

## Article

# Toward Servitized Research: An Integrated Approach for Sustainable Product-Service Innovation

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**Abstract:** This article proposes to bring the sustainable product-service innovation (PSI) field into a next phase—after two phases of exploring why and how firms achieve sustainable PSI growth, we suggest to further focus on finding *when* they actually do so. Based on prior studies, we pinpoint and describe two main shortcomings in the current body of PSI literature: (1) an overemphasis on the firm level, and (2) an overuse of descriptive case studies. These shortcomings are used as stepping-stones for formulating a research approach that integrates *Multiple Levels* (namely, the firm, its environment, and its people), mixes different *Methods* (both qualitative and quantitative) and that turns researchers to *Action* (through advice and training). This MLMA approach offers ample new research opportunities and turns the servitization research community into a *servitized* community by leveraging academic insights to better support firms in improving their economic and environmental performance.

**Keywords:** product-service innovation; multiple levels; theory integration; mixed methods; action research



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## 1. Introduction

Sustainable product-service innovation (PSI)—or *servitization* [1]—refers to the transition of firms from selling basic products and services to providing integrated product-service offerings in order to differentiate from the competition, improve customer value [2,3], and increase their economic performance while decreasing their environmental impact [4,5]. It is considered an economic megatrend that bolsters sustainability [6], as it covers a variety of business models whereby customers no longer attach importance to owning a product (e.g., light bulbs) but rather receiving a solution (e.g., light) [4,7]. Moreover, the application of digital technologies further enables firms in offering services that improve both economic and environmental sustainability [8,9], as smart combinations of service and technology reduce the consumption of natural resources and thus ecologically modernize industry [7]. For instance, in the automotive sector, a dual green-digital servitization strategy has been found to lead to better productivity outcomes and strengthen firms' competitiveness [10].

The antecedents of traditional PSI go back at least 150 years, as manufacturers from the US in the second half of the 19th century, enabled by the latest technologies such as the telegraph and railroad, started offering services on top of products [11]. For example, McCormick, a manufacturer of reapers (the most complex piece of farming machinery at the time), reduced production during harvest to send workers out in the field for repair services. In the 21st century, new technological (r)evolutions such as the Internet of Things (IoT), the collection and analysis of Big Data, and Artificial Intelligence (AI), are again increasingly reshaping the role of firms like Joy Global, a mining equipment manufacturer

that operates fleets of equipment far underground and dispatches technicians only when problems requiring human intervention arise [12]. Today, simply providing products or services is no longer considered sufficient to survive and prosper in an increasingly competitive, green and connected world, as customers require suppliers to support them through a variety of increasingly integrated, sustainable solutions [13,14] and product-service systems (PSS) that require less resources, less energy, reduce waste, and that are better for the environment [5,15–17].

Research into servitization started to take off in the late 1980s, when Vandermerwe and Rada first described how firms—not just manufacturers, but companies from almost all industries—are trying to compete by offering “bundles of goods, services, support, and knowledge . . . with services in the lead role” ([18], p. 314). Since then, interest in PSI began to grow, slowly at first, then exponentially. Over the years, the field matured into an established research community that publishes more than 100 articles per year [19]. So far, we have seen two main research phases. The first phase (from the 1980s until about the late 1990s) was mostly concerned with establishing *why* firms focus on PSI growth, setting the boundaries of the field. The current second phase (starting around 2000) engages more with the question regarding *how* firms can achieve such growth, building and strengthening the field’s intellectual core and conceptual foundations [4,20]. Also, on top of economic growth, studies started considering firms’ environmental impact [4]. Over time, several research sub-communities developed—particularly, the PSS community (with explicit links to sustainability), the solution business community and the service science community—though rather in isolation [2]. Moreover, besides Europe and the US, interest also began to grow in Asia, such as in China and South Korea [4], and scholars started to venture into other industries besides equipment manufacturing, such as chemicals [21], logistics [22,23], entertainment [24,25], agriculture [26,27], energy [28] and city development [29].

Today, the servitization research field has reached several barriers. First, as an area of research, it lacks a strong identity due to the fragmented and detached research contexts of the different sub-communities, each with their own preferred levels of analysis, methods and terminologies [30]. This has increased complexity and limited knowledge accumulation [2]. Second, there is an overemphasis on qualitative research—particularly, case studies of large manufacturers from mature, Western industries [2]. This bias implies that servitization is and can only be analysed in an exploratory, descriptive manner [20]. Third, few studies have investigated to what extent PSI *actually* improves firms’ environmental impact. Only recently, some efforts are being made [5,31]. So, the research community has come at a crossroad (or rather multiple crossroads), and recent reviews of the literature suggest consolidating the field by building on past research, bridging the different sub-communities, promoting interdisciplinary studies, challenging prevailing assumptions and by further broadening the scope to other regions and sectors [2,20,32,33].

With this article, we aim to suggest a way to address these shortcomings by proposing a more integrated research approach. After two decades of exploring *how* firms could be successful in servitization and sustainable PSI [20], we argue that we need to complement the current exploratory approach to servitization with a more confirmatory perspective to answer the question: *When* do firms actually achieve sustainable PSI growth? We explicitly focus on *sustainable* growth, implying that firms combine raising revenues and profits through PSI with lowering their environmental impact. This turn would come with at least three avenues toward future progress. First, we suggest to broaden the current approach to PSI, which has been mainly concerned with elements at the firm level [34,35], by further extending into the macro-environment of firms as well as into their micro-foundations rooted in leader behaviour. This offers the opportunity to further explore what configurations of factors [1,36]—at the level of the firm, the environment, and the individual—lead to servitization success [37] or failure [38]. Second, this approach uses a combination of different methods—both qualitative and quantitative—to get a better integrated and fine-grained view of servitization. Third, and finally, we suggest that we—as a research community—become *servitized* ourselves, which we can do if we take

this more comprehensive and configurational approach. That would imply moving from conducting research to also offering firms customized advice and training based on the latest academic insights [6]. This way, we will not only support local firms in sharpening their competitive edge and improving their environmental impact, but also unlock new research opportunities for our field. To summarize, we suggest a research approach that covers *Multiple Levels*, integrates different *Methods*, and turns researchers toward *Action*—in short: an MLMA research approach.

