



## From servitization to digital servitization: How digitalization transforms companies' transition towards services

Camila Favoretto<sup>a,\*</sup>, Glauco H.S. Mendes<sup>a</sup>, Maicon G. Oliveira<sup>b</sup>, Paulo A. Cauchick-Miguel<sup>c</sup>, Wim Coreynen<sup>d,e</sup>

<sup>a</sup> Department of Production Engineering, Federal University of São Carlos, Rod. Washington Luis km 235, 13565-905 São Carlos, SP, Brazil

<sup>b</sup> Institute of Science and Technology, Federal University of Alfenas, R. Gabriel Monteiro da Silva, 700, 37130-001 Alfenas, MG, Brazil

<sup>c</sup> Department of Production and Systems Engineering, Federal University of Santa Catarina, R. Eng. Agrônomo Andrei Cristian Ferreira, 88040-900 Florianópolis, SC, Brazil

<sup>d</sup> School of Business and Economics, Vrije Universiteit Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

<sup>e</sup> Utrecht University School of Economics, Utrecht University, Kriekenplein 21-22, 3584 EC Utrecht, The Netherlands

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### ABSTRACT

Servitization and digitalization are two business model innovations that have affected product companies. From the convergence of these two trends, digital servitization emerged as a novel concept. Digital servitization pushes product companies to radically transform their business model, creating new challenges for its implementation. This paper aims to uncover how digitalization fundamentally transforms product companies in their transition towards services. Based on a systematic review of the literature, we analyze a sample of 180 articles published between 2005 and 2020 using both descriptive and content analysis techniques. Our review thereby offers both theoretical and managerial contributions. We descriptively analyze the evolution of the research field. Furthermore, we propose a new unified definition of digital servitization and discuss nine servitization dimensions where digitalization influences servitization—motivations; strategy; service offerings; structure; culture; resources and capabilities; processes; performance; and servitization ecosystems—leading to a new conceptual framework for digital servitization. Finally, we identify several directions for future digital servitization research.

### 1. Introduction

Manufacturers such as Rolls-Royce, Caterpillar, ABB, Siemens, IBM, Cisco, and other companies, particularly from developed, often Western economies, have transformed their business models to compete by providing services rather than products alone (Baines, Bigdeli, Sousa, & Schroeder, 2020; Gebauer, Paiola, Saccani, & Rapaccini, 2020; Kohtamäki, Parida, Oghazi, Gebauer, & Baines, 2019; Rabetino, Harmsen, Kohtamäki, & Sihvonen, 2018). The focus on services started in the late 1980s based on the integration of products and services (Vandermerwe & Rada, 1988) to achieve mainly competitive and sustainable goals (Rabetino et al., 2018; Tukker, 2004). Only after the seminal works of Baines et al. (2007) and Baines et al. (2009) on product-service systems, the term “servitization” gained high popularity among both product companies and different research communities (Rabetino et al., 2018).

Thus, the focus on services moved from a product/technology perspective to encompasses also business model innovation and organizational change (Baines et al., 2020; Rabetino et al., 2018).

Growth through services has led product companies to seek servitization (Kowalkowski, Gebauer, Kamp, & Parry, 2017; Lexutt, 2020; Raddats, Kowalkowski, Benedettini, Burton, & Gebauer, 2019), which emphasizes the transition from a product-centered to a service-centered business model (Baines et al., 2017; Kowalkowski et al., 2017; Rabetino et al., 2018). Although servitization can generate financial, strategic, and marketing benefits (Baines, Lightfoot, Benedettini, & Kay, 2009; Martinez Hernandez, Neely, Velu, Leinster-Evans, & Bisessar, 2017), it also imposes challenges on product companies regarding the development of service offerings, service departments, a service-oriented culture, and new service processes and capabilities (Baines et al., 2020; Martinez Hernandez et al., 2017).

\* Corresponding author.

E-mail addresses: [camila.favoretto@estudante.ufscar.br](mailto:camila.favoretto@estudante.ufscar.br) (C. Favoretto), [glauco@dep.ufscar.br](mailto:glauco@dep.ufscar.br) (G.H.S. Mendes), [paulo.cauchick@ufsc.br](mailto:paulo.cauchick@ufsc.br) (P.A. Cauchick-Miguel), [w.coreynen@vu.nl](mailto:w.coreynen@vu.nl) (W. Coreynen).

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More recently, the advance of novel digital technologies (e.g., the Internet of Things (IoT), big data, and cloud computing) have also urged product companies to rethink their business model (Verhoef et al., 2019). The digitization of information and tasks (Frank, Mendes, Ayala, & Ghezzi, 2019; Verhoef et al., 2019) has progressed towards digitalization, in which digital technologies are employed to change existing processes for greater efficiency and better customer value (Ardolino et al., 2018; Verhoef et al., 2019). However, digital technologies can also promote a full digital transformation of business models by implementing a new logic to create, deliver and capture value (Favoretto, de Sousa Mendes, Godinho Filho, de Oliveira, & Ganga, 2021; Kohtamäki et al., 2019; Verhoef et al., 2019). Thus, digital technologies can affect product companies at different levels, from altering their operational tasks and processes to promoting a company-wide transformation with broad organizational implications (Favoretto et al., 2021; Verhoef et al., 2019).

In the last few years, the literature has often reported on the mutual relationship between servitization and digitalization (e.g., Coreynen, Matthysens, & Van Bockhaven, 2017; Frank et al., 2019; Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2017). Servitization demands the use of novel information and communication technologies (ICTs) to better understand customers' needs and processes, to collect and exchange data, and to improve their offerings (Martín-Peña, Díaz-Garrido, & Sánchez-López, 2018; Tronvoll, Sklyar, Sörhammar, & Kowalkowski, 2020). In the same vein, digitalization also stimulates the offering of smart products, digitally-enabled services, and digital services (Paschou, Rapaccini, Adrodegari, & Saccani, 2020; Vendrell-Herrero, Bustinza, et al., 2017). Although servitization and digitalization can be implemented separately in product companies (Vendrell-Herrero, Bustinza, et al., 2017), they show great convergence (Frank et al., 2019; Gebauer et al., 2020). From this convergence, digital servitization (DS) emerged as a novel concept, referring to the use of digital technologies in the processes and offerings related to servitization (Paschou et al., 2020; Tronvoll et al., 2020; Vendrell-Herrero, Bustinza, et al., 2017).

New challenges arise when companies combine servitization and digitalization (Frank et al., 2019; Gebauer et al., 2020; Paschou et al., 2020). DS can push product companies to radically transform their business model, particularly of those interested in providing digitally enabled advanced services (Gebauer et al., 2020; Schroeder, Naik, Bigdeli, & Baines, 2020). Indeed, early servitization-related studies already highlighted the role of technology, digital technologies, in particular, to support the provision of services (e.g., Kowalkowski, Kindström, & Gebauer, 2013). Nevertheless, the rapid advance of digitalization is fundamentally altering how products are built, services provided, and how companies structure their organization and business model (Gebauer et al., 2020; Tronvoll et al., 2020; Verhoef et al., 2019). Thus, DS refers to the most pervasive use of digitalization, implying major business improvements and changes in the servitization strategy adopted by product companies (Paschou et al., 2020; Rabetino, Kohtamäki, Brax, & Sihvonen, 2021; Sjödin, Parida, Kohtamäki, & Wincent, 2020; Tronvoll et al., 2020). Therefore, we posit that DS is more complex than the simple use of digital technologies and that a new logic is required for creating value through servitization. Based on this reasoning, we consider that digitalization truly changes the content (i.e., *what* have manufacturers changed) of servitization strategy. In this sense, Paschou et al. (2020) state that it is crucial to define how the adoption of DS changes companies' operations and processes in practice. Other recent studies also call for more research to better understand the DS phenomenon (Gebauer et al., 2020; Kohtamäki, Parida, Patel, & Gebauer, 2020; Rabetino et al., 2021; Tronvoll et al., 2020). Thus, it is necessary to uncover the profound changes in business logic demanded by DS.

This paper addresses the DS construct as a response to the lack of clarity regarding this phenomenon (Paschou et al., 2020; Tronvoll et al., 2020). A lack of theoretical consistency concerning the DS content may intensify the fuzzy landscape of its research. As a consequence, it may produce a fragmented and diverse understanding, making comparisons

among studies difficult and failing to ensure consolidation of knowledge. To the best of our knowledge, only a few reviews have addressed the DS theme (e.g., Kohtamäki et al., 2019; Martín-Peña et al., 2018; Paschou et al., 2020). Some reviews have explored the impact of specific digital technologies on servitization, such as remote monitoring (e.g., Grubic, 2014) and big data (Ren et al., 2019), while others have attempted to characterize this phenomenon or summarize the convergent literature on these two domains (e.g., Kohtamäki et al., 2019; Martín-Peña et al., 2018). The review by Raddats et al. (2019), for instance, emphasizes the need for more research on how to leverage digital technologies to offer new services (although it focuses mainly on the servitization literature in general), whereas the review by Paschou et al. (2020) examines the convergence between servitization and digital technologies, providing a highly descriptive analysis of this literature.

Complementing earlier reviews, this study is slightly different in its objectives (mapping the influence of digitalization in the transition towards services) and its coverage (a more comprehensive coverage of the DS-related literature). In essence, its goal is to seek answers to the following research questions: (i) How does digitalization change the content of servitization? (ii) What are the main research directions for digital servitization research? Based on a systematic review of the literature, which is useful at this point because of the rapidly growing attention to DS, this paper aims to uncover how digitalization fundamentally transforms product companies in their transition towards services. In doing so, we cover the most recent literature by analyzing a sample of 180 articles published between 2005 and 2020 using both descriptive and content analysis techniques. This study thereby offers four contributions. First, we descriptively analyze the evolution of the research field, demonstrating that although the use of the term DS is still quite recent, the influence of ICT tools and digital technologies in servitization has been examined much earlier. Second, following prior definitions, we propose a new unified definition of DS. Third, applying a company-holistic approach (similar to prior works, e.g., Rabetino, Kohtamäki, & Gebauer, 2017; Fliess & Lexutt, 2019), we discuss nine dimensions where digitalization affects servitization—motivations; strategy; service offerings; structure; culture; resources, and capabilities; processes; performance; and servitization ecosystems—leading to a new conceptual framework for DS. Finally, we identify several directions for future DS research.

The next section describes the research design. Section 3 presents the results of descriptive analysis and content analysis, highlighting DS conceptualization and the dimensions of servitization affected by digitalization. Section 4 presents the proposed conceptual framework and research propositions. The future agenda is presented in section 5. Finally, the contributions and limitations are presented in section 6.

## 2. Research design

### 2.1. Sample selection

The relevant literature was identified through Scopus and ISI Web of Science (WoS) searches conducted using three main terms: servitization, digitalization, and DS. The set of keywords for each term was chosen based on other relevant reviews covering the domains investigated in this study (Table 1). The search string included the intersection (AND) between the first two keyword sets (servitization and digitalization) and the third keyword set (OR) related to DS.

The literature search process was performed according to Fig. 1. The inclusion criteria selected were articles and reviews written in the English language and published in peer-reviewed journals. The search was carried out in March 2021 and included articles that were published until December 2020. After discarding duplicates, the screening process started by reading the articles' titles, keywords, and abstracts. The eligibility criteria were applied in both searches to ensure the relevance of the final sample. To be included, the articles had to (i) deal with concepts related to servitization and digitalization as main topics, (ii)

**Table 1**  
Keywords used in the search strings for titles, keywords, and abstracts.

Terms	Keywords	Reference
Servitization	(serviti*ation OR "product-service system*" OR "integrated solution*" OR "smart service*" OR "service transformation" OR "service infusion" OR "advanced service*" OR "service transition")	(Baines et al., 2017; Kohtamäki et al., 2020; Paschou et al., 2020)
Digitalization	(digitali*ation OR digiti*ation OR "emerging technologies" OR "ICT" OR "big data" OR "cloud computing" OR "Internet of Things" OR "IoT" OR "remote control" OR "remote monitoring" OR "digital manufacturing" OR "digital technology*" OR "digital transformation" OR "Industry 4.0" OR "predictive analytic*" OR "advanced manufacturing" OR "additive manufacturing" OR "augmented reality" OR "virtual reality" OR simulation OR "cybersecurity" OR "cyber-physical system*" OR "RFID" OR "automation and industrial robots" OR "3D printing" OR "smart data" OR "smartization" OR "smart manufacturing" OR "smart factory")	(Ardolino et al., 2018; Kohtamäki et al., 2020; Martín-Peña et al., 2018; Paschou et al., 2020)
Digital servitization	("digital serviti*ation" OR "digital PSS" OR "smart product-service system*" OR "smart PSS" OR "smart serviti*ation")	(Bustinzá, Gomes, Vendrell-Herrero, & Tarba, 2018; Frank et al., 2019; Kohtamäki et al., 2020; Paschou et al., 2020)

address aspects related to the convergence of servitization and digitalization, and (iii) deal with the context of product companies. Articles that did not meet these criteria were excluded (e.g., Bhatti et al., 2020; Wu, Ota, Dong, & Li, 2016; Xiao et al., 2018). Two authors of the research team were involved in this screening process. When a consensus was not reached, a third author was involved. In the following stage, the articles were read in full (emphasizing the introduction and result sections), since decisions can be tricky when an abstract is not clear (in terms of what the paper was about). Only articles that met the inclusion criteria and were able to contribute to the research objectives were selected. Finally, to overcome the potential limitations of the search string, a backward snowball process based on Wohlin (2014) was performed, which resulted in the selection of five additional articles, mainly articles already included in other DS reviews (e.g., Allmendinger & Lombreglia, 2005; Eloranta & Turunen, 2016). Based on this process, 180 focal articles comprise the final sample (see Table A of the supplementary files).

