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Servitization: Revisiting the State-of-the-art and Research Priorities

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Abstract

Purpose – This paper consolidates the servitization knowledge base from an organisational change perspective, identifying developed, developing and undeveloped topics to provide a platform that directs future research.

Design/methodology/approach – This paper addresses three objectives: a) it comprehensively examines organisational change management literature for selection of a theoretical framework, b) it classifies extant studies within the framework through a systemic literature review, and (c) it analyses 232 selected papers and proposes a research agenda.

Findings – Analysis suggests increasing global awareness of the importance of services to manufacturers. However, some topics, especially related to servitization transformation, remain undeveloped.

Research limitations/implications – Although the authors tried to include all publications relevant to servitization, some might not have been captured. Evaluation and interpretation relied on the research team and subsequent research workshops.

Practical implications – One of the most significant challenges for practitioners of servitization is how to transform a manufacturing organisation to exploit the opportunity. This paper consolidates literature regarding servitization, identifying progress concerning key research topics and contributing a platform for future research. The goal is to inform research to result eventually in a roadmap for practitioners seeking to servitize.

Originality/value – Although extant reviews of servitization identify themes that are examined well, they struggle to identify unanswered questions. This paper addresses this gap by focusing on servitization as a process of organisational change.

Keywords – servitization, organisational change, systemic literature review, advanced services

Article Classification – Research paper

1. Introduction

Interest in the role of services in manufacturing continues to grow (Bustinza *et al.*, 2015). Since Vandermerwe and Rada (1988) exposed the servitization phenomena in a manufacturing context, and Wise and Baumgartner (1999) highlighted the value of going downstream, research has progressed steadily. Between 1991 and 2000, 22 articles were published on the topic, increasing to 101 between 2001 and 2010 (Lightfoot *et al.*, 2013). These publications came from a range of communities; researchers of services marketing, service management, operations management, product-service systems, and service sciences are all contributing, establishing the field.

Conceptual foundations of servitization are consequently establishing. Definitions have coalesced **as servitization being a process of building revenue streams for manufacturers from services** (Johnstone *et al.*, 2009; Baines and Lightfoot, 2013; Smith *et al.*, 2014). A manufacturer can offer various forms of such services, ranging from those supporting a good to those supporting customers (Mathieu, 2001; Eggert *et al.*, 2014). These broadly categorise into base (e.g., goods and spare parts), intermediate (e.g., helpdesks, training, maintenance, repairs, and overhauls), and advanced services (e.g., customer support agreements and outcome contracts) (Baines and Lightfoot, 2013). Examples of companies delivering advanced services include Alstom and ABB (Miller *et al.*, 2002; Davies, 2004), Thales Training and Simulation (Mulholland, 2000; Davies, 2004), and Rolls-Royce Aerospace (Howells, 2000). Advanced services are receiving significant attention from researchers (Spring and Araujo, 2009; Baines and Lightfoot, 2013).

The motives for and benefits to competing through advanced services are also becoming documented. These include growth in revenue and profit (Eggert *et al.*, 2014), improving responses to customer needs (Ostrom *et al.*, 2010), improving product innovation (Eggert *et al.*, 2011), building new revenue streams (Baines and Lightfoot, 2013), increasing customer loyalty (Gaiardelli, Songini, *et al.*, 2014; Saccani *et al.*, 2014), and setting higher barriers to competition (Oliva and Kallenberg, 2003; Durugbo, 2014). Collectively, these group into defensive (i.e., cost reductions for customers and competitor lockouts for providers) and offensive (i.e., business growth for both customers and providers) components (Baines and Shi, 2015). **The potential for these benefits is stimulating manufacturers to explore servitization, and advanced services particularly. However, how to deliver these services is challenging many companies.**

The literature recently explored the broad topic of organisational design. There is a recognition that delivering advanced services demands capabilities that differ from those used during production (Oliva and Kallenberg, 2003; Gebauer *et al.*, 2005; Datta and Roy, 2010; Ceci and Masini, 2011; Biege *et al.*, 2012). A variety of authors addresses this topic. Spring and Araujo (2009) provide a conceptual framework for intra-firm capabilities, and Roy and Cheruvu (2009) offer a similar framework, focusing on infrastructural factors. Baines and Lightfoot (2013) identify six practices and technologies that manufacturers deploy to deliver advanced services. Although many questions remain unanswered, or need to be answered more convincingly, a picture of how manufacturing organisations should be configured to deliver advanced services is emerging, but researchers have given less attention to processes of servitization.

Transforming a manufacturing organisation to compete through advanced services is a challenge to both researchers and practitioners, and only a few notable contributions address the topic. Martinez *et al.* (2010) argue that although there exists significant literature and theoretical frameworks in the general field of organisational change, no models explain change toward servitization. Identifying four types of service networks and the capabilities required for forming such networks, Gebauer *et al.* (2013) discuss transformation toward providing integrated solutions for products and services. In general however, research on this topic is fragmented and discursive, and a clear and inclusive research agenda has yet to be established. This is inevitably a barrier to the adoption of servitization.

