

Digital Servitization and Business Model Innovation in SMEs: A Model to Escape From Market Disruption

Sofia Lamperti , Angelo Cavallo , and Claudio Sassanelli 

Abstract—The progress and the adoption of digital technologies can rapidly make products, processes, and business models obsolete, until disrupting entire markets. In this context, small–medium enterprises (SMEs) operating in manufacturing are especially challenged due to their limited resources and smallness liabilities. Firms can implement, design, and deliver new smart and connected products that change the way they compete and trigger the provision of services—until redesigning the entire business model. However, little knowledge is available on how SMEs may effectively trigger and catalyze such transition. Using an interpretative research approach inspired by the design research methodology, in this article, we explore how SMEs may leverage digital servitization to escape from a disrupted market. Based on our findings, an original digital servitization model tailored for SMEs is proposed. Finally, the study provides a set of research and managerial implications on how SMEs can overcome market disruption in the manufacturing context through digital servitization and business model innovation.

Index Terms—Business model innovation (BMI), digital servitization (DS), digital transition, lean start-up, small and medium enterprises (SMEs).

I. INTRODUCTION

OVER the years, digital technologies have pervasively affected the way through which companies operate and support their business model (BM) [1], altering the very nature of products, processes, and strategies [2] and disrupting market structures [3]. The integration and embedding of digital technologies often involve the core business of many companies, bringing into managers' agendas a wide spectrum of business opportunities [4]. Through the adoption of digital technologies, manufacturing companies can implement, design, and deliver

new smart and connected products that change the way they compete and trigger the provision of services [2], [5].

In this regard, *Digital Servitization* (DS) represents a possible answer to these ongoing challenges [6]. In the literature, DS has been defined as digital-enabled services relying on digital components embedded in physical products that enable new digital BMs [7], find novel ways of value cocreation, generate knowledge from data, improve the firm's operational performance, and gain a competitive advantage over rivals [8], [9]. To support DS, manufacturing firms need to change their culture [10], adopt a more customer-centric view [11], change the design approach of these new systems [12], and adjust the other mechanisms of their BMs [13], [14], [15].

This promising, although emergent, research stream can already count on valuable research contributions. Some scholars have analyzed how DS may impact the supply chain [16]. Others have argued the adoption of a platform strategy for better use of DS (e.g., [17]), while some have stressed the role of organizational change to accommodate such a new way to create value (e.g., [10], [18]). Still, other studies have called for additional research, in specific contexts [19], of the role of DS as an important driver for adapting, changing, and innovating a firm's BM [20]. DS often goes along with business model innovation (BMI) intended as “designed, novel, nontrivial changes to the key elements of a firm's BM and/or the architecture linking these elements” [19, p. 201].

Notwithstanding the promising efforts, the field currently shows a limited understanding of the relationship between the DS and BMI. This is especially true with reference to small and medium enterprises (SMEs) engaged in manufacturing [21], [22] that are facing the serious challenges of market disruption, intended as a market in decline, drastically altered by a new entry (i.e., new technologies and BMs) that has changed its competitive dynamics and structure [23], [24]. Despite SMEs being generally considered the engine of countries' economies [25], scholars have been paying major attention to large corporations [26].

Enhancing the understanding of how manufacturing SMEs may undertake DS and BMI is important, given the following points.

- 1) Little is known about manufacturing SMEs specifically engaging with DS to cope with market disruption [23].
- 2) Research is needed about the outer context that influences the time to adopt a service strategy [27], such as drastic changes in market structure.

Manuscript received 10 January 2022; revised 21 April 2022, 22 September 2022, and 31 October 2022; accepted 21 December 2022. Review of this manuscript was arranged by Department Editor A. Brem. (Corresponding author: Angelo Cavallo.)

Sofia Lamperti is with the Montpellier Management Institute, University of Montpellier, 34090 Montpellier, France (e-mail: sofia.lamperti@umontpellier.fr).

Angelo Cavallo is with the Politecnico di Milano, Department of Management, Economics and Industrial Engineering, 20156 Milan, Italy (e-mail: angelo.cavallo@polimi.it).

Claudio Sassanelli is with the Department of Mechanics, Mathematics and Management, Politecnico di Bari, 70125 Bari, Italy (e-mail: claudio.sassanelli@poliba.it).

Color versions of one or more figures in this article are available at <https://doi.org/10.1109/TEM.2022.3233132>.

Digital Object Identifier 10.1109/TEM.2022.3233132

- 3) Few studies explain in detail how BMI connects with servitization [20] and even fewer analyze it specifically with reference to the emergent substream of DS in the SMEs' context [28].

Given the above arguments, this article examines how DS can become an opportunity for an SME to escape from a disrupted market and how DS and BMI are connected to each other. To this aim, and by employing the design research methodology (DRM) [29], a model to guide SMEs through the DS journey to escape disrupted markets is proposed. An application case was conducted for its validation. Specifically, we investigated an SME located in Italy, originally operating in the (disrupted) broadcasting sector, that is beginning to provide new product–service solutions based on the Internet of Things (IoT) technologies.

With this study, we provide two main contributions. First, we propose a DS model, extending previous research with reference to a specific and underinvestigated context: SMEs operating in a disrupted market. Second, this study contributes to the ongoing debate on the link between DS and BMI, showing how each step of the DS journey may involve BM changes.

The rest of this article is organized as follows. In Section II, the research context is presented as the basis of the investigation. In Section III, after showing the research methodology, the case is described. Section IV introduces the results and Section V discusses them. Finally, Section VI provides a conclusion, focusing on the research's value and its limitations.

II. RESEARCH CONTEXT

A. Digital Servitization

First introduced in the seminal work of Vandermerwe and Rada [30], the term servitization refers to the process where firms set out to create greater value by developing new services and/or improving the existing ones. Servitization enables companies to move from a product-centric perspective toward the provision of integrated bundles consisting of both physical goods and intangible services—in the literature, often named product–service systems (PSSs) [31]. In this context, digital technologies constitute a strategic lever to foster knowledge exploitation along the PSSs' lifecycle [32]. In particular, servitization finds, in the dynamicity of IoT analytics and artificial intelligence, the potential for innovative PSSs on an unprecedented scale [33]. Along with this evolution, a part of the servitization literature has moved toward the study of service provision enabled by digital technologies, giving rise to a substream of research known as DS [34], [35], [36], which is differentiated for the digital aspects and features of the services introduced. Table I collects some definitions of DS selected from the extant literature. Considering the objective of this research, the more inclusive definition is the one outlined by Paschou et al. [9]. It expresses DS as the development of new services and/or the improvement of the existing ones using digital technologies that can enable new BMs.

B. DS Journey in SMEs

SMEs are enterprises composed of less than 250 employees and having an annual turnover not exceeding EUR 50 million

TABLE I
SELECTED DEFINITIONS OF DS (ORDERED CHRONOLOGICALLY)

Authors	Definition
	[99]
Holmström and Partanen (2014)	“DS is described as the provision of digital services embedded in a physical product.”
	[16]
Vendrell-Herrero et al. (2017)	“DS refers to those BMs that enhance the traditional non-digital goods and services with the implementation of ICT or other digital technologies.”
	[9]
Paschou et al. (2020)	“DS can be conceptualized as the development of new services and/or the improvement of the existing ones through the use of digital technologies. These can be exploited to enable new (digital) BMs, to find novel ways of (co)creating value as well as to generate knowledge from data, improve the firm's operational performance, and gain a competitive advantage over rivals.”
	[10]
Bustinza et al. (2018)	“DS includes different technology-enabled BMs that enable firms to achieve a competitive advantage by providing customer knowledge-based digital services during the entire product life cycle.”
	[100]
Sánchez-Montesinos et al. (2018)	“DS may be described as the sub-branch of servitization that implies the dematerialization of physical goods by electronic means for the purpose of bolstering firms' performance and competitiveness through the support of ICT capabilities.”
	[43]
Sjödín et al. (2020)	“DS is the transformation in 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/or a balance sheet total not exceeding EUR 43 million [37]. The service transition is a complex matter for SMEs [38], [39], [40]. It is acknowledged that undertaking a servitization journey is less common in SMEs than in large firms [41]. Due to their smallness, SMEs (often) do not possess the knowledge or resources to successfully undertake this journey [13]. On the one hand, introducing or extending the service business may not generate the expected returns (service paradox) [42], discouraging manufacturing SMEs to undertake this journey. On the other hand, pursuing a digital transformation is not an easy matter, as the initial investment may appear unaffordable for an SME, together with the risk of overestimating the related benefits (digitalization paradox) [43].

In the literature, some scholars have provided different models to facilitate the (digital) servitization journey and help managers in their decision making [44]. For instance, Oliva and Kallenberg [45] discussed the product–service continuum and the process model for developing installed base service capabilities. Kindström and Kowalkowski [46] developed a four-stage model that drives companies through new services development in the manufacturing context. In addition, Sjödín et al. [43] proposed an agile cocreation process for DS in order to tackle the risk of digitalization. However, these models are not specifically targeted for manufacturing SMEs. Considering the complexity of the transition and the fact that SMEs represent 90% of businesses [47], more research is needed on how SMEs may go through the DS transition.

C. DS and BMI

A BM is the value architecture through which an organization creates, delivers, and captures value in a relationship with a network of exchange partners [20], [48], [49], [50]. The introduction of services enabled by digital means might change the manufacturing company's value proposition and impact the other value mechanisms of the BM [51], [52]. Since the 1960s, practitioners have listed the distinctive ontological features of services, such as the traditional intangibility, heterogeneity, inseparability, and perishability [53], to which coproduction with customers and simultaneity have been added [54]. Some researchers highlighted the differences between new-service development and new product development. First, service innovation produces the enablers for the service and not the service itself [55]; second, it is important to make the new-service fit with the existing business architectures [56]. The literature seems to agree on the fact that DS may have disruptive effects on the BMs of product-oriented firms: it may affect the firm's internal and external processes and interdependences, involving the re-configuration of internal capabilities, value and pricing models, revenues and cost structures, and power and collaboration in the value system. From this perspective, Paiola and Gebauer [28] described how DS requires innovation in the firm's BM. Moreover, considering the external context of analysis in this study, the innovation of the BM can result as an important factor in responding to crises linked to market disruptions as well as the recent COVID-19 pandemic [57], [58], [59], [60]. However, the literature shows that manufacturing SMEs rarely understand how they should reconfigure the elements of their BM to pursue this innovation [61] and offer digital services. Therefore, we deem that it can be relevant for practice to advance our knowledge on methods that can support SMEs in DS [27]. Advancing our understanding of DS and BMI for SMEs will provide important implications for research and practice.

III. RESEARCH METHODOLOGY

In this section, the research design is first presented, showing how the journey toward DS has been designed. Later, the methodology for the literature review and the market and case selection are explained. Finally, a section regarding the data collection and analysis outlines the logic used for connecting practical evidence to theoretical concepts.