## 2.2. Data analysis

First, a descriptive analysis was performed to collect the articles' basic information, such as the frequency of publications, most influential focal articles, and research methods. The intention was to synthesize the focal articles (Tranfield, Denyer, & Smart, 2003). The results of the

descriptive analysis are reported in section 3.1. A content analysis (Elo et al., 2014; Miles & Huberman, 1994) was performed to conceptualize DS (section 3.2) and to identify the influences of digitalization on servitization (section 3.3). Both approaches (descriptive and content analyses) were carried out with the support of NVivo 11 Plus software, which was used for the coding process, a comparison of the results, and information crossing (Bazeley & Jackson, 2013). We explored both the manifest and latent contents of the focal articles based on Seuring and Gold (2012). For instance, while authors explicitly demonstrated the influences of digitalization on servitization (e.g., *digital technologies require a reconsideration of manufacturers' product design practices - coded as change in the development process*), other influences were identified by the interpretation of the extracted data (text fragments) during the coding process (e.g., *DS calls for collaboration across firm boundaries – coded as change in the organization design imperatives*). Although this process was carried out rigorously, it may have resulted in a source of bias. We mitigated this risk by discussing the results with the full research team. Two authors of the research team were involved in the coding process, and the final categorization was discussed among all the authors.

Fig. 2 shows the coding structure developed during the content analysis. The text fragments were extracted from the focal articles, and they were processed using the "twin slate" approach (*tabula geminus*) since the extant theory influenced the identification of the codes already in the earliest stages of the coding process (Kreiner, 2016). Consequently, the codes were not originated by a "blank slate" approach (Gioia, Corley, & Hamilton, 2013). For instance, the fragment "...a digitalization strategy helps reorganize delivery processes through digital platforms (Reim, Sjödin, & Parida, 2019)" was coded as changes in delivery processes (see Table B of the supplementary files for more illustrative examples). During the coding process, main analytic categories were derived. Lastly, aggregate dimensions were also defined considering the extant servitization literature (e.g., Kindström & Kowalkowski, 2014; Lexutt, 2020; Rabetino et al., 2017; Raddats et al., 2019). The goal was to classify the codes into recognized categories that represent diverse dimensions of DS. These categories were refined and a consensus was reached in nine categories: (c1) motivations: as reasons that lead companies to implement a DS; (c2) strategy: represents the actions undertaken to implement the DS strategy; (c3) service offerings: how digitalization affects the types of services and nature of offers; (c4) structure: encompasses the organizational changes needed to adapt to the DS strategy; (c5) culture: considers the organizational values to support the DS; (c6) resources and capabilities: assets and competencies linked to digitalization that must be added to a servitized company; (c7) processes: how digitalization changes processes, such as product-service development, sales and service delivery in product served companies; (c8) performance: encompasses the financial and non-financial returns expected with DS; and (c9) servitization ecosystem encompasses a broad perspective involving multi-actors (suppliers, partners, customers and other actors) and contextual aspects related to DS.

## 3. Results and discussions

### 3.1. Descriptive analysis

Fig. 3 presents the number of publications per year as well as the

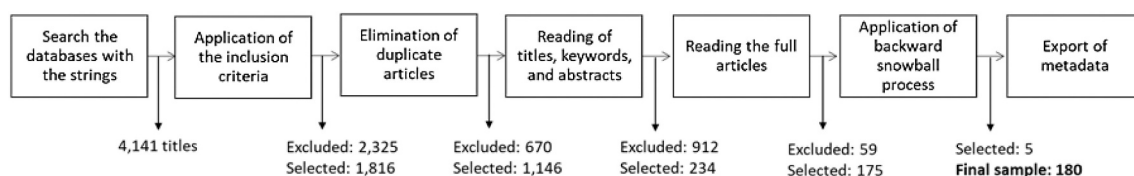


Fig. 1. Literature search process.

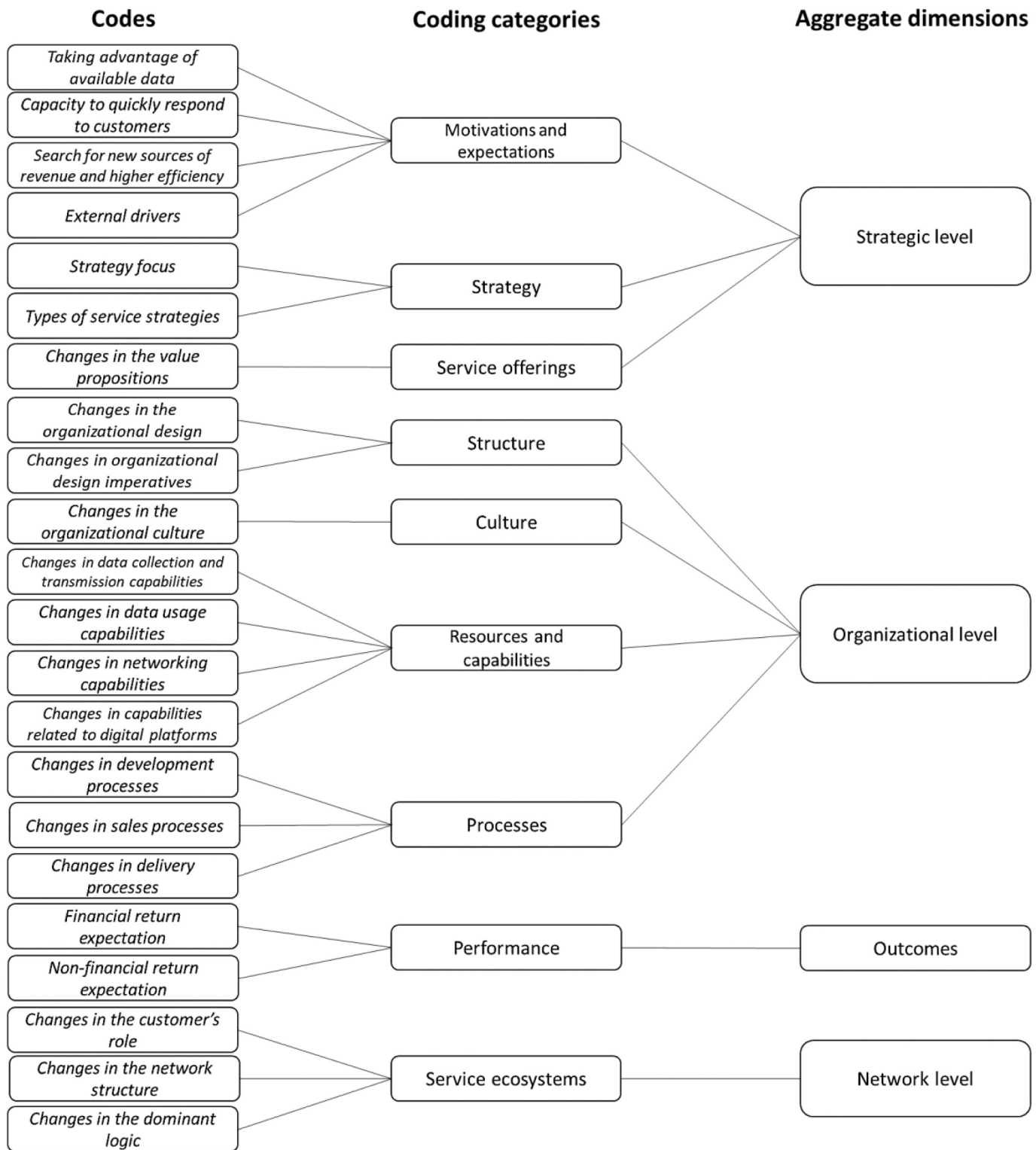


Fig. 2. General coding structure.

research methods employed by the focal articles. The first seminal article was published in 2005 (Allmendinger & Lombreglia, 2005). After a gap of a few years, the following articles were published between 2009 and 2020, during which we detect two distinct periods: before and after 2017, when DS was first established as a new concept. The papers published before 2017 can be grouped in two main themes: (i) servitization (with an indirect focus on digitalization), and (ii) digitalization (with an indirect focus on servitization). Thus, they contributed to the

emergence of the DS concept in the servitization literature. After 2017, many studies have started to focus directly on DS as the main unit of analysis (e.g., Bustinza et al., 2018; Vendrell-Herrero, Bustinza, et al., 2017) rather than focusing on the use of digital technologies to enable services in product companies. A significant increase (68.3%) in the number of published articles occurred in 2018 and 2020, indicating a recent interest in this subject. Therefore, the influence of digital technologies on servitization has been examined since the early years of our

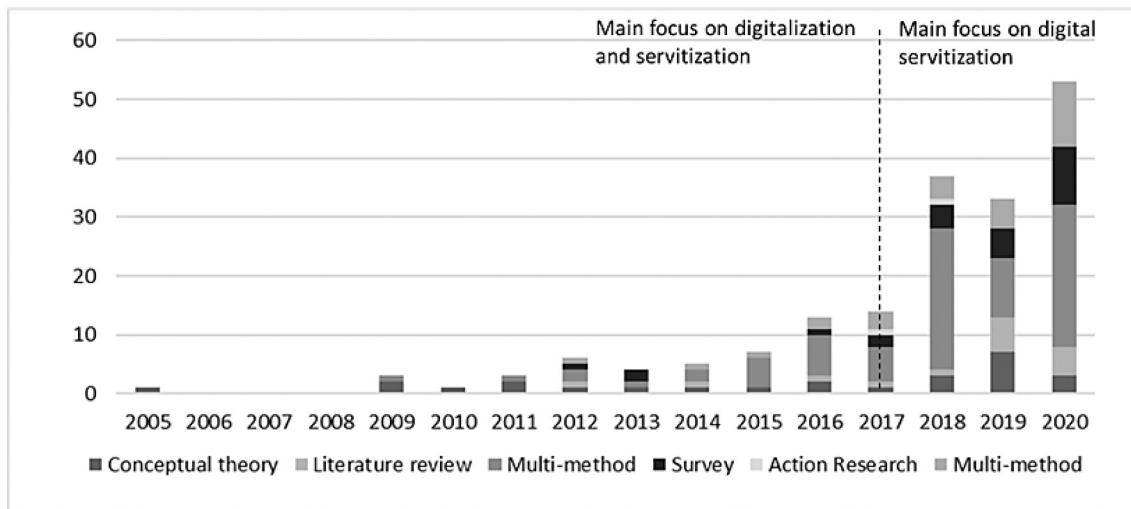


Fig. 3. Number of publications and research methods up to 2020.

