A Review of Servitization Theoretical Foundations

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Abstract:

Purpose: This study seeks to analyse how the servitization topic has been addressed through different theoretical approaches. More specifically, the aim is to answer two key questions: What theoretical approaches have been used to study the phenomenon of servitization? What specific aspects of the servitization process have been analysed through each theoretical approach?

Design/methodology/approach: This paper adopts a systematic literature review. The first step involves a descriptive analysis, which is then followed by a thematic one.

Findings: The results show that the topic of servitization has been analysed according to the main boundary of the firm theories (Resource-based view, Game theory, and Transaction cost economics) and to organizational boundaries (Contingency theory and Resource dependence theory), among others. From the perspective of these theoretical frameworks, the following topics have received the most scholarly attention: Performance, Capabilities, Supply Chain Management, Business Model, Strategy, and Sustainability.

Originality/value: Observations are made on the relevance that diverse theories have on the development of research into servitization. The most suitable theoretical lenses are recommended for future research.

Keywords: servitization, organisational boundary theory, boundary of the firm theory, systematic literature review

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1. Introduction

The last twenty years have witnessed major technological advances that together with the freeing up of global trade have led to increased competition in the manufacturing sector. This sharp increase in competition has prompted the relocation, or even closure, of many western industrial firms due to the lower labour costs in other countries (mainly in Asia). Faced with this increase in competition, manufacturing firms have now been forced to reinvent themselves, and many have seized the business opportunity involved in launching the process of marketing services alongside their products (Johnson, Herrmann & Bauer, 1999).

Vandermere and Rada (1988) have referred to this process as servitization, which may be understood as a process for increasing value by adding services to products. It is a way of creating value-added capabilities that are
distinctive and sustainable regarding competitors (Baines, Lightfoot, Benedettini & Kay, 2009a), whereby instead of simply providing products, a firm begins marketing product-service systems (PSS) (Visnjic & Van Looy, 2013). In short, servitization is when manufacturing firms provide their customers with a comprehensive range of products and services in order to increase the latter’s user value and experience.

The literature has analysed the servitization process from different angles (Forkmann, Henneberg, Witell & Kindström, 2017). It is a complex, contingent and even paradoxical issue that involves myriad organizational, operational, strategic, relational and even ecosystemic issues. Given this complexity and the considerable increase in the number of publications on this transition process, recent studies have focused on the need to strengthen the theories related to the servitization process (Rabetino, Harmsen, Kohtamäki & Siivonen, 2018; Raddats, Kowalkowski, Benedettini, Burton & Gebauer, 2019).

Gioia and Pitre (1990), for example, have defined theory-building as “any coherent description or explanation of observed or experienced phenomena”. Bacharach (1989) considers a theory to be “a statement of relations among concepts within a set of boundary assumptions and constraints. It is no more than a linguistic device used to organize a complex empirical world”. Theories help researchers to make sense of the world around us. Over and above a mere description, theories allow predicting the nature of relationships between phenomena. In turn, phenomena of interest uncover topics of practical significance. Theories sometimes arise from a new idea or a metaphor that leads to the development of a conceptual model that then helps to reconsider theoretical approaches, being referred to as “theory building” (Colquitt & Zapata-Phelan, 2007). On other occasions, previously established theories are applied within a new context to help to understand a topic, which is known as “theory testing”.

Within the field of servitization, there is a need for more studies on both theory building and theory testing. Rabetino et al. (2018) and Eloranta and Turunen (2015) consider the need to extend and develop this research topic using well-established theories and theoretical frameworks from different disciplines. Li, Kumar, Claes and Found (2020) have expressed the need to study social and organizational theories, calling for the increased use of well-established ones from mature fields and borrowing ideas to stimulate knowledge accumulation.

The purpose of this research is to study how the topic of servitization has been analysed through different theoretical approaches. The specific aim is to answer two key questions: (1) What theoretical approaches have been used to study the phenomenon of servitization? (2) What specific aspects of the servitization process have been analysed by each theoretical approach?

We shall be using a systematic review of the literature to answer these two questions. The first step will involve using a descriptive analysis to find all those articles published on servitization that are related to one or more of the theoretical approaches, and the second step will consist of a thematic analysis of the main topics studied in the selected articles.

This review helps to identify the theoretical lens that best explains the phenomenon of servitization, revealing its strategic importance and the need for an organizational aspects-servitization-performance fit. In addition, it also highlights the two main challenges that industrial firms must face: digitalization and the natural environment.

The paper is organised into three clearly differentiated sections. The first one describes the methodology, specifically identifying the keywords used in the search and the criteria applied for the systematic literature review, as well as the papers that comprise the sample and their subsequent screening. The following section will involve studying the results based on the papers obtained in two clearly differentiated analyses: one descriptive and the other thematic. Finally, the third section summarises the conclusions, outlining this study’s contributions and limitations.

2. Methodology

Answering our two questions has involved conducting a systematic two-stage review of the literature, beginning with a descriptive analysis based on activity indicators and then proceeding with a thematic analysis (Tranfield, Denyer & Smart, 2003).
The review’s first step requires identifying and selecting the data to be used. Again according to Ramos-Rodríguez and Ruiz-Navarro (2004), the data sources are papers published in scientific journals, as their content is deemed to be “certified knowledge” (this term is commonly used to describe those papers that have successfully undergone a critical peer review).

In particular, Elsevier’s Scopus database has been used to find the papers because it is the most comprehensive electronic database for citations and abstracts (it provides 20% more coverage than Web of Science) and has more consistent results (Falagas, Pitsouni, Malietzis & Pappas, 2008). Moreover, Scopus is considered as an effective tool for electronic literature search, which has been evidenced by Tukker (2015) or Li et al. (2020) in their revisions. The decision to choose scientific papers rather than other documentary sources, such as books, PhD theses or congress proceedings, is based on their consideration as certified knowledge, being understood as research that has been submitted to peer review and successfully passed their critical evaluation (Callon, Courtial & Penan, 1993).

The identification of the pertinent papers for conducting our research has involved the use of a search string consisting of terms related to the servitization process and each one of the theoretical approaches to be studied. The keywords have been chosen according to the study by Rabetino et al. (2018), involving some of the primary search terms used in their research. The timeframe for the search has extended from 1988, the publication year of the paper by Vandermerwe and Rada (1988), which first referred to the transformation process under study here as servitization, through to December 2020. Table 1 lists the terms used, the search conditions established, and the papers found.

This initial search produced 117 papers. This was followed by an analysis of these papers’ abstracts and keywords to discover whether they were sufficiently relevant to PSS. Three papers were discarded from Scientific management theory because they had not been published in journals, but in conference proceedings instead. A further 24 papers were discarded for not being considered relevant, more specifically because they did not relate to industrial companies although they did relate to services. Out of these latter papers, four corresponded to Game theory, one to Industrial organization, eleven to Linear programming, two to Resource-based, three to Organizational behavior, and three to Scientific management. After screening, there were 93 papers in the final sample. The list of papers analysed is provided in Appendix A. Figure 1 illustrates the review process we have conducted.