A substantial body of literature regarding servitization of manufacturing is forming. This is further evidenced through review articles over the past decade; Baines *et al.* (2007) review 40, Baines *et al.* (2009) 58, Sakao *et al.* (2009) 103, Velamuri *et al.* (2011) 169, Beuren *et al.* (2013) 149, Lightfoot *et al.* (2013) 148, and Hou and Neely (2013) 166. These reviews provide invaluable signposts for researchers, reflecting debates and priorities at various times, and are cited extensively. Consequently, review papers have yet to address the processes of servitization highlighted above. This paper address this gap by consolidating the servitization knowledge base from the perspective of organisational change, and identifying topics both developed and undeveloped to direct future research.

Adopting a traditional approach to reviewing literature would be insufficient to achieve these objectives. Although traditional reviews succeed at identifying themes that the literature examines extensively, they struggle to establish questions that remain unanswered. We overcome this limitation by focusing on servitization as a process of organisational change, and adopting a theoretical framework from related literature (Pettigrew, 1988; Pye and

Pettigrew, 2005). We then conduct a systemic literature review (Tranfield *et al.* 2003) using the framework to elucidate the strengths and weaknesses found in research, synthesising an agenda for future studies. The goal is to guide researchers so they can develop a plan for manufacturers wishing to servitize.

2. A Theoretical Framework

2.1. Theoretical frameworks of organisational change

In markets characterised by innovative technologies, fluctuating customer preferences, and dynamic competition, it is not a question of whether firms should change, but of where, how, and in what direction they must change (Meyer, 2007). Organisational change represents a difference in form, quality, or state over time (Van de Ven and Poole, 1995), motivated by alignment between a firm's basic setup and environmental attributes (Rajagopalan and Spreitzer, 1997). It is a matter of continually renovating organisational structure and capabilities to serve evolving customer requirements.

Developing a holistic framework that evaluates organisational change has been an enduring quest of scholars in management studies for years. Often, theoretical frameworks and approaches to organisational change management are contradictory (Todnem By, 2005), focusing on specific change parameters. Researchers are inattentive to broad, systemic, simultaneous exploration of variables that are salient during organisational change (Self *et al.*, 2007).

Several prominent studies, for instance, focus on the “*content*” (or the effect of change) on the people, processes, or organisations, evaluating the outcomes of events measured in terms of both performance (e.g., process improvement metric) and/or state (e.g., existence of a new technology). Such studies include Burke and Litwin's (1992) model, which explains how an individual behaviour and psychological condition are affected by organisational change; and Kanter's (2003) model captures how business structure and layers are influenced by change initiatives.

A second group of studies concentrates on the “*contexts*” (i.e., circumstances or situations of change), taking both internal and external perspectives (Armenakis and Bedeian, 1999). For instance, Haveman (1992) analyses legislative and technological factors and their effects on organisational change; and Cross *et al.* (2013) explain how variables in a business ecosystem influence organisational change.

A third group of studies focuses on the “*processes*” (i.e., the method of change), encompassing different phases through which organisational change progresses (Self *et al.*,

2007). An example is Lewin (1947), compromising unfreezing, moving, and freezing phases. Several scholars (Armenakis *et al.*, 2000; Kotter and Cohen, 2002) elaborate on Lewin's classic change model for practitioners to use as a framework for introducing organisational change.

Only a handful organisational change models draw together content, context, and process variables simultaneously. Prominent among them is a framework proposed by Pettigrew (1988), and later by Whipp *et al.* (1989) and Pye and Pettigrew (2005). Focusing on the organisation, the framework can be used to understand why change occurs (through analysis of outer and inner contexts), how changes take place (through analysis of processes), and subsequent effects on people, processes, and organisations (through analysis of content). This integrative structure complements our goal of conducting a broad and inclusive study of the servitization process, and so has been adopted for this study.

2.2. Development of a theoretical framework to review servitization

Pettigrew (1988) subdivides the categories of context, content, and process into a fluid range of descriptors regarding change. They deserve careful consideration to ensure they are a) relevant and meaningful to the study of servitization, b) broad, inclusive, and up-to-date, and c) sufficiently defined to study the topic. In this section we reflect upon the categories in the Pettigrew model and extend these to develop our own theoretical framework to study servitization.

Context of transformation

Pettigrew (1988) suggests that two aspects of "context" should be considered when evaluating change: a) the inner context, which refers to internal factors, and b) the outer context, which refers to external factors. More recently within strategic change literature (Kelly and Amburgey, 1991; Pye and Pettigrew, 2005; Hatch, 2012), these factors are extended to include (internal) organisational structure, corporate culture, power and leadership, political characteristics, strategic directions, degree of trust, and stage of board development, and (external) political, economic, social, technological, environmental, industrial, and regulatory components. Clearly all such factors have the potential to affect the adoption of servitization within a manufacturing organisation.

Process of transformation

Examination of organisational change literature shows “processes” are considered variously, causing confusion (Pettigrew *et al.*, 2001; Langley *et al.*, 2013). Pettigrew (1997) defines process as a sequence of individual and collective events, actions, and activities unfolding over time in context. Van de Ven (1992) and Van de Ven and Sun (2011) extend this by viewing process in three ways: a) as a logic or model that explains a causal relationship between independent and dependent variables, b) as a category of concepts of individual and organisational actions such as decision-making techniques, and strategy formulation and implementation methods, and c) as a sequence of events that describe how things change over time. These distinctions clarify process terminology, and so we adopted them for our framework as models, techniques, and pathways.