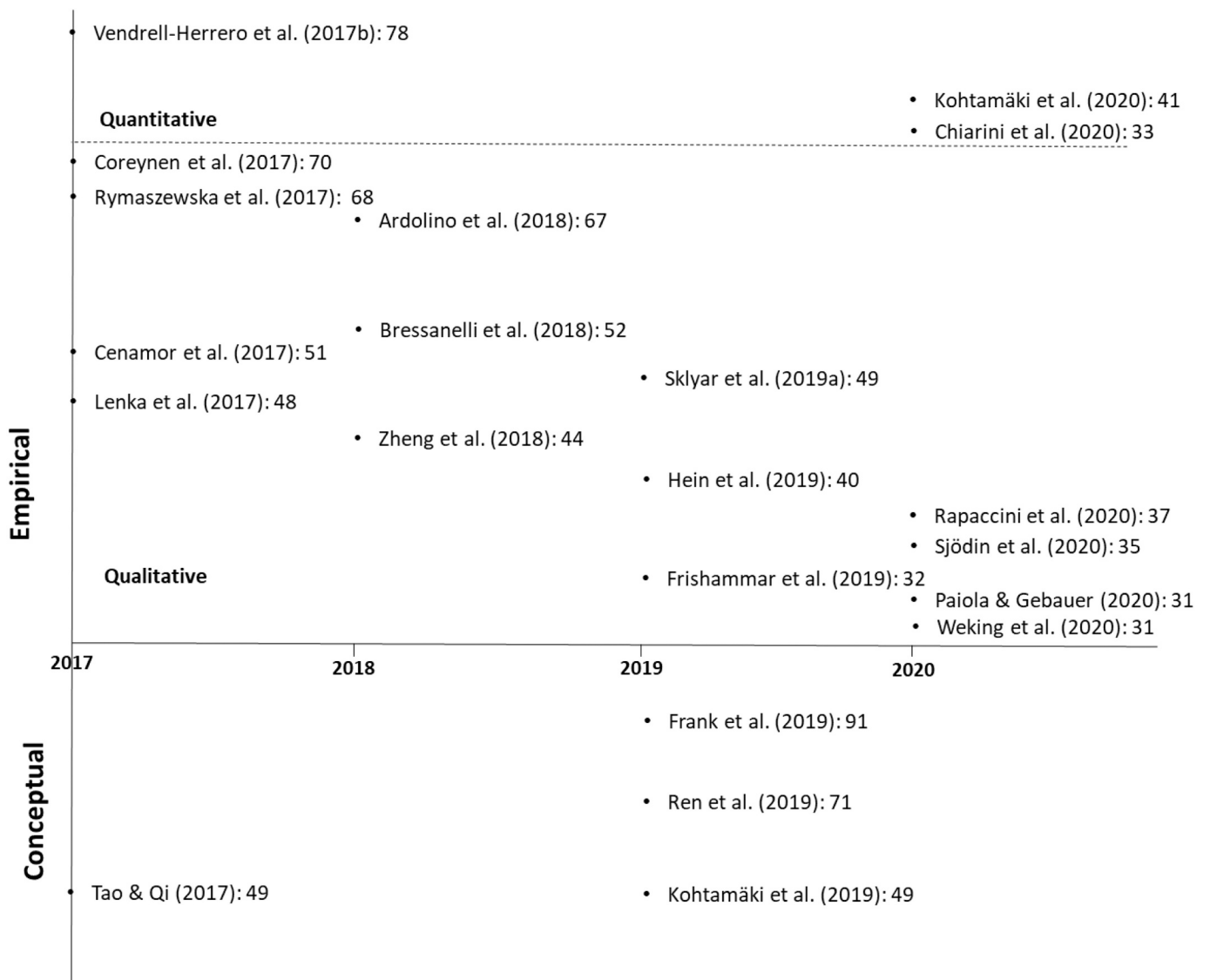


Fig. 4. Most influential focal articles.

Note: After parentheses, the average citation/year (dividing the total number of citations by the number of years that the article was published) calculated in March 2021 based on the Google Scholar.

sample, yet the investigation of the convergence between servitization and digitalization under the name of DS is more recent.

As also shown in Fig. 3, empirical studies comprise approximately 77% of the sample. Among the empirical studies, 60.1% (83 publications) adopted a case study method, 20.3% (28) used a multi-method approach, 18.1% (25) employed a survey, and only 1.4% (2) applied action research. The predominance of qualitative studies is usually expected for an emerging theme (Von Krogh, 2012) and this kind of study is mainly dominant in the traditional servitization literature (Kowalkowski et al., 2017). Considering that DS is a recent research theme, researchers have attempted to understand it by using case studies and other qualitative approaches. The most prolific journals (at least five publications in our final sample) are the following: (i) Industrial Marketing Management (14 publications); (ii) Journal of Cleaner Production (9); (iii) Advanced Engineering Informatics (8); (iv) IFAC-PapersOnLine (7); (v) Sustainability (7); (vi) International Journal of Production Research (6); and (vii) Journal of Business Research (5). Interestingly, traditional servitization and product-service system journals also appear as leading journals in DS. Considering that DS expands the scope of traditional servitization and that it is grounded in the same theoretical foundations and research community, this result was expected.

Considering only the DS papers published from 2017 until 2020, we also identified the most influential focal articles based on their citations by year of publication. Fig. 4 presents the articles that obtained at least an average of 30 or more citations per year. The figure also indicates the type of article (e.g., conceptual, empirical, qualitative, or quantitative).

Among the most influential articles, the one with the highest average number of citations per year is a conceptual article. Frank et al. (2019) discusses the interfaces and convergence between servitization and Industry 4.0. Furthermore, they propose a conceptual framework that connects both types of innovation. Other conceptual articles cover a variety of topics, including the value of big data in servitization (Ren et al., 2019), service-oriented intelligent manufacturing (Tao & Qi, 2017), and a literature review on business models for DS (Kohtamäki et al., 2019).

Among the empirical articles, the work by Vendrell-Herrero, Bustinza, et al. (2017) is the most influential. This quantitative study analyses the influence of DS on the dominance and interdependency in the value chain. The second most influential empirical paper is the qualitative study by Coreynen et al. (2017), presenting three paths for servitization (industrial, commercial, and value servitization). Other influential empirical articles address a variety of research topics such as the relationship between DS and circular economy (Bressanelli, Adrodegari, Perona, & Saccani, 2018), services improved by digital technologies (Cenamor, Sjödin, & Parida, 2017; Rymaszewska, Helo, & Gunasekaran, 2017), new typologies or strategies for DS (Ardolino et al., 2018; Chiarini, Belvedere, & Grando, 2020; Paiola & Gebauer, 2020; Weking, Stöcker, Kowalkiewicz, Böhm, & Krmar, 2020), DS capabilities (Lenka, Parida, & Wincent, 2017), smart product-service systems (PSS) (Zheng, Lin, Chen, & Xu, 2018), ecosystems (Hein et al., 2019; Sjödin et al., 2020; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019), DS financial performance (Kohtamäki et al., 2020), innovation (Frishammar, Richtner, Brattström, Magnusson, & Björk, 2019), and DS as a way to cope with the COVID-19 pandemic (Rapaccini, Saccani, Kowalkowski, Paiola, & Adrodegari, 2020). The content of these articles is further explored in the following sections.

### 3.2. Digital servitization conceptualization

Digitalization and servitization are considered two different types of business model innovations (Coreynen, Matthyssens, Vanderstraeten, & Van Witteloostuijn, 2020; Frank et al., 2019). Thus, it is possible for product companies to start offering services or to develop service processes without the support of digital technologies (Raddats et al., 2019). In the same vein, it is possible to invest in digitalization without a focus on providing services (Verhoef et al., 2019). However, servitization and

digitalization are also strongly interconnected (e.g., Frank et al., 2019; Gebauer et al., 2020; Kohtamäki et al., 2019). In fact, digitalization is an important enabler of servitization (Coreynen et al., 2020). It facilitates the development of operations by reducing operating costs as well as by improving the quality of the services offered (Coreynen et al., 2020; Kindström & Kowalkowski, 2014; Vendrell-Herrero, Bustinza, et al., 2017). Digital technologies can also become an integral part of the solution offered to customers (Coreynen et al., 2020) by incorporating digital components into physical products, making them intelligent and connected (Kohtamäki et al., 2019; Porter & Heppelmann, 2014; Vendrell-Herrero, Bustinza, et al., 2017).

Considering that DS encompasses the convergence of servitization and digitalization (Gebauer et al., 2020; Raddats et al., 2019), its conceptualization should encompass the definitions of these previous two phenomena. After conducting an overview of the definitions of the concepts that support DS, a unified definition of DS was derived. First, based on the content analysis, we identified the definitions provided in the literature (Table 2). Second, we evaluated the content of each definition and identified two main orientations. The first one emphasized the creation and offering of products and services enabled by digital technologies (e.g., Kohtamäki et al., 2019; Paschou et al., 2020; Vendrell-Herrero, Bustinza, et al., 2017). The second orientation focused on the business model perspective and it was more aligned with the traditional concepts of servitization and digitalization (e.g., Bustinza et al., 2018; Sjödin et al., 2020; West, Gaiardelli, & Rapaccini, 2018), emphasizing their organizational transformational process. Third, we used visualization and frequency of terms. We assessed the terms for each definition (the words within a definition but we concentrate on nouns and adjectives). Thus, we counted the frequency of each term and considered a cut-off of two times. In general, the most used words were services, product, digital, business model, physical, companies, competitiveness, value, logic, dematerialization, ICT, performance, goods, offerings, transition, capabilities, competitive advantage, creation, and electronic product. Finally, we derived a synthesis definition based on the most frequent terms in each group.

Adding to the extant DS conceptualizations, we propose the following unified definition: “*Digital servitization is the transformational process by which a product company changes its product-centered business model to a service-centered business model with the support of digital technologies, enabling the reconfiguration of its business processes, capabilities, products, and services to improve the value for customers and increase the company’s non-financial and financial performance*”. We emphasize some fundamental elements in this definition: (i) DS continues to be understood as a process of organizational transformation; (ii) service orientation remains a strategic driver; (iii) digitalization is highly pervasive as it leads to major business improvements and changes in the servitization strategy; (iv) the infusion of digital technologies stands out (i.e., the relevance and application of digital technologies in customer offers, business processes, and business model logic); (v) offers (products and services) are modified by digital technologies, and (vi) a win-win relationship should be established to create value for both customers and the company. In short, this unified definition aims to join both technical (i.e., offering and technology) and business perspectives.

### 3.3. Influences of digitalization on servitization

Based on the content analysis on how digitalization changes the traditional servitization, nine dimensions were discovered: motivations; strategy; service offerings; structure; culture; resources and capabilities; processes; performance; and servitization ecosystems.

#### 3.3.1. Motivations

The literature highlights several reasons why servitization can be leveraged from the adoption of digitalization. We emphasize the following: (i) *taking advantage of available data*; (ii) *capacity to quickly respond to customers*; (iii) *search for new sources of revenue and efficiency*;

**Table 2**  
Definitions of DS.

Reference	Definition
(Cenamora et al., 2017)	The enabling of manufacturing firms such that they can add services to their offerings, improve the quality of services, and reduce operational costs.
(Rymaszewska et al., 2017)	The provision of digital services embedded in physical product offers, opening up possibilities for new business models and welcoming new entrants.
(Vendrell-Herrero, Bustinza, et al., 2017)	The provision of digital services incorporated into a physical product.
(Bustinza et al., 2018)	Technology-enabled business models that enable companies to gain a competitive advantage by providing digital services based on customer knowledge throughout the product life cycle.
(Opazo-Basáez, Vendrell-Herrero, & Bustinza, 2018)	A servitization sub-branch that implies the dematerialization of physical goods by electronic means in order to increase the companies' performance and competitiveness by supporting the capabilities of ICT.
(West et al., 2018)	A journey for technology-driven service innovation.
(Sánchez-Montesinos, Opazo Basáez, Arias Aranda, & Bustinza, 2018)	The introduction of digital technologies to increase the efficiency of service provision and the value of its offerings as a direct consequence of the integration of technologically enabled products and services.
(Kohtamäki et al., 2019)	The transition to smart product-service-software systems that enable the creation and capture of value through monitoring, control, optimization, or autonomous functions.
(Raddats et al., 2019)	The possibility to extend even beyond new service offerings that encourages companies to progress towards a digital transformation of the manufacturer's business model.
(Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019)	The utilization of digital tools for the transformational processes whereby a company shifts from a product-centric to a service-centric business model and logic.
(Zheng, Wang, Chen, & Khoo, 2019)	A solution pack incorporating information technology to the product itself, acting as a way and tool to generate electronic value-added services.
(Kohtamäki et al., 2020)	The use of digital technologies to create and appropriate value from product-service offerings; thus, DS is understood as the interplay between digitalization and servitization.
(Paschou et al., 2020)	The development of new services and/or the improvement of existing ones through the use of digital technologies.
(Sjödin et al., 2020)	The transformation of processes, capabilities, and offerings within industrial firms and their associate ecosystems to progressively create, deliver, and capture increased service value arising from a broad range of enabling digital technologies.

and (iv) *external drivers*.