| Search tips and limits |
|------------------------|
| **Servitization** | serviti* OR servicing OR "product-service systems" OR "integration of products and services" OR "service growth" OR "service transition" OR "service science" OR "integrated solution" OR "solution offering" OR "service infusion"… |
| **Limit:** | Article title, Abstract, Keywords Published between 1998 and 2020 Document type: paper Search conducted between January and December 2020 (final check on 15/12/2020) |
| **Servitization + theory** | Search strings and results |
| Agency theory | … AND "agency theory" Three papers found |
| Bureaucracy theory | … AND "bureaucracy theory" No papers found |
| Contingency theory | … AND "contingency theory" Ten papers found |
| Elements administration | AND "elements administration" No papers found |
| Servitization + theory            | Search strings and results                                      |
|----------------------------------|-----------------------------------------------------------------|
| Ecological theory                | … AND "ecological theory"                                       |
|                                  | One paper found                                                 |
| Administrative behavior          | … AND "Fatalism"                                                |
|                                  | No papers found                                                 |
| Game theory                      | … AND "game theory"                                             |
|                                  | Twenty papers found                                             |
| Human relations theory           | … AND "human relations theory"                                  |
|                                  | No papers found                                                 |
| Industrial organization          | … AND "industrial organization"                                |
|                                  | Five papers found                                               |
| Institutional theory             | … AND "institutional theory"                                    |
|                                  | Three papers found                                              |
| Linear programming               | … AND "Linear programming"                                      |
|                                  | Fourteen papers found                                           |
| Organizational behavior          | … AND "organizational behavior"                                |
|                                  | Six papers found                                                |
| Resource-based theory            | … AND "resource-based"                                          |
|                                  | Thirty one papers found                                         |
| Resource dependence theory       | … AND "resource dependence"                                     |
|                                  | Four papers found                                               |
| Scientific management            | … AND "scientific management"                                  |
|                                  | Five papers found                                               |
| Social practice theory           | … AND "social practice theory"                                  |
|                                  | Four papers found                                               |
| Transaction cost                 | … AND "transaction cost"                                        |
|                                  | Eleven papers found                                             |

Table 1. Selection criteria and keywords

![Figure 1. The review process](image-url)
3. Findings

The sample’s 93 papers have been used to conduct a descriptive analysis of the following indicators of size: the journals in which they were published and their authors.

The 93 papers have been published in 58 different journals. As an overview, Table 2 below lists those journals that have published three or more papers.

| Journal                                                        | No. papers | Theory                  | Frequency |
|                                                               |            |                        |           |
| Industrial Marketing Management                               | 6          | Agency                  | 1         |
|                                                               |            | Resource-based          | 3         |
|                                                               |            | Industrial organization | 1         |
|                                                               |            | Institutional           | 1         |
| Journal of Business and Industrial Marketing                  | 5          | Resource-based          | 4         |
|                                                               |            | Transaction cost        | 1         |
| Journal of Cleaner Production                                 | 5          | Transaction cost        | 2         |
|                                                               |            | Institutional           | 1         |
|                                                               |            | Social practice         | 2         |
| International Journal of Production Economics                 | 5          | Game                    | 1         |
|                                                               |            | Contingency             | 1         |
|                                                               |            | Resource-based          | 3         |
| International Journal of Production Research                  | 3          | Game                    | 1         |
|                                                               |            | Ecological              | 1         |
|                                                               |            | Linear programming      | 1         |
| International Journal of Operations and Production Management | 3          | Contingency             | 2         |
|                                                               |            | Organizational behavior | 1         |

Table 2. Journals with three or more publications (author’s own work)

Among these six journals, International Journal of Production Economics, International Journal of Operations and Production Management and International Journal of Production Research publish papers related to the topics of engineering, production and management. In turn, the papers published in Journal of Business and Industrial Marketing and Industrial Marketing Management are more closely related to industrial marketing and management. Finally, Journal of Cleaner Production is an interdisciplinary publication that focuses on Cleaner Production.

The six journals featured in Table 2 are ranked in percentile 1 in CiteScore 2019, with the exception of one of the topics (Business, Management and Accounting-Marketing) in Journal of Business and Industrial Marketing, which is ranked in percentile 2.

As is the case with the journals, there is a broad range of authorship for the papers in the sample. Specifically, only nine scholars have published two or more of the papers (Table 3).

As regards the authors publishing the most on the topic under study here, first place corresponds to Asian scholars, and this is due to the sharp increase in publications that have been written in China on the subject of servitization, which stands to reason because that country today records the world’s highest industrial output. On the other hand, the table features scholars such as Baines, Gebauer, Parida and Kohtamäki, who are leading authorities in servitization-based research. These results are consistent with those reported by Martín-Peña, Pinillos and Reyes (2017) and Rabetino et al. (2018).
| Authors       | Frequency |
|--------------|-----------|
| Chang, C-Y   | 3         |
| Cheng, T.C.E | 2         |
| Chang, F.    | 2         |
| Baines, T.   | 2         |
| Chicksand, D.| 2         |
| Gebauer, H.  | 2         |
| Kohtamäki, M.| 2         |
| Parida, V.   | 2         |
| Lin, L.      | 2         |

Table 3. Authors with two or more publications

This descriptive analysis concludes with Figure 2, which lists the year of issue of the papers analysed.

![Annual production of articles](image)

Figure 2. Annual production of articles

Most of the papers on servitization, together with the different theoretical frameworks underpinning them, have been published in the past 20 years. These results are consistent with those reported in prior studies, such as those by Díaz-Garrido, Pinillos, Soriano-Pinar and García-Magro (2018), Rabetino et al. (2018), and Li et al. (2020), which reveal an exponential increase in the number of publications dealing with servitization.

4. Discussion of Results

The review of the papers analysed reveals that the following theories have underpinned the subject of servitization over the past 32 years: Resource-based theory, Game theory, Transaction cost theory, Contingency theory, Resource dependence, Social practice theory, Linear programming, Organizational behavior, Agency theory, Scientific management, Industrial organization, and Ecological theory. Table 4 details the number of papers that have been analysed for each one of these theoretical approaches. By contrast, the topic of servitization has not been addressed through other theoretical approaches, such as Bureaucracy theory, Elements administration, Administrative behavior, and Human relations theory. There are some papers in which aspects of servitization have been addressed by two or more theories, such as those by Ceci and Prencipe (2008), Ceci and Masini (2011), Yan, Li and Cheng (2020) (Contingency theory and Resource-based theory); Chang, Zhou, Zhang, Xiao and Wang (2019) (Resource dependence and Game theory) or Kohtamäki, Parida, Oghazi, Gebauer and Baines (2019), Zhang, Wang, Gao and Li (2019) (Transaction cost and Resource-based theory).
All these theoretical approaches may be divided into two main groups: boundary of the firm and organizational boundary theories, on the basis that economics is dedicated to the study of the way in which players may choose to use their scarce resources with different applications. It may therefore be stated that economics (seen from a classical viewpoint, and originating in British marginalism through Jevons, the Austrian school by the hand of Menger, and Walras for the development of general equilibrium theory) is the source of the different approaches that make up boundary of the firm theories, and which seeks to explain why firms exist and the nature of their relationship with the market. On the other hand, organizational boundary theories provide the foundations for the organizational design of any kind of institution (public or private, for-profit and not-for-profit) (Table 4). To answer the first question initially posed, the results show that servitization has basically been underpinned by the following four theoretical approaches: Resource based, Game theory, Transaction cost, and Contingency theory, as these account for around 71% of the papers studied (Table 4).

**Table 4. Theoretical Approaches and servitization**

| THEORETICAL APPROACHES | No. Papers found | No. Papers analysed | Frequency % |
|------------------------|------------------|--------------------|-------------|
| Resource-based         | 31               | 29                 | 31.18       |
| Game                   | 20               | 16                 | 17.20       |
| Transaction cost       | 11               | 11                 | 11.83       |
| Contingency            | 10               | 10                 | 10.75       |
| Industrial organization| 5                | 4                  | 4.30        |
| Social practice        | 4                | 4                  | 4.30        |
| Linear programming     | 14               | 3                  | 3.23        |
| Organizational behavior| 6                | 3                  | 3.23        |
| Resource dependence    | 4                | 4                  | 4.30        |
| Institutional          | 3                | 3                  | 3.23        |
| Agency                 | 3                | 3                  | 3.23        |
| Scientific management  | 5                | 2                  | 2.13        |
| Ecological             | 1                | 1                  | 1.08        |

**Resource-based theory** argues that differences between firms are primarily the result of firm heterogeneity regarding their bundles of resource and capability endowments (Barney, 1991; Rumelt, 1984; Wernerfelt, 1984). This theory contends that firms are capable of creating and upholding competitive advantages through the development and integration of a series of valuable, rare and inimitable resources. This theory has provided the theoretical underpinnings for a large number of the papers analysed (31.18%). This is in keeping with other prior studies in which this theory serves as a platform for many literature discussions focusing on service infusion (Oliva & Kallenberg, 2003).