The remainder of this article is structured as follows. Based on a summary and discussion of the current body of literature, we first describe two current shortcomings of sustainable PSI research: (1) The overemphasis on the firm level, and (2) the limited use of different, complementary methods. Subsequently, we suggest a more integrated research approach and its different steps in further detail. Finally, we conclude this article by summarizing its core contributions to the field as well as its limitations.

## 2. Current Shortcomings of PSI Research

### 2.1. Overemphasis on the Firm Level

So far, most servitization and sustainable PSI research takes place at the firm level [2], covering a variety of topics [3], such as (a) service strategies [39,40] and PSS types [17], (b) how firms should organize themselves, for instance, in the sense of whether they should separate or integrate the product and service business [41], (c) what resources and capabilities they should develop [6,42], and (d) what processes help them create, deliver and capture value [43,44]. Traditionally, studies tend to focus on one specific issue, yet lately a firm-holistic approach is increasingly being promoted [37] to better understand the complexity of servitization [45].

A holistic approach identifies and links initiatives at different organizational levels [35] and systematically integrates insights across different value processes [43]. For example, prior holistic studies have examined (a) the links between the resources and capabilities necessary for successful service innovation while considering the firm's strategy and structure [34], (b) the connections between the firm's business model, organization [45] and operations [46], and (c) the shift to solutions from a financial, customer, internal and learning perspective [35]. Yet, despite the integration of a wide variety of intra-firm topics, two perspectives are still often neglected: the relationship with the firm's external macro-environment and the human micro-dimension. Both are particularly important to further develop the sustainability angle of PSI and strengthen firms' growth and environmental impact.

First, developments in the macro-environment can have a profound effect on service business models [46] and servitization success [37]. For instance, customers may (or may not) be willing to exchange product ownership for services [47]. Also, the absence or presence of regulatory institutions emphasizing resource efficiency and recycling may discourage firms from moving into servitization or encourage them, respectively [7]. Therefore, managers should first understand the environment wherein they are active before implementing a service strategy adapted to current market conditions [48].

Until recently, relatively few studies investigated the influence of the environment on firms' service strategizing [49] or the contextual conditions conducive to servitization [32,36]. Two examples are Gebauer's [39] exploration of different environment-service strategy configurations (or "fits") and Turunen and Finne's [50] analysis of different environmental contingencies affecting firms' service transition. Recently, the topic of "territorial servitization", which is the process of knowledge-intensive business service (KIBS) sectors contributing to local manufacturing activity, emerged [51]. This research stream studies how regions benefit from servitization by creating employment [52], opening up new markets, efficiently allocating resources [28] and improving sustainability [53]. However, though some claim that servitization is always beneficial to firms [54], the interaction between the firm and the business environment is too complex to warrant such a simple prediction [55]. For instance, depending on the industry's growth rate, servitizing firms

are more (or less) likely to see their firm value increase. In high-growth industries, service transition strategies actually decrease firm value, because resources are shifted away from persistent growth in the core product market [56]. Also, some studies refer to the “dark side” of servitization, as it may temporarily even destroy value [51], and territorial behaviour may also negatively impact supplier-buyer relationships [57].

To date, studies have investigated environmental factors such as environmental uncertainty [58], the intensity of the competition [49], the complexity of customer needs [59], the impact of legal and technological developments [60] and the presence of KIBS [61]. However, many macro-environmental challenges and drivers still remain empirically underexplored, such as broader regulatory, social, cultural and political influences [30,45], while other elements deserve to be further investigated, such as how to operationalize and test the concept of territorial servitization [51]. In short, there is still ample opportunity to study the impact of different environmental dimensions, not only on sustainable PSI drivers, decisions and outcomes [36], but also on strategies, offerings and transition paths [37].

Second, the micro-level human dimension of servitization has also received very little attention [2,38]. Recent reviews of the literature suggest using more psychological and sociological approaches to understand how individuals—their attitudes, perceptions, personalities, behaviours and interactions—shape sustainable servitization processes and outcomes [35,43,62]. For example, cognitive phenomena such as an overemphasis on *tangible* product characteristics (rather than *intangible* services) and an aversion of risk that often comes with providing solutions, can limit managers to extend into the service business [63]. In contrast, when such cognitive barriers are absent, managers are more likely to develop a service business strategy [64]. Also, depending on their implicit power motivation, decision makers are more (or less) likely to attach importance to prosocial goals such as taking care of the environment [65]. Therefore, explaining firm-level phenomena from a micro-level perspective—known as “the microfoundations movement” [66]—is considered a valuable route for sustainable PSI research [38].

Only recently, the study of the microfoundations of servitization has begun to take shape. For example, Lenka et al. [67] identified several tactics that individuals adopt to overcome organizational resistance, and Coreynen et al. [68] explored what motives drive decision-makers to integrate products and services. However, as far as we know, no study has investigated the microfoundations of *sustainable* PSI. In fact, a recent survey shows that managers at manufacturing companies attach only limited importance to the ecological aspects of servitization [62]. PSI research would not only benefit from critically reviewing the role of the manager [55,69], also employees require further investigation [3,70], since they are also vital for companies to extend into services [62]. For example, Ulaga and Loveland [71] found that successful service salespeople exhibit different personality traits than people selling products. Moreover, Kohtamäki et al. [72] suggest that a service-oriented mindset should be shared by the *entire* organization, not just by the people dealing with customers.

