

Review

The state-of-the-art of the theory on Product-Service Systems

Ai Qiang Li^{a,*}, Maneesh Kumar^b, Björn Claes^c, Pauline Found^{a,b}^a Buckingham Business School, The University of Buckingham, Buckingham, UK^b Cardiff Business School, Cardiff University, Cardiff, UK^c The Open University Business School, The Open University, Milton Keynes, UK

ARTICLE INFO

Keywords:

Review of reviews
Product-service systems
Servitisation
Productisation
Value co-creation
Systems approach

ABSTRACT

Product-Service Systems (PSS) terminology is becoming increasingly common across management disciplines. Despite rapid growth in the number of PSS publications, relatively little attention has been dedicated to advancing the theoretical underpinnings required for robust PSS research. This paper aims to address this issue through a two-stage systematic review. Initially, we conducted a first-stage 'review of reviews' to set up a broad database for the preliminary understanding of PSS evolution and its theoretical progress. Subsequently, we undertook a second-stage review to explore the use of different theories for developing PSS research. We identify four clusters of theories and illustrate how they underpin ten distinct research themes and a systems approach in PSS. We then construct a framework of five theoretical lenses (identity, competence, efficiency, power and systems) that guide theory development discussion in PSS research. We argue that further research would benefit from adopting a systems approach that explores the interactions in PSS and favors interdisciplinary theory development. More studies on productisation and comparable studies between servitisation and productisation are also encouraged, for example, between industrial and consumer products and between B2B and B2C models.

1. Introduction

Since the 1980s, many manufacturers and service providers have been redefining their strategic focus, away from purely selling products (or services) towards providing more integrated blends of products and services (Vandermerwe and Rada, 1988; Goedkoop et al., 1999; Mont, 2002; Tukker, 2004; Baines et al., 2007; Johnson and Mena, 2008; Rabetino et al., 2018), the latter of which are perhaps better known as Product-Service Systems (PSS) amongst academics. Research shows that PSS, when done well, facilitates (1) higher revenues (Mont, 2002; Oliva and Kallenberg, 2003; Baines and Lightfoot, 2013), (2) sustainable relationships with customers (Gebauer et al., 2005; Sjödin et al., 2016; Bustinza et al., 2017), and (3) better environmental performance (Goedkoop et al., 1999; Mont, 2002; Lindahl et al., 2014). As a result, PSS and the ability to deliver them successfully have increasingly been recognised as a key factor for success by both practitioners and researchers alike.

Accompanying the surge of PSS, many alternative terms to describe the phenomenon and develop the concept have been put forward, including 'servitisation' (Vandermerwe and Rada, 1988; Kastalli and Looy, 2013; Lightfoot et al., 2013; Rabetino et al., 2018), 'eco-efficient

(producer) services' (Hinterberger et al., 1994; Meijkamp, 1998; Zaring et al., 2001; Bartolomeo et al., 2003), 'integrated solutions' (Buxton et al., 1997; Davies et al., 2006), 'service transition' (Oliva and Kallenberg, 2003; Fang et al., 2008; Salonen, 2011; Kowalkowski et al., 2015; Lütjen et al., 2017; Martinez et al., 2017), service infusion (Brax, 2005; Eloranta and Turunen, 2015; Forkmann et al., 2017b; Rabetino et al., 2018), 'productisation' (Baines et al., 2007; Harkonen et al., 2015; Lahy et al., 2018), 'outcome/availability-based contracts' (Ng et al., 2009; Settanni et al., 2017; Visnjic et al., 2017), 'hybrid offerings' (Uлага and Reinartz, 2011), 'integrated product and service offering' (Sakao et al., 2013; Lindahl et al., 2014) and 'smart connected products' (Porter and Heppelmann, 2014, 2015). In recent years, research on PSS has increasingly been conducted across a variety of disciplines, including strategy, marketing, sustainability, service science, business management, design, engineering, and information systems (Boehm and Thomas, 2013; Lightfoot et al., 2013; Bustinza et al., 2017; Kowalkowski et al., 2017; Rabetino et al., 2018). While the proliferation of PSS across academic disciplines can be interpreted as a sign of maturation, it has also resulted in several issues.

First, different disciplines have developed their own terminologies to describe the same phenomenon, which obstructs interconnection and

* Corresponding author.

E-mail address: brightfutureli309@gmail.com (A.Q. Li).

communication among research communities (Boehm and Thomas, 2013; Annarelli et al., 2016; Rabetino et al., 2018). For example, marketing scholars appear to prefer 'hybrid offering' and 'integrated solutions', while researchers in the field of sustainability tend to refer to the concept as 'eco-efficient services'. Indeed, Rabetino et al. (2018) found that the number of papers co-authored by scholars from different communities is low, providing evidence for the apparent lack of interdisciplinarity. Among other things, they observed about 70 percent of the references belong to the same community. They concluded that the fragmented multidisciplinary domains and the use of multiple labels and concepts can hinder the recognition from adjacent disciplines and limit knowledge accumulation (Rabetino et al., 2018).

Second, these disciplines also use different theoretical bases to explain the phenomenon of PSS in an isolated manner (Annarelli et al., 2016), and the theoretical support of these communities is relatively endogenous (Rabetino et al., 2018). As a result, there has been a debate on the theoretical foundations for analysing the phenomenon (Bustinza et al., 2017), and very little concerted effort has been made to understand how different theoretical lenses facilitate a better understanding of PSS when investigated from an interdisciplinary perspective (Ng et al., 2013). Moreover, many scholars have pointed out the lack of robust theoretical underpinning and development in PSS research (Tukker and Tischner, 2006; Baines et al., 2007; Claes and Martinez, 2010; Velamuri et al., 2011; Kowalkowski et al., 2017), as Kowalkowski et al. (2017, p. 2) argued that 'much of the research still lacks a strong theoretical foundation, and substantial theoretical extensions are rare'. Thus, there is scarcely any review paper that specifically addresses the state-of-the-art of theory development in PSS and a systematic investigation is called for. In this context, theory is defined as 'a statement of concepts and their interrelationships that shows how and/or why a phenomenon occurs' (Corley and Gioia, 2011, p. 12), and theory development not only means theory building, but also theory testing and theory application in the PSS context.

Third, manufacturers continue to struggle for the optimised financial performance by integrating products and services. For example, they are encountering the so-called 'service paradox', where substantial investment in services does not bring about the expected financial returns (Brax, 2005; Gebauer et al., 2005; Neely, 2008; Kastalli and Looy, 2013; Benedettini et al., 2015; Posselt and Roth, 2017; Sousa and da Silveira, 2017). Scholars argue that this is, to a large degree, due to the insufficient theoretical explanation (Posselt and Roth, 2017) and the lack of a systems approach in PSS (Gebauer et al., 2005; Kastalli and Looy, 2013; Rondini et al., 2017). In a PSS context, a systems approach means the focus of interrelatedness between products and services, product and service organisations, and among the actors in the PSS network. However, extant PSS literature scarcely addresses how theory supports a systems approach.

The above three issues have motivated us to assess the state-of-the-art of PSS in order to understand the progression in PSS research through different theoretical lenses and how each lens provides a different perspective for explaining PSS. We do so by asking the following two questions: (1) What is the state-of-the-art of theory development in PSS? (2) How do scholars use different theories to underpin a systems approach in PSS?

The major contributions of this paper are threefold. First, following the work of Kowalkowski et al. (2017) and Rabetino et al. (2018), we visually relate various fragmented PSS terms in a chronological order in order to oversee the big picture of PSS evolution. Second, distinct from other review papers on PSS, our work is the first review paper that specifically reports theory development in PSS, which enriches the extant PSS literature. Third, we provide a framework of using five theoretical lenses (identity, competence, efficiency, power and systems) to systematically explain PSS and the issues practitioners are facing.

The remaining sections are structured as follows: Section 2 introduces the methodology, consisting of a two-stage systematic review: stage I is a 'review of reviews', aiming to identify various terms and

establish the 'big picture' of PSS, while stage II is a subsequent review based on the 'big picture' to specifically explore the theory development in PSS. Sections 3 and 4 report the main findings of the two reviews respectively, and Section 5 discusses the findings, draws conclusions, and summarises future research.

2. Methodology

To answer the research questions, a systematic literature review was conducted. This provided robust results through adopting replicable, scientific and transparent processes (Tranfield et al., 2003; Pittaway et al., 2004). Specifically, we designed a two-stage review: in stage I, we reviewed the extant literature review articles published on PSS and compiled a 'review of reviews'. In stage II, we conducted a specific review to assess the theory development in the PSS field. Notably, the two review stages complement each other (Fig. 1). For each review, we followed a two-stage reporting process: (1) first, we carried out a descriptive analysis to report a statistical summary of the findings and (2) second, we conducted a thematic analysis to convey the main themes (Tranfield et al., 2003; Annarelli et al., 2016). The review process is illustrated in Fig. 1.

We selected Scopus as the single database for our review for the reason that Scopus is the largest and most comprehensive abstract and citation database of peer-reviewed literature. Scopus is considered as an effective tool for electronic literature search both in keyword searching and citation analysis, particularly for works published after 1995 (Falagas et al., 2008) and evidenced by Tukker (2015), Annarelli et al. (2016) and Qu et al. (2016) in their reviews. The inclusion and exclusion criteria are summarised in Table 1. The full lists of papers reviewed in stage I and II are summarised in Appendix A.1 and A.2 respectively.

During the initial search of Stage I, we collected a total of 313 papers. In each paper, we read the abstract and keywords to check if the paper is a review paper on PSS. If we couldn't decide on this, then we read the full text. By doing this, the number was reduced to 46. Then, from citation analysis (snowball effect), three papers were added to the sample. These included the works of Mont (2002), Tukker and Tischner (2006) and Schmenner (2009). Though these papers do not use the search strings such as 'systematic review' and 'state-of-the-art', they do provide comprehensive discussions of the PSS evolution. We also added a conference paper by Leoni (2015) as it is the first one that pointed out clearly that, compared with 'servitisation', little has been done on 'productisation', one of the two directions towards PSS. During Stage II review, we identified the paper of Briscoe et al. (2011) that should be classified as a review paper. Thus, we moved it to this list. Finally, a total set of 51 review papers was collected.

During the initial search of Stage II, a total of 414 papers were identified. We firstly scrutinised the abstracts and keywords of these papers to decide whether they are sufficiently related to PSS. After removing 246 papers, the remaining 168 papers in the sample were read in full. Then papers that included the terms 'theoretical' and/or 'theory (theories)' in the full-text, but that did not indicate or use any specific theory were removed. Papers that were identified as review papers that had already been listed in Stage I review, including the work of Sakao et al. (2009), Spring and Araujo (2009), Eloranta and Turunen (2015), Brax and Visintin (2017), Bigdeli et al. (2017) and Baines et al. (2017) were also excluded from the Stage II list. This left us with a final sample of 60 papers.

3. Findings from the 'review of reviews' (stage I)

3.1. Descriptive analysis

The list of the review papers is shown in Appendix A.1. Among the 51 review papers, 30 reviews (59%) are conducted in recent five years (2014–2018). The top journals with at least two publications represent five disciplines including business and operations management,

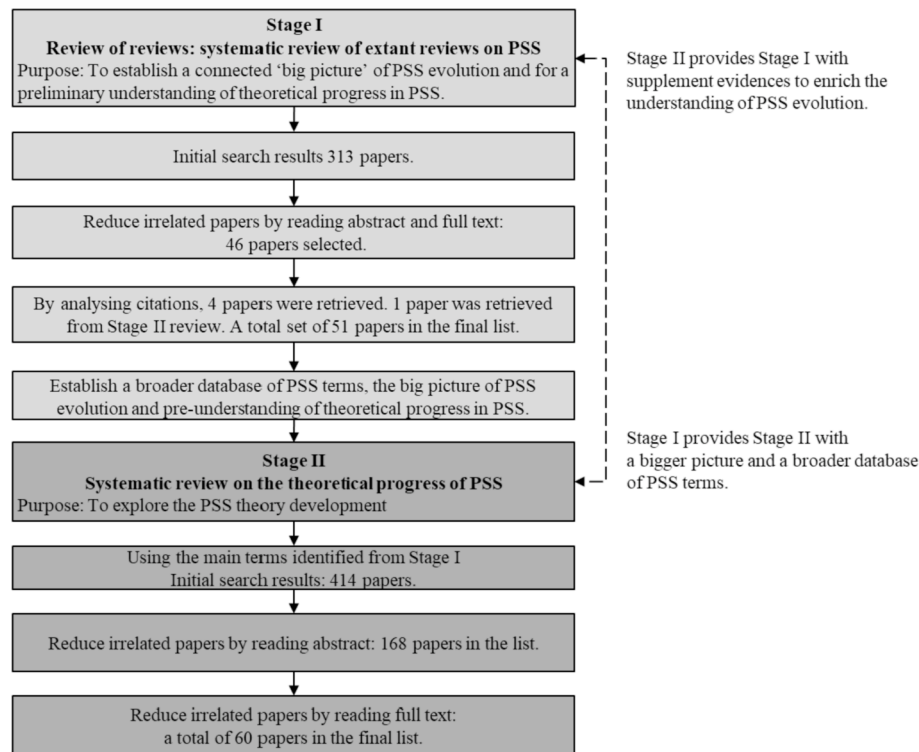


Fig. 1. The two-stage review process.

sustainability, marketing, service management, and technology and engineering. 17 papers (33%) include the review on theories, of which only 5 had detailed discussions on theories.

