent sections present the knowledge stocks and flows, and then the shared research concerns across the communities. Finally, we conclude by summarising the contributions of this study and the implications this poses for future work.

2 Communities engaged with servitization research

Research in the field of servitization has, for some time, taken place in five principal research communities (Baines et al., 2009a). However, the constitution and focus of these communities continues to evolve. In this section we introduce each community and summarise their origins, evolution, and unique disciplinary perspectives.

2.1 Services marketing

With a firm foot-hold in the marketing tradition, researchers in the field of services marketing have largely evolved from a perspective of the exchange and distribution of commodities, to a focus on a customer relationship management perspective of the provision of services. Hereafter, we refer to these academics as the services marketing research community.

In the first issue of the *Journal of Marketing*, a review of the existing research indicated that work was primarily concerned with the exchange and distribution of commodities (Taylor, 1936). Over the intervening years, the emphasis of marketing moved from economic exchange, to marketing management with a stronger focus on satisfying the customer coming to the fore (Drucker, 1954; Levitt, 1960). In the following decade, the marketing mix (Kotler, 1967) or the 4P's of product, price, place and promotion added further granularity to the way in which a firm could adjust its offering to satisfy customers, independent of market forces. In the late 1970s there was acknowledgement that the marketing of services was different to products (Shostack, 1977). However, products and services are often inseparable, and the sale of a product could lead to a relationship where services could be sold over an extended period of time (Levitt, 1983), moving marketing from transactional to relational exchange and an acknowledgement that goods and services needed to be treated differently. The work of Shostack (1977) and Levitt (1983) acted as the precursors of two new streams of marketing – services marketing and relationship marketing. Since the 1970s, services marketing has grown into a major sub-discipline of the marketing field of study. Services marketing scholars have argued that the marketing of goods and services is different, since services are intangible, heterogeneous, inseparable and perishable – IHIP (Fisk et al., 1993). The relationship marketing literature is founded on the premise that competition is between firms and that exchange between actors increasingly has a temporal, relational dimension as opposed to being solely about discrete transactions (Morgan and Hunt, 1994).

In the early twenty-first century the validity of the 4Ps was being challenged (Day and Montgomery, 1999), for its lack of recognition of marketing as an innovating and adaptive force. Furthermore, Lovelock and Gummesson (2004) challenged the IHIP paradigm for services marketing, by noting the shortcomings of its premise that four unique characteristics make services different from goods. They offer an alternative perspective, suggesting that exchanges not resulting in the transfer of ownership from seller to buyer are fundamentally different from those that do, and that service provision offers benefits through access or temporary possession, not ownership. At the same time a

new service-centred dominant logic was being proposed, based on the exchange of intangibles, specialist skills, knowledge and processes, where value is defined by and co-created with the customer rather than embedded in output (Vargo and Lusch, 2004). This service-dominant logic (SDL) marketing paradigm argues that all marketing research and practice must break free from the manufacturing-based model of exchange of output. This view was challenged by Stauss (2005, p. 223), who suggested that its adoption would be a Pyrrhic victory since “it fails to recognise the manifest difference between production and consumption with respect to goods”. However, Ambler (2005) considers the SDL and the Lovelock and Gummesson (2004) views as alternative perspectives on marketing, where many are needed to fully explain the tasks facing marketers.

2.2 Service management

This has largely evolved from mainstream operations and strategy domains and tends to focus on service organisations and organisational culture as opposed to the goods/service division. Hereafter, we refer to these academics as the service management research community.

Since the 1960s we have moved into a service society where services constitute a larger part of national economic output. In the paper “The industrialisation of services” (1976) Theodore Levitt points out that, even at that time, the service sector of industrialised nations had been in the ascent for almost three quarters of a century, and at the same time Sasser (1976) argues that immediacy makes service industries distinct from manufacturing and therefore balancing service supply and demand is not easy. Gummesson (1994) stated that during the 1980s, service management established its own identity and comments that the traditional goods/service division was outdated. In a similar vein “The service factory” concept (Chase and Garvin, 1989) is seen as a key contribution in reversing the trend in operations management literature, which focussed on manufacturing-related concepts in a services environment (Voss, 1992).

The classification, positioning and delivery strategy for services has been addressed by a number of authors, for example: Silvestro et al. (1992) propose service positioning along a process diagonal; Collier and Meyer (1998) use four service quadrants based on labour intensity and customer contact; and Kellog and Nie (1995) introduce a service process/service package (defined by the degree of customisation) matrix. More recently, Heineke and Davis (2007) discuss the emergence of service management and go on to argue that applying manufacturing operations management concepts to service operations is limiting, and that there is a need for a trans-disciplinary approach appropriately suited to the characteristics of services industries. Machuca et al. (2007) add to this in their review determining the state of affairs of service management research in the most relevant operations management journals.

2.3 Operations management

The broad field of operations has complemented its traditional focus on production and productivity-oriented analyses for efficiency improvements, with an emphasis on operations management and strategy in the delivery of product and service combinations (Morris and Johnson, 1987; Quinn et al., 1990; Wise and Baumgartner, 1999; Windahl et al., 2004; Spring and Araujo, 2009; Baines et al., 2009a). Hereafter, we refer to academics in this field as the operations management research community.

Since the term servitization was first coined in 1988 by Vandermerwe and Rada, there has been a growing output of articles and papers addressing the “servitization of manufacturing” in both research and practitioner literature, from the USA and Western Europe, by authors from the operations management discipline.

Baines et al. (2007) suggest that “the innovation of a manufacturing organisation's capabilities and processes to shift from selling product to selling an integrated product and service offering that delivers value in use” is the process of servitization. Tukker (2004) positioned various forms of this type of process on a product-service continuum (Tukker, 2004), ranging from products with services as an “add-on”, to services with tangible goods as an “add-on”. Manufacturers tend to deliver these integrated product and service offerings using customer-centric strategies in order to provide “desired outcomes” for customers. Examples of leading practice in the literature are focused on

larger organisations supplying high-value capital equipment such as Alstom and ABB (Miller and Hartwick, 2002; Davies, 2004), Thales Training & Simulation (Mulholland, 2000; Davies, 2004) and Rolls-Royce Aerospace (Howells, 2000; Baines et al., 2009a). These demonstrate how traditionally-based manufacturing companies have moved their position in the value-chain from product manufacturers to providing customers with “desired outcomes”.