In sum, to further advance the sustainable PSI research field, we need to view firms from a multi-level perspective that includes not only the firm and its many internal strategic, processual and organizational dimensions, but also the environmental (macro) level in which firms are active as well as the individual (micro) level on which they are founded. Together, this may stimulate developing a truly configurational perspective on sustainable PSI growth.

## 2.2. Limited Use of Different Methods

Methodologically, though the PSI research field uses a wide range of approaches, from non-empirical papers (e.g., conceptual articles) to empirical work based on both/either qualitative and/or quantitative methods, the field is still dominated by conceptual work and descriptive qualitative studies [2]. The dominance of these methods can also be clearly observed in the sustainable PSS literature [15,46] and the more recent digital and territorial

servitization research streams [33,51], with this side remark that the PSS community also often uses simulations and modelling as methods [2].

The current body of servitization and sustainable PSI literature is built on many illustrative and comparative case studies, offering a thorough understanding of the context, content, process and outcomes of servitization [2,32]. For example, Bressanelli et al. [8] conducted an in-depth case study of a household appliance company that implemented PSI to see how digital technology enables a circular economy transition, and de la Calle et al. [9] looked at four capital goods companies to investigate how digital servitization affects sustainability. This type of qualitative research is useful for exploring new research topics, such as the congruence between PSI, digitalization and sustainability [9], and also for better understanding the microfoundations of PSI, such as the capabilities necessary to sustain enterprise performance [73].

However, the popularity of descriptive qualitative research [32] may also limit further theoretical development. In the sustainable PSI domain, case studies are often not based on theory, nor are they aimed at theory building [2,20]. The PSS community in particular uses little theory, and their articles so far have focused mostly on conceptual discussions. An example is the oft-cited article by Tukker [17] on eight different types of PSS and their environmental potential. Also, they focus almost exclusively on *successful* service transitions [37,70]. Although the literature pays some attention to the topics of servitization *failure* and *de-servitization* [60], such cases have received far less attention than their successful counterparts [37,70]. Finally, many studies consider mostly large corporations in developed economies, particularly original equipment manufacturers (OEMs) from Western countries [2], hence side-lining small and medium-sized enterprises (SMEs) as well as other potentially interesting regions and sectors where sustainable PSI is taking place [33].

Calls and suggestions for future research commonly ask to complement qualitative research with more quantitative studies to accept (or reject) prior assumptions and predictions regarding servitization [2,33,37]. According to a 2018 count, only nine per cent of servitization studies apply quantitative methods [2]. They are mainly focused on finding whether servitization leads to better financial performance [37], using a wide range of measures, such as firm value [56], revenues and profits [74], and return on assets growth [75]. Overall, it has been found that servitized firms have higher sales and profits than non-servitized firms [54]. Only recently, attention is also being paid to sustainability outcomes. For instance, a study found that PSI has a positive impact on the environment, especially when undertaken by large companies [40]. Yet, the servitization, performance and sustainability relationship is more complex and requires much further investigation [10,31,36,76].

For one, most studies do not take account of how complex or advanced the firm's service business actually is. It was long assumed that firms gradually evolve from product to service providers by adding services to their product portfolio [77]. Yet in practice, they often combine multiple positions along the product-service continuum, offering basic services for one customer segment and advanced services for another [78]. Therefore, future studies should consider firms' product and service portfolio to assess their degree of servitization more precisely [79]. Second, studies often focus on the simple direct relationship between servitization and performance [74,75], neglecting different firm-internal and environment-external elements as performance influencers [1] as well as the relationship with firms' environmental impact. For instance, it has been suggested that future research should focus on how different organizational capabilities [6,33] and tactics [46] can contribute to both economic performance and the environment, and how the legal, fiscal and competitive environment influence these relationships [32,37,62]. Third, it remains unclear whether servitization is a successful strategy for *all* companies that take this road. Future studies should consider larger samples of firms, both small and large, and also from different industries, sectors and regions, to find whether the results also apply to different contexts [2,70].

In conclusion, the emphasis so far on descriptive qualitative and successful case studies, which remain important to track the latest evolutions, may provide inconclusive and potentially biased evidence regarding some aspects of sustainable servitization [55] when coming with a lack of theoretical development and empirical validation [20]. Also, the limited number of quantitative studies thus far has only offered a first yet incomplete view of the servitization-performance-sustainability relationship. Therefore, to move the sustainable PSI research field forward, future studies would benefit from more longitudinal and cross-sectoral research [15] that combines both qualitative and quantitative methods with the aim to develop rigorous theory and generalizable evidence that is relevant for business practice.

### 3. An Integrated Research Approach

Based on the above-mentioned shortcomings, we propose an integrated research approach to consolidate the sustainable PSI research field, unlock new research opportunities and support businesses in improving both their economic and environmental impact. This approach extends the current holistic view of servitization by considering *multiple levels* (not just the level of the firm, but also the environment in which they are active in tandem with the people that move the organization forward). It also mixes both qualitative and quantitative empirical *methods*. Finally, it urges researchers to *act* and bring about positive, sustainable change among firms rather than just observe and report. In short, we propose a Multi-Level, Method and Actionable (MLMA) research approach.

