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The servitization of manufacturing: investigating contributions to knowledge production

Abstract

Purpose: The servitization of manufacturing is a diverse and complex field of research interest. The purpose of this paper is to provide an integrative and organising lens for viewing the various contributions to knowledge production from those research communities addressing servitization. To achieve this, we set out to address two principal questions, namely: *(i) where are the knowledge stocks and flows amongst the research communities? and (ii) what generic research concerns are being addressed by these communities*.

Design/Methodology/Approach: Using an evidenced based approach, we have performed a systematic review of the research literature associated with the servitization of manufacturing. This investigation incorporates a descriptive and thematic analysis of 148 academic and scholarly papers from 103 different lead authors in 68 international peer-reviewed journals.

Findings: Our work proposes support for the existence of distinct researcher communities namely; *services marketing, service management, operations management, product-service systems* and *service science management and engineering*, which are contributing to knowledge production of the servitization of manufacturing. The generic research concerns being addressed within these communities are associated with the concepts of *product-service differentiation, competitive strategy, customer value, customer relationships* and *product-service configuration*.

Research limitations/implications: Our review is limited by the issues addressed in the literature by specific researcher communities and there is likely to be a wealth of literature addressing other relevant research (e.g. vertical integration, outsourcing). Therefore, immediate opportunities for future work are rooted in the limitations of our own work and in broadening our perspective of the servitization field.

Originality/value: This research has further developed and articulated the identities of distinct researcher communities actively contributing to knowledge production in the servitization of manufacturing, and to what extent they are pursuing common research agendas. This study provides an improved descriptive and thematic awareness of this existing body of knowledge, allowing the field to progress in a more informed and multidisciplinary fashion.

Keywords: Service, manufacturing, product-service systems (PSS), servitization, service science, services marketing, management.

Paper type: Literature review and analysis

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 competitiveness, otherwise known as the servitization of manufacturing (Vandermerwe and Rada, 1988).

Since the term servitization was first coined it has been studied by researchers from a broad range of academic traditions. Often they have worked within their distinct research communities and provided unique perspectives on the rationale, design and delivery of servitization (e.g. Oliva and Kallenberg, 2003; Slack, 2005; Malleret, 2006). Topics that appear to have received particular attention include service business growth (e.g. Martin and Horne, 1992; Wise and Baumgartner, 1999; Gebauer et al, 2008), solutions provision (e.g. Galbraith, 2002; Miller et al., 2002; Windahl and Lakemond, 2006; Davies et al., 2006), after-sale marketing (e.g. Cohen et al., 2006), service profitability (e.g. Samli et al., 1992; Anderson and Narus, 1995; 2006: Neely, 2009) and new business models (Edvardsson et al, 2008: Lindahl et al, 2009). This proliferation is growing and is testimony to the increasing recognition of the importance of services to manufacturers, and yet researchers still tend to operate largely within their specific community.

Servitization within manufacturing is evidently a diverse and complex field with contributions arising across a range of research communities. Improved awareness and cohesion across these will help to improve the quality and rate of knowledge production, and establish the important research challenges. Therefore, 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. To achieve this we pose the following research questions, namely: *(i) where are the knowledge stocks and flows amongst the research communities? and (ii) 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 understanding.

Similar to previous researchers, we chose to deploy an evidenced based approach to our investigation. We have been inspired by the process of systematic review (Tranfield *et al,* 2003) and studied its application in other scholarly works (Leseure *et al*, 2004; Thorpe *et al*, 2005; Bakker, 2010 and Meier, 2011), which allowed us to appreciate the subtle variations in adoption practices by academics. Our research questions have been addressed using the systematic review process and principles, incorporating both the descriptive and thematic analyses, of 148 academic and scholarly papers from 68 international peer-reviewed journals. The review also makes a methodological contribution by adopting this approach, originating from the medical sciences, in the management and organisation field, a field of inquiry where concepts are poorly defined and operationalised. This review is timely given the wider context provided by increasing academics and government interest in the future of the manufacturing sector.

The outcomes of this review are an understanding of where knowledge resides across research communities, where interactions and communications are strong, and where the common areas of inquiry are located. In this way, this work both confirms and expands on previous research, published in the International Journal of Operations & Production Management, that indicates that the principal research communities are services marketing, service management, operations management, product-service systems (PSS) and service science management and engineering (Baines et al, 2009). Our work has shown that each of the communities is actively contributing to knowledge

production by drawing on particular academic perspectives. There are however significant variations in engagement and interaction amongst the communities. Nevertheless, across these communities there is a shared interest in the concepts of product-service differentiation, competitive strategy, customer value, customer relationships and product-service configuration. .

This paper describes our investigation into 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 this topic of servitization, their origins and general interests. Our research methodology is then described. 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 implications this poses for future work.

2. Research communities currently engaged with servitization

The research communities that are engaged with servitization have been apparent for sometime (Baines et al, 2009). Prior to examining their scholarly works, this section introduces each community and summarises their origin, evolution, and unique disciplinary perspectives.