*Taking advantage of available data.* Offering a service allows a product company to interact more with its customers, consequently, it increases the company's knowledge about the customers' needs and processes (Genzlinger, Zejnilovic, & Bustinza, 2020). Digital technologies facilitate the collection of large amounts of data during the product's life cycle, which can be converted into intelligent data (Bressanelli et al., 2018; Chen, Lu, Ming, Zhang, & Zhou, 2020; Chen, Ming, Zhou, Chang, & Sun, 2020; Ren et al., 2019; Rymaszewska et al., 2017). Thus, customer knowledge and available data can be combined to create new digital and smart services (Tronvoll et al., 2020; Zheng et al., 2018) that are capable of improving customers' experience and achieving greater customer loyalty (Genzlinger et al., 2020; Papazoglou, Elgammal, &

Krämer, 2020; Paschou et al., 2020). Although the motivation to enhance service infusion due to the availability of data is well-recognized, studies suggest the need to overcome barriers such as the lack of standardization in data sharing system, problems in data integration, questionings concerning data reliability, and gaps between the physical and digital worlds (e.g., Genzlinger et al., 2020).

*Capacity to quickly respond to customers.* Digital technologies provide product visibility. For example, sensors and the IoT can diagnose equipment conditions and emit alerts on how the equipment will behave or fail, enabling preventive and predictive maintenance (Boehmer, Shukla, Kapletia, & Tiwari, 2019; Bressanelli et al., 2018; Papazoglou et al., 2020). Thus, companies can react more quickly to unpredicted circumstances, ensuring shorter response times and higher quality decisions (Boehmer et al., 2019; Chiarini et al., 2020). The capacity to respond quickly to customers has a positive impact on customer satisfaction and leads to the development of business models based on exclusive value propositions (Boehmer et al., 2019; Rymaszewska et al., 2017). Nevertheless, the use of digital technologies to provide quick responses should be accompanied by the redesign of operational processes (e.g., replacement of spare parts and technical assistance processes) so that the response to the customer is effective (Bressanelli et al., 2018).

*Search for new sources of revenue and higher efficiency.* Product companies need to recoup the investment made in digital technologies; this goal can be achieved by the expansion of new digitally enabled, and fully digital services (Ardolino et al., 2018; Gebauer et al., 2020). There are good examples of how digitalization has enabled the offering of advanced services, such as those linked to fleet management systems (e.g., Hallstedt, Isaksson, & Öhrwall Rönnbäck, 2020; Lenka et al., 2017; Reim et al., 2019) or new services developed due to the customer's data availability and a greater understanding of customer processes (Papazoglou et al., 2020). Thus, product companies can generate new service revenues from digital technologies (Pagoropoulos, Maier, & McAloone, 2017; Sjödin, Parida, & Kohtamäki, 2019). Another avenue is that digitalization also improves efficiency (Cenamora et al., 2017; Lindström, Hermanson, Blomstedt, & Kyösti, 2018; Ren et al., 2019). For instance, detecting problems remotely allows risk and cost reductions (Naik, Schroeder, Kapoor, Bigdeli, & Baines, 2020). Many other initiatives to adopt digital technologies have resulted in reducing transaction costs and improving efficiency for product companies (Papazoglou et al., 2020). Moreover, costs can be reduced throughout the value chain and processes can become more reliable (Lindström et al., 2018).

*External drivers.* Little is known about the external factors that drive firms to develop a DS strategy (Coreynen et al., 2020). For instance, exploitative product companies are more likely to pursue digitization in a highly technological turbulence environment, whereas explorative product companies are more likely to venture into servitization when competition is intense. Another external factor - customer uncertainties - can negatively influence the implementation of DS since customers may be reluctant to adopt new technologies (Klein, Biehl, & Friedli, 2018) or customers may be also worried about data collected by digital technologies (Klein et al., 2018; Reim et al., 2019; Zheng et al., 2019). Finally, Legal and governmental conditions (e.g., government legislation and incentives) also emerge as external factors that have consequences for DS (Klein et al., 2018; Vendrell-Herrero, Myrthianos, Parry, & Bustinza, 2017). Thus, the environment in which product companies operate will influence the levels of digitalization and servitization in DS.

### 3.3.2. Strategy

Digitalization also influences the *service-led strategies* implemented by a product company since it influences the focus and types of the service strategies. We emphasize the following: (i) *strategy focus* and (ii) *types of service strategies*.

*Strategy focus.* Kowalkowski et al. (2013) argue that digitalization leads to service differentiation, regardless of whether the services are product-oriented or customer-oriented. It also enables the offering of

advanced solutions such as outcome-based contracts that include customized technical consulting, process optimization, and customer training tools. Nevertheless, customized digital services can be difficult to scale because they are tailored to specific customers, which also contributes to the digitalization paradox (Sjödin et al., 2020).

*Types of service strategies.* Ardolino et al. (2018) discuss how the type of digital technology shapes the service strategy. The emphasis on the IoT is critical for companies that follow an availability provider strategy, whereas predictive analysis allows strategies focused on performance (e.g., advanced service provisioning based on customer data). Coreynen et al. (2017) also propose three types of DS strategies. In ‘*industrial servitization*’, digitalization increases the efficiency of the company’s operations, enabling product-related services (e.g., product training). In a ‘*commercial servitization*’ strategy, product companies exploit digital technologies to deliver services that improve customer processes (e.g., customer related-services). Last, the focus of a ‘*value servitization*’ strategy is to combine digitalization and servitization to create value for both companies and customers. Lastly, digitalization also allows product companies to move from providing smart service towards providing a platform (Beverungen, Kundisch, & Wunderlich, 2020; Kohtamäki et al., 2019; Weking et al., 2020). In this sense, Beverungen et al. (2020) conceptualized three types of platforms as strategic options - ‘smart data platform’, ‘smart product platform’, and ‘matching platform’. Therefore, digitalization shapes new emphasis (e.g., industrial servitization or availability provider) or options (e.g., from base services provider to platform provider) to the service strategies that have been proposed.

### 3.3.3. Service offerings

Digitalization enables *changes in the value propositions* (e.g., from analogue to digital services) and their elements (the inclusion of new services). In this sense, Raddats et al. (2019) argue that services can be either non-digital, digitally-enabled, or digital, depending on the extent of digitalization. In general, digital services usually replace (or cannibalize) traditional offers since these traditional services can be replicated at a very low marginal cost (Zheng et al., 2019). Furthermore, digitalization also allows the provision of smart products and services (Allmendinger & Lombreglia, 2005). While the smart products use new technology to collect, process, and produce information (Lu, Lai, & Liu, 2019; Zheng et al., 2019), smart services are enabled by smart products (Kamp, Ochoa, & Diaz, 2017; Klein et al., 2018; Zheng et al., 2019). When these elements are offered as an integrated solution, they form a smart PSS, a term referring to the integration of smart products and smart and digital services in the market to meet the needs of individual customers (Chen, Lu, et al., 2020; Lee, Chen, & Trappey, 2019; Lu et al., 2019; Zheng et al., 2019). The terms digitalized PSS and cyber-physical PSS have been used in the literature as smart PSS synonyms (Zheng et al., 2019). Therefore, product companies can deliver new value propositions based on digitally-enabled PSS, which are associated with product dematerialization (Genzlinger et al., 2020) and with the extension of its life cycle (Chen, Lu, et al., 2020; Han, Heshmati, & Rashidghalam, 2020). In this way, it transcends the scope of the traditional PSS and can be characterized as an IT-driven value co-creation strategy (Liu, Ming, Qiu, Qu, & Zhang, 2020; Pirola, Boucher, Wiesner, & Pezzotta, 2020).

### 3.3.4. Structure

Digitalization requires changes in the organizational design of servitized companies. We focus on: (i) *organizational design configuration* and (ii) *the imperatives of organizational design*.

*Changes in organizational design configuration.* The creation of independent service organizations in product companies has been defended by several studies (Baines et al., 2017; Fliess & Lexutt, 2019). Equally, digitalization literature posits the advantages of separate functional areas (Verhoef et al., 2019). Based on these findings, it is supposed that product companies with high levels of DS (e.g., advanced services and intense digitalization) would benefit most from separate service and

digital units. Conversely, companies with low levels of DS would rely on traditional structures of product companies (Porter & Heppelmann, 2014). Bustinza et al. (2018) contribute to the identification of factors that should be considered in the separation of product and service organization decisions (e.g., the necessity of agility and the company’s strategic capacity). In general, digital service centers assume an essential role to support consistency in obtaining and analyzing data, as well as in ensuring the reliability of service delivery platforms (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Tronvoll et al., 2020). Regardless of whether the organizational design is integrated or separated, intense collaboration and information-sharing among all actors in the network are essential for the development of innovative services (Genzlinger et al., 2020; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Tronvoll et al., 2020). Another change refers to the reconfiguration of the service units because services can be delivered digitally by central service centers or platforms instead of performed locally at the company or customer’s site (Rapaccini et al., 2020; Reim et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). Thus, digitalization alters the design of front-end and back-office service activities, suggesting a centralization of the digital service centers and, less dependence on local front-end service units (Cenamor et al., 2017; Reim et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). Moreover, a closer coupling between front- and back-end and between product and service units is also demanded (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Tronvoll et al., 2020).

*Changes in organizational design imperatives.* The literature has indicated some imperatives that are necessary to support the DS implementation. The first one is the commitment to change, which is critical to transform processes, create new values, and ensure the alignment between strategy and organizational design. The company’s leadership (Abou-Foul, Ruiz-Alba, & Soares, 2020; Bustinza et al., 2018; Huikkola, Rabetino, Kohtamäki, & Gebauer, 2020; Kohtamäki et al., 2019) must legitimize and articulate the company’s vision reinforcing DS. An example demonstrating the achievement of the company’s acceptance and commitment to transformation is reported by Tronvoll et al. (2020), in which change agents prepared an internal white paper to be used as a contract and a change mechanism. The second imperative is agility (Hallstedt et al., 2020; Verhoef et al., 2019), which should be incorporated into the organizational structure (e.g., reinforcing internal and external collaboration mechanisms) and into the organizational culture as well (e.g., values that encourage service and a digital mindset in the company) (Bustinza et al., 2018; Sjödin et al., 2020; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). For example, this digital mindset included the production of services through the formalization and standardization of specific customer solutions (Tronvoll et al., 2020). The third imperative is that collaboration must be increased. Studies (e.g., Kohtamäki et al., 2019; Parida & Wincent, 2019; Tronvoll et al., 2020) show that the success of DS depends on the collaboration between internal and external actors. Thus, collaborative approaches should stimulate both structural embeddedness (the actors’ adjustments to changes in the ecosystem) and relational embeddedness (reinforcing trust, information-sharing, and joint problem-solving). For instance, digital platforms allow company and customer collaborations and information exchange. Therefore, taking advantage of the DS demands flexible, collaborative, and agile organizational forms. More importantly, this organizational change must be legitimated by the company (Bustinza et al., 2018; Kohtamäki et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019).

### 3.3.5. Culture

Studies on servitization have already confirmed the importance of a service-oriented culture (Fliess & Lexutt, 2019; Raddats et al., 2019), which is also valid for digitalization (Klein et al., 2018; Verhoef et al., 2019). In this last case, companies implementing a digitalization hired employees with a digital mindset and analytical skills to facilitate the digital transition (Favoretto et al., 2021; Klein et al., 2018; Verhoef



et al., 2019). Studies on how digitalization affects a service-oriented culture are still incipient (Kohtamäki et al., 2019), however, if DS represents a convergence of servitization and digitalization, DS needs a supportive culture that incorporates both customer-oriented values in service delivery (Frishammar et al., 2019) and values related to agility, innovation, and analytical thinking to be able to deal with the accelerated development life cycle of software and digital infrastructure (Tronvoll et al., 2020). Besides those values, in a digitally servitized company, organizational culture should center around discovery (Tronvoll et al., 2020) and entrepreneurship (Huikkola et al., 2020). It is unrealistic to expect that changing the corporate imperatives and the organizational culture would be simple. On the contrary, it requires time and determined management (Genzlinger et al., 2020; Huikkola et al., 2020). Moreover, it demands changes in how employees see and interact with technology (Bustinza et al., 2018; Frishammar et al., 2019) as well as how top management supports and legitimizes these values (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). In short, DS requires an organizational culture that combines continuous changes due to servitization (Martinez Hernandez et al., 2017) and disruptive and discontinuous changes due to digitalization (Paiola & Gebauer, 2020). The lack of a culture that emphasizes both service and technology components prevent servitized companies from offering advanced services enabled by digital technologies (Ardolino et al., 2018; Bustinza et al., 2018; Coreynen et al., 2017).