This approach consists of four major steps between which researchers can iteratively move back and forth: (1) in-depth interviews with decision makers and employees to gather qualitative information about their firm's sustainable PSI transition, business environment and microfoundations, (2) supplemented with a thorough quantitative assessment (3) as well as data collected through action research, and finally (4) analyses of the data collected cross-sectionally, with more longitudinal data that will be added over time. Figure 1 provides an overview of this approach and its four steps. In Sections 3.1–3.3 we discuss each data collection step in further detail, drawing from other studies as well as our own research as illustrative examples. In Section 3.4, we discuss the opportunities for data analysis created by combining these prior steps.

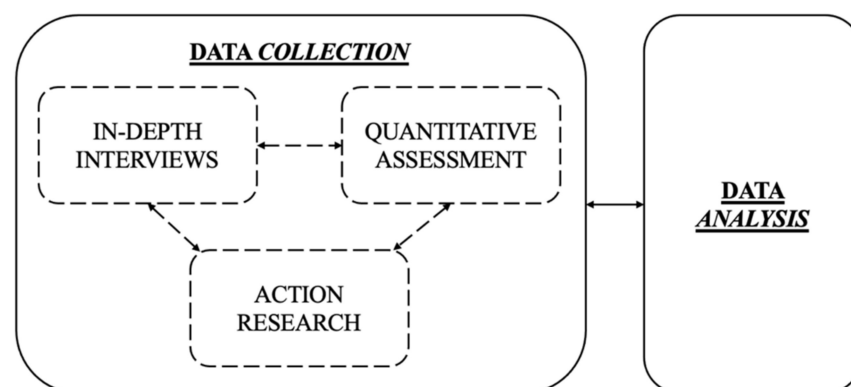


Figure 1. The MLMA research approach.

#### 3.1. In-Depth Interviews

Although the PSI research domain consists mostly of case-based studies, the need to integrate other research methods does not imply that researchers should discontinue visiting firms and conducting in-depth interviews. Qualitative research will always remain important for discovering new topics, such as the use of digital technologies in servitization [3,33] as well as their combined effect on sustainability [9] and for unravelling the subtle dynamics between different levels. For the mixed-methods approach that we suggest, researchers need to visit firms to fully understand their unique transition toward sustainable PSI, combined with a quantifiable assessment (see Section 3.2. Quantitative

Assessment), so that they can offer proper advice and training (see Section 3.3. Action Research) and follow up through additional interviews and assessments.

Through interviewing, researchers get a thorough understanding of the focal firm as well as the content, process and context of their sustainable PSI journey [32,45], considering different levels at play. *Content* refers to the outcome of the strategic transition, involving finding answers to “what”-questions such as: What types of service does a manufacturer offer [79]? And what productivity gains are achieved through digital and green servitization [10]? *Process* involves the way strategy comes about. This perspective is concerned with answering “how”, “who” and “when”-questions such as: How do firms empower development teams to prioritize the most resource efficient and sustainable solutions [6]? Who is better at selling (intangible) services [71]? And when does the firm choose for deservitization [60]? Finally, *Context* relates to the set of circumstances under which the strategy process and content are determined. This perspective aims to find out more about the “where” of strategy (either inside or outside of the organization) and is associated with questions such as: Where do employees face resistance to sustainable servitization [67]? And in what regulatory environments are firms encouraged to improve their resource efficiency [7]? In short, during the interviews, researchers should not simply focus on one aspect but consider the firm’s *process*, *content*, and *context* simultaneously, albeit with a main focus on only one aspect at the time while keeping the other two in mind in order to have a focused discussion [80].

Ample examples of interview-based research are available. By way of illustration, we mention two studies that explicitly discuss servitization from a content-process-context perspective. First, Coreynen et al. [81] worked with eight product-oriented firms to explore how firms scale-up their service business, focusing on three main questions: (1) What are firms’ current and intended service offerings; (2) How do they scale-up services; and (3) Where inside the organization are the barriers that prevent them from scaling-up? Over a period of 18 months, two rounds of semi-structured interviews were conducted, combined with other methods, including focus-groups and workshops with the firms’ CEOs joined by managers in charge of one of the firm’s key operations (see more in Section 3.3. Action Research). Second, Baines et al. [82] studied 14 companies to understand and describe the servitization process, its transformation stages and the contextual factors (both internal and external to the firm) that affect it. Over the course of four years, the authors conducted 62 semi-structured interviews with at least three key stakeholders from different personnel ranks. These and other studies [83,84] often give thorough descriptions of how the research has been conducted: from selecting the cases (e.g., best practice examples or based on sector and size), to collecting the data (e.g., multiple rounds of one to two-hour semi-structured interviews with key decision-makers and personnel) and analysing the results (e.g., coding common elements to detect first-order categories, build second-order themes, and aggregate abstract theoretical dimensions).

Despite their useful insights, these type of qualitative (case) studies have their limitations. For instance, they cannot offer a rigour estimate of effect sizes (e.g., what factors *actually* help firms scale-up services, and to what extent?), systematically control for alternative explanations (e.g., what if *other* factors were present?), nor provide generalization over large samples [85]. Also, most general and sustainable PSI studies select and discuss only *successful* cases, which may lead to bias. Therefore, to find rigorous causal evidence, additional quantitative data collection and analysis are necessary.

### 3.2. Quantitative Assessment

Besides interviewing firms’ decision-makers and employees, researchers can also collect information through a quantitative assessment exercise. A quantitative approach allows the researcher to reduce phenomena to numerical values for statistical analyses. The relationships between these phenomena can be investigated in terms of generalizable causal effects, creating opportunities for prediction [86].

By way of example and relating to prior literature that discusses servitization and sustainable PSI from a holistic perspective [34,37], we illustrate the nature of such quantitative measures as can be constructed with data regarding the firm, the environment and the individual. For each of these levels, there are already several validated measures and scales at our disposal. Below, we discuss these elements as well as a selection of PSI studies that have used them (see also summaries in Tables 1–3), yet this discussion is by no means meant to be exhaustive. Also, on top of drawing from the sustainable PSI literature, we list measures used in the general servitization literature, since they are relevant to both research fields. For example, the importance of networking capabilities has been emphasized in both the servitization and sustainable PSI literature [87,88].