3.2. Thematic analysis

3.2.1. A broader definition and scope of PSS

The emergent literature on PSS not only uses a variety of terms for what is principally the same concept, it also proposes different definitions. In this paper, we largely adopt the definition of Mont (2002) though in it we do embrace a systems approach. Specifically, we define PSS as a system of products, services and supporting infrastructure that interact with each other to jointly deliver customers better results than the sum of the individual components. Following the logic of Pawar et al. (2009), we use the term PSS to describe any such combination so that it not only embraces the synonymous terms such as 'integrated solutions' and 'hybrid offering', but also other related concepts such as performance-based logistics (PBL), outcome-based contracts (OBC), servitisation, productisation, etc.

3.2.2. The 'big picture' of PSS evolution

Through their work, several authors (e.g. Kowalkowski et al. [2017] and Rabetino et al. [2018]) have significantly contributed to the formation of the big picture of PSS evolution. We further visualise this evolution in a chronicle order, particularly by adding the theoretical progress of PSS research.

The evolution of PSS can be divided into three phases. The first phase took place between 1999 and 2004. It should be noted that several terms and/or concepts such as 'goods-service continuum' (Rathmell, 1966), 'servitisation' (Vandermerwe and Rada, 1988) and 'services-based strategy' (Quinn et al., 1990) were already introduced prior to 1999, which set the scene for shaping the research trend and domain on PSS. In 1999, more terms were put forward including 'product service systems' (Goedkoop et al., 1999), 'servicing' (White et al., 1999), 'selling functions' (Agri et al., 1999) and 'go downstream' (Wise and Baumgartner, 1999). As a result, the boundaries of the research domain on PSS were

established and a conceptual foundation started to emerge from 2000 onwards (Kowalkowski et al., 2017). Some foundational articles such as the work of Mont (2002), Oliva and Kallenberg (2003) and Tukker (2004) were published during this phase. Moreover, two EU-wide PSS projects were completed in this period (see Fig. 2) making an important contribution to the understanding of the concept: the first project on creating eco-efficient producer services (1998–2001), followed by the second SusProNet project (2002–2004). They facilitated cross-country and interdisciplinary collaboration on PSS. This phase was also largely characterised by the inclusion of emerging concerns on environment and economy sustainability and related government policy (Rabetino et al., 2018). For example, the world first two reports on PSS (Goedkoop et al., 1999; Mont, 2000), the report on servicing (White et al., 1999) and the report on eco-efficient producer services (Zaring et al., 2001) were funded by the Dutch, Swedish, American and EU environmental departments respectively.

The second phase started around 2005 and lasted till 2009. In this phase, the number of publications on PSS is decreasing, as the main blue line indicates in Fig. 2. PSS was in a process of reflection, summary and adjusting directions. This can be seen from the work by Tukker and Tischner (2006) and Baines et al. (2007). There was also a growing interest from business practitioners as they encountered a challenge of solving the service paradox (Brax, 2005; Gebauer et al., 2005; Neely, 2008; Reinartz and Ulaga, 2008). However, theory development during the first and second phases is slow and sparse (Tukker and Tischner, 2006; Baines et al., 2007). The third phase started around 2009 and is ongoing. So far, the key themes that have emerged in this phase include value co-creation, systems and networks, ICT and digitalisation (Briscoe et al., 2011; Martín-Peña et al., 2018; Rabetino et al., 2018). During this phase, a third EU-wide project 'PSS Cluster' also started under the EU Horizon 2020 Initiative (also interwoven with the EU Co-creation Project). This phase is furthermore characterised by an increasing theory development (Baines et al., 2017). The growing trends toward networks, co-creation, and shared resources encourage scholars to focus on network-related and relational capabilities (Eloranta and Turunen, 2015) that calls for a systems approach.

Table 1

The selection criteria and keywords for the review (in Scopus).

Stage	Search strings and limit
Stage I: Review of reviews	<p>Search strings (readers can directly copy the following strings in 'Advanced Search'): (TITLE-ABS-KEY (("Product-Service systems" OR "integration of products and services" OR serviti*ation OR producti*ation OR "Service infusion" OR "Service growth" OR "Service transition" OR "Service science" OR "Integrated solution" OR "Solution offering" OR "Hybrid offering")) AND TITLE-ABS-KEY (("systematic review" OR "systematic literature review" OR "multidisciplinary review" OR "multidisciplinary literature review" OR "comprehensive review" OR "comprehensive literature review" OR "extensive literature review" OR "extensive review" OR "structured review" OR "critical review" OR "thematic analysis" OR "bibliometric analysis" OR typology OR evol* OR agenda OR journey OR "state-of-the-art")) AND DOCTYPE (ar OR re) AND PUBYEAR > 1997</p> <p>Limit: Article title, Abstract, Keywords Published from 1998 to 2018 Documentation type: Article or Review Search conducted between Jan.–Sep. 2018 (last check on 23/09/2018) A total number of 313 papers analysed</p>
Stage II: Review on theory development	<p>Search strings (readers can directly copy the following strings in 'Advanced Search'): (TITLE-ABS-KEY ((dematerialisation OR dematerialisation OR "Eco-efficient Services" OR "Functional Economy" OR "Functional sales" OR Servitisation OR Servitisation OR Servicization OR Servicisation OR Servicification OR Servicizing OR "Service transition" OR "Service transformation" OR "Service paradox" OR "Service infusion" OR "Goods service continuum" OR "Product service continuum" OR "Product-Service Systems" OR "Integrated Product-Service" OR "Integrated Product and Service Offerings" OR "Integrating Product Services" OR "Combining Product Services" OR "Bundling Product Services" OR "Mixing Product Services" OR "Integrated solutions" OR "Solution selling" OR "Solution offerings" OR "Solution network" OR "Customer solution" OR "Complex Products and Systems" OR "Hybrid Offering" OR "Performance-based logistics" OR "Outcome-based contracts" OR productisation OR productisation)) AND TITLE-ABS-KEY ((theory OR theories OR theoretical)) AND ALL ((interac* OR interrelate* OR interdependen* OR holis* OR system*))) AND DOCTYPE (ar) AND PUBYEAR > 1997 AND PUBYEAR < 2019</p> <p>Limit: Article title, Abstract, Keywords Published from 1998 to 2018 Documentation type: Article Search conducted between Jan.–Sep. 2018 (last check on 23/09/2018) A total number of 414 papers analysed</p>

Note: The strings of (interac* or interrelate* or interdependen* or holis* or system*) are used to search for papers with the 'systems approach', which emphasises interaction, interrelatedness, interdependence, or holistic, systemic or systematic views.

Notably, in the third phase, productisation has started to receive more scholarly attention, in part driven by the advances of practitioners such as Amazon's movement from a pure service offering to adding a physical product (e.g. Kindle), and Google's effort to develop self-driving cars and modular phones. Following the call for further research on productisation by Harkonen et al. (2015) in IJPE and Leoni (2015) in RESER conference, several scholars have made important strides in this direction. The three phases of the evolution of PSS are summarised in Fig. 2.

4. Findings on the theory development in PSS

4.1. Descriptive analysis

To further explore the theory development in PSS, we reviewed a total of 60 papers (Appendix A.2). They were grouped into 10 research themes: organisations, strategy and change (20%), value co-creation (16.7%), consumer behaviour (15%), business models (15%), resources and capabilities (8.3%), service systems and innovation (8.3%), financial performance (6.7%), the service paradox (3.3%), sustainability (3.3%) and supply chain management (3.3%). Theory development to explain PSS is largely built through conceptual papers (35%) and case studies (48%) (Fig. 3). In recent five years (2014–2018), quantitative methods (13%) have been increasingly applied to test the emerging PSS concepts and related theories.

The findings showed that all the 60 reviewed papers either apply theories to the PSS context (87%) or test theories in this context (13%). Details are provided in Appendix A.2. The comparison of the papers further revealed an emergence of three levels of theory use, including 'only mentioning theories', 'some details on theories' and 'more detailed discussions on theories'. The criteria for the levels are based on the depth to which a given theory or theories applied. 'Only mentioning theories' refers to authors only mentioning the names of theories, without providing any further explanation. 'Some details on theories' refers to authors introducing a theory or theories and explaining how they underpin their research at, at least one place of their paper, but not throughout their paper. Lastly, 'more detailed discussions on theories' refers to papers in which authors explicitly apply and explain theories throughout the paper, including in the literature review, findings, analysis and conclusions.

While theory development was scarce prior to 2008, efforts in this regard have been increasing steadily since 2009 (the third phase). Particularly in the period between 2013 and 2018 a significant surge can be witnessed in the level of 'some details on theories' and 'more detailed discussions on theories', as shown in Fig. 4. Top journals with two or more of such publications are grouped into four research disciplines: business and operations management including IJPE (5, abbreviations explained in Appendix A.2), IJOPM (3), IJPR (3) and EMJ (2); marketing including IMM (13), sustainability including JCP (7); technology and engineering including CIRP JMST (2) and IJTPM (2), and service management including JSR (2).

4.2. Thematic analysis

4.2.1. The mapping of theories and research themes

Based on the purpose and application context of theory, we grouped the theory development in PSS into four clusters: systems theories, social and organisational theories, theories in resources and capabilities, and theories in psychology and behaviour. They were used to explain PSS in ten identified research themes. Their relationships are mapped in Fig. 5.

It shows that each cluster of theories is used to underpin different research themes. For example, the cluster of systems theories is mostly used to explain value co-creation in the PSS network, as PSS actors are crossing boundaries, and interactively exchanging resources and developing capabilities to create value together (Ng et al., 2009; Xing et al., 2013; Batista et al., 2017). The cluster of systems theories is also widely used to explain organisational changes (Turunen and Finne, 2014; Lee et al., 2016) and business models (Tongur and Engwall, 2014; Lee et al., 2015; Zhang et al., 2017).

Notably, Fig. 5 also shows that the theme of the service paradox receives surprisingly less theoretical attention. As Posselt and Roth (2017) pointed out that the service paradox is closely related to the insufficient theoretical explanation of how firms achieve competitiveness through servitisation. This directs scholars towards future research. Furthermore, only very few authors combined two or more theories to frame their research in a more systemic way (see Appendix A.2). The use

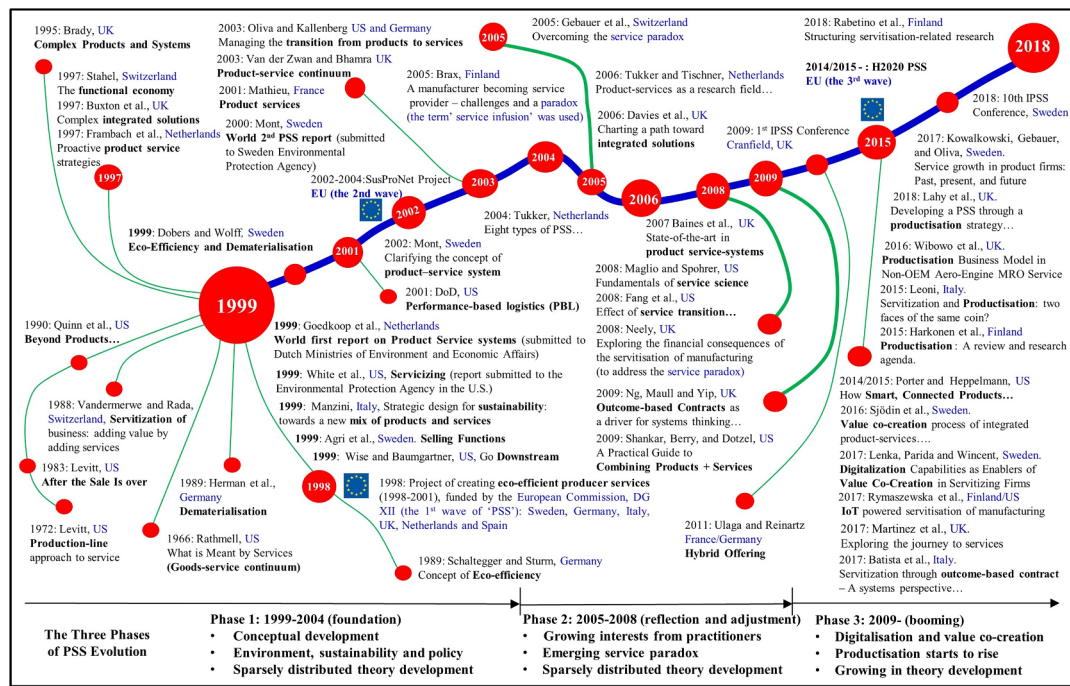


Fig. 2. The big picture (chronicle chart) of PSS evolution (adapted from [Li and Found, 2017]).