The subject of servitization analysed through Resource-based theory refers to assets that are valuable, rare, inimitable, or organised (VRIO) (Eloranta & Turunen, 2015). As regards the resources and capabilities related to servitization, the literature has identified three main resources and potentially capabilities: installed base (e.g., Oliva & Kallenberg, 2003; Ulaga & Reinartz, 2011; Wise & Baumgartner, 1999), unique and complex ranges (e.g., Ulaga & Reinartz, 2011; Gremyr, Lölberg & Witell, 2010), and improved services-relationships (e.g., Tuli, Kohli & Bharadwaj, 2007). Furthermore, the services added to the product range may be considered a resource, providing financial value (Kohtamäki, Partanen, Parida & Wincent, 2013) and driving innovation (Wallin, Parida & Isaksson, 2015). As regards capabilities, the unique ones related to servitization have also been singled out (e.g., Gebauer & Fleisch, 2007; Storbacka, 2011), as has the role played by complex combinations of resources and capabilities in
avoiding imitation (Oliveira & Roth, 2012). Kanninen, Penttinen, Tinnilä and Kaario (2017) have analysed the type of capabilities firms in industry require as servitization spreads.

Resource-based theory has provided the reference framework for studies that analyse servitization through digitalization (Coreynen, Matthyssens & Van Bockhaven, 2017), as well as for deciding the service strategy and growth options that may be most appropriate and successful, considering the resources required in each case (Raddats, Burton, & Ashman, 2015; Raddats & Easingwood, 2010).

Game theory has been used in 17.20% of the papers analysed. This is a discipline that was launched by Von Neumann, Morgenstern & Kuhn (1944) based on the transcription of a situation into abstract formulations based on logics and rules assuming rational behavior. Generally speaking, it can be classified into non-cooperative and cooperative game approaches (Song & Panayides, 2002).

This theoretical approach is used to analyse the return on the servitization strategy (Lee; Yoo & Kim, 2016). Zhong (2014) adopts Game theory for conducting a quantitative analysis of coordination mechanisms for integrating products and services through the creation of mathematical models. It is also an ideal theoretical model for analysing the relationships between consumers and service providers (Hsieh & Yeh, 2018). Hezarkhani (2017) uses Game theory to manage these relationships, seeking to coordinate the parties’ efforts to optimise the gains made by the entire system, instead of focusing on the decision-making problems they face. Gómez & Heredero (2013) consider that gamification leads to an improvement in users’ experience, pursuing the aim of motivating, achieving, promoting and upholding greater engagement with the features of the products and services that firms offer them. This renders it expedient to consider that Game theory is a useful framework for analysing consumers’ behavior in the provision of services and the impact of the co-creation of value between businesses and consumers. Lee et al. (2016) use Game theory to identify the situations in which a servitization strategy is more profitable (depending both on the degree of dependence between the service being provided and the tangible assets and on the operation of the retail channel).

The origin of Transaction cost theory, which is a feature of 11.83% of the papers analysed, has been attributed to Coase (1937), who reported that the existence of firms lies in the fact that markets operate with certain costs, as well as being imperfect. These so-called transaction costs reflect the market’s operating costs. According to this neoclassical approach, prices in a perfectly competitive market contain all the information to ensure the exchange can take place. According to Transaction cost theory, the pricing system is costly, which explains the existence of organizations; in turn, the coexistence of markets and organizations is explained by the characteristics associated with the different types of transaction, which refer to the information and nature of the goods being exchanged (Williamson, 1977).

Transaction cost theory has acted as a yardstick for analysing new business models when applying servitization processes in general (Mont, Dalhammar & Jacobsson, 2006) or new business models involving territorial servitization (Bellandi & Santini, 2019). It has also provided the basis for sundry studies related to digital servitization. Nevertheless, Kohtamäki et al. (2019) consider that transaction costs can be significant in the provision of product-service-software systems because of the sale and delivery of highly complex, bespoke smart solutions. Delivering smart solutions also incurs significant transaction costs because of upstream interactions with the service supply chain, in addition to product supply. Likewise, an analysis has been conducted from a transaction cost perspective to understand how supply chains are organised regarding relations involving suppliers, manufacturers, and providers in the field of servitization (Boehmer, Shukla, Kapletia & Tiwari, 2020; Wiig, 2001). All the factors commonly associated with influencing transaction costs (asset specificity, uncertainty and frequency) are significantly higher for firms with more fully implemented supply chain management, making a more integrated solution advantageous (Lietke & Boslau, 2007).

Contingency theory has been used in 10.75% of the papers. Walker, Chicksand, Radnor and Watson (2015) consider it a suitable theory for explaining the topic of servitization. This theory postulates a link between the environment, organizational structure and performance (Drazin & Van de Ven, 1985; Duncan, 1972; Venkatraman, 1989). According to this theoretical approach, it is argued that a strategy is successful only when there is a fit (i.e., a degree of internal consistency) between existing capabilities and external environmental contingencies.
This interpretation of fit may be used to obtain the configurations of different contingencies, each one with distinctive implications for organizational design (Child, 1975). A direct implication of the contingent approach for the study of servitization is that, as such, there is no better strategy when addressing a servitization process in an industrial firm.

Yan et al. (2020) merge Contingency theory with Resource-based theory to analyse the success of servitization in companies based on two factors of organizational design: a service-focused organizational structure and a service-focused organizational culture. Ceci & Prencipe (2008) investigate the way in which the environmental context and companies’ organizational structure influence their strategic choice and lead to different configurations of capabilities. In a similar vein, Ceci and Masini (2011) apply these same theories to analyse how the differences in fit between environmental variables and strategic choices partially account for performance differences among integrated solution providers.

The results show that the topic of servitization has not been addressed through other theoretical approaches, such as Bureaucracy theory, Elements administration, Administrative behavior, and Human relations theory. These are classic theoretical approaches within Organizational boundary theories, with a clear pragmatic orientation focused on worker analysis: job design, productivity, behavior, …

To answer the second question and identify those specific aspects of the servitization process that have been analysed through each one of these theoretical approaches, this research has been informed by research topics identified in the study by Li et al. (2020): Organizational aspects, Value co-creation, Consumer behavior, Business models, Resources and capabilities, Innovation, Performance, Sustainability, Supply chain management. A few more have been added, such as the following: digitalization, Industry 4.0, Circular economy, Human resource management, and CRM. The data on the frequency with which each topic has been addressed are contained in the following table (Table 5).

| Research topics                  | Total | Organizational theories | Theories of the firm | Frequency | Aggregate frequency |
|----------------------------------|-------|-------------------------|----------------------|-----------|---------------------|
| Performance                      | 20    | 6                       | 14                   | 21.51     | 21.51               |
| Capabilities                     | 15    | 3                       | 12                   | 16.13     | 37.63               |
| Business models                  | 10    | 1                       | 9                    | 10.75     | 48.39               |
| Supply chain management          | 8     | 3                       | 5                    | 8.60      | 56.99               |
| Strategy                         | 6     | 2                       | 4                    | 6.45      | 63.44               |
| Sustainability                   | 6     | 2                       | 4                    | 6.45      | 69.89               |
| Consumer behavior                | 5     | 1                       | 4                    | 5.38      | 75.27               |
| Value co-creation                | 4     | 3                       | 1                    | 4.30      | 79.57               |
| Organizational aspects           | 3     | 2                       | 1                    | 3.23      | 82.80               |
| Innovation                       | 3     | 0                       | 3                    | 3.23      | 86.02               |
| Flexibility                      | 3     | 1                       | 2                    | 3.23      | 89.25               |
| Digitization                     | 3     | 2                       | 1                    | 3.23      | 92.47               |
| Circular economy                 | 2     | 2                       | 0                    | 2.15      | 94.62               |
| Human resources                  | 2     | 1                       | 1                    | 2.15      | 96.77               |
| Industry 4.0                     | 2     | 0                       | 2                    | 2.15      | 98.92               |
| Customer relationship management | 1     | 0                       | 1                    | 1.08      | 100.00              |

Table 5. Research topics in the theoretical underpinnings of servitization

The research topic that most frequently appears in the papers analysed involves **performance** (21.51%), which is studied from the perspective of different theories, such as Contingency theory (Ceci & Masini, 2011), Linear programming (Geng, Chu, Xue & Zhang, 2011), Resource dependence theory (Shah, Jaja, Chatha & Farooq, 2020;
Chang et al., 2019), Agency theory (Datta, 2020), Game theory (Arabi, Mansour & Shokouhyar, 2018; Gómez & Heredero, 2013; Hezarkhani, 2017; Lee et al., 2016) and Resource-based theory (Fang, Palmatier & Steenkamp, 2008; Yan et al., 2020; Zhang et al., 2019), These results are consistent with those reported by Wang, Lai, and Shou (2018), identifying numerous studies that analyse the impact that servitization has on performance.