### 3.2.1. The Firm

*Service offerings*—Prior studies have used a range of measures to determine firms' service offerings. For example, Homburg et al. [89] assembled a list of 31 *industrial services* and asked respondents whether they offered them or not; Antico et al. [90] posited twelve *services supporting products* versus eight *services supporting customers*, which were recently also used by Lexutt [91]; Partanen et al. [92] developed a multi-dimensional scale for 15 *industrial service offerings*; and Morgan et al. [59] combined Neely's [93] twelve *service categories* with six more from Eggert et al. [74]. Most recently, Kohtamäki et al. [75] used a list of 22 *operational, R&D, and consulting services* based on prior work [87,92] to ask respondents to what extent each service is currently offered to customers.

*Strategies*—Regarding strategy, some prior studies have simply asked firms if they consider the *integration* of products and services *important*, and whether they have developed a *strategy* (or *plan*) for its implementation [49,68]. Others asked similar questions about product-service *innovation* [40,94], or they combined *digital* with *green servitization strategy* measures [10]. Furthermore, because servitization is defined as a strategic transition to offer customers better *value*, prior servitization work has used Treacy and Wiersema's value disciplines framework [95] to explain different service strategies [14,35]. This framework describes three types of value that firms can offer (i.e., *product leadership, customer intimacy* and *operational excellence*) to differentiate themselves from the competition, has been operationalized by Reimann et al. [96] for quantitative research purposes and recently used by Coreynen et al. [68] to determine the strategic drivers of servitization.

*Capabilities*—The literature discusses many skills that are necessary for successful servitization [37], yet few have been included in quantitative research. For instance, Rönnberg Sjödin et al. [97] considered different configurations of capabilities related to *service development, mass service customization, digitalization* and *network management*, drawing from other research for measurement scales. Kohtamäki et al. [87] took a more fine-grained view of network capabilities, further focusing on *partner knowledge, relation skills, coordination* and *internal communication*. The sustainable PSI domain urgently needs to develop and test more scales related to service development and implementation capabilities. A useful starting point could be the article by Fischer et al. [98], who listed different *sensing, seizing, and reconfiguring* capabilities for *exploiting* and *exploring* service business opportunities. In fact, on top of operational capabilities, the literature can draw inspiration from the *dynamic capabilities* literature [73] to find the underlying mechanisms related to servitization and firms' sustainable performance and growth. For instance, Coreynen et al. [49] considered the influence of *exploration* and *exploitation* [99], drawing from the study by Bierly and Daly [100] for scales, to unravel the antecedents of (digital) servitization. Also *agility*, which is the ability to accommodate and adapt to changes in a dynamic environment [84], is increasingly pinpointed as an important driver for digital servitization [48,101].

*Culture*—In prior work, several measures have been used to better understand a firms' service culture, orientation and climate. Homburg et al. [89] introduced two scales related to the *service orientation of corporate culture* (namely, *service values* and *behaviour*) and three scales related to human resource management (HRM) practices (*personnel recruitment, training* and *assessment/compensation*) [72,91]. Gebauer et al. [102,103] further extended



these scales by separating managers' values and behaviour from those of employees, and they also considered the firm's *organizational structure* (i.e., whether the service organization is integrated or separate) as well as the *proximity of the service organization to the customer*. Antioico et al. [90] took a slightly different approach by considering *top management's commitment* and *visionary leadership of services, service rewards, service technology, and cross-functional communication* between service employees and the rest of the firm. Also Oliva et al. [41] and Lexutt [91] looked into *service commitment*.

**Table 1.** Firm-level measures.

Measures	Operationalizations and Reference Studies
Service offerings	<ul style="list-style-type: none"> <li>• Industrial services [89,92]</li> <li>• Services supporting products and customers [90,91]</li> <li>• Service categories [59,74,93]</li> <li>• Operational, R&amp;D and consulting services [75,87]</li> </ul>
Strategies	<ul style="list-style-type: none"> <li>• Product-service integration [49,68]</li> <li>• Product-service innovation [94]</li> <li>• Digital and green servitization [10]</li> <li>• Value strategies [68,96]</li> </ul>
Capabilities	<ul style="list-style-type: none"> <li>• Service development, mass service customization, digitalization capabilities [97]</li> <li>• Network capabilities [87,97]</li> <li>• Sensing, seizing and reconfiguring capabilities [98]</li> <li>• Exploration and exploitation [49,100]</li> <li>• Agility [48,106]</li> </ul>
Culture	<ul style="list-style-type: none"> <li>• Service orientation of corporate culture (i.e., values and behaviour) and HRM practices (recruitment, training, assessment and compensation) [72,89,91]</li> <li>• Organizational structure and proximity to the customer [104,107]</li> <li>• Top management's service commitment [41,90,91]</li> <li>• Visionary leadership of services [90]</li> </ul>
Performance	<p><u>Financial:</u></p> <ul style="list-style-type: none"> <li>• Service profitability [89,90]</li> <li>• Firm value [56]</li> <li>• Return on sales [89,103]</li> <li>• Market share [104]</li> <li>• Overall yearly revenues and profits [74]</li> <li>• Return on assets [75]</li> <li>• Productivity [40]</li> </ul> <p><u>Non-financial:</u></p> <ul style="list-style-type: none"> <li>• Quality of customer relationships [89]</li> <li>• Retaining old customers [41]</li> <li>• Winning new customers [91]</li> <li>• Satisfying customers [41,94]</li> </ul>
Environmental impact	<ul style="list-style-type: none"> <li>• Attitude to environmental impact disclosure [5]</li> <li>• Policies on emissions reduction, environmental assurance and environmental supply chain management [5]</li> <li>• Reduction waste, energy usage and emissions [31]</li> </ul>
Firm characteristics	<ul style="list-style-type: none"> <li>• Age, size and sector [49,68,72,105]</li> <li>• Product-service orientation [49,68]</li> </ul>