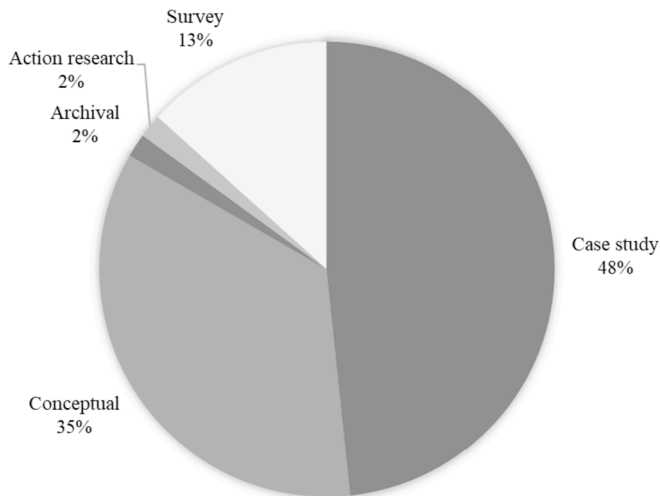


Fig. 3. Theory development by methodology.

of multiple theories provides researchers more opportunities to arrive at an enlarged understanding of the phenomenon (Lewis and Grimes, 1999). For example, Turunen and Finne (2014) used competing theories including behavioural theory, institutional theory, and contingency theory to explain the influence of environment on servitisation. They combined the institutional and ecological perspectives to explore social, economic, and political factors and the changing dynamics in the process of servitisation. As a result, their study provides a systemic understanding of servitisation in terms of its operating environment, both internally and externally. For another example, Salonen and Jaakkola (2015) adopted the four firm boundary conceptions (identity, competence, efficiency, and power) proposed by Santos and Eisenhardt (2005) and used them as analytical lenses to investigate internal and external resource integrations in solution business. The multiple theoretical lenses draw upon a rich set of established theories such as organisational identity (identify view), resource-based view (competence view), resource dependence (power view) and transaction cost economics

(efficiency view). The theories are interrelated, coevolutionary and synergistic, enabling the authors to develop a more theoretically inclusive analysis and a holistic understanding of resource integration.

4.2.2. How theories underpin the systems approach

Based on the earlier definition of PSS in section 3.2.1, we argue that PSS should be viewed as a connected whole where elements interact with each other, rather than being purely investigated on one side such as 'servitising' or a simple bundle of product and services. The review showed that an increasing number of scholars has started looking at the interactions in PSS. From the papers that discussed interactions between the PSS elements (e.g. products, services, organisations, and actors in the supply network), we extracted three clusters of interactions: the interactions between products and services, the interactions between product and service organisations, and the interactions in the PSS supply network.

Scholars used a variety of theories to explain the three interactions in PSS. For example, to emphasise the interactions between products and services in PSS, Windahl and Lakemond (2006) took the network lens to frame their argument that the service content in integrated solutions should not be seen as a stand-alone after-sales offering, but rather as an integrated part of the total offering. Xing et al. (2013) adopted the systems perspective and argued that PSS should be viewed as a connected whole with a form of synergy between product and services in order to deliver the desired results as neither is capable of achieving on its own. Forkmann et al. (2017a) adopted configuration theory to explain that manufacturers should consider both service infusion (adding services to products) and service defusion (removing services from products) based on the dynamic change of market and business needs.

Subsequently, scholars pointed out that the interrelatedness and harmony between product and service elements requires seamless interactions between product and service organisations. For example, Böhm et al. (2017) argued that manufacturing firms must configure financial, managerial, and personnel resources between the product and service businesses by taking the lens of configuration theory. Robinson et al. (2016) claimed that firms should constantly coordinate internal activities according to activity theory. Windahl and Lakemond (2006) took the lens of contingency theory to highlight that manufacturers'

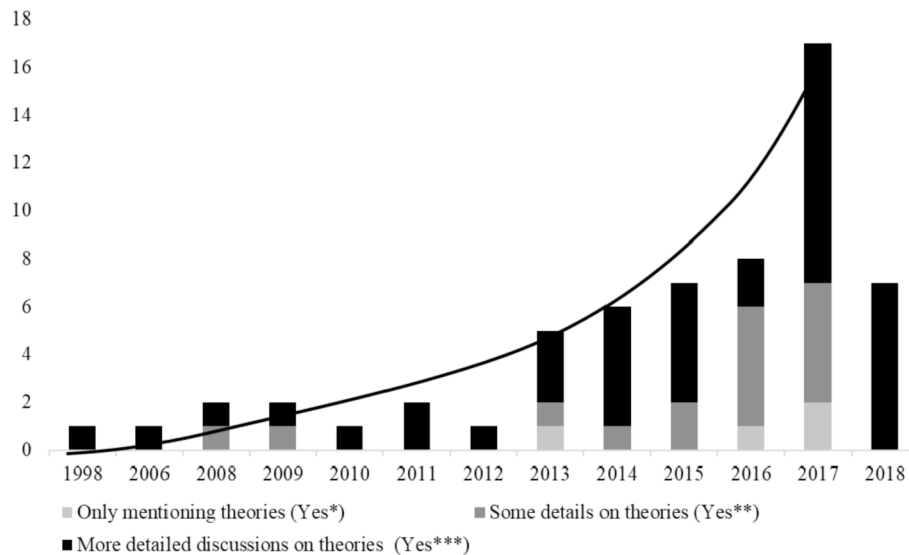
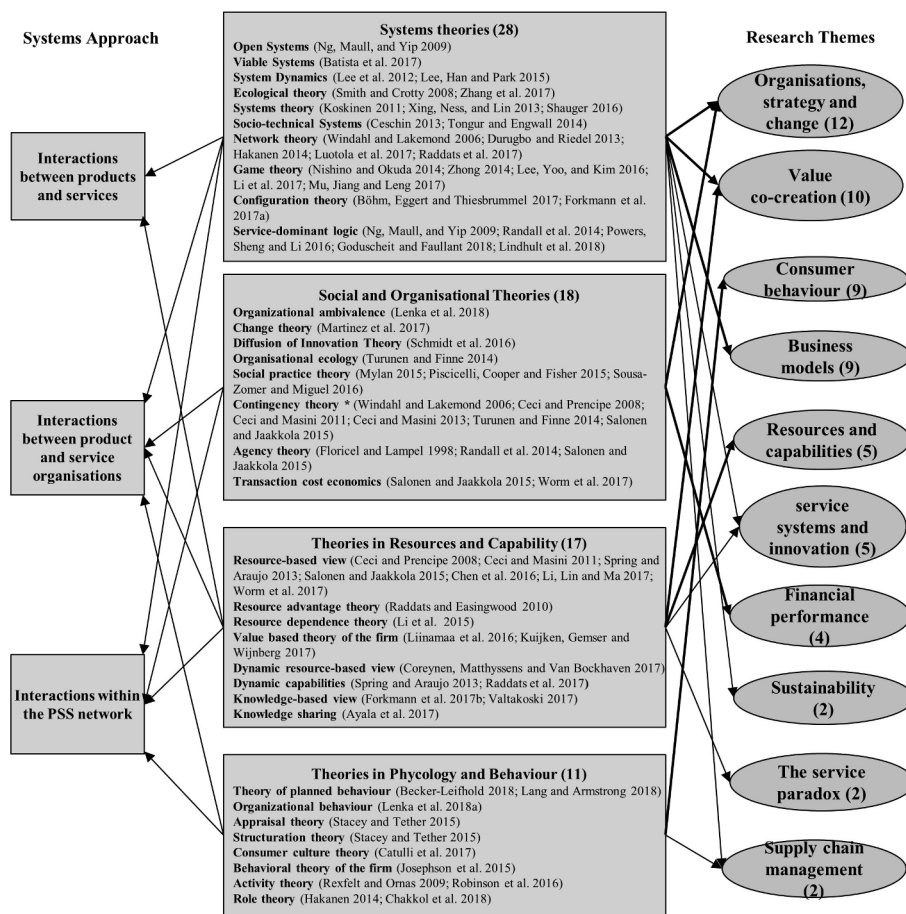


Fig. 4. PSS papers with theory development by year (till Sep. 2018).



* Contingency theory can be also grouped into systems theory

Fig. 5. The mapping of clusters of theories with the research themes and systems approach.

differentiation (i.e. separating services from product manufacturing) must be followed by an emphasis on internal integration of the resources between product and service lines.

Finally, other scholars emphasised that delivering a complete PSS goes beyond boundaries of firms involving many other actors that interact with each other in the supply network. For example, Windahl

and Lakemond (2006) continued to explain by taking the network lens that developing solutions involves high interaction and sometimes-blurred boundaries within the network, in which customer involvement and partnerships with companies providing complementary products become a necessity. Ng et al. (2009) took the open systems perspective and Raddats et al. (2017) used the lens of dynamic

capability to explain the interactivity for value co-creation. More details about how different theories were used to explain the interactions in PSS are summarised in Table 2.

Clearly, it is not necessary to apply systems theories to embrace a systems approach. Other adjacent theories, such as dynamic capability and organisational ambivalence are also useful to gain a better insight into one of these interactions. However, only very few researches such as the work of Xing et al. (2013) and Windahl and Lakemond (2006) applied one or more theories to explain all the three interactions in PSS, so that a holistic understanding of PSS can be gained. For example, Xing et al. (2013) consistently adopted the systems theory to discuss the three interactions in PSS for value co-creation. Windahl and Lakemond (2006) applied a combination of network theory and contingency theory to orchestrate the connectedness required for integrated solutions.

Based on the discussions above, a conceptual framework (Fig. 6) is constructed to illustrate the theoretical lenses for explaining PSS from a systems approach perspective. As it is said that PSS should be viewed as an open system with blurring boundaries both within PSS providers' own organisations and the whole supply network (Windahl and Lakemond, 2006; Ng et al., 2009; Chakkol et al., 2018), we argue that the four boundary conceptions (theoretical lenses) by Santos and Eisenhardt (2005) provide useful guidance for further theory development in PSS research, particularly when PSS interactions across boundaries are considered. However, the four boundary conceptions may work against each other if they are investigated individually, or when they are used to explain a specific aspect. Thus, we propose a fifth lens - the systems view - to mitigate this risk and thus harmonise the explanation. Regarding the underlying theories, we use the four clusters of theories (see Fig. 5) to show how they underpin the five theoretical views. For example, in the competence view, social and organisational theories, theories in resources and capabilities and systems theories can be applied to explain how firms gain competence in PSS offerings. This is illustrated in Fig. 6.

5. Discussions, conclusions, and research agenda

This paper is distinct from other systematic literature reviews on PSS in that we started from a 'review of reviews' to understand PSS in a more comprehensive and systemic manner. We established the big picture of PSS evolution over the last decades in a chronicle order and in a visual way, which enriches the landscape drawn by Kowalkowski et al. (2017) and Rabetino et al. (2018). We observed a three-phase development of PSS and identified, in the ongoing third phase, the emerging theme of value co-creation and the latent theme of productisation. Scholars can benefit from overseeing the connections in this big picture, which brings more opportunities for interdisciplinary communications and collaborations among broader PSS research communities. The big picture also facilitates a more holistic approach in PSS research and incentivises scholars to scrutinize their findings through different theoretical lenses that have their roots in different disciplines.