The literature has traditionally analysed a service-based strategy as a source of competitive advantage in goods manufacturing firms (Wise & Baumgartner, 1999), and which furthermore enable those firms defining it to enhance their performances (Neu & Brown, 2005). Nevertheless, servitization does not always have positive outcomes, which leads to the consideration of what is referred to as the “service paradox” (Gebauer & Friedli, 2005). The theoretical analysis developed here enables us to explain the difference in outcomes because there are organizational factors that may moderate the relationship between servitization and outcomes (Yan et al., 2020). In addition, the different ways of measuring results may give rise to variations in the analysis of the relationship between servitization and performance (Shah et al., 2020). Zhang et al. (2019), for example, identify a non-linear relationship between servitization and financial performance, while Fang et al. (2008) conclude that an industrial firm’s decision to provide services may have both positive and negative effects. Specifically, the effects that servitization has on firm performance may be positive only when the level of service sales attains critical mass (around 20% to 30% of the firm’s overall turnover), ensuring that the services provided are strongly related to the firm’s core manufacturing business.

The second most common research topic in the papers studied here involves capabilities (16.13%). This subject has specifically been analysed mostly through theoretical approaches such as Resource-based theory (Coreynen et al., 2017; Hasselblatt, Huikkola, Kohtamäki & Nickell, 2018; Huikkola & Kohtamäki, 2017; Ulaga & Reinartz, 2011), Contingency theory (Ceci & Masini, 2011; Ceci & Prencipe, 2008), and Resource dependence theory (Li, Zhu, Lin, Ma, & Huang, 2015).

Studies such as those conducted by Ceci and Masini (2011) analyse the operational and dynamic capabilities required for servitization, calling upon manufacturers and customers to work together to create capabilities to enable service offerings and optimise service performance. Known examples of such capabilities in the context of servitization are ‘hybrid offering sales’, ‘hybrid offering deployment’ and ‘service-related data processing and interpretation capabilities’ (Ulaga & Reinartz, 2011). Coreynen et al. (2017) and Kohtamäki et al. (2019) have focused on the capabilities required for developing digital servitization.

Third place corresponds to Business models, an approach that specifically features in 10.75% of the papers in our sample. This topic has been analysed mainly through boundary of the firm theories, such as Game theory (Nishino, Wang, Tsuji, Kageyama & Ueda, 2012), Industrial organization theory (Kohtamäki et al., 2019), Resource-based theory (Kessler & Stephan, 2013; Kohtamäki et al., 2019; Lütjen, Tietze & Schultz, 2017), and Transaction cost theory (Bellandi & Santini, 2019; Mont et al., 2006).

The servitization of the manufacturing sector involves the emergence of a new business model that is modifying the structure of many industries that opt for the provision of holistic solutions (Ceci & Masini, 2011). In their approach to a successful servitization process, companies need to redesign their business model (Baines et al., 2009a). This literature review has identified different studies that analyse this aspect from different perspectives. For example, Nishino et al., (2012) define a ‘platform-type product service system’ as a comprehensive business model with a common platform on which service providers, consumers, and manufacturers mutually interact. Parida, Sjödin and Rein (2019) describe the impact that the digitalization undertaken by manufacturing firms has on their service business model (digital servitization). Kohtamäki et al. (2019) consider that business models in digital servitization should be viewed from an ecosystem perspective.

Fourth place corresponds to Supply Chain Management (SCM), which has been analysed through, among others, Contingency theory (Engelseth & Jafari, 2018); Resource dependence theory (Shah et al., 2020), and Transaction cost theory (Boehmer et al., 2020; Lietke & Boslau, 2007; Wiig, 2001).

SCM encompasses the efforts involved in delivering and producing products and services in the value chain (Vendrell-Herrero, Bustinza, Parry & Georgantzis, 2017). Shah et al. (2020) contend that the focus on servitization encourages organizations to enhance internal, supplier, and customer integration, which in turn enhance
servitization (basic and advanced service provision), specifically positing that servitization-oriented firms need to improve a specific dimension of their supply chain integration to reinforce a particular type of service provision.

Finally, there are two research topics that have appeared in 6.45% of the papers, namely **Strategy** and **Sustainability**.

**Strategy** has been analysed mainly through Resource dependence theory (Chang et al., 2019; Li et al., 2015); Contingency theory (Pleshko & Heiens, 2011; Pleshko, Heiens & Peev, 2014) and Game theory (Chang et al., 2019; Hsieh & Yeh, 2018; Li, Ji, Chen & Jiao, 2017; Wang, Zheng, Zhao & Tian, 2019; Zhong, 2014).

Baines, Lightfoot, Peppard, Johnson, Tiwari, Shehab et al. (2009b) for example, have already highlighted the strategic importance of servitizing the manufacturing sector, analysing industrial firms’ internal production and support operations to ensure the effective and efficient delivery of products and their closely associated services. Service-oriented manufacturing and integrated solutions have therefore emerged as a new strategy in corporate practice (Li et al., 2015). The theoretical underpinnings analysed show that there are scholars that consider servitization to be a competitive-level strategy (Lee et al., 2016), in the sense that traditional manufacturing firms launch services to supplement their products as a market differentiation strategy (Raddats & Easingwood, 2010). By contrast, other firms view it as a functional-level strategy; for example, Fang et al. (2008) evaluate the effectiveness of service transition strategies as a marketing approach. Zhong (2014) contends that product-service integration enables a firm to improve its overall turnover, whereby it should adopt appropriate income distribution strategies to promote its product-service integration.

**Sustainability** has been addressed through sundry approaches, such as Institutional theory (Stål & Corvellec, 2018); Social practice theory (Retamal & Schandl, 2018; Sousa-Zomer & Miguel, 2016); Game theory (Arabi et al., 2018; Chang et al., 2019; Hezarkhani, 2017), and Resource-based theory (Leismann, Schmitt, Rohn & Baedeker, 2013).

The importance of the launch of services by manufacturing firms may also be analysed from the perspective of environmental sustainability, which highlights the need to manage a product’s lifecycle through the provision of different kinds of services. These theoretical approaches reveal that servitization is a suitable approach for achieving sustainability because of the potential PSS have to simultaneously deliver social well-being and economic prosperity (Sousa-Zomer & Miguel, 2016). What’s more, PSS provides a combination of products and services that may fulfil customers’ expectations, offering an alternative to the purchase of an existing product or a new one (Leismann et al., 2013). Retamal and Schandl (2018) and Stål and Corvellec (2018) have analysed PSS (or servitization systems) as circular business models.

5. Conclusions

With a view to shedding some light on the increase in the number of publications on servitization, and faced with the need to improve the theories related to the servitization process itself, our findings provide an alternative theoretical lens by combining different approaches to account for the success of firms’ transformation in this field.