Content of transformation

“Content” deals with the effect or outcome of the process. Strategic management literature traditionally views content at the levels of function, business, and/or corporation (Wit *et al.*, 2010; Wheelen and Hunger, 2011). This view was extended recently to include organisational networks. Collectively, these four levels capture the results of change holistically, and so are incorporated in the theoretical framework

Descriptive and prescriptive orientation

The Pettigrew framework is often applied to retrospective studies of change, describing how events occurred (Stockdale and Standing, 2006). Although manufacturing practitioners are inspired by such studies, they invariably seek guidance concerning implementing change, and the research community responds. It is therefore important to ensure the framework expands to capture research that both describes how change occurred and prescribes how to approach change. These distinctions are interlinked and complimentary, but academics and scientists are drawn to descriptive contributions and evidence, whereas practitioners seek prescriptions to overcome businesses problems.

Resultant theoretical framework

These distinctions, combined with the three sets of factors outlined above, enable a theoretical framework that represents disparate aspects of organisational change. Table 1

demonstrates this, providing a platform for evaluating current knowledge regarding servitization from an organisational change perspective.

		CONTEXT OF THE CHANGE											PROCESS OF CHANGE			OUTCOMES OF CHANGE			
		External						Internal					Models	Techniques	Pathways	Network Level	Corporate Level	Business Level	Functional Level
		Political	Economic	Social	Technological	Environmental	Industry	Regulation	Structure	Culture	Power	Political Characteristics							
RESEARCH ORIENTATION	DESCRIPTIVE (when, how, and what change occurred)	<i>What was the situation when the change occurred?</i>											<i>How did the change occur?</i>			<i>What changed?</i>			
	PRESCRIPTIVE (when, what, and how should change occur)	<i>When should the change take place?</i>											<i>How should the change occur?</i>			<i>What should be changed?</i>			

Table 1. A theoretical framework developed to critique servitization knowledge stocks

3. Methodology

We explore servitization as a process of organisational change. The theoretical framework (Table 1) summarises factors a study in this domain expects to explore. By reviewing current knowledge on servitization using the framework, the strengths and weaknesses of extant research are revealed, and an agenda can be developed to guide future research.

3.1. Choice of review procedure

Servitization studies are conducted across several research communities (Baines *et al.*, 2009; Lightfoot *et al.*, 2013). Any review of the topic must be sufficiently broad to encompass these communities, and sufficiently rigorous to ensure results are reliable. A systemic literature review methodology (Tranfield *et al.*, 2003) was designed to manage diverse knowledge for academic inquiry. Our study therefore adopted the three generic stages of the systematic review process: a) detailed planning and scoping of the search, with precise definitions of the aim and objectives to be addressed, b) rigorous execution to identify and select publications, and assess the quality, relevance, and strength of results, and c) compiling, analysing, and reporting results of the review. A summary of each stage follows.

3.2. Planning and scope

Databases were identified to cover the broad range of relevant research communities comprehensively. These included Compendex, Inspec, Scopus, Web of Science, ProQuest, ABI Inform, and Emerald. For completeness, a similar search of Internet sources was planned using Google Scholar. One problem with the topic of servitization is that scholars use disparate terms to describe transformation toward advanced services (Baines *et al.*, 2009), and the boundaries of those terms remain blurred (Hou and Neely, 2013). A range of keywords were therefore identified initially, including *service operations, service integration, servitization, service economy, integrated solutions, product-related services, aftermarket, and service science*. Three more keywords combined with “services” were also used including *sustainability, classification, and framework*. Many of these keywords were combined with *manufacturing and product* to ensure their relevance to this study.

This breadth of databases and keywords resulted in a range of publications, with varying relevance to this review. To accommodate this, the review focused on journal publications available in English. We then used a simple grading system to rank papers according to the extent to which they address servitization, and associated topics of product-service systems

(PSS) and advanced services. Those papers that used these terms frequently were ranked highest and reviewed first.

3.3. Execution and results

Based on the process described above, 302 peer-reviewed journal articles were identified. An initial screening discounted manuscripts that a) lacked clear contributions to servitization research, focusing on the term to explore another subject/issue, b) focused on only service industries such as tourism, or c) focused on sustainability and supply chain management, with no relevance to servitization. The subsequent pool of articles was recorded in a spreadsheet. These steps condensed the dataset to 232 articles. The papers were written by 183 lead authors, and published between January 1988 and April 2015.

The articles were categorized according to broad academic disciplines and associated researcher communities (Lightfoot *et al.*, 2013). Table 2 shows principal communities contributing to servitization, with the bulk of contributions from operations management and with *International Journal of Operations and Production Management (IJOPM)* particularly a journal central to contributions. Further examination revealed a recent increase in servitization papers published in marketing and innovation/technology disciplines. The United Kingdom has the highest number of publications in the area of servitization (120 papers), followed by Finland (36) and Sweden (35).