Then we investigated the progression of theory development in PSS research. Our findings show that there has been significant growth in the number of theory development papers over the last few years. Scholars from different disciplines apply an increasingly broad range of theories to underpin the research themes that we have identified in the literature. Our review also supports the fact that PSS papers with strong theory applications are more powerful than papers with weak or no theory applications in explaining how and/or why the phenomena such as service paradox and value co-creation occurs. Further, two or even more theoretical lenses can provide more explanatory power compared to a single theoretical lens (e.g. the work of Salonen and Jaakkola [2015]). We applaud this development as it addresses the concerning gaps identified by Tukker and Tischner (2006), Baines et al. (2007), Claes and Martinez (2010) and Kowalkowski et al. (2017).

Our findings are consistent with the argument of Baines et al. (2017) and Rabetino et al. (2018), who claimed that there is a steadily growing of theory on PSS. While significant strides have been made in

Table 2

Summary of how different theories underpin the systems approach in PSS.

Interactions	Arguments	Theory	Reference
Interactions between products and services	• Service content must not be seen as a stand-alone after-sales offering but as an integrated part of the total offering	Network theory	Windahl and Lakemond (2006)
	• PSS is a connected whole with a form of synergy between product and services to deliver the desired results as neither can achieve on its own	Systems theory	Xing et al. (2013)
	• Firms internalise activities of integrating products and services that are proximate to the existing resource base and interdependent on each other	Resource-based view and resource dependence	Salonen and Jaakkola (2015)
	• The product and service elements of a PSS offering should be designed simultaneously to fit each other.	Dynamic resource-based view	Coreynen et al. (2017)
Interactions between product and service organisations	• Manufacturers should consider both service infusion and service defusion	Configuration theory	Forkmann et al. (2017a)
	• Firms met organisational ambivalence during servitisation owing to co-existing product and service orientations	Organisational ambivalence	Lenka et al. (2018a)
	• Organisational differentiation (i.e. separating services from the product business) must be followed by an emphasis on integration (i.e. internal collaboration)	Contingency theory Systems theory	Windahl and Lakemond (2006) Xing et al. (2013)
	• Service and product business must be handled in an integrated manner	Configuration theory	Böhm et al. (2017)
Interactions within the PSS network	• Manufacturing firms must allocate financial, managerial, and personnel resources to the service business	Activity theory	Robinson et al. (2016)
	• Systems integrators must constantly coordinate internal and external activities	Systems theory	Ng et al. (2009) Xing et al. (2013)
	• Delivering PSS is complex interplay between various stakeholders and requires a systemic partnership for value co-creation	Dynamic capability	Raddats et al. (2017)
	• PSS actors need interactively developed capabilities for value co-creation		

(continued on next page)

Table 2 (continued)

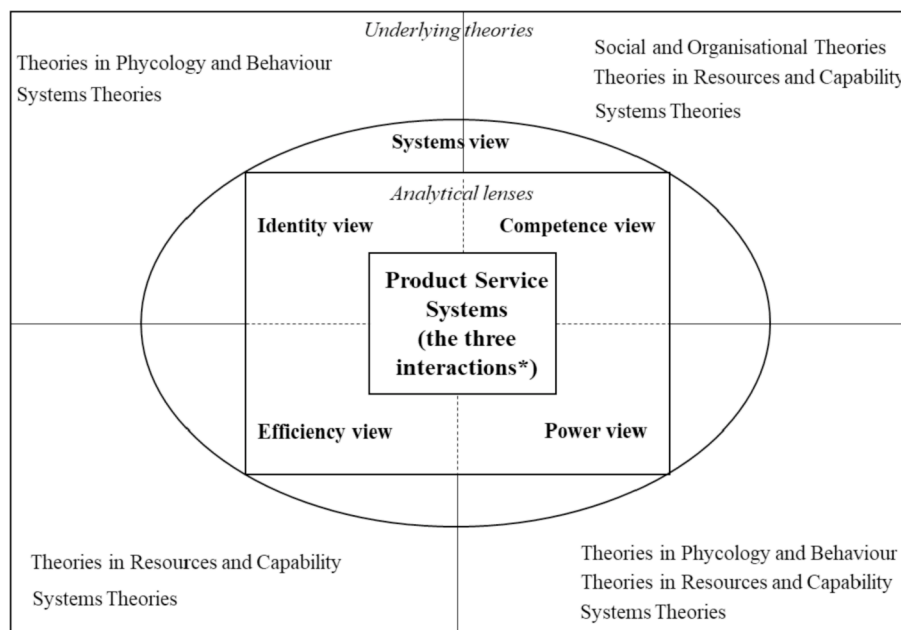
Interactions	Arguments	Theory	Reference
	<ul style="list-style-type: none"> PSS providers seek to be the central integrator of resources and to increase the power in the network 	Resource-based view and resource dependence	Salonen and Jaakkola (2015)
	<ul style="list-style-type: none"> PSS providers involve in customer's processes to interactively develop offerings 	Viable systems theory	Batista et al. (2017)
	<ul style="list-style-type: none"> Developing solutions involves high interaction and sometimes-blurred boundaries. Customer involvement and partnerships with companies providing complementary products are needed. 	Network theory	Windahl and Lakomond (2006)
	<ul style="list-style-type: none"> Boundary spanners connect organisations and enable the effective provision of solutions across the PSS supply chain 	Boundary spanning (role theory)	Chakkol et al. (2018)

establishing a theoretical foundation for PSS, further opportunities do exist for improving the comprehensiveness and deepness of this foundation. First, in line with Walker et al. (2015), our review also indicates that the majority of studies focus on theory application or theory testing in the PSS context, rather than on theory building, and that theories from psychology and organisational behaviour may have salience to explain PSS in future research. For example, research on how firms behave when facing organisation tensions during the process of integrating PSS will build organisational identity and behaviour theories. For another example, research on PSS actors' expectations from value co-creation will reveal the cognitive and incentive aspect in the PSS network. Such research will build middle-range theories to make general

predictions in the given PSS context, which is called for to address emerging issues in PSS (Rabetino et al., 2018). Second, considering that progression in theory development has been built mainly on qualitative case studies and conceptual designs, a broadening of the methodological approach to include quantitative and a mixed method designs to PSS research seems opportune.

The review also shows a theoretical shift from the focus of static resource based view (Ceci and Prencipe, 2008; Ceci and Masini, 2011; Salonen and Jaakkola, 2015; Chen et al., 2016; Li et al., 2017a, b; Worm et al., 2017) to dynamic capability and systems views (Ng et al., 2009; Spring and Araujo, 2013; Xing et al., 2013; Batista et al., 2017; Luotola et al., 2017; Raddats et al., 2017; Goduscheit and Faullant, 2018; Lindhult et al., 2018). The findings are consistent with the summary of Eloranta and Turunen (2015) and Rabetino et al. (2018). This is because a dynamic capability view is more appropriate to understand the struggles faced by firms moving into PSS as it represents an evolutionary view of firm resources and capabilities (Velamuri et al., 2011). PSS should be also viewed as a system with a form of synergy, co-capability and co-creation partnership (Ng et al., 2009; Xing et al., 2013; Batista et al., 2017).

Reflection on theories is important because theories inform how researchers or practitioners interpret and solve problems (Walker et al., 2015). Our findings indicate that many of the widely-cited applied research papers in the PSS chronicle chart lack a rigorous theoretical foundation. Examples of this include the works of Levitt (1983), Vandermerwe and Rada (1988), Quinn et al. (1990), Wise and Baumgartner (1999), Oliva and Kallenberg (2003), Porter and Heppelmann (2014), amongst others. This raises an important question about the current balance between the practical relevance (usefulness) and scientific rigor (robustness) in PSS research. Traditionally, PSS research has focussed on addressing the immediate imperative need to improve the profitability and competitiveness of manufacturers challenged by the relentless pressure to expand the market and reduce the costs of the production of goods (and services). As PSS becomes more widespread and better understood, and as the body of research is reaching a higher level of maturity, scientific rigor should follow this trend. The latter can be achieved through a more explicit application of existing organisation and management theories and, where these are unsuitable or altogether



*Interactions between products and services, interactions between product and service organisations, and interactions among the actors in the PSS supply network.

Fig. 6. The theoretical lenses for PSS research (adapted from Salonen and Jaakkola [2015]).

absent, the creating of interdisciplinary or new theories.

Finally, we find that besides the cluster of systems theories, other clusters of theories such as social and organisational theories can provide additional insights that may prove to be imperative to comprehensively adopt the systems approach in explaining the three interactions in PSS (Table 2). The systems approach was further conceptualised through the framework of five theoretical lenses (identity, competence, efficiency, power and systems, Fig. 6). This systemic analysis provided scholars with more informed understanding of PSS. However, at present, most of the research only addresses one of the interactions. We have found very few exceptions besides the work of Windahl and Lakemond (2006) and Xing et al. (2013) who looked at the interactions between the PSS components, internal organisations, and external actors. This may limit both scholars and practitioners to form a holistic overview of the PSS phenomenon, e.g. to comprehensively explain and overcome the service paradox. Thus, a systems approach is important to better understand the PSS phenomenon and to conduct rigorous research on PSS.

From the above discussion, we identified several research directions that we argue need scholars' attention to ground the PSS literature on a firmer base.

First, while servitisation has attracted significant scholarly attention in the recent years, (empirical) research on productisation has been so far largely overlooked. In our analysis, only two representative case studies of Wibowo et al. (2016) and Lahy et al. (2018) pay explicit attention to this. This is curious for the fact that most western economies (and certainly those in which the phenomenon of servitisation has gained foothold) are generally predominantly service driven economies comprising more service-based firms than product-based. Examples of productisation are emerging, including Amazon's Kindle and other own-brand products, Google's phone and self-driving car, Microsoft's PCs and virtual reality devices and CCB's (China Construction Bank) own online mall. As we discussed in Section 3.2, servitisation and productisation refer to the processes through which firms obtain PSS from a systemic offering point of view. However, in the academic context, there are many questions awaiting to be answered to mature our understandings on productisation. For example, which kind of service providers are more likely to add products to their service offerings? The non-OEM MRO service providers, or online and software giants that have advantages of digital platforms such as Amazon and Microsoft, or logistics companies that have an international network, or banks like CCB that have a large customer base?

We therefore argue that it is imperative to carry out more case studies on productisation as well as studies that identify and compare the differences and similarities between servitisation and productisation. For example, is servitisation more applicable for industrial products and Business-to-Business (B2B) model while productisation fits to consumer products and Business-to-Consumer (B2C) model? Such studies will enrich our understanding of the blended product-service offerings that lie between pure products and pure services. Wibowo et al. (2016) has made first strides in this direction with their study on how non-OEM MRO service providers in the aerospace industry adopt productisation strategy to compete with the servitisation strategy of OEMs. More theoretical consideration is furthermore required to underpin such studies on productisation, as Harkonen et al. (2015) pointed out that the borrowing suitable established theories such as institutional theory and resource based view might prove an interesting perspective. Interestingly, in their recommendations about future research, Rabetino et al. (2018) also called for increasing the use of well-established theories from adjacent mature fields and borrowing ideas from other communities to stimulate knowledge accumulation. The two views consistently emphasise the future needs of inter-disciplinary collaboration for theoretical development. Our proposed framework of the five theoretical lenses (Fig. 6) can serve as a guide for such direction.

Second, value co-creation is emerging as an interdisciplinary topic

across many fields including marketing, sustainability, service management, and business and operations management. It is increasingly interwoven with new digital technologies and platforms such as Big Data and Internet of Things (IoT) that enhance connectivity and interactivity, which is argued to be a fundamental requirement for value co-creation (Lenka et al., 2017; Rymaszewska et al., 2017). Further research is not only needed to quantify the role of data in PSS offerings and how they are shaped and maintained, but also to address highly complicated issues of data sharing and ownership between the entities that jointly provide the PSS. Further research is also needed to study the relation between data accuracy and performance of PSS and how benefits (value co-created) are distributed between contributing companies. Our review shows that value co-creation involves many aspects such as innovation, marketing, resources and capabilities, psychology and behaviour, and socio-technical systems. The contribution of all these functions is imperative for successful PSS, yet their functioning is conditional to having full and accurate data of the performance of PSS. Thus, interdisciplinary research that applies multiple theoretical lenses is required in both the role that these functions play in PSS and the data that they require to perform. New theories for value co-creation taking these aspects into account are highly encouraged.