We propose using a double theoretical lens by combining different theories to analyse different research topics, which include the following:

- There is no doubt about the importance of servitization in the manufacturing sector, although it remains to be seen whether it should be considered a strategy at competitive level or, by contrast, at functional level in the field of production and operations, as well as in terms of marketing. Resource dependence, Contingency, and Game theories may provide the appropriate frameworks for identifying different generic configurations of servitization strategies. There is a need for a further exploration of the strategic approach to servitization to discover whether or not it may be considered a functional strategy within a firm; for example, for the field of production and operations, or even for marketing.
- Resource-based and Contingency theories may also be applied to the analysis of the relationship between organizational aspects, servitization and performance. This is consistent with other prior studies, such as those conducted by Yan et al. (2020) and Ceci and Masini (2011). It would be expedient to propose models of fit between environmental and organizational variables, capabilities, and resources in order to identify
the more profitable type of servitization model. This would help to explain how capabilities in servitization generate competitive advantage and the types of configurations of resources and processes they require. These theories might constitute the theoretical lens that best explains the service paradox.

• It would be expedient to analyse the earnings and costs linked to different levels of servitization from the perspective of Transaction cost and Resource-based theories (Zhang et al., 2019) to ensure industrial firms make the right decision when launching a servitization process. These analyses could be supplemented by the study of value co-creation.

• Different industries are now facing the major challenge of digitalization. The Internet of Things (IOT), smart data-based products and services, and technologies are forcing organizations to create wholly new business models focused on products and service-based approaches. Specifically, advances in information technology and digitalization are prompting new business models involving digital servitization. It would be convenient to identify the dynamic capabilities that need to be deployed in industries that are intensive in technology and R&D, which would also lead to improvements in performance. These studies should be conducted within the theoretical framework of Resource-based and Resource dependence theories.

• In turn, concern for the environment and sustainability are topics that merit greater analysis, in the sense that servitization may feasibly be considered an enabler of sustainability. This finding is consistent with prior studies, such as the one by Díaz-Garrido et al. (2018). Nevertheless, sustainability will not be achieved solely through innovations in terms of the provision of services, as there is a need for additional research that considers sustainable consumption and demand with a view to introducing sustainable PPS that are profitable from an economic, environmental and social perspective. This may be readily argued through Social practice, Game and Resource-based theories.

• Dealings with customers and suppliers within SCM in industrial firms will require a far-reaching review of the internal and external supply and demand of goods and services to ensure the combination and acquisition of the resources and capabilities required for servitization, in line with the findings reported by Shah et al. (2020). These analyses should be framed within the lens of theoretical approaches such as Contingency theory, Resource dependence theory, and Transaction cost theory.

Our study makes a significant contribution to the state-of-the-art on the theory of servitization, specifically helping to analyse the theoretical lens that can better explain the subject of servitization in general, and its associated research topics in particular.

This study has several implications for the servitization literature. First, identifying the theoretical foundations that demonstrate a great degree of scientific maturity of servitization-related research. Second, not only the thematic areas that may be of interest for future research have been identified, but also the theoretical foundations under which such research could be developed have been indicated.

The present study has several practical implications for managers who are engaged in servitization. It is expected that servitization can help industrial companies in undertaking the digital transformation of their businesses and in improving environmental sustainability.

Notwithstanding this contribution, our paper has certain limitations. Firstly, we have used only one database (SCOPUS) and the peer-reviewed papers featured in it. Some publications may therefore have been overlooked. Secondly, we have only considered papers written in English, whereby there may be other publications drafted in other languages, such as Chinese, Italian, French or German, for example.

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### Appendix A. Papers analysed.

| Paper Title                                                                 | Year | Authors                        | Keywords                                                                 | Methodology       | Research Theme                  |
|-----------------------------------------------------------------------------|------|--------------------------------|--------------------------------------------------------------------------|-------------------|---------------------------------|
| Balancing specialized and generic capabilities in the provision of integrated solutions | 2011 | Ceci, F. Masini, A              | Firm size, industrial performance, structural, information technology, model test | Survey            | Capabilities, organizational aspects, performance |
| Theoretical perspectives in operations management: An analysis of the literature | 2015 | Walker, H., Chicksad, D., Radnor, Z., Watson, G. | Operations management, Literature review, Theory, Capabilities, integrated solutions, IT sector, contingency theory, resource-based view | Conceptual, literature review | Theories, Capabilities, organizational aspects |
| Configuring capabilities for integrated solutions: Evidence from the IT sector | 2008 | Ceci, F. Precipe, A.            | Marketing strategy, Strategic fit, Firm performance, Credit unions, Miles and Snow typology, Porter typology | Survey            | Strategy                        |
| The impact of strategic consistency on market share and ROA                  | 2014 | Pleshko, L.P., Heiens, R.A., Peev, P. | Marketing strategy, Strategic fit, Firm performance, Credit unions, Miles and Snow typology, Porter typology | Survey            | Strategy                        |
| A contingency theory approach to market orientation and related marketing strategy concepts: Does fit relate to share performance? | 2011 | Pleshko, L.P., Heiens, R.A.     | Product-service systems (PSS), Risk management, Service delivery system design, Servitization, Sharing economy, Trust | Survey            | Value co-creation, business models, Organizational aspects, business models |
| Service delivery system design for risk management in sharing-based product service systems: a customer-oriented approach | 2020 | Hazéle, S., Van Vaerenbergh, Y., Delcourt, C., Kabadiy, S | Specialised capabilities in integrated solutions: The role of fit | Survey            | Marketing, Alderson, transvection, servitisation, SCM, Business models, performance, SCM, Flexibility |
| Successful business models for service centres: an empirical analysis       | 2020 | Gaiardelli, P., Songini, L.     | Successful business models for service centres, Servitization, Top performer Servitization, Organizational change, Organizational design factors, Culture, Firm performance | Survey            | Business models, performance, Organizational aspects, performance, hr |
| The impact of service-oriented organizational design factors on firm performance: The moderating role of service-oriented corporate culture | 2020 | Yan, K. Li, G., Cheng, T.C.E.  | Marketing complex product designs in the contemporary value chain | Survey            | SCM                             |
| Specialised capabilities in integrated solutions: The role of fit            | 2013 | Ceci, F. Masini, A.            | Specialised capabilities in integrated solutions: The role of fit | Survey            | SCM                             |
| Ecological theory (1)                                                        | 2017 | Zhang, W., Shi, Y., Yang, M. Tang, R., Pan, X. | Ecosystem evolution mechanism of manufacturing service system driven by service providers | Case study        | Ecological evolution             |
| Fatalism                                                                    | 2018 | Stål, H.I. Corvillé, H.        | Flavoured business models, circular economy, decoupling, sustainable business models, institutional theory, product-service-systems | Case study        | Circular economy, business models, flexibility |
| Human relations theory                                                       | 2017 | Alsharari, N.M., ElAalz, M.A.  | How institutional pressures and systems characteristics shape customer acceptance of smart product-service systems | Case study        | Accounting, SIG                  |
| Institutional theory (3)                                                    | 2018 | Kropp, E., Totzek, D.          | Management accounting change and the implementation of glmis: A Jordanian case study | Case study        | Accounting, SIG                  |
| Linear programming (14)                                                     | 2020 | Kropp, E., Totzek, D.          | How institutional pressures and systems characteristics shape customer acceptance of smart product-service systems | Survey            | SCM, Strategy, performance, consumer behavior |
| Optimization of a Distributed Cogeneration System with solar district heating | 2014 | Puigjaner, L., Lainez, J.M.    | Linear programming, Capturing dynamics in integrated supply chain management | Survey            | SCM, Strategy, performance, creation value |
| Capturing dynamics in integrated supply chain management                    | 2008 | Puigjaner, L., Lainez, J.M.    | Linear programming, Capturing dynamics in integrated supply chain management | Case study        | SCM, Strategy, performance, creation value |