**Table 2.** Environment-level measures.

Measures	Operationalizations and Reference Studies
Market/Industry	<ul style="list-style-type: none"> <li>• Market turbulence [104,108]</li> <li>• Commoditization (e.g., price sensitivity, switching costs) [96]</li> <li>• Industry growth [56]</li> <li>• Competition and competitive intensity [56,59,64,108]</li> <li>• Technological turbulence [49,108]</li> <li>• Presence of manufacturers and KIBS [52,109–111]</li> <li>• Quality of the entrepreneurial ecosystem [110]</li> </ul>
Region/Country	<ul style="list-style-type: none"> <li>• Employment and unemployment rates [52,109]</li> <li>• Gross domestic product and patents [111]</li> <li>• CO<sub>2</sub> emissions [10]</li> </ul>

*Performance*—When discussing firm performance, prior research has looked into both financial and non-financial measures [37], either by asking the respondent directly or by consulting secondary sources, including: (a) *direct service profitability* [89]; (b) *overall profitability relative to product sales and service volume* [90]; (c) *firm value* [56]; (d) *return on sales for the firm and also in comparison to the industry* [89,103]; (e) *market share and financial performance relative to competitors* [104]; (f) *the role of the service business in the firm’s financial portfolio* [41]; (g) *overall yearly revenue and profits* [74]; (h) *sales and profit performance* [54,72]; (i) *productivity* [40]; (j) *return on assets* [75]; and (k) non-financial service success such as *winning new customers* [91], *retaining old customers* [41], *quality of customer relationships* [89] and *customer satisfaction* [41,94].

*Environmental impact*—Though studies increasingly pay attention to sustainability, few employ concrete quantifiable measures to assess firms’ environmental impact. We list three recent examples: Doni et al. [5] assessed firms’ *attitude to environmental disclosure, total energy consumption, and policies on emissions reduction, environmental assurance and environmental supply chain management*; Hao et al. [31] measured firms’ *environmental performance* by considering their *reduction of waste, energy usage and emissions* during the past three years; and Kozłowska [40] asked managers about their firm’s environmental impact, though the question only concerned their perception. In the future, sustainable PSI studies should complement qualitative questions with more with quantitative measures, such as regarding firm’s resource efficiency [6,53], energy use [17], and efforts to extend products’ lifespan and close the loop [7,8].

*Control variables*—Firms’ *age, size, and sector* are often used as control variables [59,73,105], which can be asked directly to the respondent or added later after consulting secondary sources, similar to the performance measures (see earlier). However, different sectors can also consist of firms that offer either products and/or services. Therefore, Coreynen et al. [49,68] introduced the *product-service orientation* (PSO) measure, involving a question making respondents select whether the firm mostly offers products (supported by additional services), or *vice versa*. In this way, within-sector heterogeneity in this regard can be captured.

### 3.2.2. The Environment

A firm’s environment is argued to consist of many different dimensions that are relevant to PSI, such as the *intensity of the competition and complexity of customer needs* [59,104], the *presence of KIBS* [52], the *speed of technological developments and the stability of rules and regulations* [30,60]. On top of interviewing decision-makers about these matters, researchers can also use quantitative measures. For instance, Jaworski and Kohli [108] offer useful scales for *competitive intensity, market turbulence and technological turbulence*, which are often used in PSI research [49,59,64]. Another aspect of the environment that often comes forward when discussing firms’ transition toward services is the level of *commoditization* [14]. For this, Reimann et al. [96] developed a multi-dimensional scale that measures *product homogeneity, customer price sensitivity, switching cost and industry stability*.

Another way to collect information on the environment is through secondary sources, such as local statistical bureaus and information service providers. For instance, Fang et al. [56] drew data from the Compustat Industry Annual Database to calculate measures for *industry growth, turbulence* and *competition*. Other examples of such studies can be found in the more recent territorial servitization field. For example, Lafuente et al. [52] combined data from the Global Entrepreneurship Monitor (GEM), the Spanish Institute of Statistics and Eurostat to create measures for the *stock of manufacturing firms* and *new KIBS businesses* as well as the *total number of freights exported, unemployment rates* and *market growth*. On top of these measures, Wyrwich [109] considered *regional knowledge*; Horváth and Rabetino [110] the *quality of the entrepreneurial ecosystem*; and Gomes [111] the number of *patents* and *gross domestic product*. Finally, the only study that we could find explicitly referring to *green* environmental measures at the macro-level, is the study by Opazo-Basáez et al. [10] that considered countries' *CO<sub>2</sub> emissions*.

### 3.2.3. The Individual

To get insight in the microfoundations of sustainable PSI, we also need to include measures of individual decision-makers and employees' key characteristics. Contrary to the firm and its environment, the people that make up an organization have been investigated to a much lesser extent in servitization research [67]. Particularly quantitative studies are far and between. Therefore, the number of individual-level variables that have been used in extant work is much lower. Yet, the literature has hinted at many individual-level elements that are argued to be relevant (and necessary) for (successful) servitization [37], such as people's *cognitions* [63], *motivations* [112,113], *personalities* [71], *knowledge* [114], *skills* [90,115] and *tactics* [67]. Disciplines such as behavioural strategy [116] and the psychology of entrepreneurship [117] offer a whole range of useful measures that can be applied for studying the microfoundations of servitization.