A. Research Design

To address the main gaps dealing with the DS transition of SMEs supporting BMI, a research methodology was set and made appropriate for different research traditions [62] in the developmental process of creating the DS journey. Adapting the research approach used in the previous research in the servitization domain [12], [63], [64], this research is classified as interpretivism, entailing qualitative methods and inductive reasoning [65]. This approach is inspired by action research and aspires to contribute to theory development. Indeed, this research can be categorized as applied engineering based [66], implying theory/concept building, together with practice-based testing in an interactive way [67]. The model proposed by this research

was tested in a real-world setting, following the guidelines of the systems development field [62]. Different methods (theory building, observation, and experimentation) have been adopted to develop the prototype of the model that constitutes, along the research process, both a proof-of-concept and a starting point for carrying on research in a qualitative iterative process [65].

Wrapping up the design of this research, leading to the proposition of a six-phase journey for DS supporting BMI, can be depicted, as shown in Fig. 1, where the correspondence among the phases of this research approach and both the DRM framework [29] and design science research [68] that are used as main references is clarified.

Three main stages, as shown in Fig. 1, constitute the research process: the conceptualization stage, the theory-building and model development stage, and the validation stage.

First, in the conceptualization part (which corresponds to the research clarification and the descriptive study I phase of DRM), an analysis of the current literature was conducted. It has to be noted that the objective of the study is not to provide a systematic literature review on the subject. Two valuable literature reviews already exist about DS: Paschou et al. [9], who specifically focused on defining the concept of DS and the convergence between servitization and digital technologies and Pirola et al. [33], who studied DS in the PSS domain and proposed a research agenda. Yet, these works were lacking in providing an overall and detailed vision of a DS journey. Therefore, both contributions, together with other studies, were instrumental to identify research gaps and to outline the major steps that are present along the journey to DS. These literature gaps were presented to the company selected for conducting this research. The company expressed a clear need for practical guidance toward the DS paradigm. Based on this need emerging from practice and on the literature analyzed, the three main streams of the research domain were identified, leading to the conceptualization of the DS journey model. More details on how the analysis was conducted and how the three research streams were identified are presented in Section III-B.

In addition, an application case was conducted. We interviewed employees belonging to the same manufacturing company selected at the beginning of this research to explore their practical needs. The company renovated its BM through DS to escape from a critical scenario caused by a market disruption. Throughout the entire research, this company was selected as an appropriate purposive sample [69], as suggested by interpretative tradition, representative of a particular population, and allowing an idiographic (intensive) study of an individual case [65]. Details about the market and case selection are discussed in Section III-C, showing, also, how data were collected and analyzed.

Through an interpretative study of the literature results, together with interactive analysis of the interviews, a six-phase model was created in the theory-building and model conceptualization stage (which corresponds to the prescriptive study phase of DRM).

Finally, in the validation phase (which corresponds to the descriptive study II phase of DRM), this model was tested by interpreting the data from the application case and verifying and triangulating them with the theory on DS and BMI. The outcome

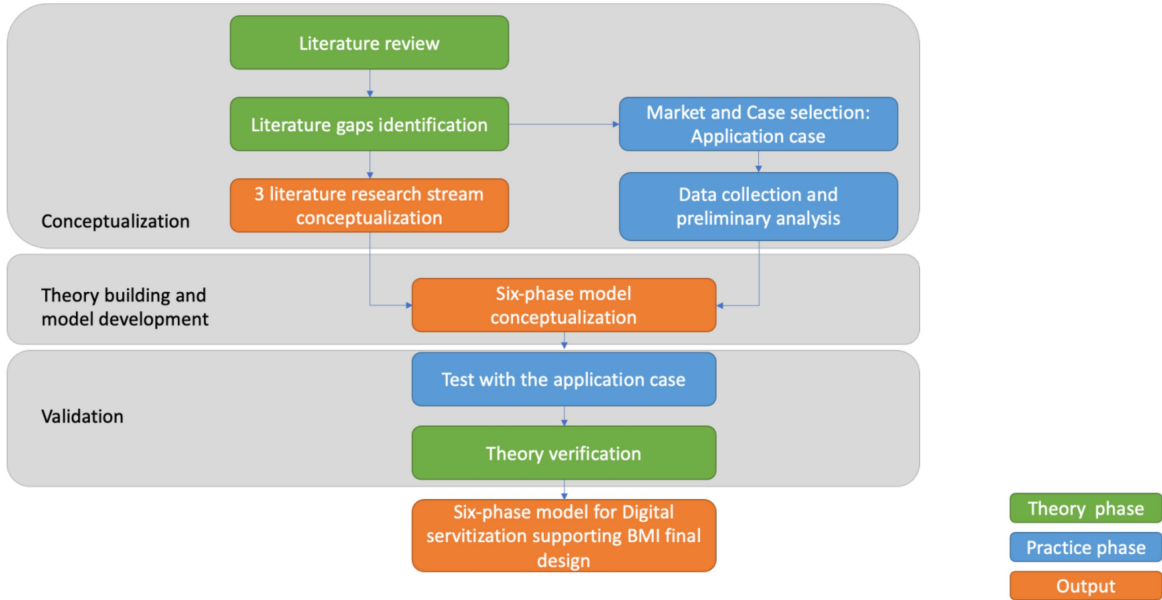


Fig. 1. Research design (see online version for colors).

of the entire research process is the design of a validated model, showing a six-phase journey for DS supporting BMI.

B. Literature Review

To conduct the literature review, some inclusion and exclusion criteria were defined. Indeed, for collecting a set of relevant research articles, two keywords' groups were chosen. On the one hand, the keywords selected were related to the essential side of the process, which is introducing services to the company BM; hence, terms, such as "servitization," "PSSs," and "integrated solutions," were selected [70]. On the other hand, the keywords selected were connected to the digital aspect of servitization, which refers to the use and implementation of digital technologies in a business context. These keywords are "digital technologies," "digital transformation," and "IoT," and the keywords related to the Industry 4.0 domain are "sensors," "big data and analytics," "artificial intelligence," "real-time optimization," "real-time localization," and "predictive maintenance." Scopus was used as the search engine since it is widely recognized as a world-leading source that provides broad coverage in this research domain and has been largely used in relevant studies of the field [61], [71]. The next step was to select the relevant publications. In this study, only research articles were included, while books, company reports, chapters, etc., were not considered. Only articles in English were included. Starting from the initial result of 991 research articles, a set of 67 relevant publications was finally used for the study based on the application of the criteria being defined (see Table II).

From the literature analysis, three main streams were conceptualized depending on the research article focus and are discussed in Section IV. These 67 articles were further analyzed to see the results of DS on the companies' BMs. Results show that only a few studies described the case of SMEs that radically changed their business through DS [28], [34], [72]. However, more research is needed that focuses on SMEs and

TABLE II
SELECTION OF THE LITERATURE REVIEWED

Steps for literature selection	Research articles
Documents identified through Scopus	991
Documents screened from records excluded because not scientific articles or not in English	687
Documents without redundancies	598
Documents considered eligible for the research depending on the title and keywords	257
Documents considered eligible for the research depending on the abstract	84
Documents finally included after the entire manuscript analysis	67

their possibility to radically change their business through DS [21], [22].

C. Market and Case Selection

To address the outlined research question formulated from the gaps in the literature, a disrupted market was identified, that is, broadcasting, since it is dramatically changing its structure for two main reasons. First, since the advent of digital technologies, the broadcasting sector has moved from analog transmission to digital. This transition has triggered a virtualization process that replaces specialized physical hardware with software that performs the same functions. Second, the advent of new content creators, such as Netflix, Amazon, and YouTube, has transformed the entertainment market, offering multiple places, spaces, and times for accessing content.

Then, a firm was selected that, operating in such a context, relied on DS to innovate its BM. The company was an Italian SME operating in the design, production, and sale of broadcast and IoT technologies that was called Company A throughout the study for confidentiality reasons. It was founded in November 2013 in Puglia by a group of people working in another telecommunications company that had failed the same year. It counted

TABLE III
DATA COLLECTION

Data type	Quantity
Preliminary interviews	7
Interviews	18
External documents and sources	14 (two company website, eight newspaper articles, four industry report)
Archival records	31 (30 informal emails, 1 business plan)
Total people interviewed	6 (four from Company A and two from Start-up B)

25 employees and an annual turnover that was less than 3 million Euros per year. The firm represented an appropriate research site for the following three main reasons. First, Company A was an SME originally operating in the disrupted broadcasting market, which was trying to reinvent its overall BM. Second, to do that, they leveraged DS. Third, after recognizing their know-how and resource constraints as typically affecting the SME action space, Company A pursued DS by opening their BMI process and, thus, by partnering with an innovative new venture specialized in the IoT and Industry 4.0 service applications. This was Start-up B (for confidentiality reasons), founded in 2013 by three young software engineers who specialized in indoor positioning and navigation. In addition, since 2015, Start-up B has been collaborating with Company A on various projects related to IoT.

D. Data From Application Case Collection and Analysis

Data were primarily collected through the analysis of primary and secondary data. Table III presents some details about this. The interviewees were mainly managers who were responsible for the successful implementation of the DS processes. This was because, in small enterprises, strategy and decision making are concerted among a few informants [73]. The interviews were conducted separately with the company and the start-up, mainly through phone calls. Open-ended questions were asked and notes were taken. The respondents had an engineering or informatics background. Furthermore, the firm managers boasted several years of professional experience, while the start-up workers were young. Therefore, based on the above-mentioned criteria, the chosen interviewees were considered appropriate informants for the study. A total of 25 conversations were recorded and transcripts were created. Several informants were interviewed multiple times to investigate emerging patterns and avoid misunderstandings. Demands formulation followed the structure of a protocol, commanded by the relevance to the research question, together with the drive toward the reasons for DS and the potential for delivering different and improved value propositions to customers. Consequently, the first set of questions was related to the original working form of their BM based on the conceptualization of the three main mechanisms (value capture, value creation, and value delivery) of a BM. For instance, questions, such as “What were you offering to customers and what are you offering now?,” “How was the firm structured and organized to reach customers?,” and “How was this value translated in monetary terms?,” were asked. Following this, the second set of questions, connected to DS, were

asked to explore and describe the phases incurred by the firm, including questions, such as “Why did you decide to include services in your value offering?,” “How did you get to the deliverable solution?,” and “What challenges did you have to cope with?.” Last, the third set of questions looked at BMI. Therefore, questions, such as “What are the main changes to your way of creating, delivering, and capturing value?,” were asked. The secondary data included all relevant notes, reports, market forecasts, and detailed specifications and descriptions of the different technologies. To avoid any bias, the presented research was designed with special attention to the context and to the selection of interviewees, data collection, and analysis. The reliability of the primary data was validated by cross-checking statements across interviews and informants and comparing them to secondary data.

IV. RESULTS

In this section, the results are presented. In Section IV-A, starting from the literature review analysis, a conceptualization of DS research streams is provided. Based on this result, in Section IV-B, the model of the six-phase DS journey is designed and described, and, later, in Section IV-C, it is validated, outlining the practical evidence coming from the application case.

A. Literature Analysis

The results of the literature analysis led to the detection of three main research streams characterizing the DS research domain (1. motivations and challenges for DS, 2. digital hermitized solutions, and 3. impacts on the ecosystem), studying it from different perspectives and answering to different related research questions.