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| Title                                                                 | Authors                                      | Year | Keywords                                                                 | Methodology          | Keywords                      |
|----------------------------------------------------------------------|----------------------------------------------|------|--------------------------------------------------------------------------|----------------------|-------------------------------|
| A systematic decision-making approach for the optimal product-service system planning | Geng, X. Chu, X., Xue, D., Zhang, Z.         | 2011 | Product-service system (PSS), Engineering characteristics (EC), Fuzzy pairwise comparison, Kano model, Non-linear programming | Case study           | Performance                   |
| A utility-driven approach to supplier evaluation and selection: Empirical validation of an integrated solution framework |                                             | 2016 |                                                                                  |                      |                               |
| Aircraft maintenance, routing, and crew scheduling planning for airlines with a single fleet and a single maintenance and crew base |                                             | 2014 |                                                                                  |                      |                               |
| Integrated stochastic optimization approaches for tactical scheduling of trains and railway infrastructure maintenance |                                             | 2019 |                                                                                  |                      |                               |
| Air traffic optimization models for aircraft delay and travel time minimization in terminal control areas |                                             | 2015 |                                                                                  |                      |                               |
| Module configuration approach for product service system design driven by customer requirements | Geng, X. Xu, S. Ye, C.                     | 2016 | Customer requirements, Quality function deployment, Product service system | Conceptual, Theoretical analysis | PSS, Quality                |
| A specialized column generation approach for a vehicle routing problem with demand allocation |                                             | 2013 |                                                                                  |                      |                               |
| Application driven inverse type constraint satisfaction problems |                                             | 2017 |                                                                                  |                      |                               |
| An initial load-based green software defined network |                                             | 2017 |                                                                                  |                      |                               |
| Centralized visual based navigation and control of a swarm of satellites for on-orbit servicing |                                             | 2020 |                                                                                  |                      |                               |
| Sustainable water supply systems for the islands: The integration with the energy problem |                                             | 2020 |                                                                                  |                      |                               |
| Organizational behavior (6)                                           |                                              |      |                                                                                  |                      |                               |
| Theoretical perspectives in operations management: An analysis of the literature | Walker, H., Chicksand, D., Radnor, Z., Watson, G. | 2015 | Operations management, theory, literature review | Conceptual, literature review | Theories                   |
| Towards a model of governance in complex (product-service) inter-organizational systems | Roehrich, J.K., Lewis, M.A.                   | 2010 | Product-Service Systems, Inter-organizational Governance, Contracts, Trust, Complexity |                      | Organizational aspects, strategy |
| An empirical study on the influences on the acquisition of enterprise software decisions: A practitioner’s perspective | Palanisamy, R., Verville, J., Bernadas, C., Taskin, N. | 2010 | Computer software, Purchasing, Decision making, Organizational behavior | Survey               | Digitalization                |
| Transforming cross-cultural conflict into collaboration: The integration of western and eastern values |                                             | 2018 |                                                                                  |                      |                               |
| Computerized Immediate Feedback Increases Product Recall Efficiency Due to Interlocking Contingencies in Food Manufacturing |                                             | 2017 |                                                                                  |                      |                               |
| The effect of organizational citizenship behaviors on the success of enterprise resource planning (ERP) information systems |                                             | 2014 |                                                                                  |                      |                               |
| Resource dependence (4)                                               |                                              |      |                                                                                  |                      |                               |
| A service-oriented dynamic multi-level maintenance grouping strategy based on prediction information of multi-component systems | Chang, F. Zhou, G. Zhang, C., Xiao, Z., Wang, C. | 2019 | Product-service-system, Service-oriented maintenance, Maintenance strategy, Grouping maintenance, Predictive maintenance, Dynamic rolling horizon | Conceptual, case study | Strategy                     |
| Joint dependence, dependence advantage, relationship learning, manufacturer servitization, resource dependence theory, service-oriented manufacturing, manufacturer-user dependence, China, cooperation, communication, value creation, joint action | | | | | |
| Manufacturer-user dependence, relationship learning and manufacturer servitisation in China | Li, J.H., Zhu, W.J., Lin, L., Ma, L.Y., Huang, Q.B. | 2015 | Survey Servitization, Supply-chain integration, Firm performance, Empirical research, | Survey               | Strategy, capabilities        |
| Servitization and supply chain integration: An empirical analysis | Shah, S.A.A. Jajia, M.S.S. | 2020 | International manufacturing strategy survey | Survey               | Performance                  |
| Chatha, K.A., Farooq, S. | | | | | |
| Title                                                                 | Authors                          | Year | Methodology/Concepts                                                                 |
|----------------------------------------------------------------------|----------------------------------|------|--------------------------------------------------------------------------------------|
| Construct Outsourcing Vendor Selection Criteria for Business Intelligence | Chang, C.-Y., Yang, J.-W. Wu, M.-C. | 2019 | Business intelligence, outsourcing vendor, selection criteria, modified Delphi method, analytic hierarchy process |
| Business practice (5)                                                | Wang, C.-Y., Wu, Y.-H., Chou, S.-C.T. | 2010 | Service innovation, service productivity, service design, Service design, management, business strategy |
| Scientific management                                                | Allen, S. G., Mugge, P.          | 2006 | Conceptual, Flexibility, quality, Strategy, Value co-creation |
| Services science to be taught at NC state                           |                                   | 2015 | Services management in highly competitive contexts of tumultuous change |
| System convergence in the crafting and execution of a services directed strategy: A technology perspective |                                   | 2015 | Toward a ubiquitous personalized daily-life activity recommendation service with contextual information: A services science perspective |
| Social practice theory (4)                                           |                                   | 2008 | Towards a ubiquitous personalized daily-life activity recommendation service with contextual information: A services science perspective |
| The role of values in collaborative consumption: Insights from a product-service system for lending and borrowing in the UK | Piscicelli, L., Cooper, T., Fisher, T. | 2015 | Collaborative consumption, Pro-environmental behavior change, Product-service systems, Social practice theory, Social psychology, Values, Sharing economy, Social practice theory, Product-service systems, Emerging economies |
| Collaborative consumption practices in Southeast Asian cities: Prospects for growth and sustainability | Retamal, M.                      | 2019 | Developing countries, households, industrial ecology, product-service system (PSS), social practices, sustainable consumption, Case study, Value co-creation |
| Dirty Laundry in Manila: Comparing Resource Consumption Practices for Individual and Shared Laundering | Retamal, M., Schandl, H.         | 2018 | Sustainable product-service systems, Sustainability, Consumption, Practice theory, Sustainable design |
| Exploring the consumption side of sustainable product-service systems (PSS): An empirical study and insights for PSS sustainable design | Sousa-Zomer, T.T., Miguel, P.A.C. | 2016 | Case study, Sustainability |

**BOUNDARY OF THE FIRM THEORY**

| Title                                                                 | Authors                          | Year | Methodology/Concepts                                                                 |
|----------------------------------------------------------------------|----------------------------------|------|--------------------------------------------------------------------------------------|
| Multitask agency, modular architecture, and task disaggregation in SaaS | Susarla, A., Barua, A., Whinston, A.B. | 2010 | Endogenous matching, information technology, modularity, multitask agency, outsourcing, service science, services |
| Mitigating adverse customer behaviour for product-service system provision: An agency theory perspective | Reim, W., Sjödin, D., Parida, V. | 2018 | Product-service systems (PSS), Agency theory, Trust, Adverse behavior, Agency mechanisms, Servitization |
| Hidden costs in different stages of advanced services – A multiactor perspective of performance based contracts | Datta, P.P.                      | 2020 | Hidden costs, Performance based contracts, Case based research, Servitization, Multi actor systems, Engagement, S-D logic, Agency theory |
| Game theory (20)                                                      |                                   |      | Case study, Performance (hidden cost) |
| A module-based service model for mass customization: Service family design | Moon, S.K., Shu, J., Simpson, T.W., Kumara, S.R.T. | 2011 | Coalitional game, mass customization, module-based service model, service family and platform design, Servitization, Channel competition, Game theory |
| When is servitization a profitable competitive strategy?              | Lee, S. Yoo, S., Kim, D.         | 2016 | Bi-level programming, configuration design optimization, genetic programming, modular design, product-CASE study, service systems (PSS) |
| Bi-Level Coordinated Configuration Optimization for Product-Service System Modular Design | Li, H., Ji, Y., Chen, L., Jiao, R.J. | 2017 | Conceptual, Business models, Innovation, Strategy, Performance |
| Categorization and mechanism of platform-type product-service systems in manufacturing | Nishino, N., Wang, S., Tsuji, N., Kageyama, K., Ueda, K. | 2012 | Service, Decision making, Business model |