In Table 3, we list the variables and measures that can be found in the servitization literature to date. Antioco et al. [90] refer to the importance of the *ability to listen* and *appeal to the customer*, which resonates with an entrepreneur's *social skills* [118]. Baines et al. [115] mention *resilience*, which relates to *emotional flexibility* or *agility* [119]. In their study on the individual differences between high-performing service salespeople and sales reps selling goods, Ulaga and Loveland [71] identified 13 potential explanatory variables, including *introversion, openness, and conscientiousness*, for which scales can be drawn from the HEXACO Personality Inventory [120]. Also on a salesperson level, Böhm et al. [121] considered a person's *customer knowledge* and *technical knowledge* [122,123], as well as her/his ability to *maintain customer relations* and *firm-internal relations* [124]. And Coreynen et al. [69] drew from McClelland's [125] Big Three motives (i.e., *the need for achievement, affiliation* and *power*) theory to explore the motivational drivers of servitization, and Hermans et al. [65] to investigate to what extent the *need for power* is associated with environmental goals.

On top of all this, there are many other dimensions that despite their relevance have only been touched upon superficially in servitization, such as *leadership skills* [69], *entrepreneurship* and *real problem-solving eagerness* [126]. Finally, it is standard practice in entrepreneurship research to include the person's *gender, age, educational background* and *work experience* as control variables [65,127].

**Table 3.** Individual-level measures.

Measures	Operationalizations and Reference Studies
Skills	<ul style="list-style-type: none"> <li>• Social skills (i.e., social perception, adaptability, expressiveness, self-promotion and ingratiation) [118]</li> <li>• Ability to maintain customer relations and internal relations [121,124]</li> </ul>
Personality	<ul style="list-style-type: none"> <li>• Emotional flexibility and agility [119]</li> <li>• HEXACO (i.e., Honesty, Emotionality, eXtraversion, Agreeableness, Conscientiousness and Openness) [120]</li> </ul>
Motivations	<ul style="list-style-type: none"> <li>• Need for achievement, affiliation and power [65,68,125]</li> </ul>
Knowledge	<ul style="list-style-type: none"> <li>• Customer and technical knowledge [121–123]</li> </ul>
Entrepreneurship	<ul style="list-style-type: none"> <li>• Entrepreneurial self-efficacy [127]</li> </ul>
Individual characteristics	<ul style="list-style-type: none"> <li>• Gender, age, education and experience [68]</li> </ul>

### 3.3. Action Research

On top of steps one and two, we also suggest a more action-oriented research approach. Introduced in the social sciences [128], action research is often used in management and lately also in servitization to bring about positive change in firms [23], thus being especially relevant for sustainable PSI. By combining qualitative and quantitative data collection techniques with action research, our approach comes close to a field experimental set-up, creating opportunities for randomized control trials, such as in economics and medicine, and for truly investigating causal inference [129].

Based on their knowledge of the literature and information so far collected through in-depth interviews (see Section 3.1) and quantitative assessments (see Section 3.2), researchers should be able to provide firms with preliminary feedback on their service transition as well as their capacity for sustainable PSI. In so doing, research findings are turned into action in the form of providing evidence-based advice and training. This advice may consist of a scorecard, showing the results of the quantitative assessments (perhaps compared with the anonymized results of other firms by way of benchmark), as well as a follow-up workshop to discuss the most important findings, which in turn may further uncover new insights. By evolving from collecting data to also providing firms customized support, we ourselves become—in a way—*servitized* researchers.

We have already experimented with such an action-oriented research approach ourselves. For a government-funded technology transfer project in Belgium, we developed a diagnostic instrument to offer companies insight in their individual service-upscaling barriers [81], which was later further developed into a tool to measure firms' general capacity for servitization [130]. For another project, we partly automatized this process by sending participants, after they have completed an online survey, a report of their results, including potential interpretations as well as a comparison with similar firms. Most recently, we further developed this methodology for a project on "Ambitious Entrepreneurship", supported by the Flemish Agency of Innovation and Entrepreneurship (VLAIO), in tandem with the Flemish Association for Small and Medium-Sized Enterprises (UNIZO). In this ongoing project, professional coaches, who have been trained by our academic team to use the researchers' toolkit, offer strategic and personal advice to decision-makers based on the results from a mixed-methods longitudinal data collection design, including interviews, surveys, secondary data and so-called BIATs (i.e., Brief Implicit Association Tests). The series of surveys, for instance, include one about the firm and another about the personality of the entrepreneur [85].

To bring the essence of this method to life, we briefly discuss an illustrative case by way of example. The plant manager of an independent supplier of complex electronics and system assemblies for harsh conditions (e.g., high temperatures, extreme vibrations, humidity), after completing the quantitative assessment, received a scorecard indicating that

the firm is active in a *technologically turbulent* and *competitive environment* [108], emphasizes *operational excellence* over other value strategies [95], and *exploits* rather *explores* business opportunities [100]. During the follow-up interview, the researcher discussed the accuracy of these results, considering the respondent's own perception of the actual situation, and shared some insights based on the literature. For instance, in *turbulent environments*, it may be better to *explore* new service opportunities rather than to focus entirely on *improving internal operations* [49,98], and it may be better in *commoditized markets* to pursue more *value-based service strategies* such as *customer intimacy* instead of *operational excellence* to differentiate from the competition [14].