1) *Research Stream 1. Motivation and Challenges:* When a firm decides to develop a new value proposition, it is motivated by some reasons. Depending on the nature of these intentions, motivations can be categorized. [47], [45] delineated three main classes: competitive, demand-based, and economic motivations. Competitive motivations suggest that firms differentiate their products by adding services to gain a competitive advantage over competitors [74]. Demand-based motivations arise from the customers’ requests for advanced or intermediate services [18], [75]. Finally, economic motivations help companies overcome stagnating or depressed product markets by introducing servitized solutions that can provide a new sustainable source of revenue [11].

Once motivations are identified and the intent is adequate, the company might overcome some possible barriers. Building on the previous literature, four kinds of challenges may be of interest in DS:

- 1) organizational;
- 2) internal capabilities;
- 3) customer management;
- 4) risk management.

The organizational challenge refers to the formal allocation of work responsibilities and the development of a management mechanism to control internal activities and support the strategy [33], [34], [61]. The main intention is to change the culture of the organization from product centric to customer centric

or service centric to embrace a digital transformation fostering intraorganizational synergies to support the development of digital service-based solutions [13], [26]. The internal capabilities challenge is connected to the issues related to the human resources competencies and skills for developing services enabled by digital means. Indeed, DS requires technical competencies and qualified profiles that can face the level of complexity of the development process [76]. The customer management challenge refers to creating and keeping a close relationship with customers through effective interactions and communications since the value delivered arises from cocreation with customers and suppliers [77]. Finally, the last challenge is connected to risk management, as servitization strategy exposes some uncertainties, such as financial risks and operational risks.

2) *Research Stream 2. Digital Servitized Solutions:* The second research stream was intended to study the process of the development and integration of digital servitized solutions in the company BM.

The introduction of advanced services through digital technologies changes the company's value proposition and, consequently, the value mechanisms of the BM, that is, value creation, capture, and delivery. Depending on the level of integration of such services in the company BM, their orientation shifts [56] from product-oriented BM to use- or result-oriented BM [31], [70]. In addition, a part of this research stream studied the potentiality of some digital technologies for DS [17], [28], [74], [78]; among these IoT and big data analytics seem to have the greatest application [9]. Conversely, some other practitioners investigated the solution design and development process, studying how companies can leverage approaches and procedures for introducing digital services successfully in the company BM and in the market [32], [43].

3) *Research Stream 3. Impacts on the Ecosystem:* The last research stream analyzed the impacts that a servitized firm has on the external ecosystem. The service provider cares more about the durability of the tangible component as it becomes the mean for the service delivery rather than the final touchpoint with the customers. Additionally, in some configurations of servitization (e.g., in a result-oriented BM), the provider is usually the owner of the asset enabling the service and, therefore, is more encouraged to limit waste, discouraging the ambiguity of the planned obsolescence that has jeopardized the relationship of trust between customer and manufacturer. Hence, the environment benefits from DS, as there is a reduction in material consumption through alternative products use [79] and a more responsible provider [70], who cares about taking back, recycling, and refurbishment, reducing waste throughout the product's life. Furthermore, society can also benefit from this perspective since public pressure on environmental issues is increasing and since new jobs can be created [80]. Finally, another stakeholder is the consumer, who occupies a central role, as his needs represent the understanding of the new offer [43].

B. Modeling the DS Journey

From the three research streams outlined in the literature analysis and the preliminary analysis of the needs and requirements of the company involved in this research, a six-phase DS

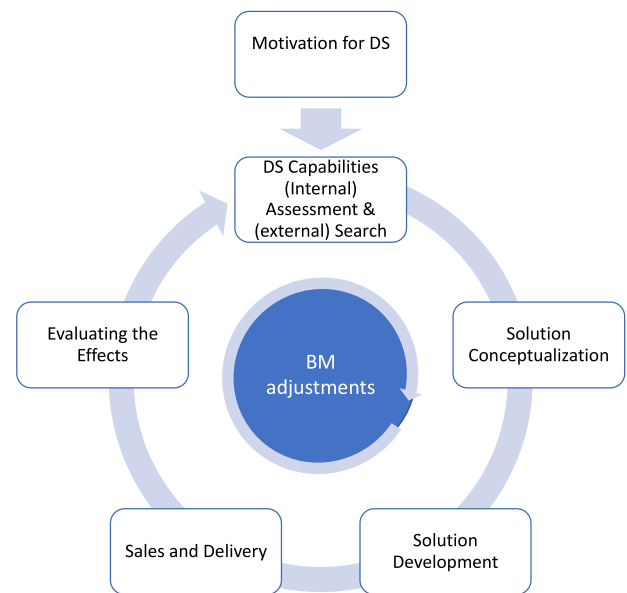


Fig. 2. Six-phase journey for DS supporting BMI in SMEs.

journey, as represented in Fig. 2, was designed by adopting an interpretative and interactive research approach.

In the six-phase DS journey here proposed, the process starts with the market sensing expressed by the “motivation for DS” phase and, later, continues with the “DS capabilities (internal) assessment and (external) search,” followed by the “solution conceptualization,” “solution development,” and “sales and delivery” phases. Finally, there is the phase aimed at “evaluating the effects” of the DS process that, in turn, might trigger the need for other adjustments in the organization of the SME and so on, making the process cyclic. As suggested by some studies in the literature [21], [43] and from the preliminary analysis of the case, the BM value mechanisms and their interactions are adjusted all along the journey to support the DS process, aligned with the actions taken in each phase.

The first phase of the journey consists of the definition of the *Motivation for DS*, which is represented in the literature analysis by the first research stream, particularly by the works of Oliva and Kallenberg [45] and Raddats [11], who defined various types of motivation for introducing new services in the value proposition of a manufacturing company. Considering the aim of this study, the motivation for DS is mainly triggered by the external condition of market disruption, which forces the company to find new markets, mainly for economic reasons. As explained by Crowley et al. [81], in this phase, it is important to clearly explain the motivations for adding digital services and communicate them in all the departments of the firm. Considering the ontological differences among products and services, the company needs to be aware and prepared to change its culture first and, then, its business structure and architecture.

The second phase of the journey is named *DS capabilities (internal) assessment and (external) search*. Again, this phase was deduced by the first research stream of the literature analysis, as it is the answer the company put in place to face the DS challenges discussed in the literature. Building on the main studies of this research stream, in this phase, the company needs

to formally reallocate the work responsibilities and assess if the employees have the technical abilities to face the complexity of the digital solution conceptualization and development process. In case the company is not able to conduct the process with its own resources, the firm can decide to leverage the competences of strategic partners. Thereby, an important activity of this phase could become the search for a strategic partner, as argued also by Bustinza et al. [10] and Sjödin et al. [43]. Finally, in this phase, the SME allocates the funds for the digital solution conceptualization and development, evaluating the risks that accompany DS. From the second research stream detected in the literature analysis (i.e., digital servitized solutions), the next three phases were deduced. They are connected to the process of the development and integration of the digital servitized solutions in the company BM.

The third phase of the journey is *Solution Conceptualization*. In this phase, the firm works to develop a concept of the digital servitized solution either alone or by sharing knowledge and know-how with the partner(s), as argued by Bofanti et al. [82], who also envisioned the potential effects of the DS process on the company and its ecosystem. To limit the failure risk, Bustinza et al. [10] and Sjödin et al. [43] pointed to the importance of adopting an agile behavior, asking potential customers for feedback to test the ideated digital solution. More importantly, this phase is key to start building the new customer relationship based on the cocreation and continuous exchange.

The fourth phase is *Solution Development*, which is strictly connected to, but at the same time also differentiated from, the previous phase. After the solution conceptualization phase, the company is aware of what customers want and can translate customers' needs into service and product features, creating more complex digital solutions based on the information collected from the agile and cocreation process. At the end of this phase, the digital solutions are ready to be sold and distributed.

In the fifth phase (*Sales and Delivery*), the company starts delivering and selling the implemented solutions. As argued by Kindström and Kowalkowski [46], this is a very important phase, as it represents the real generation of value due to the cocreation aspect of services. Moreover, the company needs to introduce new cost and revenue streams, given the differences in selling digital solutions compared with the traditional products.

Finally, the sixth and last phase is *Evaluating the effects* of DS on the ecosystem. This phase is represented in the literature by the third research stream, which is aimed at assessing the impacts of DS. After envisioning the effects of DS adoption on the company's ecosystem in phase 3 (solution conceptualization), in this last phase of the journey, their effectiveness and efficiency are actually evaluated, as argued by multiple authors [70], [83]. Moreover, the company can gain access to new information that might enable new digital solution features and related strategic actions.

C. Application Case

Below, the description of the application case conducted with Company A to validate the model described and proposed in Section IV-B is provided. The case strongly contributed to its

development and improvement, grasping the practical evidence expressed by the interviewed leading actors of the DS journey.

1) *Phase 1. Motivation for DS*: As mentioned before, the broadcasting sector has been affected by strong changes triggered by digital technologies, affecting the profitability of manufacturers. In this landscape, Company A decided to find new revenue streams that could provide profitability within a three- to four-year horizon. In its research, the company scouted different technology opportunities and markets where it could leverage its own competencies to remain or become competitive. Particularly, the Chief Innovation Officer (CIO) spotted, in the growing IoT market, the possibility to invest the company's resource base in building sensors and communicating devices. To understand the potentialities of IoT products and their interconnected systems, Company A participated in seven lectures organized by the local engineering university. From the words of the Chief Executive Officer (CEO):

We involved all employees in the IoT lessons to make them aware of the new company's direction and to encourage the generation of innovation at every level of the company. We need all the engineers to be aligned with the new vision and to contribute to creating this new business building on their strong resources and capabilities.

During this preliminary phase, Company A recognized the need to involve all the employees to facilitate the adoption of a service-oriented culture. As stated by the CEO: "*Services are different from products in many aspects. The engineers have always worked with tangible components; therefore, they needed to understand and adjust their way of thinking and operating to services features, such as intangibility and cocreation, to support the new business.*" Therefore, the board of directors organized a series of meetings with all the employees every two weeks for updates and to discuss the possible applications of their technical competences in the different IoT applications. This first phase lasted approximately 5–6 months.

2) *Phase 2. DS Capabilities (Internal) Assessment and (External) Search*: Once strategic motivations had been identified and shared, the technical team started scrutinizing the internal capabilities aimed at creating smart sensors. Being that the microwaves are the primary technology of the broadcasting market to be applied to foster interaction among smart sensors, the team created competitive sensors. They were based on asynchronous signals communication with low information (12–18 bytes) through a particular network (SigFox) that enabled higher distances transmission and lower battery consumption. However, when the team wanted to collect the signals information, they had to cope with a lack of knowledge. As the leader of the technical team reported in one interview:

We are a team of electronic engineers. We are competitive when it comes to the hardware and to making sensors communicate; however, we do not have any software knowledge to create an environment where to collect the data from our own sensors and offer monitoring and controlling services.