Third, a systems approach will help to systematically study the emerging phenomenon such as the service paradox and value co-creation. Many papers investigating PSS limit their scope to the service side in the manufacturer's organisation. Insufficient emphasise is put on the interactions between products and services and interventions of customers. Further, the interactions in PSS are mainly explored from conceptual designs and sporadic, fragmented case studies. Thus, comprehensive studies that embrace different interactions in PSS are encouraged. The framework of five theoretical lenses (identity, competence, efficiency, power and systems) provides a theoretical guide for investigating PSS through a systems approach.

Fourth, the difficulties in overcoming the service paradox is a joint effect of insufficient theoretical explanation and a lack of systems approach to managing the synergy between product and service, and the tensions between product and service organisations, which directs scholars to consider the theoretical aspect and all the possible interactions in PSS by asking several questions. Which theoretical lens can best explain the service paradox? Theories in resources and capabilities, social and organisational theories, or systems theories? Will the study of organisation tensions bring in the development of emerging theories such as paradox theory (Rabetino et al., 2018)? Is the paradox owing to a lack of systemic consideration of identity, competence, efficiency, power and systems?

Each of the above identified directions provides intriguing opportunities for further research and better understanding of each will significantly strengthen the theoretical foundation of the rapidly growing body of literature on PSS.

As with any reported research, our paper is not without limitations. First, we focused on one single data source, Scopus, and peer-reviewed journal papers that are included in that database. It is therefore possible that we may have missed publications that some may deem important. Second, we only considered research publications in English, while some early works on PSS (before 1999) may be written in other languages such as Italian, French, German, Dutch and Scandinavian for example. This may have restricted us from capturing a comprehensive list of related publications. Ongoing review and scrutiny of the ever-growing body of PSS literature should address both these points.

Acknowledgments

We much appreciate the useful and insightful comments we received from the reviewers and editors from the first review onwards, which helped and encouraged us to get the paper to its current state.

Appendix A.1. The list of papers reviewed in stage I: the ‘review of reviews’ (to be continued)

Item No.	Reference	Journal	Discipline	Focus	Reviews on theory?
1	Amor et al. (2018)	JCP	Sustainability	IO (Industrial Organisation) and PSS models	No
2	Díaz-Garrido et al. (2018)	JETM	Technology and engineering	Changes in the intellectual structure of research on servitisation between 1980 and 2015	No
3	Ziaee Bigdeli et al. (2018)	PPC	Business and operations management	Performance measures assessing a manufacturer's servitisation efforts	No
4	Luz Luz Martín-Peña et al. (2018)	SC	Business and operations management	Digitalisation and servitisation of manufacturing	No
5	Rabetino et al. (2018)	IJOPM	Business and operations management	Organise and connect past research from different servitisation-related communities	Yes***
6	Green et al. (2017)	IJPE	Business and operations management	Thematic analysis of traditional and customer co-created servitisation	Yes***
7	Zhang and Banerji (2017)	IMM	Marketing	Challenges of servitisation	No
8	Kowalkowski et al. (2017)	IMM	Marketing	Past, present, and future of service growth	Yes**
9	Brax et al. (2017)	IJOPM	Business and operations management	Service modularity and architecture	No
10	Baines et al. (2017)	IJOPM	Business and operations management	Servitisation transformation from an organisational change perspective	Yes**
11	Brax and Visintin (2017)	IMM	Marketing	Meta-model of servitisation	No
12	Martín-Peña et al. (2017)	JETM	Technology and engineering	Intellectual structure of servitisation	No
13	Bigdeli et al. (2017)	CR	Sustainability	Organisational change towards servitisation	Yes**
14	Luoto et al. (2017)	IMM	Marketing	Paradigmatic assumptions of servitisation research	No
15	Harkonen et al. (2017)	JSM	Marketing	Service productisation	No
16	Annarelli et al. (2016)	JCP	Sustainability	Definitions, benefits, barriers, drivers, and economic, environmental & social impact	Yes**
17	Pigosso and McAloone (2016)	CIRP JMST	Technology and engineering	Best practices for PSS development in terms of environmental sustainability	No
18	Bertoni et al. (2016)	CIRP JMST	Technology and engineering	Value driven design in PSS	No
19	Qu et al. (2016)	Cii	Technology and engineering	Design, evaluation, and methodologies	No
20	Sabbagh et al. (2016)	TQMBE	Business and operations management	Methodology implications in automotive PSS	No
21	Nudurupati et al. (2016)	JSTP	Service management	Challenges of servitisation	No
22	Gebauer et al. (2016)	UBR	Business and operations management	The past, present, and future of service research in product-oriented companies	Yes*
23	Weeks and Benade (2015)	TiS	Technology and engineering	A generic servitisation framework	No
24	Vasanthan et al. (2015)	JiIS	Technology and engineering	PSS design	No
25	Reim et al. (2015)	JCP	Sustainability	PSS business models and 5 sets of tactical practices	No
26	Eloranta and Turunen (2015)	JSM	Service management	Links between the service infusion and strategy literature	Yes***
27	Plepys et al. (2015)	JCP	Sustainability	The role of public policy on servicing	No
28	Harkonen et al. (2015)	IJPE	Business and operations management	Productisation	Yes*
29	Grubic (2014)	JMTM	Technology and Engineering	The role of RMT in servitized strategies	No
30	Salminen et al. (2014)	JBIM	Marketing	Type of relevance on integrated solutions	No
31	Lightfoot et al. (2013)	IJOPM	Business and operations management	Communities contributing to servitisation	No
32	Boehm and Thomas (2013)	JCP	Sustainability	Definitions across disciplines	No
33	Park et al. (2012)	JETM	Marketing	Taxonomy and typology	No
34	Vasanthan et al. (2012)	JED	Technology and engineering	Definition and design methodologies	No

Note: Yes* Only mentioning theories; Yes** Some details on theories; Yes*** More detailed discussions on theories.

Appendix A.1. The list of papers reviewed in stage I: the ‘review of reviews’

Item No.	Reference	Journal	Discipline	Focus	Reviews on theory?
35	Biege et al. (2012)	IJOPM	Business and operations management	Process modelling	No
36	Cavalieri and Pezzotta (2012)	Cii	Technology and engineering	PSS engineering	Yes*
37	Bankole et al. (2012)	IJCIM	Technology and engineering	Product-service system affordability in defence and aerospace industries	No
38	Wang et al. (2011)	IJPR	Business and operations management	Definition, development & framework	No
39	Velamuri et al. (2011)	Jfb	Business and operations management	Hybrid value creation	Yes***
40	Berkovich et al. (2011)	BISE	Business and operations management	Requirements engineering	No
41	Nordin and Kowalkowski (2010)	JSM	Service management	A framework of solutions offerings	No

(continued on next page)

(continued)

Item No.	Reference	Journal	Discipline	Focus	Reviews on theory?
42	Baines et al. (2009)	IJOPM	Business and operations management	Servitisation definition, origin and drivers	No
43	Pawar et al. (2009)	IJOPM	Business and operations management	Product, service and organisation (PSO)	No
44	Spring and Araujo (2009)	IJOPM	Business and operations management	Respective roles of products and services	Yes**
45	Sakao et al. (2009)	JMTM	Technology and engineering	Research and practices of PSS development	No
46	Baines et al. (2007)	PIB	Technology and engineering	Definitions, features, benefits, barriers and tools & methodologies	Yes*
47*	Leoni (2015)	RESER 2015	Service management	Servitisation and productisation	No
48*	Schmenner (2009)	IJOPM	Business and operations management	The historical integration of manufacturing with service in the USA	Yes**
49*	Tukker and Tischner (2006)	JCP	Sustainability	PSS development	Yes**
50*	Mont (2002)	JCP	Sustainability	Concepts, benefits, drivers and barriers	Yes*
51**	Briscoe et al. (2011)	EMJ	Business and operations management	Different lenses for understanding complex service systems	Yes***

* retrieved by citation analysis; ** retrieved from Stage II review

BISE: Business & Information Systems Engineering; CIRP JMST: CIRP Journal of Manufacturing Science and Technology; CiI: Computers in Industry; IJCIM: International Journal of Computer Integrated Manufacturing; IJOPM: International Journal of Operations & Production Management; IJPE: International Journal of Production Economics; IMM: Industrial Marketing Management; JBIM: Journal of Business and Industrial Marketing; JCP: Journal of Cleaner Production; JED: Journal of Engineering Design; JETM: Journal of Engineering and Technology Management; JIIS: Journal of the Indian Institute of Science; JfB: Journal für Betriebswirtschaft; JMTM: Journal of Manufacturing Technology Management; JSM: Journal of Service Management; JSTP: Journal of Service Theory and Practice;; PIB: The Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture; PPC: Production Planning and Control; RESER 2015: The 25th Annual RESER Conference “Innovative Services in the 21st Century” Proceedings (Copenhagen); SC: Strategic Change; TiS: Technology in Society; TQMBE: Total Quality Management & Business Excellence; UBR: Universia Business Review.

Appendix A.2. The full list of papers reviewed in stage II of PSS theoretical progress (to be continued)

Item no.	Author & year	Journal (Abbr.)	Methodology	Research theme	Theory development		
					Level	Type	Theories
1	Becker-Leifhold (2018)	JCP	Survey	Consumer behaviour	Yes***	T	Theory of planned behaviour
2	Lang and Armstrong (2018)	JFMM	Survey	Consumer behaviour	Yes***	T	Theory of planned behaviour
3	Lindhult et al. (2018)	SB	Conceptual	Business models	Yes***	A	Service-dominant logic
4	Goduscheit and Faullant (2018)	JPIM	Case study	Service systems and innovation	Yes***	A	Service-dominant logic
5	Lenka et al. (2018a)	JBR	Case study	Organisations, strategy and change	Yes***	A	Organisational behaviour
6	Lenka et al. (2018b)	IJOPM	Case study	Organisations, strategy and change	Yes***	A	Organisational ambivalence
7	Chakkol et al. (2018)	IJOPM	Case study	Supply chain management	Yes***	A	Boundary spanning
8	Ayala et al. (2017)	IJPE	Case study	Business models	Yes***	A	Knowledge sharing
9	Batista et al. (2017)	IJPE	Case study	Value co-creation	Yes***	A	Viable systems theory
10	Martinez et al. (2017)	IJPE	Case study	Organisations, strategy and change	Yes***	A	Change theory
11	Forkmann et al. (2017a)	JSR	Case study	Business models	Yes***	A	Configuration theory
12	Luotola et al. (2017)	IMM	Case study	Value co-creation	Yes***	A	Actor-network theory
13	Worm et al. (2017)	JAMC	Case study	Financial performance	Yes***	A	Resource-based view and transaction cost economics
14	Zhang et al. (2017)	IJPR	Conceptual	Business models	Yes**	A	Ecological theory
15	Li et al. (2017a, b)	IEEE TSMCS	Conceptual	Service systems and innovation	Yes*	A	Game theory
16	Mu et al. (2017)	IJPR	Conceptual	Business models	Yes*	A	Game theory
17	Catulli et al. (2017)	JCP	Conceptual	Consumer behaviour	Yes***	A	Consumer culture theory
18	Valtakoski (2017)	IMM	Conceptual	Service paradox	Yes**	A	Knowledge-based view
19	Kuijken et al. (2017)	IMM	Conceptual	Service paradox	Yes**	A	Value based theory of the firm
20	Coreynen et al. (2017)	IMM	Case Study	Resources and capabilities	Yes**	A	Dynamic resource-based view
21	Li et al. (2017a, b)	IJTPM	Case Study	Resources and capabilities	Yes***	A	Resource-based view
22	Forkmann et al. (2017b)	IMM	Conceptual	Business models	Yes**	A	Knowledge-based view
23	Raddats et al. (2017)	IJOPM	Case study	Value co-creation	Yes***	A	Dynamic capability theory and network theory
24	Böhm et al. (2017)	IMM	Survey	Financial performance	Yes***	T	Configuration theory
25	Sousa-Zomer and Miguel (2016)	CIRP JMST	Conceptual	Consumer behaviour	Yes**	A	Social practice theory
26	Schmidt et al. (2016)	CIRP JMST	Case study	Consumer behaviour	Yes***	A	Diffusion of Innovation Theory
27	Liinamaa et al. (2016)	IMM	Action research	Organisations, strategy and change	Yes**	A	Value based theory of the firm
28	Powers et al. (2016)	IMM	Case study	Value co-creation	Yes**	A	Service-dominant logic
29	Robinson et al. (2016)	RTM	Case study	Organisations, strategy and change	Yes**	A	Activity theory

(continued on next page)

(continued)