2.1 A marketing perspective

With a firm foot-holding in the marketing tradition, researchers in the branched field of services marketing have largely evolved their emphasis from the exchange and distribution of commodities to a focus on customer relationship management in the provision of services. Hereafter, we refer to academics progressing this field as the service 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 (Vargo and Lusch, 2004), with a stronger focus on satisfying the customer coming to the fore (e.g. Drucker, 1954; Levitt, 1960). In the following decade the marketing mix (e.g. 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 independently 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 21st century the validity of the 4Ps was being challenged (Day and Montgomery, 2000), for its lack of recognition of marketing as an innovating and adaptive force. Furthermore, Lovelock and Gummesson (2004) challenged the IHIP paradigm for service marketing, by noting the shortcomings of its perspective that four unique characteristics make services different from goods. They offer an alternative perspective of marketing, 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 of marketing research and practice must break free from the manufacturing-based model of exchange of output. This view was challenged by Stauss (2005), 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" (p223). 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 A service management perspective

The service management researchers have largely evolved from main stream operations and strategy domains and tend to focus on the organisation of service based businesses and industries. Hereafter, we refer to academics progressing this field 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 operations 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. Machua et al (2007) add to this in their review determining the state of affairs of service operations management research in the most relevant operations management journals.

The service management research community recognises that satisfying customers and gaining competitive advantage with a market offering requires greater value to be added to a core product through a variety of service activities that are customer oriented and value adding (Gronroos, 1994). This perspective clearly provides a contribution for researchers studying the servitization of manufacturing.

2.3 An operations perspective

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, 2009). Hereafter, we refer to academics progressing 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' both research and practitioner literature, from the USA and Western Europe, by authors from the operations, marketing, service and wider business disciplines.

Servitization may be defined as 'the innovation of an organisations capabilities and processes to shift from selling product to selling an integrated product and service offering that delivers value in use' (Baines et al., 2007). There are various forms of servitization, that can be positioned on a product-service continuum (e.g. Tukker, 2004), ranging from products with services as an 'add-on', to services with tangible goods as an 'add-on'. They tend to be delivered using customer centric strategies in order to provide 'desired outcomes' for the customer. Examples in the literature of leading practice in the adoption of servitization 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, 2009). 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, 2009; Schmener, 2009), business (Wise and Baumgartner, 1999; Gebauer et al, 2004; Cohen, 2006; Jacob and Ulaga, 2008) and even government (Hewitt, 2004). 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, 2010). This servitization of manufacturing is clearly an area of particular interest and activity to the operations management community.

2.4 An ecological and environmental perspective

Adhering to an ecological and environmental tradition, Scandinavian researchers have born an interest in Product-Service Systems (PSS), seeking to address the ability of product-service combinations to improve social, economic and environmental and industrial sustainability. Hereafter, we refer to academics progressing this field as the PSS research community.

The foundational work on PSS is exemplified by Goedkoop's report (1999) 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). These characteristics are examples where PSS research can draw from knowledge in the operations and services marketing communities respectively. 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, 2001). While some methods and practices are proposed for designing and operating a PSS (Luiten et al, 2001; Maxwell and van der Horst, 2003), these tend to lack the pedigree that is formed through careful evaluation in practice. 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 Lindhqvist, 2003; Wong, 2004), and manufacturers may be concerned with pricing, absorbing risks and shifts in organisational configuration (Goedkoop, 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, 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 product related services (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 within the operations and PSS communities.

2.5 A service science perspective

The service science perspective has largely evolved from the 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, service science is a relatively new interdisciplinary concept articulated for the effective provision of services. It focuses, not merely on one aspect of service, but rather on service as a system of interacting parts that include people, technology, and business (Chesbrough and Spohrer, 2006). Service science is the study of complex service systems and the co-creation of value in complex configurations of resources (Spohrer et al, 2007; Vargo and Maglio, 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 announcement of the service-science management and engineering research community (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). Hereafter, we refer to academics progressing this field as the service science management and engineering research community (SSME).

As such, the 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 the growing stream of marketing thought, service-dominant logic, as foundational to service science and to the study of value creation in service systems. The service science community's interdependence with the other research communities and inherent inter-disciplinary nature has been overtly stated by leading figures in this community (Spohrer, 2009).

Service science has become a fast developing research theme, and is contributing considerable debate and dialogue as demonstrated by recent events such as the first International Symposium on

Service Science (Leipzig, 2009). At this conference many aspects of service science such as the modelling of service systems, services and customer orientation, service engineering, service oriented software structures and hybrid products and services were presented from both academic and practitioner viewpoints (see Alt et al, 2009).

3. Research methodology

3.1 Aim and questions

Given that servitization is being addressed by the different research communities, this review seeks to obtain a more detailed understanding of knowledge production both within and across these. This is a multi-community research activity whose nature, boundaries and interactions are yet still to be comprehensively defined. Therefore, the aim of our study has been 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. To achieve this, this study has set out to address the following two questions *(i) where are the knowledge stocks and flows amongst the research communities? and (ii) what generic research concerns are being addressed by these communities?*

3.2 Method

To address these questions we have undertaken a review of published research following the principles and process of systematic review methodology (Tranfield *et al*, 2003). We now turn to describe this methodology. 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 for 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 been used in health, education and increasingly management fields to synthesis and organise research findings from multiple studies, in an orderly and transparent manner. Our study adopted some, but not all, of the elements of the orthodox systematic review process as articulated for the management science field (Tranfield *et al*, 2003). In particular we have remained faithful to the constituents of the process that promote transparency, replicability and linearity through scientific rationale to establish a number of steps that guided the enquiry. The review procedure undertaken is summarised in Figure 1 and further explained below.