To cope with this, the board of directors recognized that scouting a partner expert in software development was needed to fill its lack of knowledge. The partner seeking lasted around six months. First, Company A unsuccessfully tried to collaborate with a software developer SME. Then, they met Start-up B

(another software developer) with whom a sense of trust was generated. In fact, the two companies were sharing the same vision of entering in the IoT market with competitive offerings. In this partnership, operational knowledge was shared, contributing to digitally transforming Company A and better organizing Start-up B operations. During their collaboration, they were mutually contaminated, and this led to the creation of synergies. To support this fruitful exchange, Company A scheduled daily meetings (lasting 3–4 h each) between its team of electrical engineers and Start-up B. In addition, to guarantee the advancement of the project and a full investment, Company A hired two new employees who were working only for the IoT project. The rest of the employees of the broadcasting segment were involved in the new business project with weekly presentations of the project advancement. The assignment of new work responsibilities to the team of engineers, the stipulation of the partnership, the hiring of new people, and the interaction with the rest of the company still working in the broadcasting sector made Company A develop ambidextrous capabilities. More importantly, all these activities triggered a reorganization of how Company A created value, positioning new key partners and key activities of the company at this stage of the DS journey. This BM adjustment supported the process of developing digital solutions. Finally, in this phase, based on an understanding of the goals and investment possibilities, the managers allocated funds for the developing, implementing, and selling of the digital servitized solutions.

3) *Phase 3. Solution Conceptualization:* Once the SME was reorganized, Start-up B and the team of engineers from Company A started collaborating to make the idea a reality. Combining the software and hardware capabilities, they first created a simple sensor and the related software, where data were collected for the provision of basic monitoring and controlling services. With this first concept solution, the firms asked its suppliers and some potential customers in the region for feedback and suggestions to, first, test if the solution was of interest and then to understand which specific digital services could be added. As stated by the CEO:

We have traditionally been successful in creating products that were competitive because of their technical features, but now the real value is hidden in customers. They must take a part in the product development. To this aim, we first created simple solutions that we developed depending on their needs. IoT applications are infinite.

The simple solution allowed to not dedicate the entire workforce and resources to the new business, permitting to test if the new business was of interest before innovating the entire BM. Therefore, it was necessary for the company to adopt an agile approach in operations and, more importantly, in the development of the solutions. Moreover, considering that customers' needs are likely to evolve or are not completely disclosed, the firms needed to iterate between the customers and the solution development many times. Hence, the team engaged a reviewing process in the solution development, testing the features through multiple iterations with potential customers. Overall, this iteration phase lasted six months. Thanks to this cyclical customer interaction, the company started creating a new customer relationship, based on continuous exchange and

cocreation, that facilitated the integration of the service culture and the support of the DS process. The perception of customers as a part of the solution development made the company innovate the way it delivers its value. Indeed, customers shifted their role and became key partners for the solution development, while their relationship became of utmost importance in the new BM configuration.

4) *Phase 4. Solution Development:* With the simple sensor presentation, Company A finally found three areas of application to develop more advanced digital solutions, which were developed by the team of engineers of Start-up B and Company A together, following the direction of the CIO. These areas were smart agriculture, smart home, and smart building. Indeed, Company A found, in the broadcasting sector, some potential customers who were adopting different technologies for their businesses and who found opportunities in the customizability of IoT sensors. Also, Start-up B's network was exploited to find new customers and validate the creation of integrated solutions. Despite the specific application of each solution, a common architecture could be identified. All the offerings were IoT solutions that can be represented by a smart object, its network, and a cloud platform enabling the collection of data and their usage for secondary purposes. The possibility to obtain more results from the same base is the consequence of the digital aspect of servitization since the services provided were enabled by the same technologies but took different forms depending on the application and customers' requests. This modified the way Company A was used to create value since the management of information from customers and the management of technology became key activities and resources, which triggered nontrivial changes in the BM architecture.

5) *Phase 5. Sales and Delivery:* Once the solutions were implemented, it was time to sell and deliver them. To be aligned with the new features of the proposed value, Company A designed new selling contracts based on agreements lasting in time and on costs structure related to the usage and not necessarily to the purchase of the tangible components. This type of contract lent more importance to the intangible part of the component (the service), which was monetized depending on the usage and not on the ownership of the hardware (the product). As stated by the CEO: "*Selling the new offerings is only the starting point of the relationship we build with our customers, which is the order winner of the new business. The new contracts are based on the usage on a period.*" More importantly, this mechanism allowed keeping customers closer and continuing the iterative process of the digital solution enhancement. This contributed to innovation in Company A's BM, as it radically changed the way the company was delivering and capturing value. Moreover, through these new value capture and delivery mechanisms, Company A learned to cultivate deeper customer relationships that lasted longer in time, based on the trust and commitment and supporting the process. In this journey, Company A was driven by the experience of Start-up B in adopting a new culture, aimed at developing service capabilities and cultivating customer relationships driven by value-in-use solutions.

6) *Phase 6. Evaluating the Effects:* Finally, considering the customizability of the new offerings, the last phase of the journey consisted of evaluating the effects of both the strategic dimension

of the company to decide whether to continue investing in IoT business and the improvement of the features (of the software and/or the hardware) of the services provided. The CEO said in one interview: *“The creation of solutions is not the final stage of the process; it is just an achievement. However, the iterative discovering of customers’ needs must follow to adjust the sensors’ features or to add new ones.”* To this aim, Company A collected and analyzed the feedback from customers that came directly from surveys asking for improvements and satisfaction scores, such as customer satisfaction surveys. In addition, the creation of the new business, together with the stipulation of a partnership between a consolidated company and a start-up, has fostered the creation of a consortium of SMEs in the surroundings of the company for the IoT market aimed at supporting an open innovation environment.

In conclusion, Table IV summarizes the results of the application case (triangulated with the theory previously analyzed) showing, for each phase of the DS journey model, the scope, the main activities, the person responsible for leading the phase, and the relative BM value mechanisms’ adjustments triggered by the activities.

V. DISCUSSION

A. Model of the DS Journey for SMEs

The DS journey model proposed represents an advancement for the extant literature related to the DS research domain. The model has been tailored for SMEs [21], [22], providing a set of managerial practices per each phase defined as composing the DS journey in order to support the adoption of the DS paradigm as an important driver for adapting, changing, and innovating the firm’s BM [20]. In fact, the model results are effective in bolstering SMEs to adapt to the external context (i.e., the market disruption) that could influence the time to adopt a service strategy [27], [44]. The model may guide SMEs in leveraging DS to escape from a disrupted market and trigger an overall BMI.

In the extant literature, some models have already been presented to facilitate and understand the servitization journey to help companies in tackling the complexities of introducing services (such as [45] and [46]) and to cope with the digitalization paradox (such as [43]). However, in the DS domain, the extant research lacks contributions focusing on SMEs, particularly operating in disrupted markets. Compared with the previous ones, the model of the DS journey proposed in this research presents a more detailed process composed of six well-defined phases, each of them enriched by a set of managerial practices for supporting SMEs to escape from disrupted markets. The originality of this model lies in its comprehensiveness, since it has been grounded on the literature review performed on DS research, combined with the information grasped from the application case even more contextualized within the case of SMEs facing market disruption.

Some commonalities with the previous literature analyzed can be recognized in the new model proposed. As stated by Sjödin et al. [15], [43], the journey starts with the definition of the SME motivations to conduct DS. However, unlike that of the article presented in [15], which focused on identifying the

digitalization needs, this model is centered on the motivation for DS to escape from a crisis in a manufacturing context. As in the “market-sensing phase” of the model proposed by Kindström and Kowalkowski [46], it is important to scout interesting DS opportunities, depending on the SME capabilities and resources, confirming the importance of this practice even (and especially) in the case of manufacturing SMEs. Our findings show how the SME, after recognizing its internal capabilities’ limits, decided to open its boundaries to an external partner and establish a collaboration. This decision revealed itself to be a relevant option for manufacturing SMEs operating in disrupted markets for two reasons. On the one hand, collaboration would help to face the liabilities of smallness. On the other hand, collaboration would help the SME to rapidly react to market disruption, as it would not have to develop new competencies internally. As recognized by Kumar [47], manufacturers usually find themselves incompetent for new-service development, which might discourage them from embracing servitization and related business opportunities.

With reference to the following phases, those of solution conceptualization and solution development, we find some analogies with the “development stage” of the model proposed by Kindström and Kowalkowski [46]. However, dissimilar to this model, the phase of solution conceptualization is separated from the effective moment of solution development and implementation. This is because the SME needs to adopt an experimental approach composed of tests and reiterations (see Section V) before proceeding with the effective constructions of the ideated solutions to limit the risk of incurring the service and digitalization paradox [43]. In the next phase, the SME is ready to sell and deliver the new DS solutions. This phase is merged into one stage, unlike in Kindström and Kowalkowski’s model [46] since, with the definition of a new selling contract based on the usage of the digital services provided with the sensor (and not on the ownership), there is also a change in the way the SME delivers the value. Finally, the last phase, which is deduced from the third research stream of the literature analysis, is partly proposed in Sjödin et al. [43]. In their model, the last phase is actually “evaluating the microservice benefits,” which is related only to a microdimension analysis level, without considering the macroeffects on the SME system.

B. BMI’s Value Mechanisms and DS

One of the main strengths and added values of this research is the systematic detection of the connection among the BMs three value mechanisms (value creation, capture, and delivery) and the six phases of the DS journey. The previous literature explored this link, although only with reference to value creation and capture, thus, failing in exploring the value delivery dynamics in a DS journey [43], [84], [85], [86]. This study mends to this limitation. Our model highlights how value delivery and creation are strictly intertwined, mostly in the third and fifth phases (“solution conceptualization” and “sales and delivery”). Building the customer relationship (Phase 5) worked as both the trigger and the catalyzer to redefine and empower the value delivery mechanism, prolonging the connection with customers and structuring the value capture dynamics (through new contracts and agreements). As opposed to the mainstream view,