### 3.3.6. Resources and capabilities

Although we recognize the importance of digital resources, the discussion focuses on how digitalization influences the capabilities of servitized companies. Capability development is a critical research topic for both the servitization (e.g., Ulaga & Reinartz, 2011) and the digitalization literature (e.g., Verhoef et al., 2019). In pursuit of DS, product companies need to combine their service-related capabilities and digital-related capabilities. Thus, we shed light on new capabilities that product companies need to deal with data and how they manage relations in a digital-enabled environment. Thus, we discuss: (i) *data collection and transmission capabilities*; (ii) *data usage capabilities*; (iii) *networking capabilities*; and (iv) *capabilities related to the use of digital platforms*.

*Changes in data collection and transmission capabilities.* IT systems and sensors allow products to connect and transmit information, which is essential for providing advanced services (Ardolino et al., 2018; Cenamor et al., 2017; Lenka et al., 2017). Thus, companies need to invest in connection and intelligence capabilities. The former refers to the ability to connect digitalized products through wireless communication networks (Lenka et al., 2017), whereas the latter enables the data collection from products with low human intervention (Boehmer et al., 2019; Lenka et al., 2017). These two capabilities are closely related to the development of digital assets to offer remote and autonomous solutions (Huikkola et al., 2020; Kohtamäki et al., 2019; Naik et al., 2020).

*Changes in data usage capabilities.* Value can be generated through data in DS. Thus, a competitive advantage can be achieved through the capability to store, explore and transform data into intelligence for processes, products, services, and businesses (Frank et al., 2019; Zheng et al., 2019). In this sense, capabilities related to the use of technologies (Ardolino et al., 2018; Rymaszewska et al., 2017), analytics (Bressanelli et al., 2018; Lenka et al., 2017; Schroeder et al., 2020), predictive capabilities (Ardolino et al., 2018), reasoning and intelligence (Lenka et al., 2017) need to be developed within the scope of DS. Efficient data management is necessary for converting data into offerings and for providing digital solutions together with its ecosystem composed of suppliers, distributors, partners, and customers (Genzlinger et al., 2020; Pirola et al., 2020; Tronvoll et al., 2020). In light of this, Coreynen et al. (2020) suggest that dynamic capabilities are also necessary to either exploit or explore current or adopting digital technologies. Product companies are less likely to change through DS without such capabilities.

*Changes in networking capabilities.* Product companies need a network

perspective in contexts characterized by the use of digital technologies and the provision of advanced services or autonomous solutions (Kohtamäki et al., 2019; Parida & Wincent, 2019; Raddats et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Verhoef et al., 2019). Relational and networking capabilities are critical for DS (Parida & Wincent, 2019; Grandinetti et al., 2020; Huikkola et al., 2020). For instance, Kamp et al. (2017) and Schroeder et al. (2020) state the importance of relational capabilities and trust-building between product companies and the customer regarding data access and sharing. In the same vein, Pagoropoulos et al. (2017) and Tronvoll et al. (2020) confirm how relational commitments to customers act as a key factor for DS. In short, the company's capability to select, attract, connect and engage a set of actors encourages value co-creation (Sjodin et al., 2020). Therefore, DS calls for collaboration across product company boundaries (mainly for autonomous solutions), which, in turn, requires networking capabilities to manage their multiple relationships and collaborate with external actors. The collaborations are reinforced by digital technologies and services, facilitating a range of co-creation activities (Kohtamäki et al., 2019; Parida & Wincent, 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Tronvoll et al., 2020).

*Changes in capabilities related to digital platforms.* Digital platforms are resources on which services can be offered and stakeholders can interact to make the value creation more dynamic (Cenamor et al., 2017; Opazo-Basáez et al., 2018; Paschou et al., 2020). For instance, studies emphasize the importance of leveraging flexible ways to provide solutions, and hence, platforms aim to offer a combination of services and information modules (Cenamor et al., 2017; Coreynen et al., 2017). Furthermore, platforms can support the DS implementation, allowing both customization and intra-firm operational efficiency (Cenamor et al., 2017; Pirola et al., 2020) and they are also relevant for managing the connections between actors (e.g., multiple suppliers and customers) within a DS ecosystem (Eloranta & Turunen, 2016; Kohtamäki et al., 2019). In this sense, platforms make it easier for external partners to access a company (e.g., suppliers and third parties), and these partners can assist in updating products and services (Opazo-Basáez et al., 2018). Another perspective is to understand a digital platform as a fully-fledged digitally enabled service business model where the company is a platform provider that connects various providers and customers (Kohtamäki et al., 2019). In the same vein, Beverungen et al. (2020) confirm that the successful transition towards the platform provider model requires, in addition to significant ICT investments, effective platform-related capabilities (e.g., digital and networking capabilities). Thus, the development of capabilities related to the use of digital platforms generates benefits to DS and represents how companies in a more advanced and “automated” way manage the relationships of this digital environment.

### 3.3.7. Processes

Digitalization also modifies business processes in the value creation and delivery architecture. For instance, changes in human resource management processes are necessary for the development of a new mindset and new digital capabilities (Coreynen et al., 2017; Lenka et al., 2017; Tronvoll et al., 2020). Following Raddats et al. (2019), we also focus our discussion on changes in processes such as (i) *product-service development*; (ii) *sales*; and (iii) *service delivery*.

*Changes in development processes.* The development of product-service-data offerings is complex and requires changes in traditional development processes (Zheng et al., 2019). For instance, software and other artifacts such as sensors are increasingly becoming an integral part of the solution (Kohtamäki et al., 2019; Zheng et al., 2018, 2019). As a result, smart products can provide important data for the company (Frank et al., 2019; Zheng et al., 2019), leading to the development of new solutions that better adapt to customers' needs (Genzlinger et al., 2020; Kohtamäki et al., 2019). This is underpinned by the adoption of a modular approach for designing products, services, and platform architecture (Cenamor et al., 2017; Sjodin et al., 2020). Moreover,

designers and engineers need to consider the complete product life cycle, developing sustainable solutions in a time-limited environment (Hallstedt et al., 2020; Han et al., 2020). Therefore, digitalization requires companies to adopt a new data-driven and modular development and to consider more elements as part of the development of the solution, increasing the complexity of traditional development processes and making the product a “carrier” of services. Nevertheless, modular design and platform approach are necessary but insufficient requirements for the design of digital solutions; co-creation practices with the customers and other partners are also demanded (Cong, Chen, & Zheng, 2020; Papazoglou et al., 2020; Sjödin et al., 2020). To conclude, despite the increase in the number of studies dealing with the development of digital solutions (e.g., Cong et al., 2020; Liu et al., 2020), approaches and tools can still be considered traditional and a re-adaptation of product-oriented design methods (Pirola et al., 2020).

*Changes in sales processes.* DS is related to the sales models adopted by the product companies and to the moves they make to get access to end-users’ data (Paiola & Gebauer, 2020). Thus, product companies should access customer data (Paiola & Gebauer, 2020); emphasize the complete solution instead of the features of the technical product (Boehmer et al., 2019), and develop new sales skills and arguments to leverage the digital solutions (Coreynen et al., 2017; Genzlinger et al., 2020). In this sense, salespeople need to have experience in services (selling based on value), more detailed knowledge of the platforms offered to customers, and, in certain cases, knowledge about customers’ businesses (Boehmer et al., 2019; Coreynen et al., 2017; Reim et al., 2019). In addition, in the context of advanced services, customers can make performance contracts with the company, and the prices can vary according to the results delivered and the level of customization (Boehmer et al., 2019; Kohtamäki et al., 2019; Paiola & Gebauer, 2020). Technology and data availability improve security for companies and customers when adopting these types of variable arrangements. Salespeople can also take advantage of the availability of end-user information to create emotional and closer relationships, in addition to sales promotions shaped to customer needs (Genzlinger et al., 2020). Therefore, digitalization makes sales more strategic, and business intelligence is the main element in the offering instead of pure products or services.

*Changes in delivery processes.* Digitalization imposes changes in the service delivery system. Service activities that were performed in a decentralized manner can be executed centrally through service centers or digital platforms remotely, contributing to service optimization and scalability (Reim et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Tronvoll et al., 2020). For those service activities that continue to be executed at customer sites, information availability provides a more complete and detailed view of the value provision (Cenamor et al., 2017). In both cases, the visibility and accuracy of real-time information contribute to mitigating operational risks associated delivery process (Kharlamov & Parry, 2020; Sánchez-Montesinos et al., 2018). Additionally, the delivery of digital solutions changes the process of interacting with customers, since the use of new channels (e.g., virtual interfaces through applications) creates new kinds of service touch-points throughout the product life cycle (Ardolino et al., 2018; Kharlamov & Parry, 2020). Thus, understanding, managing, and measuring customer experience in this new digital context is vital for service providers (Papazoglou et al., 2020). Lastly, a circular approach can also be developed for the delivery process to virtualization and dematerialization of physical offers (Weking et al., 2020) and the reconfiguration of the supply chain (Han et al., 2020).

### 3.3.8. Performance

Studies addressing this DS-performance relationship are still incipient, but they have attracted researchers’ attention due to their evident appeal and the former service and digitalization paradoxes (e.g., Abou-Foul et al., 2020; Gebauer et al., 2020; Kohtamäki et al., 2020; Sjödin et al., 2020). In this section, we summarize initial works that assess the impacts of DS on (i) *financial return expectations* and (ii) *non-financial*

*return expectations.*

*Financial return expectations.* Only a few studies (Abou-Foul et al., 2020; Kharlamov & Parry, 2020; Kohtamäki et al., 2020; Martín-Peña et al., 2018; Visnjic, Ringov, & Arts, 2019) have investigated the impact of DS on companies’ performance. Gebauer et al. (2020) posit that although product companies face those two paradoxes that might jeopardize a company’s financial returns. In the same vein, empirical studies have confirmed the positive financial consequences of DS, which can be explained by the incorporation of digital technologies in the service offering, which improves the customer experience, reduces time, and cuts costs for manufacturers (Abou-Foul et al., 2020). For instance, Kharlamov and Parry (2020), who investigated publishing companies in the United Kingdom, state that publishers benefit from increased productivity and service growth when digital solutions are developed. Conversely, smaller publishers benefit only from digitalization, which limits the returns with servitization. Another study by Kohtamäki et al. (2020) identifies a significant and non-linear (U-shaped) effect in the interaction between servitization and digitalization. Thus, financial performance is negative in companies with low/moderate levels of digitalization and advanced levels of servitization. However, companies with higher levels of servitization and digitalization achieve positive results. In sum, it seems that servitization is necessary to obtain a financial return with digitalization (Visnjic et al., 2019), although to clarify this hypothesis, further investigation of the DS-performance relationship is required. Lastly, Schroeder et al. (2020) when investigating the IoT’s contributions to advanced services in product companies showed that more than 30% of the initiatives failed to create the expected financial return.

*Non-financial return expectations.* Kohtamäki et al. (2019) propose that different DS business models (e.g., product-oriented service provider, industrializer, customized-integrated solution provider, and outcome provider) provide different gains. For instance, the industrializer business model uses modularized products and services to obtain higher levels of efficiency. Other types of non-financial results have been highlighted such as customer satisfaction (Chen, Lu, et al., 2020), customer lock-in (Sánchez-Montesinos et al., 2018) and, competitors lock out (De la Calle, Freije, Ugarte, & Larrinaga, 2020; Genzlinger et al., 2020; Sánchez-Montesinos et al., 2018). Studies have also presented environmental benefits (Bressanelli et al., 2018; Opazo-Basáez et al., 2018; Zheng et al., 2018). For instance, resource efficiency through the use of digitalization can extend product life and allow the ‘closing the loop’ (Bressanelli et al., 2018). In the same vein, the use of digital platforms to monitor and optimize resources also contributes to reducing consumption and achieving environmental gains (Lindström et al., 2018; Papazoglou et al., 2020).