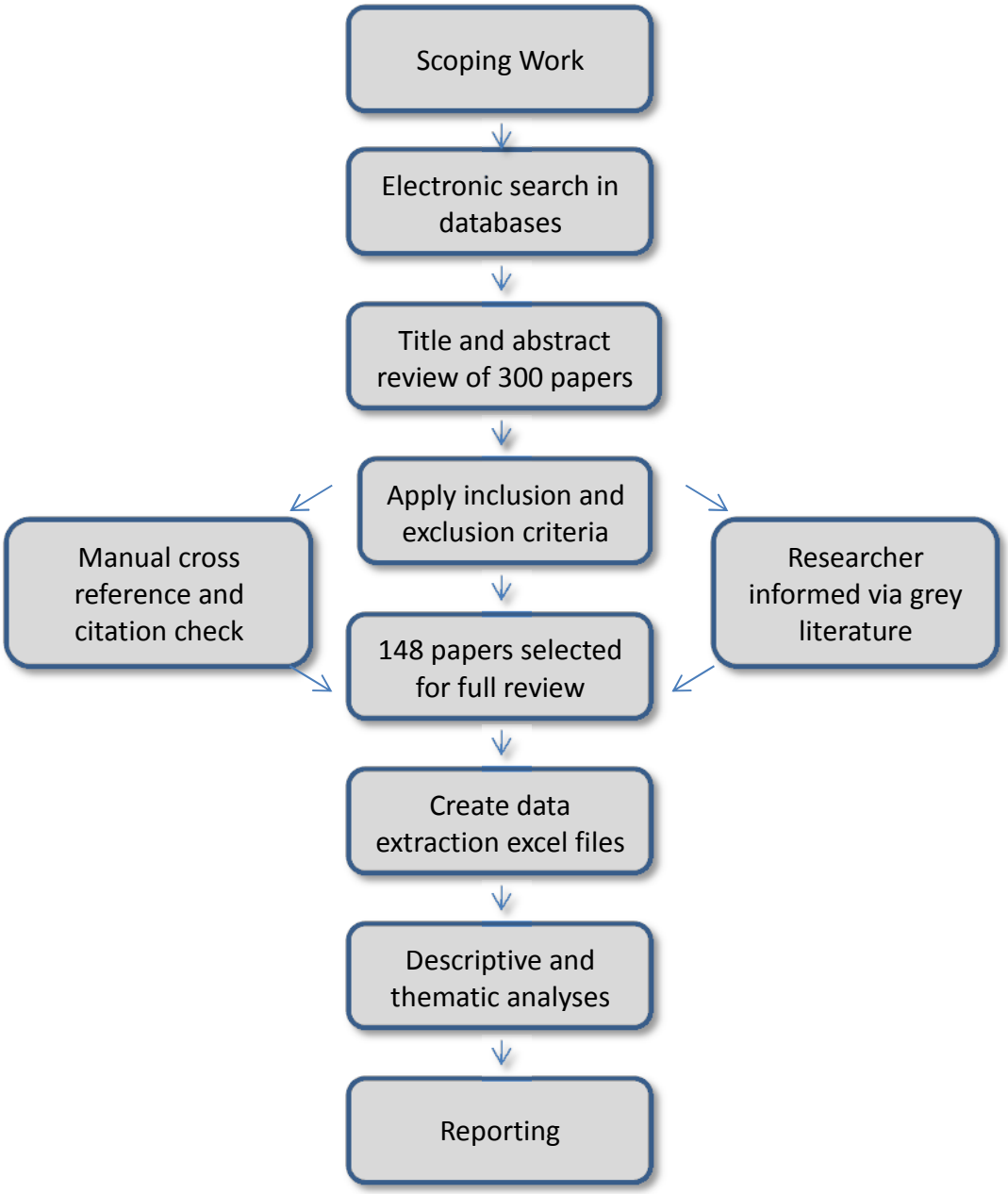


Figure1. Systematic Review Procedure

This figure summarises the overall review process adopted by the authors to establish the base data and information on which the paper is founded.

3.3 Execution of method

Publications data has been taken from databases that comprehensively cover the research communities outlined in section 2. These have included Compendex, Inspec, Web of Science, Proquest, ABI Inform and Emerald. Our searches have been based on a broad range of terms and strings associated with both manufacturing and services research. These have included, for example, *service operations, service integration, servitization, sustainability, service economy, product substituting service, functional economy, integrated solutions, product-related services, aftermarket, value, value in use, intangibility, tangibility, product marketing, service science, classification, framework*. Many of these key words were combined with '*manufacturing*' or '*product*' in order to ensure their relevance to this study. This 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 similar search of Internet sources was also conducted using Google Scholar.

Through this process, 300 relevant and individual items were identified as the potential basis for our thematic analysis. Initial analysis of abstracts and content allowed this pool to be further reduced to 110 academic and scholarly articles that were most relevant to a manufacturing context. These inclusion and exclusion choices subsequently led to cross-checking of authors and references, which then increased the list to 148 principal articles that we have taken to represent the current body of knowledge associated with the servitization of manufacturing. Overall, these articles were produced by 103 different lead authors and in 68 different journals and provided the raw material for our full descriptive and thematic analysis. The articles were subsequently clustered according to their broad academic tradition and perspective, and researcher community by taking into account the research field of interest, the nature of the research concerns and the aims of peer-reviewed academic and scholarly journals and conferences as channels for research dissemination. For example and typically speaking, research articles from the journals International Journal of Production Management (IJOPM) and Journal of Operations Management (JOM) would be allied to broader operations academic tradition and so providing a unique 'operation's perspective' on research matters.