Item no.	Author & year	Journal (Abbr.)	Methodology	Research theme	Theory development		
					Level	Type	Theories
30	Lee et al. (2016)	IJPE	Case study	Organisations, strategy and change	Yes**	A	Game theory
31	Chen et al. (2016)	IJPE	Survey	Service systems and innovation	Yes*	T	Resource-based view
32	Shauger (2016)	IJSSE	Conceptual	Service systems and innovation	Yes***	A	Systems theory
33	Salonen and Jaakkola (2015)	IMM	Case study	Resources and capabilities	Yes***	A	Resource-based view, agency theory, contingency theory, etc.
34	Li et al. (2015)	IJTPM	Survey	Value co-creation	Yes***	T	Resource dependence theory
35	Mylan (2015)	JCP	Case study	Consumer behaviour	Yes**	A	Social practice theory
36	Lee et al. (2015)	CIE	Conceptual	Business models	Yes***	A	System dynamics
37	Stacey and Tether (2015)	DS	Conceptual	Consumer behaviour	Yes***	A	Appraisal theory and structuration theory
38	Piscicelli et al. (2015)	JCP	Case study	Consumer behaviour	Yes***	A	Social practice theory
39	Josephson et al. (2015)	JSR	Archival	Financial performance	Yes**	A	Behavioural theory of the firm
40	Randall et al. (2014)	IJPDLM	Survey	Supply chain management	Yes***	T	Service-dominant logic, theory of incentives and agency theory
41	Turunen and Finne (2014)	EMJ	Conceptual	Organisations, strategy and change	Yes***	A	Theory of organisational ecology, institutional theory and contingency theory
42	Hakanen (2014)	IMM	Case study	Value co-creation	Yes***	A	Organisational learning theory, social network theory and role theory
43	Nishino and Okuda (2014)	JJIMA	Conceptual	Business models	Yes***	A	Game theory
44	Tongur and Engwall (2014)	Technovation	Case study	Business models	Yes***	A	Socio-technical system
45	Zhong (2014)	JIEM	Conceptual	Financial performance	Yes**	A	Game theory
46	Xing et al. (2013)	JCP	Conceptual	Value co-creation	Yes***	A	Systems theory
47	Durugbo and Riedel (2013)	IJPR	Conceptual	Value co-creation	Yes*	A	Network theory
48	Ceci and Masini (2013)	IJBSR	Survey	Organisations, strategy and change	Yes***	T	Contingency theory
49	Ceschin (2013)	JCP	Case study	Value co-creation	Yes**	A	Socio-technical systems
50	Spring and Araujo (2013)	IMM	Conceptual	Service systems and innovation	Yes***	A	Resource-based view and dynamic capability
51	Lee et al. (2012)	JCP	Conceptual	Sustainability	Yes***	A	System Dynamics
52	Ceci and Masini (2011)	ICC	Survey	Resources and capabilities	Yes***	T	Resource-based view and contingency theory
53	Koskinen (2011)	IJPOM	Conceptual	Organisations, strategy and change	Yes***	A	Systems theory
54	Raddats and Easingwood (2010)	IMM	Case study	Organisations, strategy and change	Yes***	A	Resource advantage theory
55	Ng et al. (2009)	EMJ	Case study	Value co-creation	Yes***	A	Open systems and service-dominant logic
56	Rexfelt and Ornas (2009)	JMTM	Conceptual	Consumer behaviour	Yes**	A	Activity theory
57	Smith and Crotty (2008)	BSE	Case study	Sustainability	Yes**	A	Ecological modernisation
58	Ceci and Prencipe (2008)	IAI	Case study	Resources and capabilities	Yes***	A	Contingency theory and resource-based view
59	Windahl and Lakemond (2006)	IMM	Case study	Organisations, strategy and change	Yes***	A	Network theory and contingency theory
60	Florice and Lampel (1998)	IJTM	Case study	Organisations, strategy and change	Yes***	A	Agency theory

Note: Yes* Only mentioning theories; Yes** Some details on theories; Yes*** More detailed discussions on theories.

T: theory testing; A: theory application; B: theory building.

BSE: Business Strategy and the Environment; CIRP JMST: CIRP Journal of Manufacturing Science and Technology; CIE: Computers and Industrial Engineering; DS: Design Studie; EMJ: European Management Journal; IAI: Industry and Innovation; JIE: Journal of Industrial Ecology; IEEE TSMCS: IEEE Transactions on Systems, Man, and Cybernetics: Systems; IJBSR: International Journal of Business and Systems Research; IJPOM: International Journal of Project Organisation and Management; IJPR: International Journal of Production Research; IJPDLM: International Journal of Physical Distribution and Logistics Management; IJSSE: International Journal of System of Systems Engineering; IJTM: International Journal of Technology Management; IJTPM: International Journal of Technology, Policy and Management; SC: Strategic Change; CMR: California Management Review; JOM: Journal of Operations Management; ICC: Industrial and Corporate Change; IJPE: International Journal of Production Economics; IJOPM: International Journal of Operations & Production Management; TIS: Technology in Society; PPC: Production Planning & Control; IMM: Industrial Marketing Management; BPMJ: Business Process Management Journal; JCSM: Journal of Competences, Strategy & Management; JJIMA: Journal of Japan Industrial Management Association; JSM: Journal of Service Management; JM: Journal of Marketing; SCM: Supply Chain Management: An International Journal; RTM: Research-Technology Management; JSR: Journal of Service Research; DI: Design Issues; JCP: Journal of Cleaner Production; IJCM: International Journal of Computer Integrated Manufacturing; JED: Journal of Engineering Design; JMTM: Journal of Manufacturing Technology Management; ISeB: Information Systems & e-Business Management; CME: Construction Management and Economics; PMJ: Project Management Journal; CII: Computers in Industry; CAIE: Computers and Industrial Engineering; IJAMT: International Journal of Advanced Manufacturing Technology; JAMC: Journal of the Academy of Marketing Science; JBBM: Journal of Business-to-Business Marketing; JBR: Journal of Business Research; JIEM: Journal of Industrial Engineering and Management; JFMM: Journal of Fashion Marketing and Management; JPIM: Journal of Product Innovation Management; RP: Research Policy; SB: Service Business.

References

- Agri, J., Andersson, E., Ashkin, A., Soderstrom, J., 1999. Selling Functions. CPM, Gotherburg.
- Amor, M. Ben, Lindahl, M., Frankelius, P., Abdennebi, H. Ben, 2018. Revisiting industrial organization: product service systems insight. *J. Clean. Prod.*
- Annarelli, A., Battistella, C., Nonino, F., 2016. Product service system: a conceptual framework from a systematic review. *J. Clean. Prod.* 139, 1011–1032.