Examples of highly cited journals	No. of articles	Discipline	Researcher community
IJOPM , JOM, IJPE, IJPR, EMJ,	131	Operations	Operations management
IMM, JM, JBIM	36	Marketing	Services marketing
Technovation, I&M	9	Innovation & technology	Innovation management
JSM, SQM, JSR,	48	Service	Service management
JCP	8	Ecological & environmental	Product-service systems
Number of core articles	232		

Table 2. Academic perspectives and communities in the servitization of manufacturing

Note: IJOPM – International Journal of Production Management; JOM – Journal of Operations Management; IJPE – International Journal of Production Economics; IJPR – International Journal of Production Research; EMJ – European Management Journal; IMM – International Marketing Management; JM – Journal of Marketing; JBIM – Journal of Business & Industrial Marketing; I&M – Information and Management; JSM – Journal of Service Management; SQM – Service Quality Management; JSR – Journal of Service Research; JCP – Journal of Cleaner Production

3.4 Analysis using the theoretical framework

The dataset of 232 articles represents the current knowledge base on servitization. Analysis then set out to map this against the theoretical framework in three steps:

Categorisation: Each article was examined briefly and positioned provisionally in the subcategories of the framework (Table 1). For example, when a paper such as Kim and Yoon (2014) examined how regulations and policies have influenced the adoption of servitization in manufacturing firms, we labelled it as descriptive and outer context. Whereas, a paper such as Gebauer *et al.* (2005), which describes how to establish a service unit with a profit and loss responsibility, was labelled prescriptive and processes of transformation. The 232 articles were categorized using this approach. The prescriptive/descriptive distinction was particularly challenging. Papers nearly always reflected management implications of a study, irrespective of whether they were retrospectives by describing a phenomenon or translative by proposing a model and evaluating its influence. **The descriptive/prescriptive attribute distinguished these two modes of research.** The task was complicated by papers such as Davies *et al.* (2006), which although based as a retrospective, proposed new ways of working to manufacturers. In these instances, we categorised a paper based on the intentions of the author and the manuscript's style.

Evaluation: The papers in each subcategory were subsequently reviewed more thoroughly to establish the relative 'maturity' of contributions, and to confirm that the initial categorisations were appropriate. In instances in which there was a range of papers from disparate authors repeating a similar message, or convergent referencing suggested the contribution was institutionalising in a community, this was taken **to indicate maturity and the papers were grouped as "Developed"**. Such a topic was the service paradox, which suggests the need to manage servitization to avoid overlapping financial benefits and costs under new service-business inclusion (Gebauer *et al.*, 2005).

By contrast, **papers classed under "Developing" were largely exploratory, proposing research questions, hypotheses, and propositions.** In this group were papers such as Bowen and Schneider (2014), which analyses business motives that underpin servitization, and **Eggert *et al.* (2014), which offers a granular view of financial performance implications from industrial service strategies.** We were mindful that developing means research is being conducted, but this does not imply that results are conclusive, and so it was appropriate to summarise the area being researched rather than its conclusions.

This evaluation also exposed “*Undeveloped*” topics. This was achieved through a combination of a) subcategories in the theoretical framework (Table 1) that suggested topics, and b) examination of future research proposed by the papers. For example, in the external context, scholars with institutional theory perspectives suggested organisations adopt servitization strategies in response to market, regulatory, and competitive pressures. Future research is therefore required for detailed examination among types of institutional pressures, and their effects on the extent (i.e., symbolic or actual) of servitization adoption.

Interpretation: As papers were reviewed with increasing depth, their contributions established and clustered, and the topography of the topic in the literature became clearer (Table 3). Particularly, 1) the *developed* topics illustrate the research contributions and so relatively established knowledge, 2) the *developing* topics illustrate the growing concentrations and so opportunities for relatively incremental and confirmatory studies, and 3) the *undeveloped* topics represent significant opportunities for new and exploratory studies. The topics in Table 3 represent how the research community is developing servitization knowledge stocks. General observations can also be formed regarding this knowledge, and so macro-research opportunities develop. To achieve this, a research workshop was convened, with forty practitioners and researchers attending, to debate and extend the findings of this study. The state of servitization research and outcomes from the workshop are discussed next.

4. Discussion

This section is structured to first reflect on the topology of the research landscape, as represented by Table 3, and then moves to reflect on the wider aspects of the existing knowledge base on servitization.

4.1. Research concentrations

The literature review allowed us to summarise consolidated conclusions concerning servitization. Since early research from Wise and Baumgartner (1999), there has been increasing global awareness of the importance of services to manufacturers. Such strategies influence a manufacturing firm’s performance positively, but relationships are complex (Bigdeli *et al.*, 2016), non-linear, and bounded (Gebauer *et al.*, 2005; Neely, 2009), and organisational change is necessary for manufacturers to deliver services (Davies *et al.*, 2007).

In this context, traditional language that describes fundamental units of exchange is unhelpful (Baron *et al.*, 2014), and traditional product-services distinctions are unnecessary (Ejermo and Bergman, 2014). Instead, typologies of service strategies are growing (Wise and Baumgartner, 1999; Raddats and Easingwood, 2010; Raddats and Kowalkowski, 2014; Cook, 2014), based on classifications of product-service value propositions (Gaiardelli, Resta, *et al.*, 2014; Smith *et al.*, 2014) and dimensions (Toossi *et al.*, 2013). These research concentrations are entirely descriptive in orientation, as yet there is no equivalent knowledge established for prescriptive studies.

4.2. Growing research concentrations

There are growing research concentrations with both descriptive and prescriptive orientations. Descriptive studies dealing with context expose fundamental weaknesses in statistical classifications to separate services and manufacturing (Christensen, 2013), and subsequent limitations of measurement systems. Broadly, they also explore international disparities of servitization adoption (Kim and Yoon, 2014), and the effects of demographics, education, regulation, firm size, and oligopolistic markets (e.g., government contracts). There is also increasing attention given to the role of value-creation systems, networks, ecosystems, and constellations in revealing market opportunities (Normann, 2001; Edvardsson *et al.*, 2014).