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Costing-based coordination between mt-IPSS customer and providers for job shop production using game theory 2017  Mu, H., Jiang, P., Leng, J.  Product service systems; operational research; job shop scheduling; Stackelberg game; coordination decision  Case study  CRM

The gamification and the enrichment of innovation practices in the firm: An analysis of experiences 2013  Gómez, C.G., Heredero, C.P.  Gamification, Business strategy, Innovation 2.0, Gameplay, Value co-creation, Games theory, Servitization Revenue management, Pricing, Game theory, Maintenance, Contracts, Servitization  Conceptual  Value co-creation, performance

Optimal design of uptime-guarantee contracts under IGFR valuations and convex costs 2017  Hezarkhani, B.  Performance, sustainability

Optimizing a warranty-based sustainable product service system using game theory 2018  Arabi, M., Mansour, S.  Performance, sustainability

Game analysis about incentive of information sharing in product servitization supply chain 2014  He, Z., Chen, J., Yao, S.  Strategy, SCM

A service-oriented multi-player maintenance grouping strategy for complex multi-component system based on game theory 2019  Chang, F., Zhou, G., Cheng, W., Zhang, C., Tian, C.  Performance-based maintenance, Proactive services, Stackelberg-Nash game Chinese bikesharing programs, Overuse, Game theory, Management modes  Case study  Strategy, sustainability

Mitigation strategies for overuse of Chinese bikesharing systems based on game theory analyses of three generations worldwide 2019  Wang, Z., Zheng, L., Zhao, T., Tian, J.  Strategy, maintenance

Manufacturing service order allocation in the context of social manufacturing based on Stackelberg game 2019  Guo, W., Jiang, P.  Strategy, Service failure, Service recovery, Game theory, Signalling game  Case study  Strategy, consumer behavior

Modeling dynamic service recovery strategies: a signaling game approach 2018  Hsieh, Y.-H., Yeh, S.-Y.  Strategy, organizational aspects

Game analysis of product-service integration Analysis of membership-type service in manufacturing using integrating approach with economic experiments and multi-agent simulation 2014  Zhong, H.  Conceptual  Game theory, product-service integration, shapley value, servitization Service engineering, multi-agent simulation, lifestyle, equilibrium analysis, service ecosystem

A Bayesian network approach for cybersecurity risk assessment implementing and extending the FAIR model 2020  Nishino, N., Okida, K.  Performance, hr, consumer behavior

A systematical analysis on the dynamic pricing strategies and optimization methods for energy trading in smart grids Execution quality and chargeback penalties in retail supply chains 2020  A scheme design of cloud + end technology in demand side management 2020

Research on the strategy of manufacturing enterprise carrying out service in full life cycle based on game theory 2012  Jia, Y.-F., Miao, R. Cao, J.-T. Wang, L.-Y. Jiang, Z.-B.  Product life cycle  Others (simulation)  Consumer behavior

Industrial organization (S)

Digital servitization business models in ecosystems: A theory of the firm 2019  Kohtamäki, M., Parida, V., Oshazi, P., Gebauer, H., Baines, T.  Conceptual  Business models, strategy, industry 4.0

Treatment of olive oil waste waters 1986  Concept generation, Conceptual design, Concept-knowledge model, Creativity, Knowledge evolution, Knowledge graph, Smart product-service system Digital technology value, Digital transformation, Ecological sustainability, Industrial entrepreneurship, Institutional entrepreneurship, Servitization  Case study  Performance, flexibility

A knowledge graph-Aided concept-Knowledge approach for evolutionary smart product-Service system development 2020  Li, X., Chen, C., Zheng, P., Wang, Z., Jiang, Z., Jiang, Z.  Performance, flexibility

CO2 reduction through digital transformation in longhaul transportation: Institutional entrepreneurship to unlock product-service system innovation 2020  Haftor, D.M., Climent, R.C  Circular economy, ecological evolution

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| Title                                                                 | Authors                                                                 | Year | Journal | doi: | Volume | Issue | Page | Data | Type | Capabilities |
|----------------------------------------------------------------------|------------------------------------------------------------------------|------|---------|------|--------|-------|------|------|------|--------------|
| Identification the intangibles arising from investments in          | Cortés, M., Gradera, E., Rodríguez, A.                                 | 2014 |         |      |        |       |      |      |      |              |
| prevention of occupational risks and their perception in            |                                                                       |      | Jiem   |      | 3466   | 4     | 517  |      |      |              |
| smes. Implications in the service sector and the servitization      |                                                                       |      |         |      |        |       |      |      |      |              |
| Resource-based (X1)                                                 |                                                                       |      |         |      |        |       |      |      |      |              |
| Hybrid offerings: How manufacturing firms combine goods and         | Ulaga, W., Reinartz, W.J.                                             | 2011 | Jiem   |      | 3466   | 5     |      |      |      |              |
| and services successfully                                           |                                                                       |      |         |      |        |       |      |      |      |              |
| Effect of service transition strategies on firm value               | Fang, E., Palmatier, R.W., Steenkamp, J.-B.E.M.                       | 2008 |         |      |        |       |      |      |      |              |
| Services growth options for B2B product-centric businesses          | Raddats, C., Easingwood, C.                                           | 2010 |         |      |        |       |      |      |      |              |
| Boosting servitization through digitization: Pathways and dynamic   | Coreysen, W., Matthysens, P., Van Bockhaven, W.                        | 2017 |         |      |        |       |      |      |      |              |
| resource configurations for manufacturers                            |                                                                       |      |         |      |        |       |      |      |      |              |
| Collaborative consumption: Towards a resource-saving consumption    | Leismann, K., Schmitt, M., Rohn, H., Baedeker, C.                     | 2013 |         |      |        |       |      |      |      |              |
| culture                                                             |                                                                       |      |         |      |        |       |      |      |      |              |
| Transitioning from product to service-led growth in manufacturing   | Ulaga, W., Loveland, J.M.                                            | 2014 | Jiem   |      | 3466   | 5     |      |      |      |              |
| firms: Emergent challenges in selecting and managing the industrial  |                                                                       |      |         |      |        |       |      |      |      |              |
| sales force                                                          |                                                                       |      |         |      |        |       |      |      |      |              |
| Seeking competitive advantage with service infusion: A              | Eloranta, V., Turunen, T.                                            | 2015 |         |      |        |       |      |      |      |              |
| systematic literature review                                         |                                                                       |      |         |      |        |       |      |      |      |              |
| Balancing specialized and generic capabilities in the provision of   | Ceci, F., Masini, A.                                                 | 2011 |         |      |        |       |      |      |      |              |
| integrated solutions                                                |                                                                       |      |         |      |        |       |      |      |      |              |
| Service innovation and new product performance: The influence of     | Chen, K.-H., Wang, C.-H., Huang, S.-Z., Shen, G.C.                    | 2016 | Jiem   |      | 3466   | 5     |      |      |      |              |
| market-linking capabilities and market turbulence                    |                                                                       |      |         |      |        |       |      |      |      |              |
| Resource configurations for services success in manufacturing       | Raddats, C., Burton, J., Ashman, R.                                   | 2015 |         |      |        |       |      |      |      |              |
| companies                                                            | Walker, H., Chicksand, D., Radnor, Z., Watson, G.                     | 2015 |         |      |        |       |      |      |      |              |
| Theoretical perspectives in operations management: An analysis of    |                                                                       |      |         |      |        |       |      |      |      |              |
| the literature                                                      |                                                                       |      |         |      |        |       |      |      |      |              |
| Configuring capabilities for integrated solutions: Evidence from the | Ceci, F., Principe, A.                                               | 2008 |         |      |        |       |      |      |      |              |
| IT sector                                                            |                                                                       |      |         |      |        |       |      |      |      |              |
| Understanding product-service system innovation capabilities        | Wallin, J., Parida, V., Isaksson, O.                                  | 2015 |         |      |        |       |      |      |      |              |
| development for manufacturing companies                              |                                                                       |      |         |      |        |       |      |      |      |              |
| Are my symptoms serious Dr Google? A resource-based                 |                                                                       | 2014 |         |      |        |       |      |      |      |              |
| typology of value co-destruction in online self-diagnosis           |                                                                       |      |         |      |        |       |      |      |      |              |
| Assessing transformational change from institutionalising           | Pagonopoulos, A., Maier, A., McAloone, T.C.                          | 2017 |         |      |        |       |      |      |      |              |
| digital capabilities on implementation and development of            | Product-Service Systems, Digitization, Customer, Maritime industry   | 2017 |         |      |        |       |      |      |      |              |
| Product/Service Systems: Learnings from the maritime industry       | Solution business, solutions, strategic capability, resource-based   | 2017 |         |      |        |       |      |      |      |              |
| Solution providers’ strategic capabilities                           |침구, T., Kohtamäki, M.                                               | 2017 |         |      |        |       |      |      |      |              |
| Service transitions of product-centric firms: An explorative study  | Lütjen, H., Tietze, F., Schultz, C.                                   | 2017 |         |      |        |       |      |      |      |              |
| of service transition stages and barriers in Germany’s energy market|                                                                       |      |         |      |        |       |      |      |      |              |
| Modeling manufacturer’s capabilities for the Internet of Things     | Hasselblatt, M., Hulikko, T., Kohtamäki, M., Nickell, D.              | 2018 |         |      |        |       |      |      |      |              |
| Internet of Things, Industrial Internet, servitization, resource-    |                                                                       |      |         |      |        |       |      |      |      |              |
| based view, Business Intelligence, digitalization                   |                                                                       |      |         |      |        |       |      |      |      |              |