TABLE IV
PHASES OF THE DS JOURNEY EXPLAINED

Phase of the Journey	Scope of the phase	Main activities	Responsible	BM adjustments
Motivation for DS	<ul style="list-style-type: none"> • Identification of the motivations for DS • Spread of the motivations and the new-service-oriented culture in all the levels of the SME 	<ul style="list-style-type: none"> • Recognition of market disruption • Technology scouting to offer digital solutions • Market-sensing constrained by SME's expertise • Courses and training sessions to raise the entire company regarding the potentialities of DS 	Board of Directors	-
DS Capabilities (Internal) Assessment and (external) Search	<ul style="list-style-type: none"> • Internal capabilities assessment • Evaluation to establish a partnership • Formal allocation of work responsibilities • Fund allocation 	<ul style="list-style-type: none"> • Involvement of the technical team to scrutinize internal capabilities • Development of a competitive product (hardware, i.e., core competence for the disrupted market) • Detection and selection of strategic partners to develop the non-core component (software) • Generation of a common vision with the partner by sharing knowledge and experiences • Scheduling of daily meetings with the partners • Hiring of new employees dedicated only to the DS project who will lead the rest of the company to the new business • Developing of ambidextrous capabilities to develop the new business while operating in the disrupted market • Involvement of employees from the disrupted market company in the new DS business to prepare them for the new business • Allocation of funds for the development of new integrated digital solutions 	Board of Directors	⇒ Value creation
Solution Conceptualization	<ul style="list-style-type: none"> • Developing a simple solution (alone or with the partner) • Adoption of an agile behavior • Start developing customer relationship 	<ul style="list-style-type: none"> • Integration of software and hardware in a simplified solution • Developing of simplified digital solutions with a recognized customer value • Consideration of potential customers as key partners in the solution development • Scheduling of meetings with potential customers to test the ideated digital solution • Awareness of changes of digital service properties 	CIO	⇒ Value creation ⇒ Value delivery
Solution Development	<ul style="list-style-type: none"> • Translating customers' needs into more advanced service features • Creating a more advanced and detailed PSS 	<ul style="list-style-type: none"> • Customer requirements implementation to develop different solutions dedicated to multiple industries • Maintenance of a common architecture in the different solutions to be applied to various project fields • Leverage of different service results from the same technological root architecture • Integration of the new value proposition in the BM and the triggered changes along the different components (creation, delivery) 	CIO	⇒ Value creation
Sales and Delivery	<ul style="list-style-type: none"> • Deepening customer relationship • Rethinking the costs and the revenue streams • Defining how to capture value from the digital solutions • Rethinking the value delivery systems 	<ul style="list-style-type: none"> • Design of new selling contracts aimed at long-lasting agreements and pay-per-use/results formulas • Co creation of service in the value delivery 	CEO	⇒ Value delivery ⇒ Value capture
Evaluating the effects	<ul style="list-style-type: none"> • Developing performance indicators • Tracking results • Evaluation and decisions for implementing or improving services' features 	<ul style="list-style-type: none"> • Collection of user experience and scout customer requirements to further improve the solutions provided • Use and analysis of data to detect new customer-driven opportunities • Consideration of the impact on the ecosystem 	Board of Directors	-

this research contends that the BMI needed for a company willing to move into DS requires orchestrating all the BMs value mechanisms. BMs are complex and dynamic systems [50], [87], [88] where the introduction of a new value proposition requires the adaptation of other BMs' value mechanisms and components. Each value mechanism is interdependent with the others. Therefore, we deem that DS starts (usually) by introducing change in the value creation mechanisms, but that soon thereafter, it will require other changes in value capture and in the value delivery mechanisms. The latter has been less considered among scholars investigating DS and BMI [43] but is an important component of every BM.

C. Experiment-Based Approach for DS and BMI

In the DS journey, Company A and Start-up B conducted a scientific execution plan composed of experiments and tests. They "started small" by building a simple product-service solution aimed at testing the market interest in personalized IoT products whose early adopters had been the clients of the previous business. This phase of testing returned positive outcomes. Therefore, soon after a first focus on testing the product-market fit, they started thinking about how to better organize to create value and deliver it to all their customers, potentially attracting new ones. In other words, they started to formalize their business by creating a dedicated business unit and hiring personnel. The process resembles the two-step model of search and execution phases of the lean start-up methodology [89]. The managers did not show any specific knowledge about lean start-up. However, their decision-making approach toward exploration activities in search of new business clearly connected with some basic principles of lean start-up, such as customer centricity in developing new offerings and cutting waste by focusing on experimentation with a small group of early adopters/beta testers before committing larger investments. Lean start-up is known as a practical approach for BMI developed originally for digital new venture contexts [90], [91], [92], [93]. Our study shows that the basic principles and models of lean start-up may also apply to the SMEs' context looking for renewal. However, some differences with lean start-up methodology emerged from the case. In the lean start-up, after the validation of the new value offering, companies look for customers' growth before adapting/building a more structured organization [89]. In contrast, our study shows that in the SMEs operating in the business-to-business context, after an initial validation, the organization changes to be able to serve and attract more customers. This can be explained by the fact that, in the business-to-business environment, the validation process, even with few customers, can already considerably reduce the uncertainty regarding the scaling phase of the new business. Our study proposes some initial evidence and related explanations of how the BMI and the experimentation process may work in SMEs operating business-to-business, as few studies have done so far [43].

D. Role of Collaboration to Deliver Digital Servitized Solutions and Address BMI

Another aspect that deserves to be highlighted in the DS journey proposed is the role of collaboration of the SME facing

the disruption with all the stakeholders involved in the entire lifecycle of the digital servitized solution. The SME oriented to renovate its BM to escape market disruption bet on grasping the competencies and knowledge available outside its ecosystem (in the specific case of both a start-up and customers) to radically change its routines, extend its value chain, and complement the assets already available inside the company. Hence, the collaboration was instrumental for the overall implementation of a new BM toward DS. Drawing from the extensive literature on BMs, we may argue that Company A was able to adopt an open BM, as opposed to the traditional closed BM configurations [94]. The open BM is the "architecture of the value creation, delivery, and capture mechanisms [a focal firm] employs" [95], whereby externally sourced activities and systematic collaborations significantly contribute to value cocreation for the focal firm and external partners [96], [97]. Few studies adopted this construct while exploring and investigating the collaboration among companies and even fewer when referring to those firms more in need of collaborations (i.e., SMEs). Our study shows how managing a collaboration effectively implies the ability to orchestrate external and internal resources while pursuing value creation, value delivery, and value capture as a final goal.

VI. CONCLUSION

In this article, we shed light on how SMEs operating in a declining market can react and renew themselves through DS. Leveraging the DRM, a model of the DS journey was developed and validated through an application case on an SME located in Italy. First, a literature review was conducted to investigate the research domain of DS, defining its main streams (1. motivation and challenges for DS; 2. digital servitized solutions; and 3. impacts on the ecosystem). Second, the DS journey was explored, investigating how SMEs manage to adapt and innovate their BM by looking at all the value mechanisms, as only a few studies have done so far. To do so, a model of the DS journey was developed to bolster SMEs to escape disrupted markets. Six main phases were detected (1. motivation for DS, 2. DS capabilities [internal] assessment and [external] search, 3. solution conceptualization, 4. solution development, 5. sales and delivery, and 6. evaluating the effects) and described. Third, an application case had been conducted to interactively contribute to the modeling of the DS journey and explored the relationship between BMI and DS in contexts affected by disruptions. Indeed, the case allowed to better characterize the model detailing per each phase the main managerial practices to be implemented, the main decision owners and actors to be involved, and the BMs' components impacted by each phase (and related activities). The application case also provided practical evidence on the relationship between DS and BMI research contexts. In addition, it unveiled the dynamics and dependencies among BMs' components along DS. Finally, it also clarified the role of collaboration to deliver a digital servitized solution and address a BMI strategy.

A. Contributions to Knowledge

Based on the results reported and discussed above, this study contributed to research in multiple ways. First, a systematization of the DS research domain was provided by detecting

three main research streams. On this basis, a model of the DS journey had been proposed, extending previous contributions with reference to the specific context of SMEs operating in a disrupted market. SMEs were the engine of most countries' economies [25], and many of them were suffering the rapid pace of technological change and globalization [37]. However, DS within such a relevant context had been underinvestigated in research. The results of this study extended the field of investigation by proposing a journey tailored for the DS domain, answering the call for guidelines and models, specifically supporting SMEs [98]. Second, this study contributed to the ongoing debate on the link between DS and BMI raised by Foss and Saebi [20]. We show how each step of the DS journey may involve some BM changes, beyond value creation or capture [43] and including the value delivery. Findings specifically showed that DS may start with changes in the value creation and then involve other BM changes. We argue that, in general, the relationship between DS and BMI was nonlinear, complex, and context specific. Third, this study contributed to the recent debate on how BMI, through experimentation, may work in SMEs operating business-to-business, as few studies had done so far. Specifically, we showed that, in the SMEs operating in the business-to-business environment context, after an initial validation of the new solution, the organization was adapted—rather than quickly attracting new customers—as proposed by the lean start-up for new digital ventures. Fourth, this study illustrated how SMEs operating in a disrupted market should be able to adopt an open BM configuration while embracing the transition to digital servitized solutions. In particular, the SMEs should be open to collaboration when the internal assessment of internal capabilities suggested that new capabilities were needed to operate the transition. Finally, this research demonstrated that DS can help companies in overcoming disrupted markets, such as broadcasting. Therefore, the study also contributed to discussing the possible external conditions triggering the choice of introducing digital servitized solutions (according to PSS BMs) in response to Baines et al. [27].

B. Contributions to Practice and Managerial Implications

This study also contributed to practice. Through the DS journey model, companies and, in particular, SMEs can be guided to escape disrupted markets. A structured process of the DS journey was proposed to raise awareness about the major issues occurring in each phase. Specifically, empirical findings suggested that the accurate management of each phase of the DS journey, along with needed changes in the overall BM, played a crucial role to enable the transition to DS for SMEs escaping from a disrupted market. In addition, we provided detailed managerial practices and activities for each phase of the DS journey. This constituted a knowledge baseline that can serve SMEs approaching the DS transition. Such activities were necessary to create a consensus and awareness about organizations' transformation process and to develop dedicated competencies related to the exploitation of digital servitized solutions. The DS journey model helped managers in the decision-making process throughout the DS transition, guiding them to cope with disrupted markets and to innovate the BM of their companies

pursuing a DS strategy. For instance, the case from Company A may inspire and stimulate managers belonging to SMEs operating in different disrupted markets to add digital servitized solutions to their offers by stipulating strategic partnerships with players that can complement their knowledge gaps and inexperience and by applying a scientific approach composed of testing, experimenting, and pivoting.

Finally, the study addressed the declining broadcasting industry, suggesting how SMEs operating in such a sector may renew themselves by building on extant competencies while leveraging collaborations through an open BM configuration.

C. Limitations and Further Developments

This study points to the need for further research that investigates the relationship between DS and BMI, especially in disrupted markets. In fact, it represents only an initial step to pave the way to future contributions able to support SMEs to systematically address, through DS, the different types of issues (related to culture, competencies, technologies, assets availability, organization, etc.) that could occur while facing market disruption.

Moreover, this study, like any other research seeking to frame reality in a model, is not free from limitations. This depends mostly on the specificity of the context under examination, which is required to limit the sample size to a single idiographic unit (that could restrict the generalization and relevance of the findings) and on the observer influence typical of qualitative studies (that could lead to the loss of valuable insights and considerations). Other practical studies of SMEs, also involved in different sectors, could be worthwhile for discussing the topic and confirming or extending/complementing the results outlined in this study. In this way, further managerial practices could be detected leading, in the long run, to the definition of both the industry-specific and the cross-sectorial ones. Indeed, tailored versions of the DS journey model developed in this research could also reveal how the BMI and the value dimensions occur and change throughout the company organization based on DS, depending on the technologies being exploited (e.g., IoT and big data). An archive of dedicated and customized managerial practices could, thus, be created based on the industry analyzed, the technology used, and the dimension and structure of the company.

ACKNOWLEDGMENT

The authors would like to thank the Editors and the anonymous Reviewers, who helped significantly enhancing the study's contributions as a result of the revision process. Any errors remain our own.