Descriptive studies dealing with inner contexts are advanced in rationalising business motives underpinning servitization, combined with influences from differing service strategies (Eggert *et al.*, 2014), their timing and rates (Falk, 2014), and effects on revenue, profit, and growth. They complement goods and services sales (Kastalli and Van Looy, 2013), and the importance of organisational focus (i.e., product versus services) and design on profitability of additional services (Suarez *et al.*, 2013; Eggert *et al.*, 2014). There is also increased attention on differing ways products and services businesses' innovations occur (Mina *et al.*, 2014), influences of service innovations on product innovation performance (Dachs *et al.*, 2014; Wang, 2014), and export performance (Kelle, 2013; Lodefalk, 2014).

In contrast, few descriptive studies exist that assess processes of servitization and the means through which organisational change occurs. Exceptions include Davies *et al.* (2007), which explores stages during change as manufacturing businesses adopt services, and Barnett *et al.* (2013), which examines the influence of incremental change in complex engineering services.

Much greater attention has been given to the content of servitization and the structures, processes, technologies, and people necessary to deliver services. These include co-design processes that blend industrial goods and services innovations (Durugbo, 2014), design (Clayton *et al.*, 2012), and search strategies to identify radical innovations (Nicholas *et al.*, 2013). The form of customer-supplier relationships (i.e., risk, information, operational, legal adaptations, norms, social capital, and trust) for differing service types (Sakao *et al.*, 2013; Kohtamäki *et al.*, 2013; Selviaridis and Norrman, 2014), combined with disparities regarding buying processes between buying goods and services (Lindberg and Nordin, 2008), is also common. Research is also appearing that examines network structures/configurations, capabilities, and relationships with intermediaries (e.g., distributors, agencies, and dealers) to support types of services (Bikfalvi *et al.*, 2013; Kohtamäki *et al.*, 2013; Nordin *et al.*, 2013; Chakkol *et al.*, 2014). Inter-organisational power in complex networks (Finne *et al.*, 2015), degrees of collaboration (Fleury and Fleury, 2014), and triadic arrangements (Finne and Holmström, 2013) are emerging topics.

Looking into organisations, studies explore business-unit configurations and organisational designs (Baines and Lightfoot, 2013, Smith, 2013), arrangements (Gebauer *et al.*, 2010), structures (Biege *et al.*, 2012), systems (Durugbo, 2013), metrics (Jääskeläinen and Laihonen, 2014), capability acquisition (Paiola *et al.*, 2013; Raddats *et al.*, 2016), human resources implications, antecedents of service climate (Bowen and Schneider, 2014), and general traits, motivations, and skills of services-centred sales forces in B2B (Johnstone *et al.*, 2014, Sheth and Sharma, 2008). Similar attention has been given to the role of ICT (i.e., Internet of Things and big data) regarding service innovations, delivery, value creation, and differentiation (Belvedere *et al.*, 2013; Kowalkowski *et al.*, 2013; Chae, 2014).

Studies that prescribe organisational change focus on processes and content, and research is developing that demonstrates how to classify service offerings from a business-model perspective (Kindström, 2010; Barquet *et al.*, 2013; Storbacka *et al.*, 2013) and conduct portfolio analysis (Kastalli *et al.*, 2013). In particular, Gebauer *et al.* (2013) offer a process model to extend service businesses, and Kindström and Kowalkowski (2009) suggest development of industrial service offerings such that firms should concentrate on developing SSP (services that support the product) portfolios before SSC (services that support customer). Loyal, core customers should be targeted initially to develop service strategies. Firms should implement organisational designs across entire businesses, and decentralise decision-making when developing SSP portfolios before SSC (Eggert *et al.*, 2014).

Content studies prescribe what to change and propose methods to design service offerings (Nordin *et al.*, 2013), evaluating new service offerings from a viewpoint of customer acceptability (Lee *et al.*, 2015), how to deliver customer experiences (Carreira *et al.*, 2013), goods-services blueprinting (Geum and Park, 2011), and visualisations that aid uncertainty and communication. These include strategies that increase services (Dimache and Roche, 2013), new organisational structures (Biege *et al.*, 2012), techniques that support service cost estimating through life costs (Settanni *et al.*, 2014), dealing with uncertainty (Erkoyuncu *et al.*, 2013), pricing and bidding (Kreye *et al.*, 2014), techniques to develop cost sharing to create capacity to deliver services, simulations (Alix and Zacharewicz, 2012; Datta *et al.*, 2013), and activity-based process modelling (Kerley *et al.*, 2011).

4.3. Research opportunities

Table 3 suggests several research opportunities, and each topic mentioned above presents opportunities for incremental and confirmatory studies. This section deals with ‘Undeveloped’ topics in each of the categories, leaving the macro challenges to be addressed shortly.

From the perspective of descriptive, external context, there is a need for research on the impact of disruptive innovations and the dynamics of technology shifts, combined with broader environmental and social aspects of servitization (Tongur and Engwall, 2014). Internally, research is needed on legal and financial frameworks that support advanced services, the roles and advantages of active manufacturing technology innovation regarding supporting services, and the social and collective dynamics of business leaders who influence the propensity to servitize.