### 3.3.9. Servitization ecosystems

Collaboration with customers, suppliers, and other partners is at the center of both the servitization and digitalization literature (Fliess & Lexutt, 2019; Raddats et al., 2019; Verhoef et al., 2019). Nevertheless, DS reinforces the ecosystem approach (Kohtamäki et al., 2019). Thus, we consider the following changes regarding (i) *the customer’s role*; (ii) *the network structure*; and (iii) *the dominant logic*.

*Changes in the customer’s role.* Digitalization increases the importance of customers and, consequently, it makes product companies more dependent on relational capital (Sjödin et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Weking et al., 2020). For instance, Sjödin et al. (2019) present governance strategies adopted by advanced service providers (e.g., formal contracts, service innovations, and relational skills) and conclude that in environments where digitalization is increasing, advanced service providers should prioritize relational governance strategies (trust, communication, mutual learning, and co-creation), and this finding is validated by other studies (e.g., Parida & Wincent, 2019; Korkeamäki & Kohtamäki, 2020; Sjödin et al., 2020). Digital technologies and capabilities enable value co-creation through perceptive and responsive mechanisms, resulting in

value propositions designed with customers and other ecosystem actors (Hein et al., 2019; Lenka et al., 2017). According to Sjödin et al. (2020), in the context of DS, customers negotiate and contribute their resources in the formulation of the value proposition. Last, Tronvoll et al. (2020) also highlight the advantage of increasing customer involvement since more interactions (co-creation) between customers and providers in design and operations are necessary due to the value propositions based on data-related opportunities and customer needs. In sum, DS reinforces the alignment with customers (and other relevant stakeholders as well) through improved coordination and collaboration in the technology-product-service networks.

*Changes in the network structure.* DS entails wide-ranging collaboration activities with suppliers, partners, and customers in technology-product-service networks (Kohtamäki et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). Although collaboration seems to be essential in DS, the increased interdependencies among actors can provoke tensions. For instance, digitalization can cause asymmetries, changes in the dominance structure and, loosening the boundaries of the business (Porter & Heppelmann, 2014), which can generate resistance between network participants (Vendrell-Herrero, Bustinza, et al., 2017). Thus, risks related to the partner's dependency, loss of know-how, and lack of trust between the company and its providers are some difficulties to be overcome in the DS process. In this case, Sklyar, Kowalkowski, Tronvoll, and Sörhammar (2019) defend that competition based on services and digital platforms indicate the need to include new types of suppliers (e.g., technology and software suppliers). As customers demand integrated solutions, these new supplying partners may obtain an integration capability, becoming not only providers but also direct competitors of the product companies. Therefore, a network perspective creates more complex environments (Beverungen et al., 2020), mainly due to the challenges in the orchestration of the involved actors (Pirola et al., 2020), regardless of whether these challenges are related to the supply chain (e.g., increasing number of suppliers, the differentiation between them, etc.) or related to industry structures (Eloranta & Turunen, 2016). Last, difficulties in data security contribute to limit the creation of collaborative networks (Lenka et al., 2017). As a result, DS needs to develop relational and networking approaches to successfully build collaborative networks and overcome obstacles related to the absence of trust and loss of power, which is especially evident due to the transformations of digitalization in servitized companies.

*Changes in the dominant logic.* DS ecosystem refers to a structure where there are interdependences and alignment between actors (Kohtamäki et al., 2019), and where actors aggregate around the digital solutions (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). Consequently, DS requires an inter-firm dominant logic, which is supported by an intense collaboration among multiple actors (Tronvoll et al., 2020; Vendrell-Herrero, Bustinza, et al., 2017). To make this collaboration on a systemic level, it is necessary to overcome challenges. For instance, the alignment of the business models of other firms within the ecosystem (Kohtamäki et al., 2019); the development of digital platforms and digital assets to ensure the information-sharing and trust (Kohtamäki et al., 2019; Pirola et al., 2020; Rymaszewska et al., 2017) and, a supply chain reconfiguration (Bustinza et al., 2018; Vendrell-Herrero, Bustinza, et al., 2017). Therefore, DS also depends on actions beyond the limits of the focal company, other actors also need to transform, requiring changes throughout the whole ecosystem (Tronvoll et al., 2020).

#### 4. Conceptual framework and propositions

The servitization research field continues to evolve due to a process of mobilization and differentiation (Rabetino et al., 2021). Its progression has followed a path based on legitimizing socially constructed narratives and creating a servitization domain's identity (Khanra, Dhir, Parida, & Kohtamäki, 2021; Rabetino et al., 2021; Raddats et al., 2019). Currently, the servitization intellectual structure encompasses a broad

range of research themes and topics that maintain thematic coherence and validity confirmation surrounding product companies' transformation towards service business models (Khanra et al., 2021; Rabetino et al., 2021). Several themes have consistently remained relevant over time. For instance, the investigation of the antecedents and challenges of implementing servitization have always called the attention of the researchers (Rabetino et al., 2021). Also, issues related to conflicts of interest among key stakeholders in the product company's network (e.g., Kohtamäki et al., 2019) and knowledge transfer within ecosystems (Bustinza et al., 2018) raise new servitization challenges, replacing older challenges more focused on separate service business units or service values (Raddats et al., 2019). Conversely, other research themes are losing their influence, such as the focus on complex solutions in capital goods as well as the contingent (strategy–structure–environment–performance) approach (Khanra et al., 2021; Rabetino et al., 2021). Lastly, we detect new, emerging themes related to value creation in network-based business models, such as product firms requiring specific relational capabilities to better engage with customers and other ecosystem actors (Khanra et al., 2021; Sjödin et al., 2019; Tronvoll et al., 2020). An ecosystem perspective and digital platforms are other emerging themes in the servitization intellectual structure (e.g., Khanra et al., 2021; Rabetino et al., 2021).

Interconnected with these rising themes in the servitization intellectual structure is DS, a new research context for servitization (Paschou et al., 2020; Rabetino et al., 2021). Different from other add-on research themes, DS is more pervasive, as it has the capacity of reinvigorating, expanding, and changing previous servitization assumptions and themes. For instance, DS brings new imperatives for organizational design besides those already propelled by servitization (Tronvoll et al., 2020). Moreover, DS requires new capabilities, such as those related to the development and management of digital platforms (Eloranta, Ardolino, & Saccani, 2021; Rabetino et al., 2021), and thus requires a more extensive ecosystem approach (Kohtamäki et al., 2019). Therefore, DS cannot be understood as a rupture or a “newborn” construct with another name (Hirsch & Levin, 1999). It is an expansion of the servitization construct since it is grounded in the same conceptual and theoretical foundations of the servitization umbrella. Additionally, it is being investigated by the same servitization community (Rabetino et al., 2021). Nevertheless, DS adds a new lens to the complexity of the servitization practices.

As argued in the previous sections, DS is a company-wide transformation due to the convergence of servitization and digitalization (Frank et al., 2019; Paschou et al., 2020; Sjödin et al., 2020). Digital technologies are not only embedded into products and services but also affect other servitization dimensions, such as the company's culture and processes, to name only two. To elevate the discussion on how digitalization transforms servitization and unfolds DS, we present a conceptual framework based on the alignment among the environment, network, structure organizational, strategy, as well as the outcomes of DS (Fig. 5). It sheds light on DS by providing an overview of how digitalization imposes changes in the traditional dimensions of servitization. We also present seven research propositions that emerge from this conceptual framework.

Little is known about the external factors or other contingencies (e.g., technological turbulence, industry dynamism, etc.) that drive product companies to DS (Coreynen et al., 2020; Kohtamäki et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). In environments increasingly infused with digital technologies, companies realize that they need to increase their level of digitalization, which might also result in different levels of servitization, depending on the firm's characteristics (Coreynen et al., 2020). Furthermore, the DS literature reveals an even more complex context than that found in traditional servitization research (Paschou et al., 2020; Struyf et al., 2021). The evolution in the offer of advanced solutions increases the combination of different items and elements of the business environment (e.g., new competitors) interfering in the progress towards DS (Coreynen et al., 2020). This

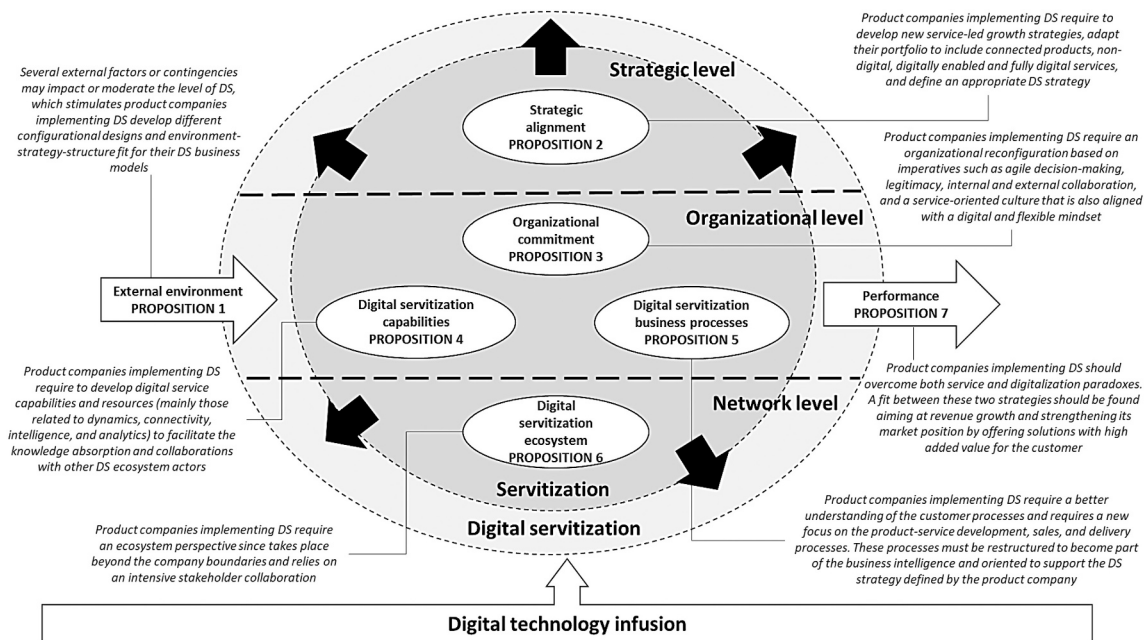


Fig. 5. The conceptual framework.

highlights the need for further investigation into the most favorable environmental conditions for DS. Consequently, DS may encourage new contingent studies and configurational designs to achieve an effective environment-strategy-structure fit (Rabetino et al., 2021). Therefore, we suggest the following research proposition:

**Proposition 1.** Several external factors or contingencies may impact or moderate the level of DS, which stimulates product companies implementing DS develop different configurational designs and environment-strategy-structure fit for their DS business models.

At the strategic level, product companies need to pay attention to a variety of strategic elements related to DS. For example, digital technologies allow product companies to achieve their full potential in offering advanced services (Gebauer et al., 2020; Pirola et al., 2020). Therefore, the digital capabilities developed by these companies influence the expansion of the portfolio of services offered and, consequently, the strategic path taken towards DS (Hsuan, Jovanovic, & Clemente, 2021; Paschou et al., 2020). This transition can be realized via different strategic routes, yet it does not necessarily lead to success and/or increased revenue because of the digitization paradox (Gebauer et al., 2020; Hsuan et al., 2021). Thus, DS can be understood as a process of strategic change of product companies, built and rebuilt from activities throughout the implementation process (Kohtamäki, Rabetino, Einola, Parida, & Patel, 2021). As our next proposition, we suggest:

**Proposition 2.** Product companies implementing DS require to develop new service-led growth strategies, adapt their portfolio to include connected products, non-digital, digitally enabled and fully digital services, and define an appropriate DS strategy.

DS also has important consequences for the organizational level. Product companies looking to implement DS are urged to embrace ambidexterity when combining digital and service organizational designs. Furthermore, DS encompasses both continuous and discontinuous change, requiring simultaneous management of servitization and digitalization as well (Chen, Visnjic, Parida, & Zhang, 2021; Tronvoll et al., 2020). This implies the development of flexible structures composed of agile organizational forms, strong leadership commitment, extensive collaboration, a digital mindset, and digital functional areas (Bustinza et al., 2018; Tronvoll et al., 2020; Struyf et al., 2021). Noteworthy, these soft and hard organizational elements should be aligned with the

transformation that is already required by a servitization strategy, such as a service-oriented culture, service functional units, and autonomy (Baines et al., 2020; Martinez Hernandez et al., 2017). Therefore, a key issue to consider is:

**Proposition 3.** Product companies implementing DS require an organizational reconfiguration based on imperatives such as agile decision-making, legitimacy, internal and external collaboration, and a service-oriented culture that is also aligned with a digital and flexible mindset.