Service led competitive manufacturing strategy is an area of growing interest for academia (Slack, 2005; Brax, 2005; Tuli et al., 2007; Neely, 2009; Baines et al., 2009a; Schmenner, 2009), business (Wise and Baumgartner, 1999; Gebauer et al., 2004; Cohen et al., 2006; Jacob and Ulaga, 2008) and even government (Hewitt, 2002). Of particular interest are product-centric services, where the manufactured product itself is central to the provision of an integrated set of services (e.g. through maintenance, repair, support, availability and capability contracts). Examples include Xerox's move from selling printers and copiers to delivering a “Document Management Service” (www.consulting.xerox.com), Rolls-Royce Civil Aerospace's “TotalCare” Service (www.rolls-royce.com/civilaerospace) and Alstom (Train Life Services) supporting the UK west coast mainline for Virgin Rail (Lightfoot et al., 2011). This servitization of manufacturing is clearly an area of particular interest and activity to the operations management community.

2.4 Product-service systems

Scandinavian researchers have focussed their interest on PSS, seeking to address the ability of product-service combinations to improve social, economic, environmental and industrial sustainability. They have followed an ecological and environmental tradition, hereafter, we refer to academics in this field as the PSS research community.

The foundational work on PSS is exemplified by Goedkoop et al.'s (1999) report on an ecological and economic basis (commissioned by VROM and EZ in Holland) and Mont (2000) in a report sponsored by the Swedish Waste Research Council. A PSS is a specific type of value-proposition (business model) that inherently focuses on fulfilling a final need, demand or function (Tukker and Tischner, 2006). It is a special case in servitization, which values asset performance or utilisation rather than ownership, and achieves differentiation through the integration of product and services that provide value in use to the customer (Baines et al., 2007). A successful PSS needs to be designed at the systemic level from the client perspective and requires early involvement with the customer and changes in the organisational structures of the provider (Mont, 2002; Manzini et al., 2001). The principal barriers to the adoption of PSS are positioned at both sides of the dyad: customers may not be enthusiastic about ownerless consumption (Meijkamp, 2000; Mont and Lindqvist, 2003; Wong, 2004), and manufacturers may be concerned with pricing, absorbing risks and shifts in organisational configuration (Goedkoop et al., 1999). A diverse range of PSS examples can be found in the literature with some demonstrating economic success, but most tending to emphasise the potential for significant environmental and social gains (Goedkoop et al., 1999; Mont, 2000). PSS solutions are seen as having the potential for decoupling environmental pressure from economic growth through focussing on asset use rather than on asset ownership (Tukker, 2004). Industrial PSS (IPS2), is a developing subset of PSS representing PSS business-to-business solutions, particularly in the field of high technology products, where technological market leadership may not directly result in market success, because the customer is not able to exploit the product features available, and the products are effectively purchased as though they were commodities.

Research in this area aims to develop a better understanding of PSS to facilitate the planning, development and effective delivery of industrial PSS (e.g. Proceedings of the 1st CIRP IPS2 Conference, 2009). Although developed in unconnected research streams and coming from different points of departure, there is a striking overlap in concepts relating to servitization within the operations management and PSS communities.

2.5 Service science

Service science has largely evolved from information systems (IS) applied domains and generally focuses on providing a better understanding of complex service systems. Originating in the IS sector and within IBM, this is a relatively new interdisciplinary concept, articulated for the effective provision of services. Hereafter, we refer to academics in this field as the service science community.

Service science focuses not merely on one aspect of service, but rather on service as a system of interacting parts that include people, technology, and business (Chesborough and Spohrer, 2006). It is the study of complex service systems and the co-creation of value in complex configurations of resources (Spohrer et al., 2007; Vargo et al., 2008). It is a melding of technology with an understanding of business processes and organisation. In pursuit of this challenging goal, recent times have witnessed the development of service-science management and engineering research (SSME) to bring together researchers and practitioners, who recognize the need for multidisciplinary services-oriented research and education (e.g. SSMEnetUK funded by EPSRC, BT, HP and IBM: www.ssmenetuk.org).

As such, SSME draws on ideas and concepts from a wide range of disciplines including computer science, engineering, cognitive science, economics, organisational behaviour, human resources management, marketing, and operations research. It aims to integrate them into a coherent science of service. Vargo et al. (2008) see SDL, as foundational to service science and to the study of value creation in service systems.

Service science has become a fast developing research theme, and is contributing considerable debate and dialogue as demonstrated by the growth of events such as the International Symposium on Service Science, launched in 2009 (Alt et al., 2009) and the launch (2010) of the Service Research Innovation Institute (SRII) led by major IT companies like IBM, HP, Microsoft, etc. in close partnership with academia and research institutes, as well as government organizations from around the world.

3 Research methodology

Based on the proposition that servitization is being addressed by different research communities, this review seeks to obtain a more detailed understanding of knowledge production both within and across them. As a multi community research activity its nature, boundaries and interactions are yet to be comprehensively defined. Therefore, the aim of our work has been to provide an integrative and organising lens for viewing the various contributions to knowledge production from research communities addressing concerns associated with the servitization of manufacturing.

To address our stated research questions we have undertaken an investigation of academic and scholarly publications following a process of systematic review. Systematic reviews in the social, engineering and management sciences are a relatively new occurrence (Pittaway et al., 2004; Van Aken, 2005). The method has been used extensively in the medical sciences in search of improved evidence for guiding future policy and practice, and more recently its merits have led to an insurgence in other fields of inquiry.

Systematic reviews have, however, been used in health, education and increasingly management fields to synthesise and organise research findings from multiple studies, in an orderly and transparent manner. Our study adopted the principles and generic framework of the orthodox systematic review process as articulated for the management science field (Tranfield et al., 2003). In particular we have adhered to the principles that a review following this process should be transparent, replicable and rational. The review procedure undertaken is summarised in Figure 1 and further explained below.