Considering both process and content, topics should focus on factors influencing the successful adoption of services, new business models, and paths to service business-unit development (Davies *et al.*, 2006; Martinez *et al.*, 2010; Gebauer *et al.*, 2012). Opportunities lie in change processes enacted when moving from product- to service-orientated climates (Bowen and Schneider, 2014), and evolutionary patterns within business models that unfold through service-innovation-driven change (Kindström and Kowalkowski, 2014). Similar opportunities lie with the dynamics of value propositions, co-creation of processes in broader networks, customer acceptance of service offerings, and greater understanding of customer behaviours (Roy *et al.*, 2009). Opportunities can also be found in the coexistence of products- and service-orientated climates in an organisation, B2C applications (i.e., current bias toward B2B or IPS2; Meier *et al.*, 2010), and links between inter-organisational relationships and

contributions intertwined between buyer and supplier in complex service strategies (Fleury and Fleury, 2014).

From a prescriptive orientation, few studies establish contextual conditions for servitization. Clearly, this is a delicate debate, with subtle treatments in descriptive studies that identify conditions where success occurred. However, opportunities exist to establish external and internal conditions conducive to service strategy adoption that maximise growth in revenue and profit (Reinartz and Ulaga, 2008). Complementing them, there exist opportunities for decision-support systems that aid managers during servitization, and holistic audits and processes of capabilities (Kindström and Kowalkowski, 2014).

4.4. Consolidation of research progression

Table 3 provides a basis for general observations regarding servitization research landscape, namely:

Knowledge regarding servitization continues to build and coalesce: Earlier, we mentioned that progressive literature reviews on servitization suggest a growing community. The articles considered during analysis support this view. While constructing Table 3, we recognised a cluster within the literature, with earlier definitions and priorities acknowledged regularly (Vandermerwe and Rada, 1988; Wise and Baumgartner, 1999; Baines *et al.*, 2007; Neely, 2009). We interpret this momentum and internal alignment of the literature as a positive reflection of research conducted in the community.

Theory building is growing: Servitization is studied from various perspectives such as service operations, service science, and service marketing, and yet there is a steadily growing link with guided theory. Particularly prevalent is resource-based and dynamic-capabilities views (Kindström and Kowalkowski, 2014). The assumption of these synthesis perspectives is that firms constitute bundles of resources and capabilities that support strategic actions and competitive positions. Hence, arguments focus on which resources and capabilities product-centric firms require for development and deployment of advanced services. Other theory-based servitization studies are based on service-dominant logic (SDL) (Vargo and Lusch, 2004, 2008).

Crossover is increasing, with topics of business model innovation and information and communication technologies: Business model terminology has been a part of servitization articles since they appeared, but early papers used it loosely. More recently, terminology has taken firmer interpretations (Kindström, 2010; Kujala *et al.*, 2011; Barquet *et al.*, 2013). For some, business model innovations subsume servitization, capturing customer interactions,

revenue architectures, and organisational changes associated with servitization. Those within the community limit business model discussions to customer interactions and revenue generation. A similar crossover is occurring with information and communication technologies, and under a variety of themes such as the Internet of Things (IoT), big data, and connected/smart products. For some, servitization is simply an information revolution (Industry Standard 4.0 suggests this), with the danger of neglecting structural and human implications. Generally, business-model and technology debates strengthen adoption of servitization, and are welcome.

4.5 Challenges to servitization research

The theoretical framework captures the state-of-the-art regarding knowledge about servitization. Although these topics classify as underdeveloped, each represents an opportunity, and when the framework is taken collectively, macro-research challenges emerge. Regarding research foci, these include:

Unified and foundational premises of advanced services: Understanding of the paths to servitization is growing (Gebauer et al., 2012), and various forms of service offerings exist. However, advanced services such as power-by-the-hour (Smith, 2013) are iconic and responsible for much interest in servitization. These demand that manufacturers move beyond a production mind-set and adopt a different business paradigm. Research rarely articulates this innovation holistically and consistently. An opportunity exists to form a premise for advanced services that is comparable to SDL (Vargo and Lusch, 2004, 2008). Such a platform would enable tighter and clinical studies. The premises of SDL (i.e., specialised skills and knowledge as a unit of exchange, goods as a distribution mechanism for service provision, and customer as co-creator of value) are a direct complement to servitization.

Processes of servitization: Outlined in the introduction, recognition that processes of servitization are at the research frontier stimulated the need for this review. Analysis suggests a lack of papers in this area, both describing how change has occurred and in prescribing how to servitize a manufacturing firm. Oliva and Kallenberg (2003) and other authors identify barriers and propose states, but few examine the dynamics of, or distinguish what is particular about, servitization versus general change.

Forward and reverse servitization: The premise of nearly all servitization papers is manufacturing transitioning from a focus on goods and production to a state at which substantial revenues are earned through services. There is an alternative strategy in which a

service firm builds technology innovation competencies and delivers advanced services (e.g. Story *et al.*, 2016). This is not simply a case of productization of services or increasing service objectivity; it is about arriving as a servitized manufacturer from a different route. We refer to this as reverse-servitization, and suggest it is an opportunity for research, businesses, and economies.