- Ayala, N.F., Paslauskis, C.A., Ghezzi, A., Frank, A.G., 2017. Knowledge sharing dynamics in service suppliers' involvement for servitization of manufacturing companies. *Int. J. Prod. Econ.* 193, 538–553.
- Baines, T., Lightfoot, H., 2013. Servitization of the manufacturing firm: Exploring the operations practices and technologies that deliver advanced services. *Int. J. Oper. Prod. Manag.* 34, 2–35.
- Baines, T., Lightfoot, H., Benedettini, O., Kay, J., 2009. The servitization of manufacturing: a review of literature and reflection on future challenges. *Int. J. Oper. Prod. Manag.* 20, 547–567.
- Baines, T., Lightfoot, H., Steve, E., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J., Angus, J., Bastl, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I., Wilson, H., 2007. State-of-the-art in product service-systems. *Proc. Inst. Mech. Eng. B J. Eng. Manuf.* 221, 1543–1552.
- Baines, T., Ziaee, A., Bustinza, O.F., Guang, V., Baldwin, J., Ridgway, K., 2017. Servitization: revisiting the state-of-the-art and research priorities. *Int. J. Oper. Prod. Manag.* 37, 256–278.
- Bankole, O.O., Roy, R., Shehab, E., Cheruvu, K., Johns, T., 2012. Product-service system affordability in defence and aerospace industries: state-of-the-art and current industrial practice. *Int. J. Comput. Integr. Manuf.*
- Bartolomeo, M., Dal Maso, D., De Jong, P., Eder, P., Groenewegen, P., Hopkinson, P., James, P., Nijhuis, L., Scholl, G., Slob, A., Zaring, O., 2003. Eco-efficient producer services - what are they, how do they benefit customers and the environment and how likely are they to develop and be extensively utilised? *J. Clean. Prod.* 11, 829–837.
- Batista, L., Davis-Poynter, S., Ng, I., Maull, R., 2017. Servitization through outcome-based contract – a systems perspective from the defence industry. *Int. J. Prod. Econ.* 192, 133–143.
- Becker-Leifhold, C.V., 2018. The role of values in collaborative fashion consumption - a critical investigation through the lenses of the theory of planned behavior. *J. Clean. Prod.* 199, 781–791.
- Benedettini, O., Neely, A., Swink, M., 2015. Why do servitized firms fail? A risk-based explanation. *Int. J. Oper. Prod. Manag.* 35, 946–979.
- Berkovich, M., Leimeister, J.M., Krcmar, H., 2011. Requirements engineering for product service systems - a state of the art analysis. *Bus. Inf. Syst. Eng.* 3, 369–380.
- Bertoni, A., Bertoni, M., Panarotto, M., Johansson, C., Larsson, T.C., 2016. Value-driven product service systems development: methods and industrial applications. *CIRP J. Manuf. Sci. Technol.* 15, 42–55.
- Biege, S., Lay, G., Buschak, D., 2012. Mapping service processes in manufacturing companies: industrial service blueprinting manufacturing companies: industrial service blueprinting. *Int. J. Oper. Prod. Manag.* 32, 932–957.
- Bigdeli, A., Baines, T., Bustinza, O.F., Guang Shi, V., 2017. Organisational change towards servitization: a theoretical framework. *Compet. Rev. Int. Bus. J.* 27, 12–39.
- Boehm, M., Thomas, O., 2013. Looking beyond the rim of one's teacup: a multidisciplinary literature review of product-service systems in information systems, business management, and engineering & design. *J. Clean. Prod.* 51, 245–260.
- Böhm, E., Eggert, A., Thiesbrummel, C., 2017. Service transition: a viable option for manufacturing companies with deteriorating financial performance? *Ind. Mark. Manag.* 60, 101–111.
- Brax, S., 2005. A manufacturer becoming service provider – challenges and a paradox. *Manag. Serv. Qual.: Int. J.* 15, 142–155.
- Brax, S., Visintin, F., 2017. Meta-model of servitization: the integrative profiling approach. *Ind. Mark. Manag.* 60, 17–32.
- Brax, S.A., Bask, A., Hsuan, J., Voss, C., 2017. Service modularity and architecture – an overview and research agenda. *Int. J. Oper. Prod. Manag.* 37, 686–702.
- Briscoe, G., Keränen, K., Parry, G., 2011. Understanding complex service systems through different lenses: an overview. *Eur. Manag. J.* 30, 418–426.
- Bustinza, O.F., Vendrell-Herrero, F., Baines, T., 2017. Service implementation in manufacturing: an organisational transformation perspective. *Int. J. Prod. Econ.* 192, 1–8.
- Buxton, I., Hodgkiss, S.W.J., King, G.D., 1997. Deployment and support of complex integrated solutions. *BT Technol. J.* 15, 116–122.
- Catulli, M., Cook, M., Potter, S., 2017. Consuming use orientated product service systems: a consumer culture theory perspective. *J. Clean. Prod.* 141, 1186–1193.
- Cavaleri, S., Pezzotta, G., 2012. Product-service systems engineering: state of the art and research challenges. *Comput. Ind.* 63, 278–288.
- Ceci, F., Masini, A., 2013. Specialised capabilities in integrated solutions: the role of fit. *Int. J. Bus. Syst. Res.* 7, 395–411.
- Ceci, F., Masini, A., 2011. Balancing specialized and generic capabilities in the provision of integrated solutions. *Ind. Corp. Chang.* 20, 91–131.
- Ceci, F., Prencipe, A., 2008. Configuring capabilities for integrated solutions: evidence from the IT sector. *Ind. Innov.* 15, 277–296.
- Ceschin, F., 2013. Critical factors for implementing and diffusing sustainable product-service systems: insights from innovation studies and companies' experiences. *J. Clean. Prod.* 45, 74–88.
- Chakkol, M., Karatzas, A., Johnson, M., Godsell, J., 2018. Building bridges: boundary spanners in servitized supply chains. *Int. J. Oper. Prod. Manag.* 38, 579–604.
- Chen, K.-H., Wang, C.-H., Huang, S.-Z., Shen, G.C., 2016. Service innovation and new product performance: the influence of market-linking capabilities and market turbulence. *Int. J. Prod. Econ.* 172, 54–64.
- Claes, B., Martinez, V., 2010. Challenges in transforming manufacturers into integrated product-service providers. In: POMS 21st Annual Conference (Vancouver, British Columbia, Canada).
- Coreynen, W., Matthyssens, P., Van Bockhaven, W., 2017. Boosting servitization through digitization: pathways and dynamic resource configurations for manufacturers. *Ind. Mark. Manag.* 60, 42–53.
- Corley, K.G., Gioia, D. a., 2011. Building theory about theory: what constitutes a theoretical contribution? *Acad. Manag. Rev.* 36, 12–32.
- Davies, A., Brady, T., Hobday, M., 2006. Charting a path toward integrated solutions. *MIT Sloan Manag. Rev.* 43, 39–48.
- Díaz-Garrido, E., Pinillos, M.J., Soriano-Pinar, I., García-Magro, C., 2018. Changes in the intellectual basis of servitization research: a dynamic analysis. *J. Eng. Technol. Manag.* 48, 1–14.
- Durugbo, C., Riedel, J.C.K.H., 2013. Readiness assessment of collaborative networked organisations for integrated product and service delivery. *Int. J. Prod. Res.* 51, 598–613.
- Eloranta, V., Turunen, T., 2015. Seeking competitive advantage with service infusion: a systematic literature review. *J. Serv. Manag.* 26, 394–425.
- Falagas, M.E., Pitsouni, E.I., Malietzis, G.A., Pappas, G., 2008. Comparison of PubMed, Scopus, web of science, and Google scholar: strengths and weaknesses. *FASEB (Fed. Am. Soc. Exp. Biol.) J.* 22, 338–342.
- Fang, E.E., Palmatier, R.W., Steenkamp, J.E.M., 2008. Effect of service transition strategies on firm value. *J. Mark.* 72, 1–14.
- Florinel, S., Lampel, J., 1998. Innovative contractual structures for interorganizational systems. *Int. J. Technol. Manag.* 16, 193–206.
- Forkmann, S., Henneberg, S.C., Witell, L., Kindström, D., 2017a. Driver configurations for successful service infusion. *J. Serv. Res.* 20, 275–291.
- Forkmann, S., Ramos, C., Henneberg, S.C., Naudé, P., 2017b. Understanding the service infusion process as a business model reconfiguration. *Ind. Mark. Manag.* 60, 151–166.
- Gebauer, H., Fleisch, E., Friedli, T., 2005. Overcoming the service paradox in manufacturing companies. *Eur. Manag. J.* 23, 14–26.
- Gebauer, H., Joncourt, S., Saul, C., 2016. Services in product-oriented companies: past, present, and future | Servicios en empresas orientadas a productos: pasado, presente y futuro. *Universia Bus. Rev.* 32–53, 2016.
- Goduscheit, R., Faullant, R., 2018. Paths toward radical service innovation in manufacturing companies-A service-dominant logic perspective. *J. Prod. Innov. Manag.* 35, 701–719.
- Goedkoop, M., Halen, C. van, Riele, H., Rommens, P., 1999. Product Service Systems , Ecological and Economic Basics. PiMC-Stoorm CS-PRé Consultants, Netherlands.
- Green, M.H., Davies, P., Ng, I.C.L., 2017. Two strands of servitization: a thematic analysis of traditional and customer co-created servitization and future research directions. *Int. J. Prod. Econ.* 192, 40–53.
- Grubic, T., 2014. Servitization and remote monitoring technology A literature review and research agenda. *J. Manuf. Technol. Manag.* 25, 100–124.
- Hakanen, T., 2014. Co-creating integrated solutions within business networks: The KAM team as knowledge integrator. *Ind. Mark. Manag.* 43, 1195–1203.
- Harkonen, J., Haapasalo, H., Hanninen, K., 2015. Productisation: a review and research agenda. *Int. J. Prod. Econ.* 164, 65–82.
- Harkonen, J., Tolonen, A., Haapasalo, H., 2017. Service productisation: systematising and defining an offering. *J. Serv. Manag.* 28, 936–971.
- Hinterberger, F., Kranendonk, S., Welfens, M.J., Schmidt-Bleek, F., 1994. Increasing Resource Productivity through Eco-Efficient Services, Eco-Efficient Services Workshop at the Wuppertal Institute, Wuppertal.
- Johnson, M., Mena, C., 2008. Supply chain management for servitized products: a multi-industry case study. *Int. J. Prod. Econ.* 114, 27–39.
- Josephson, B.W., Johnson, J.L., Mariadoss, B.J., Cullen, J., 2015. Service transition strategies in manufacturing: implications for firm risk. *J. Serv. Res.* 19, 142–157.
- Kastalli, I.V., Looy, B. Van, 2013. Servitization: disentangling the impact of service business model innovation on manufacturing firm performance. *J. Oper. Manag.* 31, 169–180.
- Koskinen, K.U., 2011. Project-based companies as learning organisations: systems theory perspective. *Int. J. Proj. Organisat. Manag.* 3, 91–106.
- Kowalkowski, C., Gebauer, H., Oliva, R., 2017. Service growth in product firms: past, present, and future. *Ind. Mark. Manag.* 60, 82–88.
- Kowalkowski, C., Windahl, C., Kindström, D., Gebauer, H., 2015. What service transition? Rethinking established assumptions about manufacturers' service-led growth strategies. *Ind. Mark. Manag.* 45, 59–69.
- Kuijken, B., Gemser, G., Wijnberg, N.M., 2017. Effective product-service systems: a value-based framework. *Ind. Mark. Manag.* 60, 33–41.
- Lahy, A., Li, A.Q., Found, P., Syntetos, A., Wilson, M., Ayiomamitou, N., 2018. Developing a product-service system through a productisation strategy: a case from the 3PL industry. *Int. J. Prod. Res.* 56, 2233–2249.
- Lang, C., Armstrong, C.M.J., 2018. Fashion leadership and intention toward clothing product-service retail models. *J. Fashion. Manag.* 22, 571–587.
- Lee, S., Geum, Y., Lee, H., Park, Y., 2012. Dynamic and multidimensional measurement of product-service system (PSS) sustainability: a triple bottom line (TBL)-based system dynamics approach. *J. Clean. Prod.* 32, 173–182.
- Lee, S., Han, W., Park, Y., 2015. Measuring the functional dynamics of product-service system: a system dynamics approach. *Comput. Ind. Eng.* 80, 159–170.
- Lee, S., Yoo, S., Kim, D., 2016. When is servitization a profitable competitive strategy? *Int. J. Prod. Econ.* 173, 43–53.
- Lenka, S., Parida, V., Sjödin, D.R., Wincent, J., 2018a. Towards a multi-level servitization framework: conceptualizing ambivalence in manufacturing firms. *Int. J. Oper. Prod. Manag.* 38, 810–827.
- Lenka, S., Parida, V., Sjödin, D.R., Wincent, J., 2018b. Exploring the microfoundations of servitization: how individual actions overcome organizational resistance. *J. Bus. Res.* 88, 328–336.