Our clustering was further validated following a full post article review and presented in Table 1. The final pool of 148 core articles were recorded and stored in an electronic repository using an Excel spreadsheet.

Examples of highly cited journals and conferences	**No. of articles**	**Academic perspective and tradition**	**Researcher community**
IMM, JM, HBR, JBIM	30	Marketing	Services marketing
SQM, JSR, JSR	33	Service	Service management
IJOPM , JOM, EMJ, MIT Sloan, EurOMA Conferences	48	Operations	Operations management
JCP, CIRP Conferences	25	Ecological & environmental	Product-service systems
JSSSE, Communications of ACM, Grid Computing, Service Science & 1st Int. Symposium on Service Science	12	Service science	Service science management and engineering
Total number of core articles	**148**		

Table 1. Academic traditions, perspectives and communities in the servitization of manufacturing

Table Abbreviations: IJOPM – International Journal of Production Management; EMJ – European Management Journal; MIT Sloan (Management Review); IMM – International Marketing Management; JM – Journal of Marketing; JBIM – Journal of Business & Industrial Marketing; SQM – Service Quality Management; JSR – Journal of Service Research; JOM – Journal of Operations Management; JSSSE – Journal of Service Science & Service Engineering.

3.4 Analysis and generation of findings

Our approach here was to address research question 1 through a largely quantitative and descriptive analysis of publications produced by the research communities, and question 2 through a more qualitative analysis to identify key themes. We refer to this approach as descriptive and thematic analysis respectively.

The descriptive element sought to generate understanding of the evolution, contributions and interactions of the researcher communities. Here, the emphasis was on understanding the

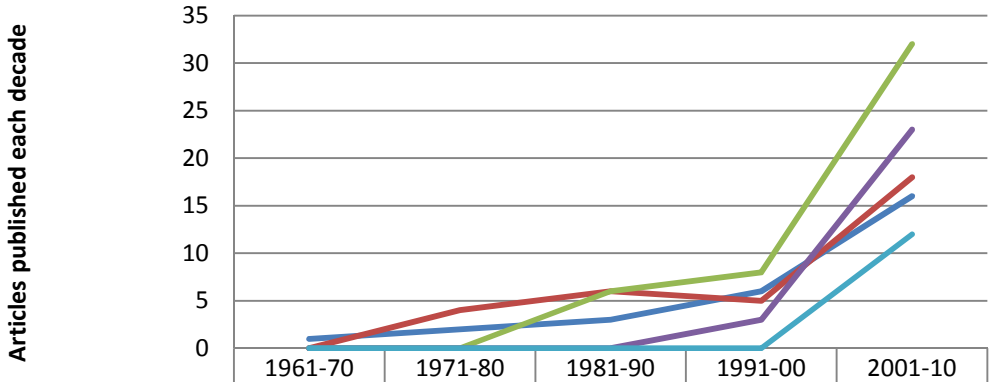
positioning and perspective of each paper, and then establishing the other publications being cited. The thematic element then involved a detailed review of the content of each research article. Here, we created a coding frame to catalogue the textual content and summaries of each paper. This coding frame emulated a tree structure with over 40 initial constructs allowing the branching of 17 sub-themes and the final consolidation of 5 generic themes. The coding framework evolved inductively as the analysis 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 reflected their relative importance

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

4. Knowledge stocks and flows within servitization research

4.1 Evolution and activity of research communities

The review process identified that 148 core articles collectively represent a body of knowledge about the servitization of manufacturing from 103 unique lead and principal authors. Figure 2 illustrates the extent of research activity and relative maturity of each of the communities operating within the confines of a particular perspective. A general incline across all the communities is clearly apparent. In the first two decades, research dissemination activity was largely confined to the communities of services marketing and service management. The operations community became more active in the late 1980s, followed by the product-service systems (PSS) community in the mid-1990s. Finally, the services science community emerged around the turn of the 21th 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.



	1961-70	1971-80	1981-90	1991-00	2001-10
Services marketing	1	2	3	6	16
Service management	0	4	6	5	18
Operations management	0	0	6	8	32
Product-service systems	0	0	0	3	23
Service science mgmt & eng	0	0	0	0	12

Figure 2. Profile of research activity by researcher community over the last 50 years

This figure is provided to show: the time span of the relevant articles reviewed; their research communities of origin; the growth in numbers of these articles over time and to demonstrate the significantly increased growth rates in all communities since the mid-1990s

4.2 Citation, and cross-citation behaviour

Figure 3 shows the extent of cross citing amongst lead and principal authors in the five research communities and illustrates the top ten most cited authors in our research sample. These authors are cited by over 20% of all lead and principal authors, with over 30% citing the top author alone.

Figure 4 further analyses the patterns of cross citation for the top ten leading authors to show which communities are citing work from each leading author. Some of these lead authors have citations for more than a single paper in the set reviewed.

Chris Lovelock, for example, is the most cited author as a result of his contribution to the service marketing literature and his prime position here 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 researchers.

A range of papers by Theodore Levitt are also cross cited, including his quintessential 'Marketing Myopia' and his position here reflects his overall contribution to marketing and service management research and its impact on more recent operations thinking on the servitization of manufacturing. Roger Schmener 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 authors qualify as the result of specific single publications that have been described as either 'seminal pieces' (Schostack, 1977; Vargo, 2004; Chase and Garvin, 1989; Quinn et al, 1990; Wise & Baumgartner, 1999 and Vandermerwe & Rada, 1988) or particularly timely in their publication due to heightened general academic interest in the servitization of manufacturing (Oliva and Kallenberg, 2003).