In the same vein, resources and capabilities should be incorporated into a servitized company to fit its digital strategy and explore the potential of digitalization (Coreynen et al., 2020; Paiola & Gebauer, 2020). New capabilities that facilitate the coordination of data and information as well as the management of the digital ecosystem and its interdependent relationships are crucial (Chen et al., 2021; Eloranta et al., 2021). It is important to emphasize that DS-oriented organizational reconfiguration will support the development of these capabilities, encouraging investment in knowledge and mutual learning (Kohtamäki et al., 2021; Struyf et al., 2021). Thus, we propose:

**Proposition 4.** Product companies implementing DS require to develop digital service capabilities and resources (mainly those related to dynamics, connectivity, intelligence, and analytics) to facilitate the knowledge absorption and collaborations with other DS ecosystem actors.

DS requires a revised focus on the value-creation and value-delivery processes, in particular product-service development, sales, and delivery processes (Raddats et al., 2019; Reim et al., 2019). This is more evident when product companies are not only interested in improving efficiency but in adding value for the customers (Coreynen et al., 2017; Frank et al., 2019). In this case, digital technologies allow customized value propositions that offer well-characterized functionalities (Boehmer et al., 2019; Genzlinger et al., 2020). Furthermore, DS is also related to companies' sales models, as outcome-oriented business models and direct access to customer data create more opportunities for new revenue streams (Chen et al., 2021; Paiola & Gebauer, 2020). Lastly, digitalization also alters how to manage both front- and back-end delivery activities (Ardolino et al., 2018; Reim et al., 2019). Therefore, investing in technologies and capabilities is critical for the delivery system to be

able to support the expansion of DS offerings (Chen et al., 2021). Following this, we present:

**Proposition 5.** Product companies implementing DS require a better understanding of the customer processes and requires a new focus on the product-service development, sales, and delivery processes. These processes must be restructured to become part of the business intelligence and oriented to support the DS strategy defined by the product company.

At the network level, digitalization promotes changes in the inter-firm processes of servitized companies, such as resource integration patterns that connect ecosystem actors (Bustinza et al., 2018; Sklyar, Kowalkowski, Sörhammar, & Tronvoll, 2019), the inter-firm positions and dominant logic (Vendrell-Herrero, Bustinza, et al., 2017), and the alignment of multi-actor business models (Kohtamäki et al., 2019). The dynamics of the network is affected by companies' new relationships with actors as well as their positioning along the value chain, making it necessary to search for a new balance between these elements and context (Kohtamäki et al., 2019; Struyf et al., 2021). This demonstrates that companies looking for DS must improve their capabilities to orchestrate the ecosystem and influence other internal and external actors to move towards this strategy to sustain a viable business model (Chen et al., 2021; Kohtamäki et al., 2021). Value co-creation is also highlighted, meaning that product companies must consider customers as co-creators in their value creation and delivery processes, which reinforces collaboration and relational aspects (Korkeamäki & Kohtamäki, 2020; Sjödin et al., 2020). Therefore, all actors in the network need to undergo some type of transformation to keep up with DS (Tronvoll et al., 2020). Thus, we propose:

**Proposition 6.** Product companies implementing DS require an ecosystem perspective since takes place beyond the company boundaries and relies on an intensive stakeholder collaboration.

Finally, the servitization literature agrees on a non-linear relationship between servitization and company performance (Wang, Lai, & Shou, 2018), yet digitalization creates additional challenges (Gebauer et al., 2020; Kohtamäki et al., 2019). This issue concerns the digitalization paradox, in which product companies invest in digital offerings but fail to enhance their revenues accordingly (Gebauer et al., 2020). Initial results posit that product companies should develop growth paths (e.g., commercializing digital solutions, utilizing product connectivity, establishing an IoT-platform-based application business), remove obstacles regarding the DS implementation, and achieve adequate levels of digitalization and servitization (Abou-Foul et al., 2020; Kohtamäki et al., 2020; Struyf et al., 2021) to overcome both paradoxes. To wrap up, DS expands the boundaries of servitization by adding a new business logic based on digitalization. Nevertheless, the organizational impact of digitalization depends on the digital level that the product company aims to pursue. In this sense, high levels of digitalization should be supported by the development of higher levels of servitization, which materialize as advanced service offerings and other necessary organizational design changes (Kohtamäki et al., 2020). Therefore, our final proposition is as follows:

**Proposition 7.** Product companies implementing DS should overcome both service and digitalization paradoxes. A fit between these two strategies should be found aiming at revenue growth and strengthening its market position by offering solutions with high added value for the customer.

## 5. Future research opportunities

Based on our findings of the reviewed papers, we identify several research opportunities related to DS. These opportunities represent research gaps that arise from less researched topics or incipient/inconclusive results. Table 3 summarizes these gaps and possible research questions traceable to key references to support them. The table is

followed by a discussion of future research directions.

**Smart PSS.** Products and services embedding digital technologies (mainly IoT) are major enablers of DS (Schroeder et al., 2020). One future research direction is to better understand customer acceptance of smart PSSs, particularly how they affect the customer experience. To this date, it remains unclear how institutional pressures and system requirements impact customer acceptance and experience (Kropp & Totzek, 2020; Papazoglou et al., 2020; Tunn, van den Hende, Bocken, & Schoormans, 2020). For instance, what is the influence of providers' organizational characteristics in smart PSS customer acceptance (Kropp & Totzek, 2020), or how to measure smart PSS experience (Papazoglou et al., 2020)? Another opportunity relates to the evolution of the design content, which has shifted from designing traditional to smart PSS (Chen, Lu, et al., 2020; Cong et al., 2020). Design methodologies, tools, and intelligent approaches for the development of smart PSS are still scarce (Pirola et al., 2020). A third interesting research direction involves how to evolve from smart PSS provision to different types of digital business models (e.g., Suppatvech, Godsell, & Day, 2019) or platforms (e.g., Beverungen et al., 2020). Thus, fruitful future research might consider the journey to more innovative and competitive digital servitized business models.

**New typologies for digital PSS.** Different typologies for services (e.g., Baines & Lightfoot, 2014; Mathieu, 2001) and product-service systems (e.g., Tukker, 2004) are offered by the literature today. However, information and technology are not critical, differentiating elements in these typologies. This need is more evident due to the dematerialization of physical goods, which means that information plays a central role in value propositions. Some initiatives can be found in the literature (e.g., Allmendinger & Lombreglia, 2005; Frank et al., 2019). However, considering the increasing importance of product-service-data offerings, there is still no widely accepted typology that captures the complexity and differences in these types of offerings. Further studies should address this issue to explain, for instance, the differences between non-digital, digital-enabled, and digital services (Raddats et al., 2019), as well as the types of information they hold and their product characteristics. Furthermore, future studies should provide clear definitions of what is meant by the terms "digital PSS" or "smart PSS", considering both technical and socioeconomic perspectives (Pirola et al., 2020), such as the types of technologies embedded in the solution (e.g., sensors, e-service) and/or the facilitators of human decisions (e.g., artificial intelligence, simulations).

**Role of digital technologies in servitization.** Technological developments are changing rapidly. Most studies have mainly focused on digital technologies, such as IoT, big data, and cloud computing, usually investigating them separately (Paschou et al., 2020). Thus, future works should continue to investigate the impact of changes in emerging digital technologies (or sets of integrated technologies) on service offerings and servitization trajectories (Ardolino et al., 2018; Gebauer et al., 2020; Pagoropoulos et al., 2017). For example, artificial intelligence (AI) and blockchain are novel technologies that have not yet been addressed explicitly in the DS literature, though they appear to have relevant potential as smart products and services involve data management and lifelong learning (Pan et al., 2019; Grandinetti et al., 2020; Paschou et al., 2020). In addition, the adoption of different digital technologies at different levels of analysis (i.e., intra- and inter-firm) can cause tensions, and future studies should investigate the richness of these initiatives (Gebauer et al., 2020; Tronvoll et al., 2020).

**Identification of DS business models.** The convergence between servitization and digitalization leads to business model reconfigurations. This development can guide future discussions, for example, on proper levels of digitalization and servitization (Frank et al., 2019). Furthermore, the literature on types of business models for DS is still scarce. For instance, this work identified only a few studies devoted to DS business models, and they only addressed them in a theoretical way (Beverungen et al., 2020; Frank et al., 2019; Kohtamäki et al., 2019). These business models should be further investigated in practice involving an adequate variety

**Table 3**  
Future research directions and potential research questions.

Direction	Gap	Potential research questions	Key representative references
Smart PSS	Unclear understanding of how to explore smart PSS	<ul style="list-style-type: none"> <li>• What are the factors contributing to customer acceptance and experience with smart PSS?</li> <li>• Which design methods and tools are more suitable for smart PSS development?</li> <li>• How to evolve from smart PSS to platforms or other digital business models?</li> </ul>	(Beverungen et al., 2020; Chen, Lu, et al., 2020; Kropp & Totzek, 2020; Papazoglou et al., 2020)
New typologies for digital PSS	Lack of typologies to explain digital offerings	<ul style="list-style-type: none"> <li>• What typologies of PSS result from the value proposal focused on services, information, and technologies?</li> <li>• What are the technical and socioeconomic perspectives that characterize a Smart PSS?</li> </ul>	(Frank et al., 2019; Pirola et al., 2020; Zheng et al., 2019)
Role of digital technologies in servitization	Research focuses on some digital technologies that are individually investigated	<ul style="list-style-type: none"> <li>• What are the changes in new technologies (e.g., blockchain) for DS?</li> <li>• How does the interaction between digital technologies contribute to the transformation of digitally servitized business models?</li> </ul>	(Ardolino et al., 2018; Pagoropoulos et al., 2017; Pan, Zhong, & Qu, 2019; Paschou et al., 2020)
Identification of DS business models	Types of business models for DS are still scarce	<ul style="list-style-type: none"> <li>• What business models result from different levels of servitization and digitalization?</li> <li>• What business model is best suited to the specifics of internal capabilities and resources as well as to the external market environment?</li> </ul>	(Beverungen et al., 2020; Chen et al., 2021; Frank et al., 2019; Kohtamäki et al., 2019; Sklyar, Kowalkowski, Sörhammar, & Tronvoll, 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019)
Adaptation of organizational design	Lack of research on organizational adaptations	<ul style="list-style-type: none"> <li>• What organizational structure provides the greatest degree of agility and orientation to services?</li> <li>• What are the synergies and trade-offs between the values of servitization and digitalization?</li> <li>• How should companies adapt their organizational designs to different models of DS?</li> </ul>	(Bustanza et al., 2018; Eloranta et al., 2021; Kohtamäki et al., 2019, Parida & Wincen, 2019, Tronvoll et al., 2020)
Set of digital capabilities	Unclear understanding of specific resources and capabilities for DS	<ul style="list-style-type: none"> <li>• What are the combinations of resources and capabilities that can lead to the success of DS?</li> <li>• How can the capabilities related to digital platforms bring competitive returns to companies?</li> <li>• What is the role of firms' ability to cope with exploration and exploitation in DS?</li> </ul>	(Ardolino et al., 2018; Coreynen et al., 2020; De la Calle et al., 2020; Hsuan et al., 2021; Paiola & Gebauer, 2020)
Involvement of actors in the ecosystem	A narrow understanding of the new relationships in the DS network	<ul style="list-style-type: none"> <li>• How can business models with various actors be managed to develop integrated digital solutions?</li> <li>• How are the company's traditional boundaries affected by the increase of the number of actors in the value network?</li> </ul>	(Beverungen et al., 2020; Huikkola et al., 2020; Kohtamäki et al., 2019; Sjödin et al., 2020)
DS and performance	Unclear impact of the changes of DS on company performance	<ul style="list-style-type: none"> <li>• How does digitalization mediate the relationship between servitization and performance?</li> <li>• How does DS affect the company's financial metrics?</li> <li>• What investments are needed in service offerings to support capturing value through digitalization?</li> <li>• What combinations of DS factors lead to increased or sustainable performance?</li> </ul>	(Martín-Peña et al., 2018; Martín-Peña, Sánchez-López, & Díaz-Garrido, 2019; Abou-Foul et al., 2020; Coreynen et al., 2020; Kharlamov & Parry, 2020; Kohtamäki et al., 2020; Hsuan et al., 2021)

of research methods, especially among SMEs, which are still under-reported (Gebauer et al., 2020). Thus, future research directions include the necessary adjustments involving service offerings, service strategies, and business models in the context of DS (Gebauer et al., 2020; Sklyar, Kowalkowski, Sörhammar, & Tronvoll, 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). In this case, it is relevant to investigate the presence of equifinality in the DS process. For example, looking for evidence whether advanced solution offerings can be reached by different paths, thus finding different business model structures (Chen et al., 2021). In addition, the transformation process itself (e.g., for platform providers) justifies further investigation, seeking to determine what is the appropriate level of change (i.e., radical, gradual, or maintaining the business model) (Beverungen et al., 2020).