REFERENCES

- [1] D. J. Teece, "Profiting from innovation in the digital economy: Enabling technologies, standards, and licensing models in the wireless world," *Res. Policy*, vol. 47, no. 8, pp. 1367–1387, 2018, doi: [10.1016/j.respol.2017.01.015](https://doi.org/10.1016/j.respol.2017.01.015).
- [2] M. E. Porter and J. E. Heppelmann, "How smart, connected products are transforming competition," *Harvard Bus. Rev.*, vol. 92, no. 11, pp. 64–89, Nov. 2014, doi: [10.1017/CBO9781107415324.004](https://doi.org/10.1017/CBO9781107415324.004).

- [3] S. Vorbach, H. Wipfler, and S. Schimpf, "Business model innovation vs. business model inertia: The role of disruptive technologies," *Berg-Und Hüttenmännische Monatshefte*, vol. 162, no. 9, pp. 382–385, 2017, doi: [10.1007/s00501-017-0671-y](https://doi.org/10.1007/s00501-017-0671-y).
- [4] S. J. Berman, "Digital transformation: Opportunities to create new business models," *Strategy Leadership*, vol. 40, no. 2, pp. 16–24, Jan. 2012, doi: [10.1108/10878571211209314](https://doi.org/10.1108/10878571211209314).
- [5] C. Sassanelli, M. Rossi, and S. Terzi, "Evaluating the smart maturity of manufacturing companies along the product development process to set a PLM project roadmap," *Int. J. Prod. Lifecycle Manage.*, vol. 12, no. 3, pp. 185–209, 2020, doi: [10.1504/IJPLM.2020.10032146](https://doi.org/10.1504/IJPLM.2020.10032146).
- [6] P. Gaiardelli et al., "Product-service systems evolution in the era of Industry 4.0," *Serv. Bus.*, vol. 15, no. 1, pp. 177–207, Mar. 2021, doi: [10.1007/s11628-021-00438-9](https://doi.org/10.1007/s11628-021-00438-9).
- [7] J. Hsuan, M. Jovanovic, and D. H. Clemente, "Exploring digital servitization trajectories within product-service-software space," *Int. J. Oper. Prod. Manage.*, vol. 41, no. 5, pp. 598–621, Jan. 2021, doi: [10.1108/IJOPM-08-2020-0525](https://doi.org/10.1108/IJOPM-08-2020-0525).
- [8] F. Vendrell-Herrero, G. Parry, O. F. Bustinza, and E. Gomes, "Digital business models: Taxonomy and future research avenues," *Strategic Change*, vol. 27, no. 2, pp. 87–90, Mar. 2018.
- [9] T. Paschou, M. Rapaccini, F. Adrodegari, and N. Saccani, "Digital servitization in manufacturing: A systematic literature review and research agenda," *Ind. Marketing Manage.*, vol. 89, pp. 278–292, 2020, doi: [10.1016/j.indmarman.2020.02.012](https://doi.org/10.1016/j.indmarman.2020.02.012).
- [10] O. F. Bustinza, E. Gomes, F. Vendrell-Herrero, and S. Y. Tarba, "An organizational change framework for digital servitization: Evidence from the Veneto region," *Strategic Change*, vol. 27, no. 2, pp. 111–119, Mar. 2018, doi: [10.1002/jsc.2186](https://doi.org/10.1002/jsc.2186).
- [11] C. Raddats, "Motivations for servitization: The impact of product complexity," *Int. J. Oper. Prod. Manage.*, vol. 36, no. 5, pp. 572–591, Jan. 2016, doi: [10.1108/IJOPM-09-2014-0447](https://doi.org/10.1108/IJOPM-09-2014-0447).
- [12] C. Sassanelli, G. Pezzotta, F. Pirola, M. Rossi, and S. Terzi, "The PSS design GuRu methodology: Guidelines and rules generation to enhance PSS detailed design," *J. Des. Res.*, vol. 17, no. 2/4, pp. 125–162, 2019, doi: [10.1504/JDR.2019.10026968](https://doi.org/10.1504/JDR.2019.10026968).
- [13] D. Kindström and C. Kowalkowski, "Service innovation in product-centric firms: A multidimensional business model perspective," *J. Bus. Ind. Marketing*, vol. 29, no. 2, pp. 96–111, Feb. 2014, doi: [10.1108/JBIM-08-2013-0165](https://doi.org/10.1108/JBIM-08-2013-0165).
- [14] L. Linde, J. Frishammar, and V. Parida, "Revenue models for digital servitization: A value capture framework for designing, developing, and scaling digital services," *IEEE Trans. Eng. Manage.*, vol. 70, no. 1, pp. 82–97, Jan. 2023, doi: [10.1109/TEM.2021.3053386](https://doi.org/10.1109/TEM.2021.3053386).
- [15] D. Sjödin, V. Parida, M. Jovanovic, and I. Visnjic, "Value creation and value capture alignment in business model innovation: A process view on outcome-based business models," *J. Prod. Innov. Manage.*, vol. 37, no. 2, pp. 158–183, 2020, doi: [10.1111/jpim.12516](https://doi.org/10.1111/jpim.12516).
- [16] F. Vendrell-Herrero, O. F. Bustinza, G. Parry, and N. Georgantzis, "Servitization, digitization and supply chain interdependency," *Ind. Marketing Manage.*, vol. 60, pp. 69–81, 2017, doi: [10.1016/j.indmarman.2016.06.013](https://doi.org/10.1016/j.indmarman.2016.06.013).
- [17] J. Cenamor, D. R. Sjödin, and V. Parida, "Adopting a platform approach in servitization: Leveraging the value of digitalization," *Int. J. Prod. Econ.*, vol. 192, pp. 54–65, 2017, doi: [10.1016/j.ijpe.2016.12.033](https://doi.org/10.1016/j.ijpe.2016.12.033).
- [18] O. F. Bustinza, A. Z. Bigdeli, T. Baines, and C. Elliot, "Servitization and competitive advantage: The importance of organizational structure and value chain position," *Res. Technol. Manage.*, vol. 58, no. 5, pp. 53–60, 2015, doi: [10.5437/08956308X5805354](https://doi.org/10.5437/08956308X5805354).
- [19] F. Vendrell-Herrero and J. R. Wilson, "Servitization for territorial competitiveness: Taxonomy and research agenda," *Competitiveness Rev.*, vol. 27, no. 1, pp. 2–11, 2017.
- [20] N. J. Foss and T. Saebi, "Fifteen years of research on business model innovation: How far have we come, and where should we go?," *J. Manage.*, vol. 43, no. 1, pp. 200–227, 2017, doi: [10.1177/0149206316675927](https://doi.org/10.1177/0149206316675927).
- [21] F. Adrodegari, T. Pashou, and N. Saccani, "Business model innovation: Process and tools for service transformation of industrial firms," *Procedia CIRP*, vol. 64, pp. 103–108, 2017, doi: [10.1016/j.procir.2017.03.056](https://doi.org/10.1016/j.procir.2017.03.056).
- [22] S. Forkmann, C. Ramos, S. C. Henneberg, and P. Naude, "Understanding the service infusion process as a business model re-configuration," *Ind. Marketing Manage.*, vol. 60, pp. 151–166, 2017, doi: [10.1016/j.indmarman.2016.05.001](https://doi.org/10.1016/j.indmarman.2016.05.001).
- [23] C. M. Christensen, M. E. Raynor, M. Rory, and R. McDonald, "What is disruptive innovation?," *Harvard Bus. Rev.*, vol. 93, no. 12, pp. 44–53, 2015, doi: [10.1353/abr.2012.0147](https://doi.org/10.1353/abr.2012.0147).
- [24] K. Miller, M. McAdam, P. Spieth, and M. Brady, "Business models big and small: Review of conceptualisations and constructs and future directions for SME business model research," *J. Bus. Res.*, vol. 131, pp. 619–626, 2021, doi: [10.1016/j.jbusres.2020.12.036](https://doi.org/10.1016/j.jbusres.2020.12.036).
- [25] A. Cavallo, A. Ghezzi, and C. Rossi-Lamastra, "Small-medium enterprises and innovative startups in entrepreneurial ecosystems: Exploring an under-remarked relation," *Int. Entrepreneurship Manage. J.*, vol. 17, no. 4, pp. 1843–1866, 2021, doi: [10.1007/s11365-020-00698-3](https://doi.org/10.1007/s11365-020-00698-3).
- [26] S. Lenka, V. Parida, and J. Wincent, "Digitalization capabilities as enablers of value co-creation in servitizing firms," *Psychol. Marketing*, vol. 34, no. 1, pp. 92–100, Jan. 2017, doi: <https://doi.org/10.1002/mar.20975>.
- [27] T. Baines, A. Z. Bigdeli, O. F. Bustinza, V. G. Shi, J. Baldwin, and K. Ridgway, "Servitization: Revisiting the state-of-the-art and research priorities," *Int. J. Oper. Prod. Manage.*, vol. 37, no. 2, pp. 256–278, 2017, doi: [10.1108/IJOPM-06-2015-0312](https://doi.org/10.1108/IJOPM-06-2015-0312).
- [28] M. Paiola and H. Gebauer, "Internet of things technologies, digital servitization and business model innovation in B to B manufacturing firms," *Ind. Marketing Manage.*, vol. 89, pp. 245–264, 2020, doi: [10.1016/j.indmarman.2020.03.009](https://doi.org/10.1016/j.indmarman.2020.03.009).
- [29] L. Blessing and A. Chakrabarti, *DRM, A Design Research Methodology*. Berlin, Germany: Springer, 2009.
- [30] S. Vandermerwe and J. Rada, "Servitization of business: Adding value by adding services," *Eur. Manage. J.*, vol. 6, no. 4, pp. 314–324, 1988, doi: [10.1016/0263-2373\(88\)90033-3](https://doi.org/10.1016/0263-2373(88)90033-3).
- [31] A. Tukker, "Eight types of product-service system: Eight ways to sustainability? Experiences from SusProNet," *Bus. Strategy Environ.*, vol. 13, no. 4, pp. 246–260, 2004, doi: [10.1002/bse.414](https://doi.org/10.1002/bse.414).
- [32] C. Sassanelli, M. Rossi, G. Pezzotta, D. A. de Jesus Pacheco, and S. Terzi, "Defining lean product service systems features and research trends through a systematic literature review," *Int. J. Prod. Lifecycle Manage.*, vol. 12, no. 1, pp. 37–61, 2019, doi: [10.1504/IJPLM.2019.104371](https://doi.org/10.1504/IJPLM.2019.104371).
- [33] F. Pirola, X. Boucher, S. Wiesner, and G. Pezzotta, "Digital technologies in product-service systems: A literature review and a research agenda," *Comput. Ind.*, vol. 123, 2020, Art. no. 103301, doi: [10.1016/j.compind.2020.103301](https://doi.org/10.1016/j.compind.2020.103301).
- [34] W. Coreynen, P. Matthyssens, and W. van Bockhaven, "Boosting servitization through digitization: Pathways and dynamic resource configurations for manufacturers," *Ind. Marketing Manage.*, vol. 60, pp. 42–53, 2017, doi: [10.1016/j.indmarman.2016.04.012](https://doi.org/10.1016/j.indmarman.2016.04.012).
- [35] M. Kohtamäki, V. Parida, P. Oghazi, H. Gebauer, and T. Baines, "Digital servitization business models in ecosystems: A theory of the firm," *J. Bus. Res.*, vol. 104, pp. 380–392, Nov. 2019, doi: [10.1016/j.jbusres.2019.06.027](https://doi.org/10.1016/j.jbusres.2019.06.027).
- [36] H. Gebauer, M. Paiola, N. Saccani, and M. Rapaccini, "Digital servitization: Crossing the perspectives of digitization and servitization," *Ind. Marketing Manage.*, vol. 93, pp. 382–388, 2021, doi: [10.1016/j.indmarman.2020.05.011](https://doi.org/10.1016/j.indmarman.2020.05.011).
- [37] European Commission, "Digitising European industry: Reaping the full benefits of a digital single market," Brussels, Belgium, 2016.
- [38] C. Kowalkowski, H. Gebauer, B. Kamp, and G. Parry, "Servitization and deservitization: Overview, concepts, and definitions," *Ind. Marketing Manage.*, vol. 60, pp. 4–10, 2017, doi: [10.1016/j.indmarman.2016.12.007](https://doi.org/10.1016/j.indmarman.2016.12.007).
- [39] F. Adrodegari and N. Saccani, "Business models for the service transformation of industrial firms," *Serv. Ind. J.*, vol. 37, no. 1, pp. 57–83, 2017, doi: [10.1080/02642069.2017.1289514](https://doi.org/10.1080/02642069.2017.1289514).
- [40] C. Kowalkowski, L. Witell, and A. Gustafsson, "Any way goes: Identifying value constellations for service infusion in SMEs," *Ind. Marketing Manage.*, vol. 42, no. 1, pp. 18–30, 2013, doi: [10.1016/j.indmarman.2012.11.004](https://doi.org/10.1016/j.indmarman.2012.11.004).
- [41] A. Neely, "Exploring the financial consequences of the servitization of manufacturing," *Oper. Manage. Res.*, vol. 1, no. 2, pp. 103–118, 2008, doi: [10.1007/s12063-009-0015-5](https://doi.org/10.1007/s12063-009-0015-5).
- [42] H. Gebauer, E. Fleisch, and T. Friedli, "Overcoming the service paradox in manufacturing companies," *Eur. Manage. J.*, vol. 23, no. 1, pp. 14–26, Feb. 2005, doi: [10.1016/j.emj.2004.12.006](https://doi.org/10.1016/j.emj.2004.12.006).
- [43] D. Sjödin, V. Parida, M. Kohtamäki, and J. Wincent, "An agile co-creation process for digital servitization: A micro-service innovation approach," *J. Bus. Res.*, vol. 112, pp. 478–491, May 2020, doi: [10.1016/j.jbusres.2020.01.009](https://doi.org/10.1016/j.jbusres.2020.01.009).
- [44] J. Lertsakthanakun, N. Thawesaengskulthai, and C. Pongpanich, "Servitization decision-making framework for Thai manufacturing companies," *Int. J. Bus. Manage.*, vol. 7, no. 12, 2012, Art. no. 147, doi: [10.5539/ijbm.v7n12p147](https://doi.org/10.5539/ijbm.v7n12p147).