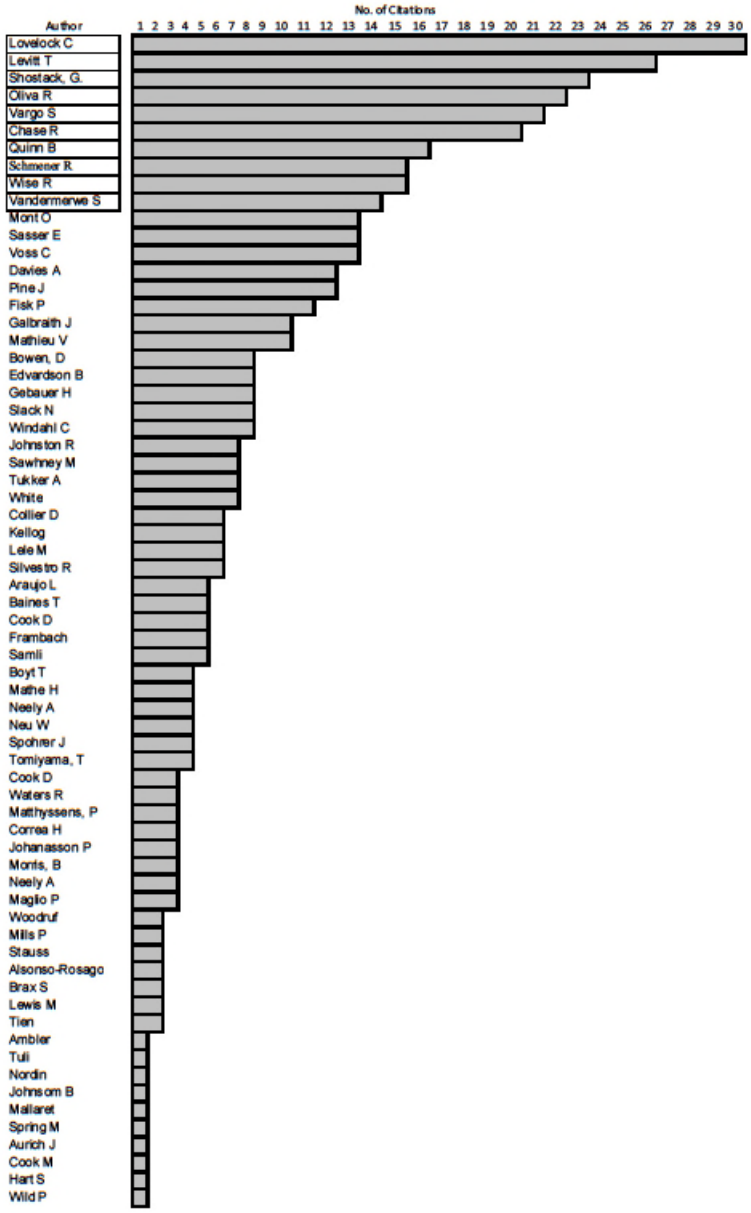


Figure 3: Lead author's Cross Citations

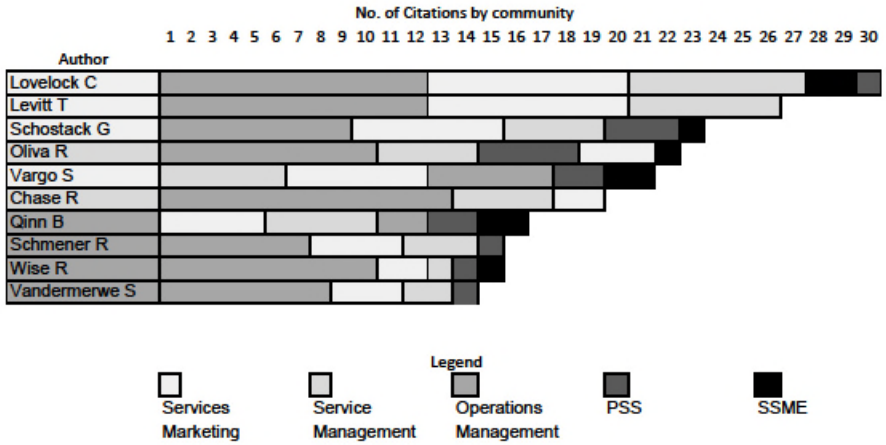
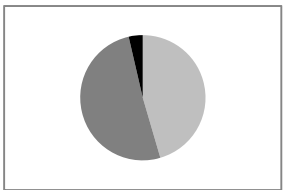
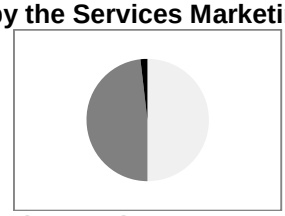


Figure 4: Ten Most Cited Authors

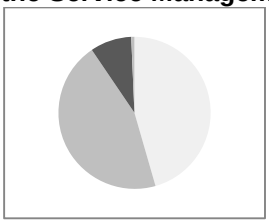
This figure sets out to show for each of the top ten most cited authors, which communities including their own are providing the citations and so indicating their potential relevance across to diferent research communities



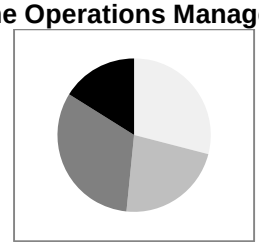
(a) citations by the Services Marketing community