Threats of servitization: Other literature suggests servitization is always positive, especially for developed, Western economies. It dampens competitors and ensures some localisation of value capture. However, what happens if a service provider is not an indigenous manufacturer? What if suppliers who are locked out are from the host economy? Clearly, there are trade-offs with servitization, and advanced services particularly must be explored to develop a balanced view.

Manufacturers as customers of advanced services: Servitization research treats manufacturers as providers of advanced services; rarely are they considered customers. Yet manufacturers are customers of advanced services, particularly during acquisition of complex manufacturing technologies such as machining, forging, and casting. This topic complicates questions about the relevance of servitization to manufacturing, and requires fuller exploration.

Challenges also exist concerning approaches authors use during research:

Language and style: Evident in many theoretically strong papers are laudable intentions to influence manufacturing performance, but the language and style of many papers represent a barrier to these ambitions. Consequently, the potential value of many contributions is unrecognised in practice. There are, however, excellent examples of papers that balance this well (Suarez *et al.*, 2013; Kowalkowski *et al.*, 2015), and so an opportunity exists to reflect on these in future research.

Adventures in future research proposals: Nearly every journal article proposes future research opportunities. Too often, however, they are conservative, simply suggesting further testing of propositions and frameworks. There is an opportunity to be ambitious and to suggest wider-ranging studies. There are also opportunities to reach beyond conventional research communities, to engage in multidisciplinary (i.e., other fields related to the topic but that retain their disciplinary objectives), interdisciplinary (i.e., involving several disciplines in a manner that requires them to cross-object boundaries), and transdisciplinary (i.e., building on interdisciplinary research but involving non-academic partners such as industrial actors

and customers to create new knowledge and research regarding common concerns) research (Tress *et al.*, 2005).

Business logic to complement theory: There is growing infusion of theory in servitization research, with references to RBV and TCE appearing frequently. This reflects increasing pressures on researchers to provide theoretically robust foundations. Although this is critical, there is also a need for papers that expound business logic, combining theory, evidence, and examples to create bold propositions for business. Wise and Baumgartner's (1999) paper is an example, and its contributions are valued highly.

Overcoming gaps with practice: It has been over a decade since Oliva and Kallenberg's (2003) and ten years since Davies *et al.*'s (2006) seminal papers were published that focus on ways of developing integrated product-service solutions based on in-depth studies of industry practices. Yet the uptake of the concepts and language of servitization is still not widespread among mainstream practitioners. New techniques are needed to fill these gaps and minimise theory-practice disparities as much as possible.

<< **Insert Table 3** >>

5. Conclusion

The most significant challenge facing both researchers and practitioners of servitization is how to efficiently and effectively transform a manufacturing organisation to exploit this opportunity. This paper consolidates literature regarding servitization, identifying progress concerning key research topics and contributing a platform for future research. The goal is to inform research to result eventually in a roadmap for practitioners seeking to servitize.

Underpinning this agenda is a systemic literature review set against a theoretical framework based on organisational change. Some 232 publications have been identified and reviewed, and has ultimately resulted in the agenda presented in Table 3, with the key research topics identified. To summarize, a) developed topics illustrate research contributions, and so represent established knowledge, b) developing topics illustrate growing concentrations, and so are opportunities for incremental and confirmatory studies, and c) undeveloped topics represent opportunities for new, exploratory studies. In addition, a set of grand challenges are identified for the research community.

As with all research, limitations are inevitable. In the context of this paper, limitations can be divided into those related to data collection/analysis methods and those related to topics that appear in Table 3. Although the literature review should have identified all

publications relevant to servitization, we might have overlooked some studies. Furthermore, evaluation and interpretation relied on the research team and a subsequent workshop. This was negated by cross-checking papers independently, but errors might have occurred.

This paper orchestrates the direction of future research on servitization. Table 3 presents a range of topics for such studies, and is foundational to the grand challenges identified in the discussion. The future opportunities are extensive, and we hope to be able to reflect on the progress of the community against these at some point in the future.