- [45] R. Oliva and R. Kallenberg, "Managing the transition from products to services," *Int. J. Serv. Ind. Manage.*, vol. 14, no. 2, pp. 160–172, 2003, doi: [10.1108/09564230310474138](https://doi.org/10.1108/09564230310474138).
- [46] D. Kindström and C. Kowalkowski, "Development of industrial service offerings: A process framework," *J. Serv. Manage.*, vol. 20, no. 2, pp. 156–172, 2009, doi: [10.1108/09564230910952753](https://doi.org/10.1108/09564230910952753).
- [47] R. Kumar, "Targeted SME financing and employment effects : What do we know and what can we do differently?," World Bank, Washington, DC, USA, Jobs Working Paper 3, 2017. [Online]. Available: <https://openknowledge.worldbank.org/handle/10986/27477>
- [48] D. J. Teece, "Business models and dynamic capabilities," *Long Range Plan.*, vol. 51, no. 1, pp. 40–49, 2018, doi: [10.1016/j.lrp.2017.06.007](https://doi.org/10.1016/j.lrp.2017.06.007).
- [49] C. Zott and R. H. Amit, "The business model: A theoretically anchored robust construct for strategic analysis," *Strategic Org.*, vol. 11, no. 4, pp. 403–411, 2013, doi: [10.1177/1476127013510466](https://doi.org/10.1177/1476127013510466).
- [50] L. Massa and C. Tucci, "Business model innovation," in *The Oxford Handbook of Innovation Management*. Oxford, U.K.: Oxford Univ. Press, 2013, pp. 420–441.
- [51] N. F. Ayala, C. A. Paslauskis, A. Ghezzi, and A. G. Frank, "Knowledge sharing dynamics in service suppliers' involvement for servitization of manufacturing companies," *Int. J. Prod. Econ.*, vol. 193, pp. 538–553, 2017, doi: [10.1016/j.ijpe.2017.08.019](https://doi.org/10.1016/j.ijpe.2017.08.019).
- [52] A. G. Frank, G. H. S. Mendes, N. F. Ayala, and A. Ghezzi, "Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective," *Technol. Forecasting Soc. Change*, vol. 141, pp. 341–351, Apr. 2019, doi: [10.1016/j.techfore.2019.01.014](https://doi.org/10.1016/j.techfore.2019.01.014).
- [53] W. J. Regan, "The service revolution," *J. Marketing*, vol. 27, no. 3, pp. 57–62, Jul. 1963, doi: [10.2307/1249437](https://doi.org/10.2307/1249437).
- [54] T. Boone, "Exploring the link between product and process innovation in services," in *New Service Development: Creating Memorable Experiences*, J. A. Fitzsimmons and M. J. Fitzsimmons, Eds. Thousand Oaks, CA, USA: Sage, 2000, pp. 92–107.
- [55] B. Edvardsson and J. Olsson, "Key concepts for new service development," *Serv. Ind. J.*, vol. 16, no. 2, pp. 140–164, 1996, doi: [10.1080/02642069600000019](https://doi.org/10.1080/02642069600000019).
- [56] M. Orellano, G. Neubert, L. Gzara, and M.-A. Le Dain, "Business model configuration for PSS: An explorative study," *Procedia CIRP*, vol. 64, pp. 97–102, 2017, doi: [10.1016/j.procir.2017.03.008](https://doi.org/10.1016/j.procir.2017.03.008).
- [57] M. Breier, A. Kallmuenzer, T. Clauss, J. Gast, S. Kraus, and V. Tiberius, "The role of business model innovation in the hospitality industry during the COVID-19 crisis," *Int. J. Hospitality Manage.*, vol. 92, 2021, Art. no. 102723, doi: [10.1016/j.ijhm.2020.102723](https://doi.org/10.1016/j.ijhm.2020.102723).
- [58] C. Wendt, M. Adam, A. Benlian, and S. Kraus, "Let's connect to keep the distance: How SMEs leverage information and communication technologies to address the COVID-19 crisis," *Inf. Syst. Front.*, vol. 24, no. 4, pp. 1061–1079, 2022, doi: [10.1007/s10796-021-10210-z](https://doi.org/10.1007/s10796-021-10210-z).
- [59] E. Bivona and M. Cruz, "Can business model innovation help SMEs in the food and beverage industry to respond to crises? Findings from a Swiss brewery during COVID-19," *Brit. Food J.*, vol. 123, no. 11, pp. 3638–3660, Jan. 2021, doi: [10.1108/BFJ-07-2020-0643](https://doi.org/10.1108/BFJ-07-2020-0643).
- [60] T. Clauss, M. Breier, S. Kraus, S. Durst, and R. V. Mahto, "Temporary business model innovation—SMEs' innovation response to the COVID-19 crisis," *R & D Manage.*, vol. 52, no. 2, pp. 294–312, 2022, doi: [10.1111/radm.12498](https://doi.org/10.1111/radm.12498).
- [61] T. Paschou, F. Adrodegari, M. Perona, and N. Saccani, "The digital servitization of manufacturing: A literature review and research agenda," 2017. [Online]. Available: <https://www.researchgate.net/publication/319628925>
- [62] J. F. Nunamaker Jr. and M. Chen, "Systems development in information systems research," in *Proc. 23rd Annu. Hawaii Int. Conf. Syst. Sci.*, 1990, vol. 3, pp. 631–640, doi: [10.1109/HICSS.1990.205401](https://doi.org/10.1109/HICSS.1990.205401).
- [63] C. Sassanelli et al., "Using design rules to guide the PSS design in an engineering platform based on the product service lifecycle management paradigm," *Int. J. Prod. Lifecycle Manage.*, vol. 11, no. 2, pp. 91–115, 2018, doi: [10.1504/IJPLM.2018.092826](https://doi.org/10.1504/IJPLM.2018.092826).
- [64] G. Pezzotta et al., "The product service system lean design methodology (PSSLDM): Integrating product and service components along the whole PSS lifecycle," *J. Manuf. Technol. Manage.*, vol. 29, no. 8, pp. 1270–1295, 2018, doi: [10.1108/JMTM-06-2017-0132](https://doi.org/10.1108/JMTM-06-2017-0132).
- [65] K. Williamson, "Research methods for students, academics and professionals: Information management and systems," *Library Rev.*, vol. 53, no. 3, p. 193, Jan. 2004, doi: [10.1108/00242530410526664](https://doi.org/10.1108/00242530410526664).
- [66] C. Potts, "Software-engineering research revisited," *IEEE Softw.*, vol. 10, no. 5, pp. 19–28, Sep. 1993, doi: [10.1109/52.232392](https://doi.org/10.1109/52.232392).
- [67] P.-E. Ellström, "Knowledge creation through interactive research: A learning perspective," in *Proc. HSS Conf.*, 2007, pp. 1–12.
- [68] K. Peffers et al., "The design science research process: A model for producing and presenting information systems research," in *Proc. 1st Int. Conf. Des. Sci. Res. Inf. Syst. Technol.*, 2006, pp. 83–106.
- [69] M. V. P. Pessoa and A. Gowda, "Integrated PSS roadmapping using customer needs and technology change likelihood," *IEEE Trans. Eng. Manage.*, vol. 69, no. 1, pp. 127–141, Feb. 2022, doi: [10.1109/TEM.2020.3024581](https://doi.org/10.1109/TEM.2020.3024581).
- [70] T. S. Baines et al., "State-of-the-art in product-service systems," *Proc. Inst. Mech. Eng., B, J. Eng. Manuf.*, vol. 221, no. 10, pp. 1543–1552, Jan. 2007, doi: [10.1243/09544054JEM858](https://doi.org/10.1243/09544054JEM858).
- [71] T. S. Baines, H. W. Lightfoot, O. Benedettini, and J. M. Kay, "The servitization of manufacturing: A review of literature and reflection on future challenges," *J. Manuf. Technol. Manage.*, vol. 20, no. 5, pp. 547–567, 2009.
- [72] M. Paiola, "Digitalization and servitization: Opportunities and challenges for Italian SMES," *Sinergie Ital. J. Manage.*, vol. 36, pp. 11–22, 2018.
- [73] C. B. Bingham and K. M. Eisenhardt, "Rational heuristics: The 'simple rules' that strategists learn from process experience," *Strategic Manage. J.*, vol. 32, no. 13, pp. 1437–1464, 2011, doi: [10.1002/smj.965](https://doi.org/10.1002/smj.965).
- [74] C. Raddats, C. Kowalkowski, O. Benedettini, J. Burton, and H. Gebauer, "Servitization: A contemporary thematic review of four major research streams," *Ind. Marketing Manage.*, vol. 83, pp. 207–223, 2019, doi: [10.1016/j.indmarman.2019.03.015](https://doi.org/10.1016/j.indmarman.2019.03.015).
- [75] H. Lightfoot, T. Baines, and P. Smart, "The servitization of manufacturing: A systematic literature review of interdependent trends," *Int. J. Oper. Prod. Manage.*, vol. 33, no. 11/12, pp. 1408–1434, 2013, doi: [10.1108/IJOPM-07-2010-0196](https://doi.org/10.1108/IJOPM-07-2010-0196).
- [76] C. Lerch and M. Gotsch, "Digitalized product-service systems in manufacturing firms: A case study analysis," *Res.-Technol. Manage.*, vol. 58, no. 5, pp. 45–52, Sep. 2015, doi: [10.5437/08956308X5805357](https://doi.org/10.5437/08956308X5805357).
- [77] M. M. Klein, S. S. Biehl, and T. Friedli, "Barriers to smart services for manufacturing companies—An exploratory study in the capital goods industry," *J. Bus. Ind. Marketing*, vol. 33, no. 6, pp. 846–856, 2018, doi: [10.1108/JBIM-10-2015-0204](https://doi.org/10.1108/JBIM-10-2015-0204).
- [78] R. Sala, V. Zanetti, G. Pezzotta, and S. Cavalieri, "The role of technology in designing and delivering product-service systems," in *Proc. Int. Conf. Eng., Technol. Innov.*, 2017, pp. 1255–1261, doi: [10.1109/ICE.2017.8280024](https://doi.org/10.1109/ICE.2017.8280024).
- [79] B. Zhang, W. Li, and G. Xie, "Ecosystem services research in China: Progress and perspective," *Ecol. Econ.*, vol. 69, no. 7, pp. 1389–1395, 2010, doi: [10.1016/j.ecolecon.2010.03.009](https://doi.org/10.1016/j.ecolecon.2010.03.009).
- [80] J. Wu, Z. Feng, Y. Gao, and J. Peng, "Hotspot and relationship identification in multiple landscape services: A case study on an area with intensive human activities," *Ecol. Indicators*, vol. 29, pp. 529–537, 2013, doi: [10.1016/j.ecolind.2013.01.037](https://doi.org/10.1016/j.ecolind.2013.01.037).
- [81] E. Crowley, J. Burton, and J. Zolkiewski, "Servitization intent as a factor in the servitization process," *J. Bus. Ind. Marketing*, vol. 33, no. 8, pp. 1125–1140, 2018, doi: [10.1108/JBIM-08-2016-0199](https://doi.org/10.1108/JBIM-08-2016-0199).
- [82] A. Bonfanti, M. Del Giudice, and A. Papa, "Italian craft firms between digital manufacturing, open innovation, and servitization," *J. Knowl. Econ.*, vol. 9, no. 1, pp. 136–149, 2018, doi: [10.1007/s13132-015-0325-9](https://doi.org/10.1007/s13132-015-0325-9).
- [83] O. K. Mont, "Clarifying the concept of product-service system," *J. Cleaner Prod.*, vol. 10, no. 3, pp. 237–245, Jun. 2002, doi: [10.1016/S0959-6526\(01\)00039-7](https://doi.org/10.1016/S0959-6526(01)00039-7).
- [84] I. Visnjic, A. Neely, and M. Jovanovic, "The path to outcome delivery: Interplay of service market strategy and open business models," *Technovation*, vol. 72/73, pp. 46–59, 2018, doi: [10.1016/j.technovation.2018.02.003](https://doi.org/10.1016/j.technovation.2018.02.003).
- [85] L. Witell and M. Löfgren, "From service for free to service for fee: Business model innovation in manufacturing firms," *J. Serv. Manage.*, vol. 24, no. 5, pp. 520–533, Jan. 2013, doi: [10.1108/JOSM-04-2013-0103](https://doi.org/10.1108/JOSM-04-2013-0103).
- [86] I. C. L. Ng, D. X. Ding, and N. Yip, "Outcome-based contracts as new business model: The role of partnership and value-driven relational assets," *Ind. Marketing Manage.*, vol. 42, pp. 730–743, Jul. 2013, doi: [10.1016/j.indmarman.2013.05.009](https://doi.org/10.1016/j.indmarman.2013.05.009).
- [87] L. Massa, C. L. Tucci, and A. Afuah, "A critical assessment of business model research," *Acad. Manage. Ann.*, vol. 11, no. 1, pp. 73–104, 2017, doi: [10.5465/annals.2014.0072](https://doi.org/10.5465/annals.2014.0072).
- [88] A. Ghezzi and A. Cavallo, "Agile business model innovation in digital entrepreneurship: Lean startup approaches," *J. Bus. Res.*, vol. 110, pp. 519–537, 2020, doi: [10.1016/j.jbusres.2018.06.013](https://doi.org/10.1016/j.jbusres.2018.06.013).
- [89] S. Blank, "Why the lean start-up changes everything," *Harvard Bus. Rev.*, vol. 91, no. 5, pp. 63–72, 2013.
- [90] T. Felin, A. Gambardella, S. Stern, and T. Zenger, "Lean startup and the business model: Experimentation revisited," *Long Range Plan.*, vol. 53, no. 4, 2020, Art. no. 101889, doi: [10.1016/j.lrp.2019.06.002](https://doi.org/10.1016/j.lrp.2019.06.002).