Publications data was taken from databases that comprehensively envelop the research communities outlined in Section 2. These have included Compendex, Inspec, Web of Science, Proquest, ABI Inform and Emerald, consistent with other reviews in the management field (Rashman et al., 2009, Pittaway et al., 2004). Our searches were based on a broad range of terms and strings associated with both manufacturing and services research. These included, for example, service integration, servitization, sustainability, service economy, product substituting service, functional economy, integrated solutions, product-related services, service marketing, aftermarket, customer service, value, value in use, intangibility, service operations, tangibility, product marketing, service infusion, service science, classification and framework. Many of these keywords were combined with “manufacturing” or “product” in order to ensure their relevance to our study. The search activity provided access to a wide variety of journal, conference and other forms of written materials such as books and magazines. For completeness, a search of internet sources

was conducted using Google Scholar. We did, however, constrain our search to articles written in English, or those articles where an English translation was available.

This process identified 300 seemingly relevant items as a basis for further analysis. Initial reading of the article abstracts, keywords and content allowed this pool to be reduced to 110 academic and scholarly articles that were relevant, in a manufacturing industry and “B2B” context, and papers that contributed concepts which were essential to understanding the evidence base. Once these inclusion and exclusion choices had been made, the cross-checking of authors and references and where possible consultation with scientific communities producing interim/unpublished relevant work (grey literature) further informed and increased the pool to 148 published principal articles. All articles were considered to be representative of the current body of knowledge associated with the servitization of manufacturing. Overall, these articles were produced by 103 different first authors in 68 journals and provided the raw data for our descriptive and thematic analyses. Each article was subsequently clustered according to the broader academic discipline and community it was addressing, the specific aspect of servitization research or practice, the research concerns it presented and the aims of the peer-reviewed journals/conferences chosen as channels for research dissemination. For example, research articles from the International Journal of Operations & Production Management (IJOPM) and Journal of Operations Management (JOM) would be allied to the broader academic discipline and research community concerned with “operations”, “operations management” and “operations strategy”. Our subsequent clustering of the 148 articles reviewed is presented in Table I.

Our analysis followed two stages. RQ1 was addressed through a largely quantitative and descriptive analysis of publications produced by the research communities. The emphasis was on understanding the positioning and perspective of each paper, and then establishing the other publications being cited.

RQ2 was dealt with using a qualitative analysis to identify dominant themes. This thematic element involved a detailed review of the content of each research article. To do this we created a coding frame to catalogue the textual content and summaries of each paper. This coding frame emulated a tree structure with over 40 initial constructs allowing the branching of 17 sub-themes and the final consolidation of five generic themes. The coding framework evolved inductively as the analysis work progressed. Records were also kept of the frequency with which specific words and terms (e.g. language, synonyms, homonyms, phrases, arguments and assertions) were used, and this was taken to reflect their relative importance.

Our analysis led us to develop our overall findings on the development of knowledge production in the field of servitization. These are now presented in the following two sections. The first deals with the findings associated with the research question addressing “knowledge stocks and flows”, and the second with the question relating to the “generic research concerns” in the field.

4 Knowledge stocks and flows within servitization research

4.1 Evolution and activity of research communities

The review process identified 148 core papers/articles from 103 different first authors, which collectively provided a representative body of knowledge about the servitization of manufacturing. Figure 2 shows the extent of the research activity and relative maturity of each of the communities. A general increase in activity across all the communities is clearly apparent. In the first two decades, research dissemination activity was largely confined to the services marketing and service management communities. The operations community became more active in the late 1980s, followed by the PSS community in the mid-1990s. Finally, the service science community emerged around the turn of the twenty-first century. The operations community is presently the most prolific in the generation of research articles directly relevant to the servitization of manufacturing as indicated by the fastest rate of growth in knowledge production in the last decade.

4.2 Citation, and cross-citation behaviour

There are distinct researcher communities providing contributions to knowledge production in the field of servitization of manufacturing, with unique and complementary perspectives, disseminated via a range of academic and scholarly journals. Figure 3 shows the extent of cross citing amongst paper/article first authors in the five research communities and illustrates the top ten most cited first authors in our research sample of 148. These authors are cited by over 20 per cent of all first authors, with over 30 per cent citing the top author alone.

To gain further insights into which communities are citing work by these authors, within our set of 148 core papers/articles, we further analysed the patterns of cross-citation for the top ten first authors. The results are shown in Figure 4.

Chris Lovelock, for example, is the most cited first author as a result of his contribution to the services marketing literature and his prime position in our review is underpinned by his 2004 article challenging the IHIP marketing perspective, which is clearly of interest, not only to services marketing and service management communities, but also relevant to the operations community and to some extent the burgeoning service science research community.

A range of papers by Theodore Levitt are cross cited, including his quintessential “Marketing myopia”, and his position in our review reflects his overall contribution to marketing and service management research and its impact on more recent operations thinking on the servitization of manufacturing. Roger Schmenner's position benefits from citations of his generic work in the field of operations management by others in the operations management community.

The remainder of our top ten first authors qualify as the result of specific single publications within our set of 14, that have been described as either “seminal pieces” (Shostack, 1977; Vargo and Lusch, 2004; Chase and Garvin, 1989; Quinn et al., 1990; Wise and Baumgartner, 1999; Vandermerwe and Rada, 1988) or particularly timely in their publication due to heightened general academic interest in the servitization of manufacturing (Oliva and Kallenberg, 2003).

The citation behaviour of researchers varies considerably across the communities. Essentially, citation behaviour indicates which community based knowledge stocks are considered valuable in generating new knowledge and understanding in any one particular community. Figure 5(a)-(e) shows a series of pie charts summarising distribution profiles of citations by research community from a total population of ~600 citations identified amongst the article/paper first authors. It clearly shows that the operations community is providing the majority of citations relating to the servitization of manufacturing. In terms of providing an indicator of the extent of cross community citation behaviour, we see the services marketing community citing operations management and service management (Figure 5(a)); the service operations community citing operations management and services marketing (Figure 5(b)); the operations management community citing mostly service management and services marketing (Figure 5(c)); the PSS community citing evenly across the other communities (Figure 5(d)) and the service science community citing mostly services marketing, service management and operations management (Figure 5(e)). Overall therefore, it is apparent that the more mature communities are drawing on knowledge stocks from within these particular communities, whereas the emergent communities of PSS and service science are drawing on a knowledge base more evenly distributed across all the communities.