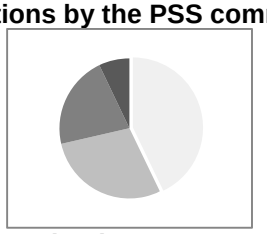
(b) citations by the Service Management community



(c) citations by the Operations Management community



(d) citations by the PSS community



(e) citations by the SSME community

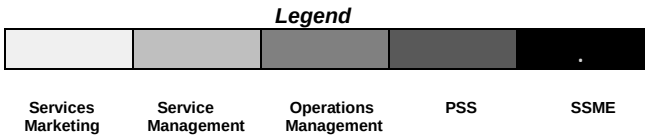


Figure 5 Cross Community Citation

This figure sets out to show how each research community has, in the literature set reviewed, been cross citing work from the other 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 indicates the top ten most popular journals for publication across the five communities. Here the vast majority (90%) of journal titles fall within the broader management field, and so reflects the dominance of services marketing, service management and operations research communities. Of this 90%, approximately 80% of these journals have high impact and broader appeal in the academic communities (3* star or 4*star rating from the Association of Business

School academic journal quality guide published in 2011). There is however a lack of references to engineering and engineering management journals. This suggests a lack of awareness or appreciation of the information and communication technologies that are enabling many product-centric service offerings to occur in practice (e.g. The Rolls-Royce Engine Health Management System, see Benedettini et al, 2009)

Figure 6. Top ten most popular research journals amongst the core articles

In summary, this section has set out to explore the evolution, contributions, and interactions of researcher communities dealing with the sevitization 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;
- 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 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

5.1 Overview of outcomes of the thematic analysis

The final stages of our thematic analysis (see section 3.4) led to the identification of five generic research concerns that are shared by the researcher communities, namely:

- product-service differentiation - *research concerns that address the differentiation of product and services constructs;*
- competitive strategy - *research concerns that address the leverage of competitive advantage by developing services- led manufacturing strategies;*
- customer value - *research concerns that address value-added, value-in-use and co-creation of value constructs;*
- customer relationships - *research concerns that address the relational nature of customer interactions and*

- product-service configuration - *research concerns that address the design and implementation of complex service offerings and their associated delivery systems.*

The extent to which these are shared across the community is captured as a series of pie charts in Figure 7. Figure 7a illustrates, 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 7b) 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 7c). The topic of customer value is predominantly addressed by Operations and services marketing (Figure 7d). Customer relationships, (Figure 7e), receives the most attention from service science management and engineering and service management but it is not addressed by product-service 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 products and services. The debate over the differences between products and services, however, 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 becoming the subject of increasing interest. The PSS research community takes the approach that 'a product is a tangible commodity manufactured to be sold and fulfil a customers need, and that a service is an essentially intangible activity with economic value done for others on a commercial basis' (Goedkoop, 1999). Authors from the PSS community such as Mont (2000), Tukker (2004) and Wong (2004) propose frameworks in which pure product manufacture is positioned at one end of a continuum that moves through to product-service combinations to the opposite extreme of pure service provision.

In the service marketing community, a principal milestone came in 1977 when Shostack proposed that 'it is wrong to imply that services are just like products "except" for tangibility' (p.73) and that marketing required a framework which accommodates intangibility instead of denying it. Levitt (1981) supports this with the view that giving tangibility to an imperceptible product feature can aid sales and post sales efforts. This is because all products are in some respects intangible, especially when they are purchased against a promise of satisfaction which may fail to be delivered if (for example) the product is used incorrectly. The service marketing community then favoured the concept of 'IHIP' (Fisk et al, 1993) and began to distinguish products from service based on intangibility, heterogeneity, inseparability and perish ability. 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 hold in situations of the non-transfer of ownership. Furthermore, Araujo and Spring (2006) 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 weakening of IHIP as a paradigm in the marketing community, and the emergence of Service-Dominant Logic (SDL), which considers service as a process rather than a unit of output (a good) are particularly interesting in the context of the servitization of manufacturing debate. Here the dominant logic is switching the focus from the asset (goods and/or services) to what the product offers the customer (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, which supports the call by Vargo and Lusch (2004) for the abandoning of product/service differentiation and suggest a move to understanding the interrelationship of products and services.