- [91] D. A. Shepherd and M. Gruber, "The lean startup framework: Closing the academic–practitioner divide," *Entrepreneurship Theory Pract.*, vol. 45, no. 5, pp. 967–998, 2021, doi: [10.1177/1042258719899415](https://doi.org/10.1177/1042258719899415).
- [92] N. Bocken and Y. Snihur, "Lean startup and the business model: Experimenting for novelty and impact," *Long Range Plan.*, vol. 53, no. 4, 2020, Art. no. 101953, doi: [10.1016/j.lrp.2019.101953](https://doi.org/10.1016/j.lrp.2019.101953).
- [93] R. Balocco, A. Cavallo, A. Ghezzi, and J. Berbegal-Mirabent, "Lean business models change process in digital entrepreneurship," *Bus. Process Manage. J.*, vol. 25, pp. 1520–1542, 2019, doi: [10.1108/BP-MJ-07-2018-0194](https://doi.org/10.1108/BP-MJ-07-2018-0194).
- [94] H. Chesbrough, "Business model innovation: It's not just about technology anymore," *Strategy Leadership*, vol. 35, no. 6, pp. 12–17, Jan. 2007, doi: [10.1108/10878570710833714](https://doi.org/10.1108/10878570710833714).
- [95] D. J. Teece, "Business models, business strategy and innovation," *Long Range Plan.*, vol. 43, no. 2/3, pp. 172–194, 2010, doi: [10.1016/j.lrp.2009.07.003](https://doi.org/10.1016/j.lrp.2009.07.003).
- [96] A. Osterwalder, Y. Pigneur, and C. L. Tucci, "Clarifying business models: Origins, present, and future of the concept," *Commun. Assoc. Inf. Syst.*, vol. 16, 2005, doi: [10.17705/1CAIS.01601](https://doi.org/10.17705/1CAIS.01601).
- [97] K. Frankenberger, T. Weiblen, M. Csik, and O. Gassmann, "The 4I-framework of business model innovation: A structured view on process phases and challenges," *Int. J. Prod. Develop.*, vol. 18, no. 3/4, pp. 249–273, 2013, doi: [10.1504/IJPD.2013.055012](https://doi.org/10.1504/IJPD.2013.055012).
- [98] F. Adrodegari and N. Saccani, "A maturity model for the servitization of product-centric companies," *J. Manuf. Technol. Manage.*, vol. 31, no. 4, pp. 775–797, 2020, doi: [10.1108/JMTM-07-2019-0255](https://doi.org/10.1108/JMTM-07-2019-0255).
- [99] J. Holmström and J. Partanen, "Digital manufacturing-driven transformations of service supply chains for complex products," *Supply Chain Manage.*, vol. 19, no. 4, pp. 421–430, 2014, doi: [10.1108/SCM-10-2013-0387](https://doi.org/10.1108/SCM-10-2013-0387).
- [100] F. Sánchez-Montesinos, M. O. Basáez, D. A. Aranda, and O. F. Bustinza, "Creating isolating mechanisms through digital servitization: The case of Covirán," *Strategic Change*, vol. 27, no. 2, pp. 121–128, 2018.



Sofia Lamperti received the B.S. degree in management engineering from Università degli Studi di Brescia, Brescia, Italy, in 2017, and the M.S. degree in management engineering from Politecnico di Milano, Milan, Italy, in 2019. She is currently working toward the Ph.D. degree in management with the University of Montpellier, Montpellier, France.

She is a visiting student with IMD Business School, Lausanne, Switzerland. Her research interests include entrepreneurial support systems for sustainability and digitalization, business model innovation, and organizational transformation for sustainability. She is a part of a European advanced doctoral program in business administration (CEFAG).



Angelo Cavallo received the M.S. degree in management engineering and the Ph.D. degree in management, economics, and industrial engineering from Politecnico di Milano, Milan, Italy, in 2013 and 2017, respectively.

He is currently an Assistant Professor with Politecnico di Milano. He is core Faculty Member with the POLIMI Graduate School of Management, where he is the Director of the International Master in Innovation and Entrepreneurship. He is the Founder and Director of the Space Economy Observatory, Politecnico di Milano. He is the author of journal articles (appearing in outlets, such as *Technovation*, *Journal of Business Research*, *Technological Forecasting and Social Change* and *International Entrepreneurship and Management Journal*), book chapters, and conference proceedings. His research interests include strategic management, entrepreneurship, digital innovation, business model innovation, corporate innovation, and entrepreneurial dynamics.



Claudio Sassanelli received two M.S. degrees in management and civil engineering from Politecnico di Bari, Bari, Italy, in 2010 and 2013, respectively, and the Ph.D. degree in management, economics, and industrial engineering from Politecnico di Milano, Milan, Italy, in 2017.

He is also holding Visiting Researcher positions with Tokyo Metropolitan University, Tokyo, Japan, and Universidade de São Paulo, São Paulo, Brazil. He is an Assistant Professor with Politecnico di Bari, Bari, Italy. His main research interests include product–service system design, specifically addressing to product lifecycle management, DfX approaches, and circular economy and Industry 4.0 paradigms.

Dr. Sassanelli manages special issues in international journals as a Guest Editor and disseminates his research being co-author of 75 publications in international journals, conferences proceedings, and book chapters in the field. He is a member of the IFIP WG 5.1 and of the editorial board of sustainability MDPI (Bioeconomy section). He carried out teaching activities on design and management of production systems and quality