4.3 Dissemination channels

The direction and vigour of the various knowledge flows might also be influenced by the reputation of the chosen channel for disseminating research output (e.g. in favour of the higher ranked, impactful and prestigious outlets). Figure 6 shows examples of the spread of papers/articles, in our core literature set, across different journals. The vast majority (90 per cent) of journal titles fall within the broader management field, and reflect the dominance of the services marketing, service management and operations management research communities. Of this 90 per cent, approximately 80 per cent have high impact and broader appeal in the academic communities (3* star or 4* star rating from the Association of Business Schools Academic Journal Quality Guide published in March 2010). It

should be noted that the relatively high number (ten) of core articles appearing in the Journal of Cleaner Production reflects the pre-eminence of this journal as a publication medium for the PSS community of researchers, as opposed to it being generally favoured by other researchers. There is, however, a clear lack of references to engineering and engineering management journals. This suggests a limited awareness or appreciation of the use of information and communication technologies that are enabling many servitized manufacturers to deliver sophisticated product-centric service offerings (e.g. the Rolls-Royce engine health management system, see Benedettini et al. (2009)).

In summary, this section has set out to explore the evolution, contributions, and interactions of researcher communities dealing with the servitization of manufacturing. The principal insights leading from this analysis are as follows:

- although interest in servitization has burgeoned recently, its “evolution” has roots that can be traced back as far as the 1960s; and
- the extent of cross-citations varies significantly across communities, and suggests that opportunities exist for increasing “interactions” and leveraging knowledge production.

5 Generic research concerns within servitization research

The thematic element of our analysis involved a detailed review of the content of each research article by creating a coding framework to catalogue the textual content and summaries of each paper. The coding framework evolved inductively as the analysis progressed. Records were kept of the frequency with which specific words and terms (e.g. language, synonyms, homonyms, phrases, arguments and assertions) were used, and this was taken to reflect their relative importance.

5.1 Overview of outcomes of the thematic analysis

The final stages of our thematic analysis led to the identification of five generic research concerns that are shared by the researcher communities, namely:

1. product-service differentiation – research concerns that address the differentiation of product and services constructs;
2. competitive strategy – research concerns that address the leverage of competitive advantage by developing services-led manufacturing strategies;
3. customer value – research concerns that address value-added, value-in-use and co-creation of value constructs;
4. customer relationships – research concerns that address the relational nature of customer interactions; and
5. product-service configuration – research concerns that address the design and implementation of complex service offerings and their associated delivery systems.

The remainder of this section explores each of these themes and their various contributions and identifies the generic research concerns going forward.

5.2 Product-service differentiation

There is considerable debate about the terminology, ideas and concepts which describe and differentiate products and services. The debate over the differences between products and services has taken place mainly in the marketing and PSS communities in which the role of products and service in the delivery of customer value is the subject of increasing interest. The PSS research community considers that:

[...] a product is a tangible commodity manufactured to be sold and fulfil a customer's need, and that a service is an essentially intangible activity with economic value done for others on a commercial basis (Goedkoop et al., 1999).

Authors from the PSS community such as Mont (2000), Tukker (2004) and Wong (2004) propose frameworks in which pure product manufacture and pure service provision are positioned at polar ends of a continuum, implying variation in between.

In the services marketing community, a principal milestone was Shostack's (1977, p. 73) proposal, that "it is wrong to imply that services are just like products except for tangibility" and that marketing requires a framework which accommodates intangibility instead of denying it. Levitt (1981) supports this with the view that giving tangibility to an intangible product feature can aid sales and post sales efforts. This is because all products are in some respects intangible, particularly if they are purchased against a promise of satisfaction which may fail to be delivered if, for example, the product is used incorrectly. The services marketing community subsequently began to distinguish products from service, based on intangibility, heterogeneity, inseparability and perish-ability (IHIP) (Fisk et al., 1993). Lovelock and Gummesson (2004), however, argue that this differentiation is not supported by evidence, and whilst it may be adequate for some goods and some services, it does not apply in situations where there is a non-transfer of ownership. Furthermore, Araujo and Spring (2006, p. 797) suggest that:

[...] what counts as a product or service depends on the nature of the producer-user interface and the institutional structure of production rather than any essentialist feature of product or service.

The gradual demise of the concept IHIP as a paradigm in the marketing community, and the emergence of SDL, which favours service as a process rather than a unit of output are interesting theoretical debates in the context of the servitization of manufacturing. Here the prevailing judgement is switching the focus from the asset (i.e. goods and/or services) to what the product offers the customer (i.e. the service). Spring and Araujo (2009) suggest that product and service centred logics will coexist in most markets where the sale of goods and service is combined. This supports the call by Vargo and Lusch (2004) for the abandoning of product/service differentiation and suggests a move to understanding the interrelationship of products and services.

5.3 Competitive strategy

A second core theme addresses the potential commercial benefits to a manufacturer who seeks to pursue a services-led competitive strategy. This is an active debate across all five communities, but particularly amongst the researchers in the operations and PSS communities. Almost 40 years ago Levitt (1972, p. 42) suggested that all commercial organisations were in the business of delivering service – "the service industries" (banking, airlines, and maintenance), product-related service from manufacturers and sales-related service from retailers. In the computer industry, "service" became viewed as central to the total product package and therefore formed an essential part of the product itself. According to Quinn et al. (1990, p. 58), business success would come from combining manufacturing and service offerings and that "many manufacturers are now thinking and behaving like service providers and are becoming largely service operations". This so-called shift in the manufacturing business model is commonly termed "servitization" (Vandermerwe and Rada, 1988; Slack, 2005; Baines et al., 2009a; Neely, 2009), leading to a move "downstream" towards the customer's end of the value chain, and a shift from operational excellence to customer allegiance (Wise and Baumgartner, 1999). Manufacturing businesses seeking to effectively design future value propositions may wish to acknowledge that what is being purchased here is not the product itself but the ultimate functionality that the user wants to realise. The adoption of a gradual strategic change by manufacturers moving to product-related services and to customer support (e.g. process-oriented engineering, parts management, maintenance) in aspiring to offer an "integrated solutions" business is supported by other authors (Oliva and Kallenberg, 2003; Gebauer et al., 2004; Brax, 2005). Davies (2004) espouses that such "integrated solutions" are now imperative to the capital goods industry strategy, which deploys business models requiring detailed knowledge of customer activities, thus encouraging heightened levels of customer centricity. It is also interesting to note Schmenner's (2009) observation that, historically the bundling of manufactured goods into services has frequently been led by companies with new products but limited manufacturing strength, and that those with significant manufacturing capabilities tend to be slower in exploiting such services.