*Adaptation of organizational design.* DS requires an organizational design (e.g., structure, culture, human resource management policies) that combines both servitization and digitalization orientations (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). Thus, principles related to these approaches (e.g., commitment, service orientation, customer focus, agility, and collaboration) should guide the organizational design of companies adopting DS (Baines et al., 2017; Bustanza et al., 2018;

Kohtamäki et al., 2019; Parida & Wincen, 2019). Future research should therefore address topics related to organizational adaptation towards DS. Tensions, dilemmas, paradoxes, and inconsistencies (Reim et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019) due to the combination of these two orientations should be addressed at intra and inter-firm levels (Tronvoll et al., 2020). Moreover, the staffing of tech-savvy companies (e.g., manager and service employee profiles) to pursue the successful implementation of digital services needs to be addressed. A mindset predominantly centered on digital technologies can limit the focus to digitalization rather than to embracing servitization through digitalization (Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019). The potential paradox between service and digital arenas should be investigated. Furthermore, the benefits of decentralizing governance from the use of digital platforms in DS processes also requires further attention (Eloranta et al., 2021), as the results found by previous studies are still controversial (Kohtamäki et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019).

*Set of digital capabilities.* Another important research avenue concerns digital capabilities favoring DS. Although several studies have addressed this topic (e.g., Ardolino et al., 2018; Lenka et al., 2017; Sánchez-

Montesinos et al., 2018), a full understanding of capability-building is still embryonic, thus future developments are expected. Specifically, quantitative articles could focus on the effectiveness of the alleged digital capabilities to support DS, also considering the type of services developed and the evolution of their impact over time (with longitudinal data, for example) (Ardolino et al., 2018; De la Calle et al., 2020). Moreover, future research could explore how technical, analytical, and dynamic capabilities interact to support companies' DS journey (Coreynen et al., 2020; Hsuan et al., 2021; Lenka et al., 2017). Despite the increasing number of studies on this topic, how capabilities related to digital platforms contribute to DS is still open for investigation, mainly concerning its competitive advantage in the vertical and/or horizontal perspective of the value chain (Gebauer et al., 2020). Furthermore, it is still possible to develop studies on how co-creation is in ecosystems involving platform providers (Beverungen et al., 2020). Future studies can also investigate the exploration and exploitation capabilities in the DS (Coreynen et al., 2020; Paiola & Gebauer, 2020).

*Involvement of actors in the ecosystem.* DS requires the involvement of actors in technology-product-service networks, the expansion of operations beyond the company, and the creation of an ecosystem perspective (Kohtamäki et al., 2019; Reim et al., 2019; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Vendrell-Herrero, Bustinza, et al., 2017). Consequently, it is necessary to better understand the configurations of certain types of relationships in ecosystems to create strategic fits and also mitigate tensions and conflicts in their network (Hein et al., 2019; Kohtamäki et al., 2019; Sklyar, Kowalkowski, Sörhammar, & Tronvoll, 2019). First, future work should investigate how DS affects customer relationships and how digitalization empowers companies' capabilities to engage with customers (e.g., through co-creation) (Beverungen et al., 2020; Kohtamäki et al., 2019; Lenka et al., 2017; Sjödin et al., 2020). Second, studies should be undertaken to better understand the company's relationships with suppliers, especially to determine which elements of the solution delivered to the customer should be developed internally, outsourced, or in partnership with external service providers (Bustinza et al., 2018; Opazo-Basáez et al., 2018). In addition, studies could find whether it makes economic sense to acquire specialized companies as a strategy for DS (Gebauer et al., 2020; Huikkola et al., 2020). Third, research is needed on how DS affects the relationship with other stakeholders (e.g., start-ups and intermediaries). Finally, it is also relevant to discuss how companies manage/balance all these relationships simultaneously, for example, through digital platforms (Beverungen et al., 2020; Cenamor et al., 2017; Hein et al., 2019; Pirola et al., 2020).

*DS and performance.* The DS-performance relationship is in its early development, offering great opportunities for further research (Abou-Foul et al., 2020; Kohtamäki et al., 2020; Martín-Peña et al., 2018; Visnjic et al., 2019). For example, studies can analyze the mechanisms by which digitalization mediates the relationship between servitization and performance (Martín-Peña et al., 2018). Moreover, the influence of moderating variables (e.g., internal and external R&D processes) can be tested (Martín-Peña et al., 2019). It would also be interesting to expand the discussion on the digitalization paradox, meaning investments in service offerings to support a return through digitalization (Hsuan et al., 2021; Kohtamäki et al., 2019, 2020; Sjödin et al., 2019). Another opportunity is the adoption of the configuration approach for DS performance studies. Thus, research can be conducted on the different combinations of DS dimensions and factors that can drive companies to different levels of performance (Kohtamäki et al., 2019; Kharlamov & Parry, 2020; Lexutt, 2020). Moreover, different configurations of the environment, technology portfolios, and DS trajectories can also be investigated regarding their impact on a company's performance (Chen et al., 2021; Coreynen et al., 2020; Hsuan et al., 2021).

## 6. Conclusion, contributions, and limitations

Servitization and digitalization are two types of business model

innovations strongly affecting product companies today. Although studies have recognized the convergence between digitalization and servitization (Kohtamäki et al., 2019; Paschou et al., 2020), only a few articles are seeking to clarify this relationship. Based on a systematic literature review of 180 articles, this article uses a firm-holistic perspective to clarify how digitalization influences nine specific servitization dimensions, namely motivations, strategy, service offerings, structure, culture, resources and capabilities, processes, performance, and servitization ecosystems. Furthermore, the identification of specific research gaps in the literature leads to the proposal of several directions for future research in this area.

### 6.1. Theoretical contributions

The present study contributes to scholarly knowledge through four key theoretical contributions. First, based on our descriptive analysis, we obtained a view of the evolution of this topic. Publications on this topic are growing exponentially, and more than half of the papers consulted are from between 2018 and 2020. There is also a relevant predominance of empirical and qualitative articles that mainly apply a case study methodology. Considering that DS is still a relatively new concept for both academics and practitioners, this study contributes to mapping the current literature addressing this topic.

Second, this study contributes to DS conceptualization. In this sense, we provide a new, integrative definition of DS, recognizing it as a transformational process by which a product company changes towards a service-centered business model with the support of digital technologies. This definition goes beyond earlier definitions, that focus only on the provision of offerings enabled by digital technologies (e.g., Kohtamäki et al., 2019; Paschou et al., 2020). The adoption of slightly different DS definitions can lead to different interpretations of the same phenomenon, which consequently creates difficulties in its operationalization and measurement, leading to validity concerns (Hirsch & Levin, 1999; Kowalkowski et al., 2017). More important yet, we contribute to the ongoing discussion regarding the DS scope and boundaries (Khanra et al., 2021; Rabetino et al., 2021; Raddats et al., 2019). In this sense, we understand that DS keeps servitization research relevant and popular due to the infusion of digitalization. However, it does not represent a substituting research construct. Indeed, DS expands the scope of traditional servitization (questioning certain assumptions and imposing new challenges), but it is grounded in the same conceptual structure, theoretical foundations, and research community. Therefore, DS is a sub-stream that establishes a new research context for servitization (Paschou et al., 2020; Rabetino et al., 2021).

Third, we advance the literature by discussing several dimensions through which digitalization affects product companies' transition towards services. These dimensions are integrated into a new conceptual framework with associated research propositions that can assist scholars in better understanding and visualizing the main influences of digitalization in servitization (Fig. 5). In this sense, we respond to calls for a more systemic and holistic approach to DS (Paschou et al., 2020). The integration of the influences or changes provoked by digitalization on servitization dimensions is particularly important as this research field is still fragmented, creating barriers for further theoretical development. Our work can help researchers, especially but not exclusively novice ones, to better understand the scope of DS. Additionally, our findings can be used for different kinds of abductive inquires. For instance, researchers are encouraged to discover new impacts of digitalization on servitization or even investigated interdependences among the changes already discovered in this study (i.e., the company's choice of DS strategy versus the expected financial return). Our findings can also support the development of research propositions (e.g., the capability needs of DS networking) or provisional causal models (e.g., assuming that a data-driven development leads to a successful performance), which are essential for moving this emerging subject forward.

Lastly, this study identifies specific avenues for moving the DS

research field forward. While the knowledge of DS is growing rapidly, there are still substantial research gaps and research opportunities to be filled (e.g., DS performance, digital solutions acceptance, DS business models), as pointed out throughout this article (see Table 3). This review offers several directions for the servitization research community on this theme. By highlighting changes in several traditional servitization dimensions, this work may inspire academics to pursue a research agenda that integrates different dimensions (e.g., digital-service culture and servitization ecosystem) and provides a more complete picture of organizational change in which DS is inevitably embedded. Furthermore, our review can help extend interdisciplinary research (e.g., sustainability or information systems) given the recent developments of digital technologies. Finally, we expect future developments regarding the research objectives and methodological approaches to move from exploratory to more confirmatory and prescriptive approaches.

### 6.2. Practical contributions

Regarding managerial implications, we offer three. First, the proposed conceptual framework can assist managers in making better decisions by understanding the most important changes involving the DS transition. For instance, managers could: (i) build opportunities based on rich data; (ii) adapt their portfolio to include connected products, such as ‘non-digital’, ‘digitally enabled’ and fully ‘digital’ services; (iii) define an appropriate DS strategy; (iv) consider to restructure the organization based on internal drivers (e.g., agility, legitimation, and collaboration) and its culture to support digital services; (v) develop DS-specific capabilities, especially those related to dynamics, connectivity, intelligence, and analytics; (vi) make appropriate changes to design data-driven offerings and service delivery; (vii) create an ecosystem to support the convergence between servitization and digitalization, and (viii) monitor the environment for DS opportunities and influences. Furthermore, this systematized view may also support managers in auditing their current DS practices and/or serve as a basis for improvements.

Second, our conceptual framework (Fig. 5) also serves as a framework for the management of DS in product companies. Indeed, the changes might be used to create different roadmaps to guide the DS process. Noteworthy, the process is contextual, unstructured, and iterative, which allows different combinations according to the products company’s goal, levels of digitalization/servitization, capabilities, and context. Therefore, configurational approaches can help managers achieve different equifinal ways to achieve DS success. In this sense, different configurations of environment, strategy, and structure may result in better company performance (Kohtamäki et al., 2019; Lexutt, 2020).

Third, our findings create specific implications for managers. For instance, the dematerialization of physical products creates opportunities for customized value propositions based on smart services and products. They are driven both by technological integration and the interaction of multiple stakeholders in the value processes. Moreover, product companies have to manage new multiple risks (e.g., data security) and realize that customers also face new risks in accepting these new digital value propositions (Papazoglou et al., 2020). Another example is that DS requires digital, service-oriented, collaborative, and agile organizational values and structures (Bustinza et al., 2018; Hallstedt et al., 2020; Tronvoll et al., 2020). Moreover, DS needs to be legitimized, emphasizing the role of organizational commitment (Tronvoll et al., 2020). Therefore, each of the identified dimensions brings specific implications for manufacturer managers.

### 6.3. Limitations

This research also suffers from limitations. Although the systematic literature review used a rigorous and well-structured method, studies may have been excluded due to the research decisions, such as keyword

selection, type of publication, and language. As the results focused on the discussion of how digitalization changes traditional servitization, other relationships were not addressed in this study (e.g., how servitization influences digitalization). Furthermore, the suggested opportunities for future research on DS were identified through the researchers’ judgment on the importance of the different research gaps found in the literature. Therefore, it is possible that the interest and experience of the research team have predisposed their vision and influenced the selection. Finally, discussions on relationships and research gaps can be complemented by more quantitative approaches, such as text mining.

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### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.indmarman.2022.01.003>.

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