- Lenka, S., Parida, V., Wincent, J., 2017. Digitalization capabilities as enablers of value Co-creation in servitizing firms. *Psychol. Mark.* 34, 92–100.
- Leoni, L., 2015. Servitization and Productization: two faces of the same coin?. In: *The 25th Annual RESER Conference on Innovative Services in the 21st Century* (Copenhagen, Denmark).
- Levitt, T., 1983. After the sale is over. *Harv. Bus. Rev.* 87–93.
- Lewis, M.W., Grimes, A.J., 1999. Metatriangulation: building theory from multiple paradigms. *Acad. Manag. Rev.* 24, 672–690.
- Li, A.Q., Found, P., 2017. Towards Sustainability: PSS, Digital Technology and Value Co-creation. *Procedia CIRP* 64, 79–84.
- Li, H., Ji, Y., Chen, L., Jiao, R.J., 2017a. Bi-level coordinated configuration optimization for product-service system modular design. *IEEE Trans. Syst., Man, Cybernet.: Systems* 47, 537–554.
- Li, J., Lin, L., Ma, L., 2017b. The transformation mechanism of servitisation in China: a resource-based perspective. *Int. J. Technol. Policy Manag.* 17, 240–261.
- Li, J.H., Zhu, W.J., Lin, L., Ma, L.Y., Huang, Q.B., 2015. Manufacturer-user dependence, relationship learning and manufacturer servitisation in China. *Int. J. Technol. Policy Manag.* 15, 311–320.
- Lightfoot, H., Baines, T., Smart, P., 2013. The servitization of manufacturing: A systematic literature review of interdependent trends. *Int. J. Oper. Prod. Manag.* 33, 1408–1434.
- Liinamaa, J., Viljanen, M., Hurmerinta, A., Ivanova-Gongne, M., Luotola, H., Gustafsson, M., 2016. Performance-based and functional contracting in value-based solution selling. *Ind. Mark. Manag.* 59, 37–49.
- Lindahl, M., Sundin, E., Sakao, T., 2014. Environmental and economic benefits of Integrated Product Service Offerings quantified with real business cases. *J. Clean. Prod.* 64, 288–296.
- Lindhult, E., Chirumalla, K., Oghazi, P., Parida, V., 2018. Value logics for service innovation: practice-driven implications for service-dominant logic. *Serv. Bus.* 12, 457–481.
- Luoto, S., Brax, S.A., Kohtamäki, M., 2017. Critical meta-analysis of servitization research: constructing a model-narrative to reveal paradigmatic assumptions. *Ind. Mark. Manag.* 60, 89–100.
- Luotola, H., Hellström, M., Gustafsson, M., Perminova-Harikoski, O., 2017. Embracing uncertainty in value-based selling by means of design thinking. *Ind. Mark. Manag.* 65, 59–75.
- Lütjen, H., Tietze, F., Schultz, C., 2017. Service transitions of product-centric firms: an explorative study of service transition stages and barriers in Germany's energy market. *Int. J. Prod. Econ.* 192, 106–119.
- Martín-Peña, M., Díaz-Garrido, E., Sánchez-López, J.M., 2018. The digitalization and servitization of manufacturing: a review on digital business models. *Strateg. Chang.* 27, 91–99.
- Martín-Peña, M.L., Pinillos, M.J., Reyes, L.E., 2017. The intellectual basis of servitization: a bibliometric analysis. *J. Eng. Technol. Manag.* 43, 83–97.
- Martinez, V., Neely, A., Velu, C., Leinster-Evans, S., Bisessar, D., 2017. Exploring the journey to services. *Int. J. Prod. Econ.* 192, 66–80.
- Meijkamp, R., 1998. Changing consumer behaviour through eco-efficient services: an empirical study of car sharing in The Netherlands. *Bus. Strateg. Environ.* 7, 234–244.
- Mont, O., 2002. Clarifying the concept of product-service system. *J. Clean. Prod.* 10, 237–245.
- Mont, O., 2000. *Product-Service Systems* (Stockholm).
- Mu, H., Jiang, P., Leng, J., 2017. Costing-based coordination between mt-IPSS customer and providers for job shop production using game theory. *Int. J. Prod. Res.* 55, 430–446.
- Mylan, J., 2015. Understanding the diffusion of Sustainable Product-Service Systems: insights from the sociology of consumption and practice theory. *J. Clean. Prod.* 97, 13–20.
- Neely, A., 2008. Exploring the financial consequences of the servitization of manufacturing. *Oper. Manag. Res.* 1, 103–118.
- Ng, I.C., Ding, X., Yip, N., 2013. Outcome-based contracts as new business model: the role of partnership and value-driven relational assets. *Ind. Mark. Manag.* 42, 730–743.
- Ng, I.C., Maull, R., Yip, N., 2009. Outcome-based contracts as a driver for systems thinking and service-dominant logic in service science: evidence from the defence industry. *Eur. Manag. J.* 27, 377–387.
- Nishino, N., Okuda, K., 2014. Analysis of membership-type service in manufacturing using integrating approach with economic experiments and multi-agent simulation. *J. Jpn. Ind. Manag. Assoc.* 65, 168–179.
- Nordin, K., Kowalkowski, C., 2010. Solutions offerings: a critical review and reconceptualisation. *J. Serv. Manag.* 21, 441–459.
- Nudurupati, S.S., Lascelles, D., Wright, G., Yip, N., 2016. Eight challenges of servitisation for the configuration, measurement and management of organisations. *J. Serv. Theory Practice* 26, 745–763.
- Oliva, R., Kallenberg, R., 2003. Managing the transition from products to services. *Int. J. Serv. Ind. Manag.* 14, 160–172.
- Park, Y., Geum, Y., Lee, H., 2012. Toward integration of products and services: taxonomy and typology. *J. Eng. Technol. Manag.* 29, 528–545.
- Pawar, K.S., Beltagui, A., Riedel, J.C.K.H., 2009. The PSO triangle: designing product, service and organisation to create value. *Int. J. Oper. Prod. Manag.* 29, 468–493.
- Pigosso, D.C.A., McAloone, T.C., 2016. Maturity-based approach for the development of environmentally sustainable product/service-systems. *CIRP J. Manuf. Sci. Technol.* 15, 33–41.
- Piscicelli, L., Cooper, T., Fisher, T., 2015. The role of values in collaborative consumption: insights from a product-service system for lending and borrowing in the UK. *J. Clean. Prod.* 97, 21–29.
- Pittaway, L., Robertson, M., Munir, K., Denyer, D., Neely, A., 2004. Networking and innovation: a systematic review of the evidence. *Int. J. Manag. Rev.* 5/6, 137–168.
- Plepyś, A., Heiskanen, E., Mont, O., 2015. European policy approaches to promote servitizing. *J. Clean. Prod.* 97, 117–123.
- Porter, M., Heppelmann, J., 2015. How smart, connected products are transforming companies. *Harv. Bus. Rev.* 97–114.
- Porter, M., Heppelmann, J., 2014. How smart, connected products are transforming competition. *Harv. Bus. Rev.* 65–88.
- Posselt, T., Roth, A., 2017. Microfoundations of organizational competence for servitization. *J. Competences, Strategy, Manag.* 9, 85–107.
- Powers, T.L., Sheng, S., Li, J.J., 2016. Provider and relational determinants of customer solution performance. *Ind. Mark. Manag.* 56, 14–23.
- Qu, M., Yu, S., Chen, D., Chu, J., Tian, B., 2016. State-of-the-art of design, evaluation, and operation methodologies in product service systems. *Comput. Ind. Eng.* 77, 1–14.
- Quinn, J.B., Doorley, T.L., Paquette, P.C., 1990. Beyond products: services-based strategy. *Harv. Bus. Rev.* 58–67.
- Rabetino, R., Harmsen, W., Kohtamäki, M., Sihvonen, J., 2018. Structuring servitization-related research. *Int. J. Oper. Prod. Manag.* 38, 350–371.
- Raddats, C., Easingwood, C., 2010. Services growth options for B2B goods-centric businesses. *Ind. Mark. Manag.* 39, 1334–1345.
- Raddats, C., Zolkiewski, J., Story, V.M., Burton, J., Baines, T., Ziaee Bigdeli, A., 2017. Interactively developed capabilities: evidence from dyadic servitization relationships. *Int. J. Oper. Prod. Manag.* 37, 382–400.
- Randall, W.S., Wittmann, C.M., Nowicki, D.R., Pohlen, T.L., 2014. Service-dominant logic and supply chain management: are we there yet? *Int. J. Phys. Distrib. Logist. Manag.* 44, 113–131.
- Rathmell, J., 1966. What is meant by services. *J. Mark.* 30, 32–36.
- Reim, W., Parida, V., Örtqvist, D., 2015. Product-Service Systems (PSS) business models and tactics - a systematic literature review. *J. Clean. Prod.* 97, 61–75.
- Reinartz, W., Ulaga, W., 2008. How to sell services more profitably. *Harv. Bus. Rev.* 86, 90–96.
- Rexfelt, O., Ornas, V.H. af, 2009. Consumer acceptance of product-service systems. *J. Manuf. Technol. Manag.* 20, 674–699.
- Robinson, W., Chan, P., Lau, T., 2016. Finding new ways of creating value: a case study of servitization in construction. *Res. Technol. Manag.* 59, 37–49.
- Rondini, A., Tornese, F., Gnani, M.G., Pezzotta, G., 2017. Hybrid simulation modelling as a supporting tool for sustainable product service systems: a critical analysis. *Int. J. Prod. Res.* 1–14.
- Rymaszewska, A., Helo, P., Gunasekaran, A., 2017. IoT powered servitization of manufacturing – an exploratory case study. *Int. J. Prod. Econ.* 192, 92–105.
- Sabbagh, O., Ab Rahman, M.N., Ismail, W.R., Wan Hussain, W.M.H., 2016. Methodology implications in automotive product-service systems: a systematic literature review. *Total Qual. Manag. Bus. Excell.* 1–37.
- Sakao, T., Rönkä, A., Sandström, G., 2013. Uncovering benefits and risks of integrated product service offerings - using a case of technology encapsulation. *J. Syst. Sci. Syst. Eng.* 22, 421–439.
- Sakao, T., Sandström, G., Matzen, D., 2009. Framing research for service orientation of manufacturers through PSS approaches. *J. Manuf. Technol. Manag.* 20, 754–778.
- Salminen, R.T., Oinonen, M., Haimala, J., 2014. Managerial implications in solution business studies: analysis of type of relevance addressed. *J. Bus. Ind. Mark.* 29, 562–573.
- Salonen, A., 2011. Service transition strategies of industrial manufacturers. *Ind. Mark. Manag.* 40, 683–690.
- Salonen, A., Jaakkola, E., 2015. Firm boundary decisions in solution business: examining internal vs. external resource integration. *Ind. Mark. Manag.* 51, 171–183.
- Santos, F.M., Eisenhardt, K.M., 2005. Organizational boundaries and theories of organization. *Organ. Sci.* 16, 491–508.
- Schmenner, R.W., 2009. Manufacturing, service, and their integration: some history and theory. *Int. J. Oper. Prod. Manag.* 29, 431–443.
- Schmidt, D.M., Braun, F., Schenkl, S.A., Mörtl, M., 2016. Interview study: how can Product-Service Systems increase customer acceptance of innovations? *CIRP J. Manuf. Sci. Technol.* 15, 82–93.
- Settanni, E., Thenent, N.E., Newnes, L.B., Parry, G., Goh, Y.M., 2017. Mapping a product-service-system delivering defence avionics availability. *Int. J. Prod. Econ.* 186, 21–32.
- Shauger, J.J., 2016. Introduction to service system governance. *Int. J. Syst. Syst. Eng.* 7, 189–206.
- Sjödin, D., Parida, V., Wincent, J., 2016. Value co-creation process of integrated product-services: effect of role ambiguities and relational coping strategies. *Ind. Mark. Manag.* 56, 108–119.
- Smith, M., Crotty, J., 2008. Environmental regulation and innovation driving ecological design in the UK automotive industry. *Bus. Strateg. Environ.* 17, 341–349.
- Sousa-Zomer, T.T., Miguel, P.A.C., 2016. Exploring the consumption side of sustainable product-service systems (PSS): an empirical study and insights for PSS sustainable design. *CIRP J. Manuf. Sci. Technol.* 15, 74–81.
- Sousa, R., da Silveira, G.J.C., 2017. Capability antecedents and performance outcomes of servitization: differences between Basic and Advanced Services. *Int. J. Oper. Prod. Manag.* 37, 444–467.
- Spring, M., Araujo, L., 2013. Beyond the service factory: service innovation in manufacturing supply networks. *Ind. Mark. Manag.* 42, 59–70.
- Spring, M., Araujo, L., 2009. Service, services and products: rethinking operations strategy. *Int. J. Oper. Prod. Manag.* 29, 444–467.
- Stacey, P.K., Tether, B.S., 2015. Designing emotion-centred Product Service Systems: the case of a cancer care facility. *Des. Stud.* 40, 85–118.
- Tongur, S., Engwall, M., 2014. The business model dilemma of technology shifts. *Technovation* 34, 525–535.

- Tranfield, D., Denyer, D., Smart, P., 2003. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *Br. J. Manag.* 14, 207–222.
- Tukker, A., 2015. Product services for a resource-efficient and circular economy - a review. *J. Clean. Prod.* 97, 76–91.
- Tukker, A., 2004. Eight types of product-service system: eight ways to sustainability? Experiences from SusProNet. *Bus. Strateg. Environ.* 260, 246–260.
- Tukker, A., Tischner, U., 2006. Product-services as a research field: past, present and future. Reflections from a decade of research. *J. Clean. Prod.* 14, 1552–1556.
- Turunen, T., Finne, M., 2014. The organisational environment's impact on the servitization of manufacturers. *Eur. Manag. J.* 32, 603–615.
- Uлага, W., Reinartz, W.J., 2011. Hybrid offerings: how manufacturing firms combine goods and services successfully. *J. Mark.* 75, 5–23.
- Valtakoski, A., 2017. Explaining servitization failure and deservitization: a knowledge-based perspective. *Ind. Mark. Manag.* 60, 138–150.
- Vandermerwe, S., Rada, J., 1988. Servitization of business: adding value by adding services. *Eur. Manag. J.* 6, 314–324.
- Vasantha, G., Roy, R., Lelah, A., Brissaud, D., 2012. A review of product-service systems design methodologies. *J. Eng. Des.* 23, 635–659.
- Vasantha, G.V.A., Roy, R., Corney, J.R., 2015. Advances in designing product-service systems. *J. Indian Inst. Sci.*
- Velamuri, V.K., Neyer, A.K., Möslin, K.M., 2011. Hybrid value creation: a systematic review of an evolving research area. *J. fur Betriebswirtschaft* 61, 3–35.
- Visnjic, I., Jovanovic, M., Neely, A., Engwall, M., 2017. What brings the value to outcome-based contract providers? Value drivers in outcome business models. *Int. J. Prod. Econ.* 192, 169–181.
- Walker, H., Chicksand, D., Radnor, Z., Watson, G., 2015. Theoretical perspectives in operations management: an analysis of the literature. *Int. J. Oper. Prod. Manag.* 35, 1182–1206.
- Wang, P.P., Ming, X.G., Li, D., Kong, F.B., Wang, L., Wu, Z.Y., 2011. Status review and research strategies on product-service systems. *Int. J. Prod. Res.* 49, 6863–6883.
- Weeks, R., Benade, S., 2015. The development of a generic servitization systems framework. *Technol. Soc.* 43, 97–104.
- White, A., Stoughton, M., Feng, L., 1999. Servicing: the Quiet Transition to Extended Product Responsibility. Tellus Institute.
- Wibowo, A., Tjahjono, B., Tomiyama, T., 2016. Productisation business model in non-OEM aero-engine MRO service providers. In: Goh, Y.M., Case, K. (Eds.), *Advances in Transdisciplinary Engineering XXX, Advances in Transdisciplinary Engineering Series*. IOS Press, Loughborough, pp. 561–566.
- Windahl, C., Lakemond, N., 2006. Developing integrated solutions: the importance of relationships within the network. *Ind. Mark. Manag.* 35, 806–818.
- Wise, R., Baumgartner, P., 1999. Go downstream: the new profit imperative in manufacturing. *Harv. Bus. Rev.* 133–142.
- Worm, S., Bharadwaj, S.G., Uлага, W., Reinartz, W.J., 2017. When and why do customer solutions pay off in business markets? *J. Acad. Mark. Sci.* 45, 490–512.
- Xing, K., Ness, D., Lin, F.R., 2013. A service innovation model for synergistic community transformation: integrated application of systems theory and product-service systems. *J. Clean. Prod.* 43, 93–102.
- Zaring, O., Bartolomeo, M., Eder, P., Hopkinson, P., Groenewegen, P., James, P., Jong, P. de, Nijhuis, L., Scholl, G., Slob, A., Örnine, M., 2001. Creating eco-efficient producer services. Gotherburg.
- Zhang, W., Banerji, S., 2017. Challenges of servitization: a systematic literature review. *Ind. Mark. Manag.* 65, 217–227.
- Zhang, W., Shi, Y., Yang, M., Gu, X., Tang, R., Pan, X., 2017. Ecosystem evolution mechanism of manufacturing service system driven by service providers. *Int. J. Prod. Res.* 55, 3542–3558.
- Zhong, H., 2014. Game analysis of product-service integration. *J. Ind. Eng. Manag.* 7, 1447–1467.
- Ziaee Bigdeli, A., Baines, T., Schroeder, A., Brown, S., Musson, E., Guang Shi, V., Calabrese, A., 2018. Measuring servitization progress and outcome: the case of 'advanced services. *Prod. Plan. Control*.