Tukker's (2004) model of a product-service spectrum illustrates differing forms of PSS business models or value propositions. These include product-oriented services, use-oriented services and result-oriented services. This framework tends to focus on the features and examples of the offering, and whilst useful in terms of organisational positioning, it is of limited value in the development of a competitive strategy. Slack (2005) advocates the importance of paying attention to how the dimensions of stretch (how far down the supply chain) and width (number of service components offered at each point of the supply chain) will affect the existing structure of the organisation. This view is strengthened by the manufacturing strategy work of Baines et al. (2005), which explores the interactions between manufacturing operations and the wider supply chain network as organisations move towards the customer's end of the supply chain.

Overall there is general agreement amongst the communities that for many firms, sustainable manufacturing business revenues are based on combining products and services to provide functionality and deliver value in use to customers (Mathieu, 2001a, b; Maxwell and van der Vorst, 2003; Sawhney et al., 2004; Gebauer et al., 2006; Cohen et al., 2006; Jacob and Ulaga, 2008; Kobler et al., 2009). This research highlights that a significant challenge is to understand the most appropriate business model to be used in any given competitive manufacturing context, and suggests that researchers in the field embrace new perspectives concerning product-service hybrids against the backdrop of the traditional views used to differentiate product and services.

5.4 Customer value

The debate on customer value follows on from the competitive strategy theme, in that it deals with manufacturers trying to establish the value of service provision to their customers. Woodruff (1997) argued that there are various definitions of customer value, creating a general lack of consensus. Customer value is inherent in, or linked through to, the use of some products and perceived by customers rather than objectively determined. Woodruff's ideas open up the debate of "embedded value" and "value in use" along with how this value is created. Ramirez (1999) argues that value is not simply added but co-created and re-created with customers and suppliers and thereby offers an alternative to the view that value is embedded in the "good" and transferred transactionally to the customer.

In the SDL perspective on marketing (Vargo and Lusch, 2004), in which service provision above and beyond goods alone is fundamental to economic exchange, the idea of the customer as a co-creator of value is again an important premise. It suggests that value is not embedded in goods but is perceived and determined by the customer on the basis of "value in use" and that knowledge is the fundamental source of competitive advantage. The co-creation of value is also a focus for researchers in the emerging field of service science (Spohrer et al., 2008) albeit in the context of large and complex service systems. Literature originating in the operations community (Vandermerwe and Rada, 1988; Wise and Baumgartner, 1999; Baines et al., 2009a; Schmenner, 2009) addresses the subject of value when considering manufacturers' strategies of adding value to their core offerings by providing customer focussed combinations of goods, services, support and knowledge. In order for suppliers to identify where they can deliver value to customers, Vandermerwe (2000) suggests that they assess their customer's activity cycle in order to identify existing value gaps (interruptions or discontinuities in the customer's experience) and convert them to value adding points. Gummesson (2007) considers the customer is always the creator of value-in-use and organisations co-create value through their interactions with customers and the end-user. Clearly, important research challenges remain in further developing the concepts of "value-in-use" and "value co-creation" in the context of servitization.

5.5 Customer relationships

Closely associated with the theme of customer value is that of customer relationships, and the tendency to move away from simple transactional business exchanges. Successful firms recognise the necessity to ensure close customer relationships and establish routines and communications for doing so at the outset (Levitt, 1983). For manufacturers expanding the service dimension of their business activities, this presents important challenges for the ongoing management effort to grow new relationships with significantly higher levels of customer engagement and intimacy (Vandermerwe and Rada, 1989; Galbraith, 2002). Focussing on the customer's processes and problems

and in some cases jointly committing to solving these, increases the risk for manufacturers as service providers, but potentially improves rewards reaped over the longer term.

The SDL paradigm of marketing (Vargo and Lusch, 2004) emphasises the relational nature of exchanges in service provision, with customers as active co-producers, in stark contrast to a goods-dominant logic of exchange where relationships are often transactional. Edvardsson et al. (2008) consider the dynamics of the relationship initiation process in service dominant B2B settings and introduce the concepts of the status of the relationship and converters (time, trust, service offering) that can move the process forward along with inhibitors (image, risks and bonds) that can block or hinder the development and maturing of the relationship. This research theme supports a move away from transactional economics and raises management challenges associated with the development of more relational approaches which value a social dimension as a mean of governing business exchange, and are often predicated on greater levels of trust.

5.6 Product-service configuration

Product-service configuration is prominent within all communities, with research concerns particularly associated with the design and delivery of services.

The processes in services design are recognised to differ from conventional product design. Authors (Coyné, 1989; De Joeng and Vermeulen, 2003; Gebauer and Friedli, 2005) argue that there is a tendency for service innovation to be haphazard, whereas it should be subject to rigorous analysis, similar to that applied to product innovation. Spring and Araujo (2009) examine how products and services combine, based on the analysis of the respective roles of products and services in delivering customer benefits, for which Windahl and Lakemond (2006) emphasise the importance of the service delivery network.

Different approaches for exploring and classifying product-service designs have been proposed. As mentioned above, Tukker (2004) puts forwards the concepts of product-oriented services, use-oriented services and result-oriented services. Boyt and Harvey (1997) classify industrial services using such characteristics as frequency of need, essentiality relative to operation of the product, risk based on negative impact of failure on the customer, complexity and direct delivery by and credibility of the service provider. Conversely, Mathieu (2001a, b) uses a 3x3 matrix topology, which includes an axis for service specificity (customer service, product service, service as a product), and organisational focus (tactical, strategic, cultural). Such classifications illustrate the scope to develop proactive service delivery strategies across different service categories (e.g. base (spares), intermediate (maintenance) and advanced (solutions provision)) (RAE, 2010).

Risk adoption (when a service provider undertakes activities that were formerly the customer's responsibility) and value creation appear to be pivotal factors when considering the design of service-oriented market propositions. The manufacturer's risk increases as the organisational focus moves from a tactical (e.g. extended warranty) to more strategic position (e.g. GE providing operational support for their medical equipment). Gebauer (2008) uses such an approach to classify four product-centric service strategies, namely "after-sales service" providing the value proposition of attractive product prices and reliable product functioning, "customer support" providing outstanding process-oriented services to prevent breakdowns, "outsourcing partners" offering cost leadership with service and product differentiation to deliver attractively priced operational services and "development partners" providing R&D support to enable outstanding process performance for the customer.