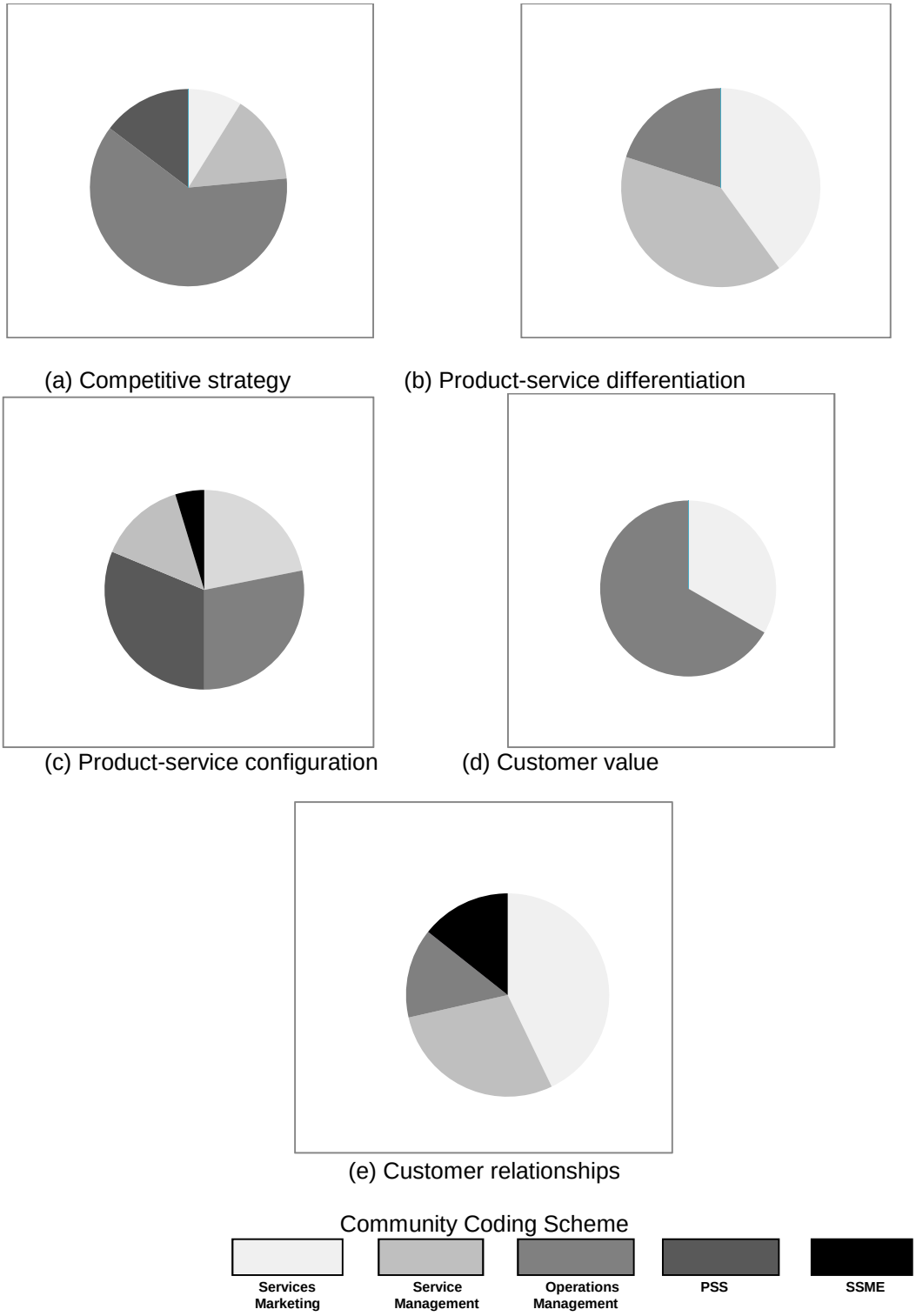


Figure 7: Themes of major focus in papers/articles addressed within the research communities

This figure shows the level of activity / interest from each research community in addressing each of the generic research concerns. Measured by the number of papers in each community found to contain relevant material

Overall, the debate about the distinguishing characteristics between products and services is set to continue and in particular amongst the services marketing, PSS and operations communities. For example, researchers such as Baines et al (2009) set out to understand the characteristics of operations strategies supporting the delivery of product-centric services, but they hold the view that there are only subtle differences between effective production and service operations. The overriding challenge is to understand the features of good operations strategy rather than to focus separately on 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 camps. Almost 40 years ago Levitt (1972) suggested that all commercial organisations were in the business of delivering service – 'the service industries' (p.42) (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), 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" (p.58) This so-called shift in the manufacturing business model is commonly termed 'servitization' (Vandermerwe and Rada, 1988; Slack, 2005; Baines et al 2009, 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). What is purchased here is not the product itself but the final functionality that the user wants to realise, which should be the starting point for the development of any business model that seeks to change the way product functionality is delivered to its market.

The adoption of a gradual strategic change by manufacturers moving to product related services then to customer support (e.g. process oriented engineering, parts management, maintenance) to reach the 'integrated solutions' business is supported by many authors (e.g. Oliva and Kallenberg, 2003; Gebauer et al, 2004; Brax, 2005). Davies (2004) points out that such 'integrated solutions' are now key to the capital goods industry strategy, which uses business models that require detailed knowledge of customer activities, thus encouraging a heightened level of customer centricity. It is interesting to note the observation by Schmener (2009), however, 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 product-service systems business models or value propositions. These include product oriented services, use oriented services, and result oriented services. This framework is, however, typical of many in the PSS literature in that it 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 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 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 when organisations move towards their customer's end of the supply chain.

Overall there is strong agreement amongst the communities that sustainable manufacturing business revenues are based on combining products and services to provide functionality and deliver value in use to customers(Mathieu, 2001; Maxwell and van der Vorst, 2003; Sawhney, 2004; Gebauer, 2006; Cohen, 2006; Jacob and Ulaga, 2008; Kobler, 2009). The overriding challenge is to understand the most appropriate form of business model for particular competitive manufacturing context. This demands future researchers to embrace the new perspectives evolving in this field amongst the backdrop of the traditional distinctions upheld between product and services.

5.4 Customer value

The debate on customer value follows on from the competitive strategy theme, in that it deals with helping individual manufacturers to establish the value of service provision to their customers. Whilst this topic is addressed implicitly in many articles across the research communities, Woodruff in 1977, 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 product and perceived by customers rather than objectively determined. This opens 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 so offers an alternative to the views on value embedded in the 'good' and transferred transactionaly to the customer.