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CONTEXT OF THE TRANSFORMATION		TRANSFORMATION	CONTENT AND RESULTS OF CHANGE
<i>External</i>	<i>Internal</i>		
DESCRIPTIVE RESEARCH (when, how, and what change occurred)			
<p>Research on ‘the external situation when change occurred’ is:</p> <p>Developed in understanding:</p> <ul style="list-style-type: none"> • There is a rise in the importance and adoption of industrial services globally <p>Developing in understanding:</p> <ul style="list-style-type: none"> • Inherent weaknesses in the statistical classification to separate services and manufacturing • International differences in the adoption of servitization and the role of demographic, educational, and regulatory factors • Differing characteristics of goods and service sectors regarding international trade • Impact of oligopolistic markets (e.g., government contracts) and how this affects contracting • Role of value-creating systems, networks, ecosystems, and constellations in stimulating companies to reveal or anticipate market opportunities • Endogenous and exogenous factors influencing a manufacturer’s ability to servitize <p>Undeveloped in understanding:</p> <ul style="list-style-type: none"> • Influence of disruptive innovation and dynamics of technology shift on servitization • Broader environmental and social aspects of servitization 	<p>Research on ‘the internal situation when change occurred’ is:</p> <p>Developed in understanding:</p> <ul style="list-style-type: none"> • Service strategies influence the financial performance of manufacturing firms positively, but evaluation is complex and relationships are non-linear and bounded <p>Developing in understanding:</p> <ul style="list-style-type: none"> • Business motives underpinning servitization • Impact of differing service strategies, their timing, and rate affect the revenue, profit, and growth of a firm • Complement between goods and services sales • Role of organisational focus (goods versus services) on profitability of additional services; service success depends on a supportive organisational design • Role of product complexity and technology in reshaping business models • Differing ways goods and service businesses innovations occur • Influence of service innovation on product innovation and export performance • Mediation of a separate service department for advanced service delivery on management commitments <p>Undeveloped in understanding:</p> <ul style="list-style-type: none"> • The manufacturer as a customer of advanced services • Legal and financial frameworks that support advanced services • Role and advantages of active manufacturing technology innovation in supporting services • Social and collective dynamics of business leaders that influence the propensity to servitize • Leadership styles • How services support the business of the firm • Influences of organisational size 	<p>Research on ‘how change occurred’ is:</p> <p>Developed in understanding:</p> <ul style="list-style-type: none"> • Organisational change takes place as manufacturing businesses adopt services <p>Developing in understanding:</p> <ul style="list-style-type: none"> • Stages in the change process as manufacturing businesses adopt services. • Influence of incremental change in complex engineering services <p>Undeveloped in understanding:</p> <ul style="list-style-type: none"> • Factors influencing adoption of servitized business models • Pathways of service business-unit development • Change processes enacted in moving from a goods- to service-orientated climate • Evolutionary patterns within business model that unfold through service-innovation-driven change 	<p>Research on ‘what was changed’ is:</p> <p>Developed in understanding:</p> <ul style="list-style-type: none"> • Language for describing the fundamental unit of exchange; traditional goods-service distinctions are unnecessary • Typologies of service strategies and classifications of product-service value propositions and dimensions <p>Developing in understanding the:</p> <ul style="list-style-type: none"> • Co-design that blends industrial goods and services innovation design strategies to identify radical innovation • Customer-supplier relationships (i.e., risk, information, operational, legal adaptations, norms, social capital, and trust) for differing service types; disparities in buying between buying goods and services • Network structures/configurations, capabilities, and relationships with intermediaries (e.g., distributors, agencies, and dealers) to support types of services; inter-organisational power in complex networks, degrees of collaboration, and triadic arrangements • Business-unit configuration and organisation design, arrangements, structures, systems, metrics, and capability acquisition. • Human resources implications; antecedents of service climate and general traits, motivation, and skills of services-centred sales force in B2B • Role of ICT (i.e., IOT, IES, and big data) in service innovation, delivery, value creation, and differentiation <p>Undeveloped in understanding:</p> <ul style="list-style-type: none"> • Dynamics of value propositions and co-creation in broader networks • Customer acceptance of service offerings and customer behaviour • Coexistence of goods- and service-orientated climates in an organisation • B2C applications (i.e., current bias toward B2B) • Link between inter-organisational relationships and contributions are intertwined between buyer and supplier for complex service strategies • Application of systems thinking to service strategies of manufacturers

Table 3. Overview of proposed agenda and summary of research topics regarding manufacturers’ adoption of advanced services

CONTEXT OF THE TRANSFORMATION		TRANSFORMATION	CONTENT AND RESULTS OF CHANGE
<i>External</i>	<i>External</i>		
PRESCRIPTIVE RESEARCH (when, what, and how should change occur)	Research on ‘ the external situation when change should occur ’ is: Undeveloped in understanding: <ul style="list-style-type: none"> External conditions that influence the right time to adopt a service strategy to maximise growth of revenue and profit 	Research on ‘ the internal situation when change should occur ’ is: Undeveloped in understanding: <ul style="list-style-type: none"> Internal conditions needed for service strategy adoption and growth in revenue and profit 	Research on ‘ how change should occur ’ is: Developing in understanding: <ul style="list-style-type: none"> A classification of service offerings from a business-model perspective, portfolio analysis, and transitioning strategies Proposed degrees of service-strategy development A process model for extending service business and development of industrial service offerings Firms should concentrate on developing SSP (services that support the product) portfolios before SSC (services that support customer) Loyal, core customers should be targeted initially to develop service strategies Firms should implement an organisational design across entire business, and de-centralise decision-making on developing SSP portfolios before SSC Maturity models are valid for evaluating new service development and IS support during implementation of services business Roadmaps for technology to support product-service integration
	Research on ‘ what should be changed ’ is: Developing in understanding: <ul style="list-style-type: none"> Design of service offering Evaluating new service offerings from the viewpoint of acceptability to customers and customer experience Goods-service blueprinting; visualisations to aid uncertainty and communication Evaluation of strategies to increase services (e.g., PSS) Identification of new organisational structures Techniques supporting service cost estimating through life costs, dealing with uncertainty, pricing, and bidding Techniques developing cost sharing to create capacity to deliver services Support systems design frameworks, simulations, and enterprise imaging; activity-based process modelling Techniques for analysing information requirements for design and delivery of complex engineering systems 	Research on ‘ how change should occur ’ is: Undeveloped in understanding: <ul style="list-style-type: none"> Decision support systems that aid managers during servitization 	Research on ‘ what should be changed ’ is: Undeveloped in understanding: <ul style="list-style-type: none"> Holistic audits and capabilities for servitization

Table 3. (continued) Overview of proposed agenda and summary of research topics regarding manufacturers’ adoption of advanced services