The delivery of services has matured from simply focussing on the application of production methods to total services businesses such as banks, hotels and call-centres. There is a widely recognised need for a trans-disciplinary approach appropriately suited to the particular characteristics of service operations (Heineke and Davis, 2007). The provision of services requires organisational principles, structures and processes that are novel to the product manufacturer, a change in the business model from being simply transaction-based to relationship-based (Oliva and Kallenberg, 2003) and involves presently ill-defined risks and cost associated with establishing a delivery network.

Effective and efficient services delivery, from within an organisation that is traditionally production oriented, presents transformational challenges. Some authors (Roscott, 1990; Oliva and Kallenberg, 2003; Mathe and Stuedacher, 2004; Windahl and Lakemond, 2006) agree that success in service delivery can be encouraged by the establishment of separate management and organisation structures, run as unique profit and loss centres. Davies et al. (2006) argues for building organisations around customers' current and future needs, and articulates a three part organisation with “front end”, customer facing units to manage strategic engagements with customers, supported by “back-end” units to provide the common elements of product-service solutions and a “strategic centre” to provide strategic direction and foster cross-functional coordination. Resistance to the cultural change needed to transform and achieve the so-called 24-7 service mind set presents a further cultural challenge for any traditional nine to five manufacturing organisation (Brax, 2005; Gebauer, 2009).

Figure 7 uses a series of pie charts to illustrate the extent to which the research concerns highlighted above are shared across the different research communities. The size of the individual pie sections reflects the number of papers in each community found to address a specific research concern. Figure 7(a) shows that the research theme of competitive strategy is shown to be a major focus particularly for the operations community, whereas the product-service differentiation theme (Figure 7(b)) has attracted attention from the services marketing, service management and operations communities. In contrast, all communities have shown an interest in product-service configuration (Figure 7(c)). The topic of customer value is predominantly addressed by operations and services marketing (Figure 7(d)). Customer relationships (Figure 7(e)) receives the most attention from service science and service management but it is not addressed by PSS research community. In summary, this section presents the findings in response to our research question regarding the “generic research concerns” amongst the communities.

6 Conclusions and future implications

6.1 Summary of contribution

Our aim has been to provide an integrative and organising lens for viewing the various contributions to knowledge production from those research communities addressing the servitization of manufacturing. Two research questions have guided this study, and against these a number of findings have emerged. Therefore, when considering the question of “what are the knowledge stocks and flows amongst the research communities?” we conclude that:

- Although interest in servitization has burgeoned recently, its evolution has roots that can be traced back as far as the 1960s.
- There are distinct researcher communities providing contributions to knowledge production in the field of servitization of manufacturing, with unique and complementary perspectives, disseminated via a range of academic and scholarly journals.
- Knowledge stocks within all communities associated with research in the servitization of manufacturing have dramatically increased since the mid-1990s. In our sample of 148 papers the largest number of published contributions were made by the operations management community. A further trend reveals that this community is in receipt of the majority of citations relating to the servitization of manufacturing research from the other communities in our study. Overall in terms of knowledge flows, it is apparent that the more mature communities, such as services marketing, service management and operations management, are drawing more on locally produced knowledge stock, whereas the emergent communities of PSS and service science are drawing on a knowledge base more evenly distributed across all the researcher communities. Given, the servitization of manufacturing is associated with the market delivery of combined manufactured products with services, the more established communities need to better recognise the diversity emerging within the entire servitization research landscape and ensure future specialisation in their communities is pursued in a more informed manner.
- Finally, the extent of cross-citations varies significantly across communities, and suggests that opportunities exist for increasing interactions and leveraging knowledge production. This is indicative of the varying degrees of interdependence amongst the communities and their opportunities for improving cohesion and

integration for thought leadership on servitization. We suspect that capitalising on these opportunities is likely to enrich the design of future research agendas in this multi-disciplinary and applied field.

Similarly, when considering the question of “what are the generic research concerns being addressed by these communities?” we conclude that of the five generic research concerns being addressed by the different researcher communities:

1. product-service differentiation is being actively addressed by the services marketing, service management and operations management communities;
2. competitive strategy is a major research concern for the operations management community;
3. customer value is being predominantly addressed by the operations management and services marketing communities;
4. customer relationships are being actively addressed by the service science community; and
5. finally, all communities have shown an active interest in product-service configuration.

Our ambition has been to provide an integrative and organising lens for viewing the various contributions to knowledge production from research communities addressing the servitization of manufacturing. In trying to do so, we hope to have identified opportunities for improving research problem design and the potential for the collective body of knowledge on servitization to move forwards and progress understanding.

6.2 Future directions

Many of the immediate opportunities for future work are rooted in the limitations of our own study. Having gained a better insight into the activities of the current researcher communities, a more sophisticated and deeper analysis of interactions would complement our findings. It might also lead to the greater precision and fidelity of our findings. In a similar way, it would be immensely valuable to bring together researchers from the different communities to debate and so refine our understanding of the major research themes. Several attempts are currently being aimed at such initiatives (indeed the service science community was formed with such a motivation). Unfortunately to date it appears that no one initiative has been sufficiently embracing to fulfil this goal.

Other opportunities lie in the further exploration of conceptual links in the servitization field. For example, servitization can be seen to be closely coupled to vertical integration (in that it deals with a manufacturer moving forwards in its supply chain to manage customers' operations). As a consequence, there is a wealth of literature on vertical integration, outsourcing, facility location, etc. that may also be relevant to enhancing our understanding of servitization practice. Although the linkages with engineering and technology researchers are weaker (see Section 4.3) manufacturers who are advanced in their services strategies (e.g. Rolls-Royce, Caterpillar, Alstom, MAN), are all making substantial investments in practice. It would be remiss of the broader management community to neglect such links.

It would also be valuable to better understand and critique the research processes favoured by the different research communities. Invariably, researchers from a management science discipline approach research practice in a different manner to engineers, and describe their work using different styles of language and discourse and publish their findings in different journals. At best, this means that researchers are challenged when they seek to learn from those in a different community to their own. If a better understanding could be gained of the processes used, and indeed where their strengths lie, then again the whole field of servitization research would undoubtedly benefit.