In the Service Dominant Logic (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 co-creator of value is again a key premise. The notion is 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, 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, 2009, Schmener, 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 that the customer is always the creator of value-in-use and companies co-create value through their interactions with customers and the end user. Important challenges remain in further developing the concepts of 'value-in-use' and 'value co-creation'. Future research should concentrate on better understanding the link between products and services and how they can be configured to create new value.

5.5 Customer relationships

Strongly linked to the theme of customer value is one of relationships, and in particular the move away from simple transactional business exchanges. Successful companies recognise at the outset the necessity of ensuring close relationships with the customer and establishing routines and communications for doing so (Levitt, 1983). This presents an important challenge for manufacturers who are significantly expanding the service dimension of their business activity, in the ongoing management of such new and different relationships and the inevitably higher levels of customer centricity involved. (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

The service dominant logic paradigm of marketing (Vargo and Lusch, 2004) emphasises the relational nature of exchange of service provision where customers are active participants in relational exchanges and co-production as opposed to the goods dominant logic of exchange in which the relationship is transactional. Edvardsson et al (2008) considers the dynamics of the relationship initiation process in service dominant B2B settings and introduces the concepts of the status of the relationship, converters (time, trust, service offering) that can move the process forward and inhibitors (image, risks and bonds) that can block or hinder the relationship developing and maturing. This research theme supports a shift away from transactional economics and raises management challenges associated with more relational approaches that value the social dimension as a mean of governing business exchange, and often predicated on greater levels of trust. Aspects such as the level of satisfaction, the trust between the parties and the perceived quality of the service can all differ between customers. Developing a better understanding of these influences and the necessary contextual conditions provides an interesting avenue for further research.

5.6 Product-service configuration

This theme is topical within all five communities, with various challenges apparent with the design and delivery of complex services.

The processes in services design are recognised to differ from conventional product design. Many authors (Coyne, 1989; De Joeng and Vanmeulen, 2003; Gebauer and Friedli, 2005) argue that there is a tendency for service innovation to be haphazard but not necessarily ad-hoc and perhaps the innovation of service strategies should be subject to rigorous analysis just like product development. Product innovation concentrates on product characteristics whereas service innovation also involves changes in the delivery process and client interface (Gebauer et al, 2008). A new approach to operations and supply strategy, is proposed by Spring and Araujo (2009), and based on recent developments in 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, direct delivery by and credibility of the service provider. Whereas Mathieu (2001) uses a 3x3 matrix topology with an axis of service specificity (customer service, product service, service as a product) and an axis of organisational focus (tactical, strategic, cultural). Such classifications can provide the ability to develop proactive service delivery strategies across different service categories (e.g. base [spares], intermediate [maintenance] and advanced [solutions provision] (RAE, 2010)

Risk adoption 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 tactical (e.g. extended warranty) through to strategic (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 to support enabling outstanding process performance for the customer.

Services delivery has matured from simply focussing on the application of production methods to entirely services businesses such as banks, hotels, and call-centres. As mentioned earlier 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 new to the product manufacturer, a change in the business model from being simply transaction-based to relationship-based (Oliva and Kallenberg, 2003) and involves new and ill-understood risks including the cost of establishing the delivery network.

Effective and efficient services delivery, from within an organisation that is traditionally production oriented, presents particular transformational challenges. Some authors (Roscitt, 1990; Oliva and Kallenberg, 2003; Mathe and Stuadacher, 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 (2006) argues for building organisations around customers' current and future needs and suggests 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 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 mindset' presents a further cultural challenge for any traditional 9 to 5 manufacturing organisation (Brax, 2005; Gebauer, 2009). Further research is required to understand the relationships between the various components of service orientation that transform manufacturing companies into service providers.

In summary, this section presents the findings in response to our research question contending with the 'generic research concerns' amongst the communities. In doing so we have explored existing and future research challenges. The principal insights leading from this thematic analysis are as follows:

- five generic research concerns are being addressed by the researcher communities namely: product-service differentiation; competitive strategy; customer value; customer relationships *and* product-service configuration;
- competitive strategy is a major focus for the operations management community;
- product-service differentiation has attracted attention from the services marketing, service management and operations management communities;
- all communities have shown an interest in product-service configuration;
- customer value is predominantly addressed by the operations management and services marketing communities and
- customer relationships is in the main addressed by the service science management and engineering community.

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 *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 and
- the extent of cross-citations varies significantly across communities, and suggests that opportunities exist for increasing *interactions* and leveraging knowledge production.

Similarly, when considering the *generic research concerns being addressed by these communities* we conclude that:

- five generic research concerns are being addressed to differing degrees by the researcher communities namely: product-service differentiation; competitive strategy; customer value; customer relationships *and* product-service configuration;
- in particular, product-service differentiation is being actively addressed by the services marketing, service management and operations management communities;
- competitive strategy is a major research concern for the operations management community;.
- customer value is being predominantly addressed by the operations management and services marketing communities;
- customer relationships are being actively addressed by the service science management and engineering community and
- all communities have shown an active interest in product-service configuration.

Our ambition in carrying out this study has been to contribute to the improved awareness, communication and cohesion across the active research communities, and in this way enable the whole body of knowledge on servitization to move forwards and further progress.

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 understandings 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.

A further opportunity lies in broadening our perspective of the servitization field. There are many research linkages that can be explored. 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 command 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 remise 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.

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