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| Title                                                                 | Year | Authors                                                                 | Journal and DOI                                                                 |
|---------------------------------------------------------------------|------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Innovative product development in hotel operations                   | 2006 | Frehse, J.                                                              | Product development, innovation, hotel industry, hotel operations, resource-based view | Business models, Conceptual capabilities |
| Digital servitization business models in ecosystems: A theory of the firm | 2019 | Kohtamäki, M., Parida, V., Ozhazi, P., Gebauer, H., Baines, T.          | Digitalization, Industry 4.0, Ecosystems, Digital servitization, Product-service systems (PSS), Firm boundaries, Business model innovation, Platforms and sustainability service transition, automotive industry, mechanical engineering, diversification, customer integration, technological change | Business models, Conceptual, Theoretical analysis digitalization |
| Service transition in the automotive industry                         | 2013 | Kessler, T., Stephan, M.                                                | Servitization, Resource-based view, Capabilities, Process industry | Business models |
| Exploring the dynamic capabilities required for servitization: The case process industry | 2017 | Kanninen, T., Penttinen, E., Timilä, M., Kaario, K.                     | Case study, China, resource-based theory, resource management, servitisation | Business models |
| Contemporary perspectives on the strategic role of information in internet of things-driven industrial services Allocation of composite mode on-orbit service resource based on improved DQN | 2018 | Turunen, T., Eloranta, V., Hakanen, E.                                 | Service infusion, Industrial services, IoT, Service infusion | Organizational aspects, Flexibility |
| Servitization and business performance: the moderating effects of environmental uncertainty Combat resource two-stage virtualization method in cloud cooperation | 2019 | Zhang, Y., Wang, L., Gao, J., Li, X.                                    | Business performance, servitization, environmental uncertainty, adjustment cost, coordination cost | Survey, Performance |
| The transformation mechanism of servitisation in China: A resource-based perspective | 2018 | Sun, H., Zhang, A., Gao, F.                                             | Case study, China, resource-based theory, resource management, servitisation | Case study, Capabilities |
| An optimal configuration method of multi-level manufacturing resources based on community evolution for social manufacturing | 2020 | Zhang, Y., Zhang, D., Wang, Z., Qian, C.                                | Social manufacturing, Resource configuration, Dynamic community, Multi-level Optimization | Case study, Organizational aspects |
| Exploring the prot model of servitising manufacturers: A resource-based perspective The impact of service-oriented organizational design factors on firm performance: The moderating role of service-oriented corporate culture | 2020 | Li, J., Lin, L., Zhang, T.                                              | Case study, Human resource, Profit model, Resource-based view, Servitization, Technology resource Servitization, Organizational change, Organizational design factors, Culture, Firm performance | Case study, Capabilities, Flexibility, Organizational aspects, Survey, Performance |
| Construct Outsourcing Vendor Selection Criteria for Business Intelligence | 2019 | Chang, C.-Y., Yang, J.-W., Wu, M.-C.                                   | Delphi method, analytic hierarchy process | Delphi, Performance |
| Transaction cost (11)                                                 |      | A new business model for baby prams based on leasing and product remanufacturing | Product-service systems; Leasing; Remanufacturing; Prams; Durable products; Eco-design Vertical integration, Supply chain integration, Downstream integration, Building materials, Retailing, Merchandising, Vertical marketing, Sweden | Conceptual, Business models |
| Vertical integration in supply chains: Driving forces and consequences for a manufacturer’s downstream integration | 2012 | Guan, W., Rehme, J.                                                    | Service science, service quality, productivity, digital connections, enterprise engineering, cyber-infrastructure, production function, scaling, extended enterprises, service cycle times, transaction costs | Case study, Organizational aspects, SCM |
| Improving service quality and productivity: Exploring the digital connections scaling model | 2009 | Cheng, Hsu., Spohrer, J.C.                                             | Digitalization, Industry 4.0, Ecosystems, Digital servitization, Product-service systems (PSS), Firm boundaries, Business model innovation, Platforms and sustainability | Conceptual, Theoretical analysis digitalization |
| Digital servitization business models in ecosystems: A theory of the firm | 2019 | Kohtamäki, M., Parida, V., Ozhazi, P., Gebauer, H., Baines, T.         | Business model innovation, Platforms and sustainability | Business models, Conceptual, Theoretical analysis digitalization |
Territorial servitization and new local productive configurations: the case of the textile industrial district of Prato

2019 Bellandi, M., Santini, E.

Industrial district, new manufacturing, knowledge-intensive business services (KIBS), territorial servitization, local productive configuration Mix Business models

Transition to circular economy on firm level: Barrier identification and prioritization along the value chain

2020 Werning, J.P., Spinler, S.

Circular economy, Barriers, Organizational change, CE-Matrix, Sets of barriers, Firm-level Case study Organizational aspects

Servitization and business performance: the moderating effects of environmental uncertainty

2019 Zhang, Y., Wang, L., Gao, J., Li, X.

Business performance, servitization, environmental uncertainty, adjustment cost, coordination cost Survey Performance

Exploring the transaction dimensions of supply chain management

2007 Lietke, B. Boslau, M.

Supply chain management, SCM networks, hybrid governance, survey, transaction costs, transaction dimensions, asset specificity, uncertainty Survey SCM

The impact of the Internet of Things (IoT) on servitization: an exploration of changing supply relationships

2020 Boehmer, J.H. Shukla, M.

Servitization, IoT, buyer-supplier relationships, manufacturing, services Case study SCM

Construct Outsourcing Vendor Selection Criteria for Business Intelligence

2019 Kapleia, D., Tiwari, M.K.

Chang, C.-Y., Yang, J.-W., Wu, M.-C.

Oil industry, Supply chain, Rm, Property rights, Economic theory, Angola Conceptual SCM

Supply chain management in the oil industry: The Angolian case

2001 Wiig, A.


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