Figure 1 Systematic review procedure

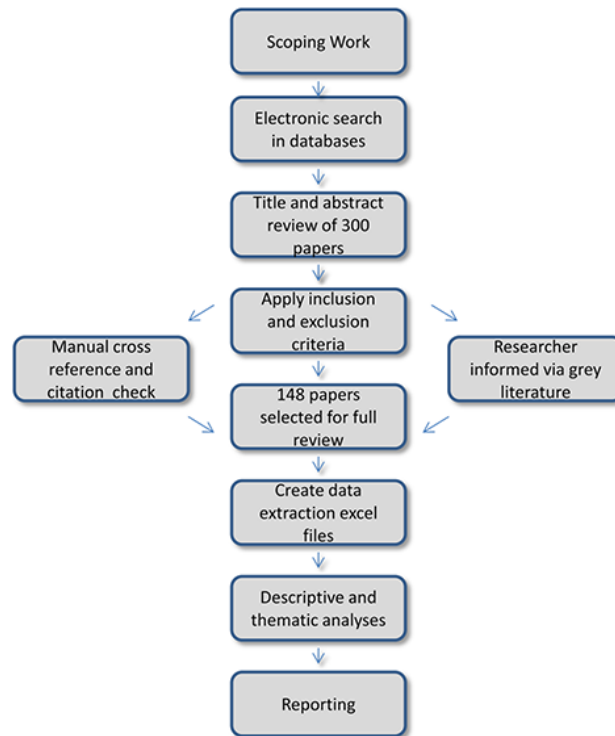


Figure 2 Profile of 50 years of servitization research activity by researcher community

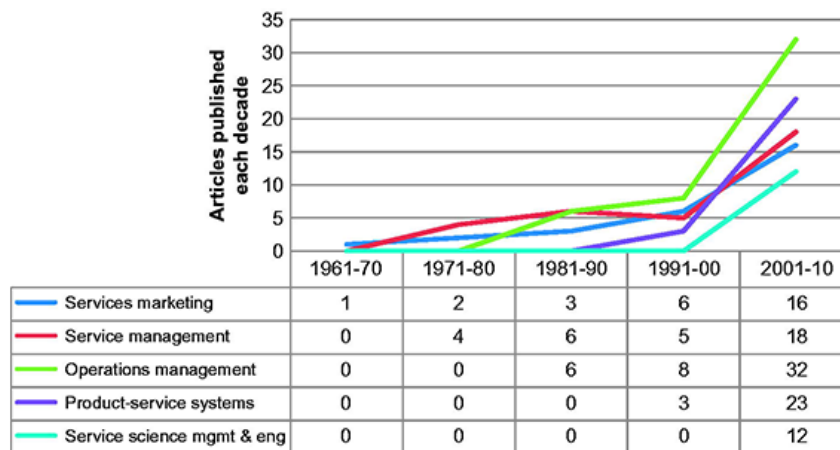


Figure 3 First author's cross citations

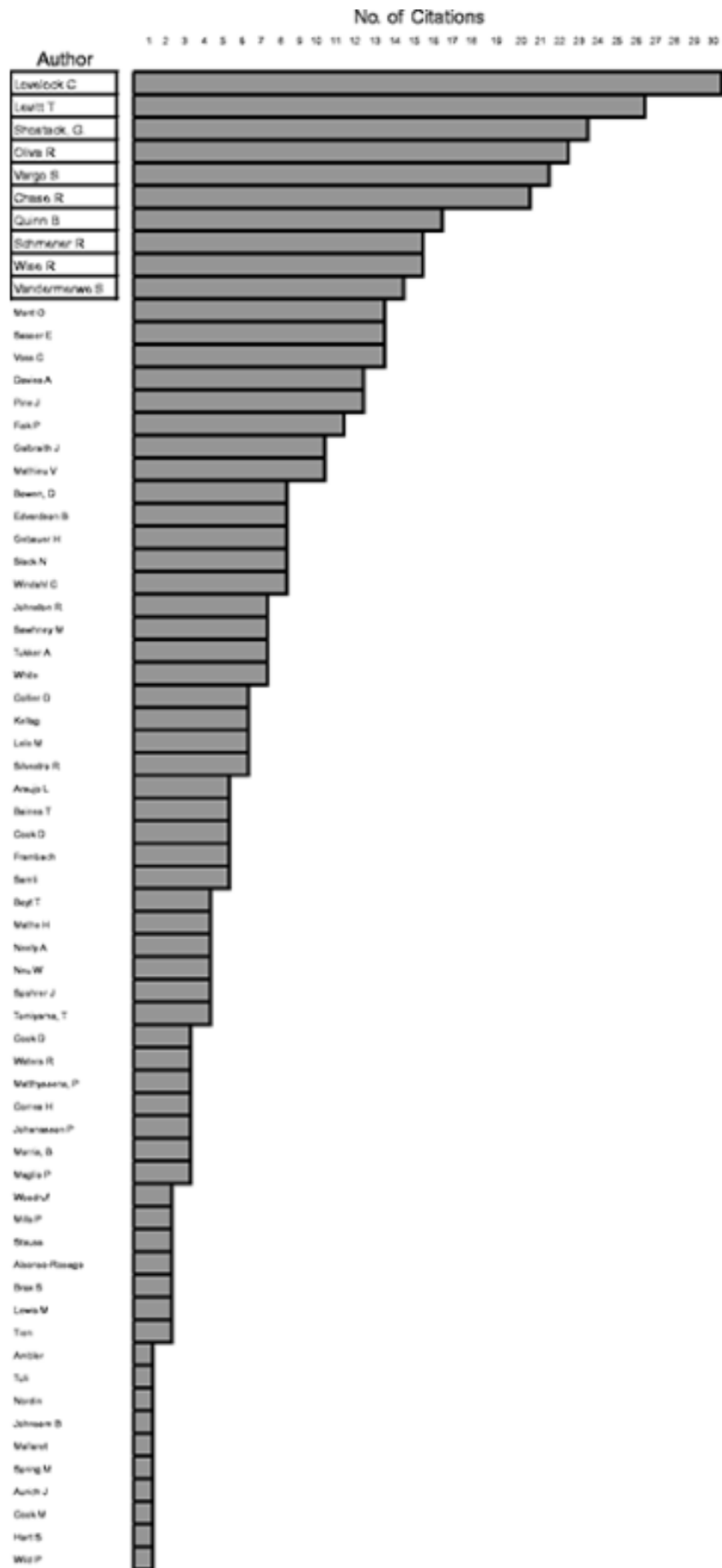


Figure 4 Ten most cited first authors

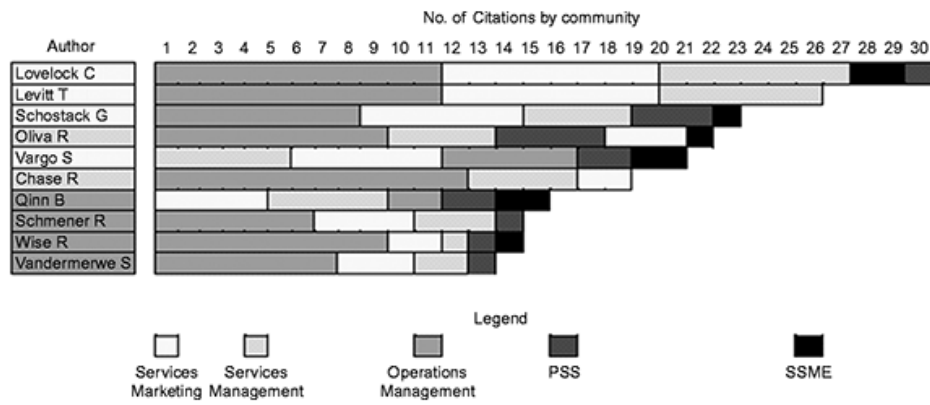


Figure 5 (a)-(e) Cross community citation

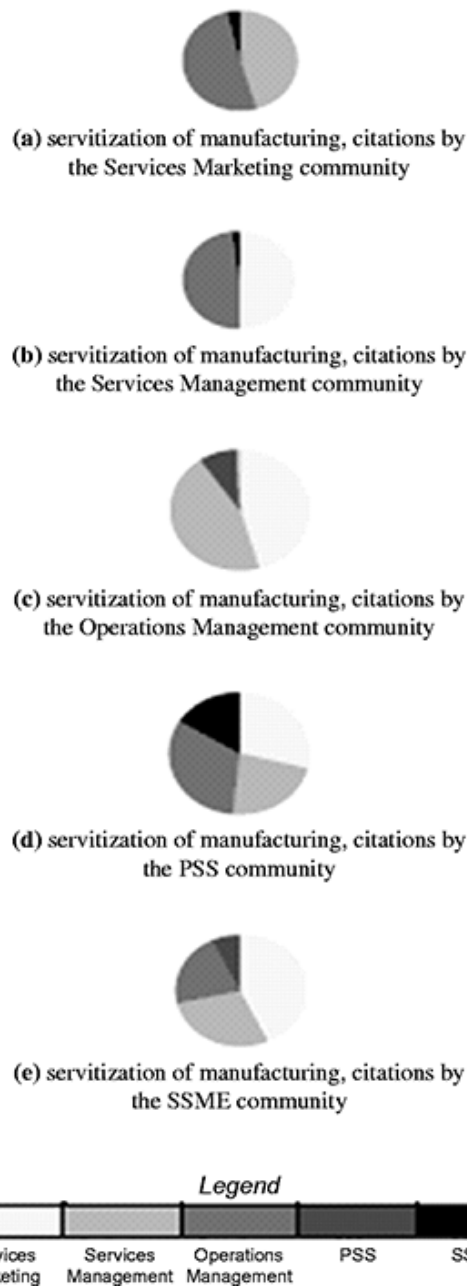


Figure 6 Top ten most popular research journals amongst the core articles for the servitization of manufacturing



Figure 7 (a)-(e) The servitization of manufacturing themes of major focus in papers/articles addressed within the research communities

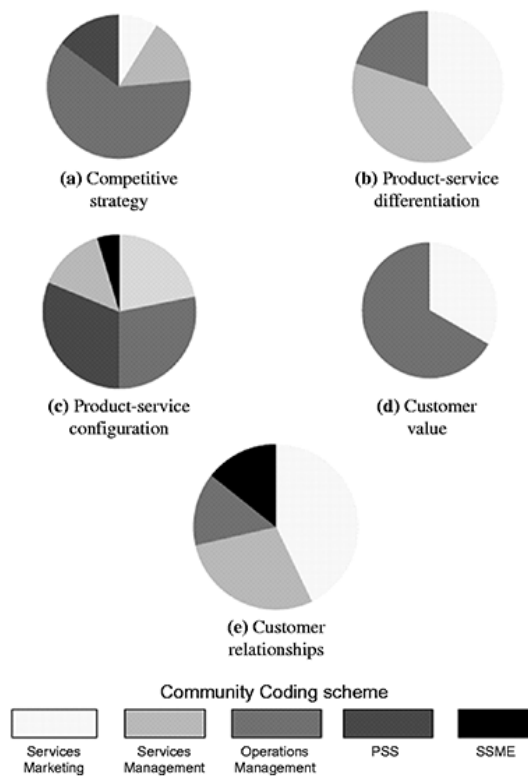


Table I Research communities in the servitization of manufacturing

Research community	Examples of journals and conferences	No. of articles
Services marketing	<i>IMM, JM, HBR, JBIM, MIT Sloan</i>	30
Service management	<i>SQM, JSR, IJSIM, HBR</i>	33
Operations management	<i>IJOPM, JOM, EMJ, MIT Sloan, EurOMA Conferences, HBR</i>	48
Product-service systems	<i>JCP, CIRP Conference Proceedings</i>	25
Service science	<i>JSSSE, CACM, Grid Computing, Service Science, Proc. ISS</i>	12
Total number of core articles		148

Table I. Research communities in the servitization of manufacturing

Notes: *IMM* – International Marketing Management; *JM* – Journal of Marketing; *HBR* – Harvard Business Review; *JBIM* – Journal of Business & Industrial Marketing; *MIT Sloan* (Management Review); *SQM* – Service Quality Management; *JSR* – Journal of Service Research; *IJSIM* – International Journal of Service Industry Management; *IJOPM* – International Journal of Operations & Production Management; *JOM* – Journal of Operations Management; *EMJ* – European Management Journal; *EurOMA* – European Operations Management Association; *JCP* – Journal of Cleaner Production; *CIRP* – College International pour la Recherche en Productique; *JSSSE* – Journal of Service Science & Service Engineering; *CACM* – Communications of the Association for Computing Machinery; *Proc. ISSS* – Proceedings of International Symposium on Service Science

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