Besides advice, researchers can also give training to (1) inform decision-makers and employees of the benefits of servitization, and (2) ameliorate some of the firm's individual barriers uncovered during prior interviews and assessments. They can either organize and give training sessions themselves, or they can collaborate with professional consultants while they observe and take notes. In the literature, we can identify a few examples of this. For instance, Bezerra Barquet et al. [131] conducted two workshops with the sales, planning, engineering and production teams of a machine tool manufacturer using the Business Model Canvas [132] to evaluate the feasibility of different PSS business models. And Coreynen et al. [81] organized two individual workshops with case firms' CEOs and three to five key employees to generate, prioritize and define ideas for internal service-upscaling projects based on front-end innovation work by Jacoby [133]. In the latter example, the visiting team consisted of both an academic researcher and a more practice-oriented consultant, who switched roles depending on the activity in question, the researcher steering the conversation mainly during the interviews, and the consultant taking the lead during the workshops.

The above examples illustrate the backbone of our action-oriented research approach, but it involves much more than that. We briefly refer to two other add-ons (full details can be found in the report by van Witteloostuijn et al. [85]). First, follow-up questionnaires (for instance up until six months after providing the advice) offers the opportunity to conduct *within-subject* effect studies (i.e., has the advice or training produced changes in behaviour and performance?). And second, by collecting performance and sustainable impact measures as well as status data of "twins" of the participating firms, researchers can perform *between-subject* effect studies (i.e., do the participating firms perform better, economically and/or environmentally, than their non-participating twins?). Next, we discuss what is possible from a rigorous research perspective in greater detail.

### 3.4. Data Analysis

At this stage, after iteratively repeating steps 1, 2 and 3 for enough firms, the researcher has collected sufficient data (i.e., notes and transcripts from in-depth interviews, responses to firm-, environment- and individual-level surveys, BIAT scores, secondary data such as sustainable impact measures, and observations during as well as after trainings) for further rigorous analysis. The MLMA approach creates opportunities for combining three types of epistemologies: induction, deduction, and abduction. Traditionally, conducting interviews is associated with induction (as described in Section 3.1), quantitative research with deduction (as illustrated in Section 3.2), and abduction is the "road in-between" that uses deductive techniques for inductive purposes. With the MLMA approach, we do not aim for either of these three ideal-types, because induction alone is insufficient for finding causal inference, and the full range of quantitative measures that we propose is too broad and varied for full deduction. Instead, we use the above three data collection *steps* as *steppingstones* to introduce a four-dimensional meta-conceptual model (instead of a traditional two-dimensional framework suggesting the relationships between a handful of variables) for explaining the many research possibilities offered by the MLMA research approach (see Figure 2).

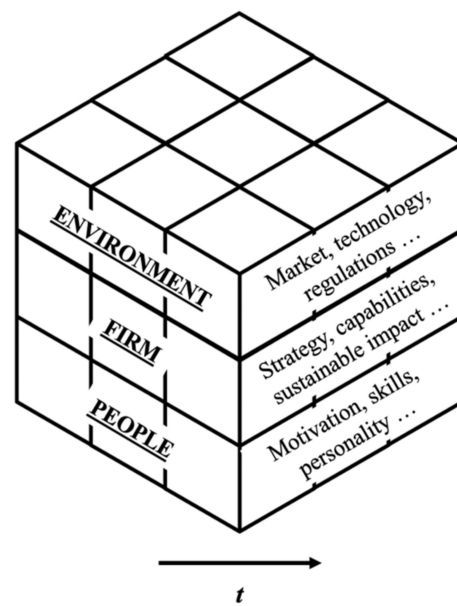


Figure 2. Meta-conceptual model for sustainable PSI research.

First, as indicated by the meta-model's horizontal layers, this framework extends the current firm-level approach, which is used most often in servitization research, by also considering the environment in which firms are active (moving one layer up) as well as the people that collectively make up the organization (moving one layer down). By further exploring the many inter-level relationships, we may develop a better understanding of the heterogeneity among firms as well as their impact on the environment. Some work in this area has already been done. For instance, Gebauer [39] identified different service strategies following different environment-strategy configurations, and Hermans et al. [65] investigated a decision maker's motivations associated with wanting to take care of the environment. Yet, there is much more to explore. Through in-depth interviews with key people about their firm's sustainable PSI transition *process*, we can take account of the *content* of their product-service offerings as well as the *context* in which they are active (for firms, that is the environment; for people, it is the organization), backed-up by thorough quantitative data collection and analysis. In so doing, we may further untangle these complicated inter-level relationships.

Second, the model's individual building blocks represent the different research topics and variables available. Based on prior research, we have discussed several topics. At the firm level, this involves, amongst others, *strategies* and *capabilities*, and we explicitly add the need for *sustainable impact* measurement to ensure that the firm also objectively assesses its environmental impact. At the environment level, this relates to the dynamics of the *market*, the speed of *technological change* and current (*environmental*) *rules and regulations*. Finally, at the individual level, this includes people's *motivations*, *skills* and *personality*. Of course, a review of the broader business literature would point to many more potentially interesting and relevant issues. For now, given the state of the art in the PSI literature, this list will suffice. So far, the sustainable PSI literature has explored these topics and their inter-relationships in mostly a descriptive manner, using only a limited set of theories and methods. For instance, studies suggest several capabilities that improve firms' environmental impact [6] and discuss the potential influence of regulatory frameworks on sustainable PSS [50], yet few have confirmed these effects quantitatively. Future research can continue to explore both current and new topics as well as their inter-relationships using qualitative methods (e.g., observations, in-depth interviews, focus groups) and investigate them through further quantitative analysis.

Third, the model's three-dimensional structure points to the necessity to keep searching for configurational fits between the drivers of and conditions for servitization [36].

Imagine the model's sides in different colours (like a Rubik's Cube) and that the building blocks can switch positions. Many combinations are possible, yet there is only limited number of combinations that path the way for sustainable PSI success [92]. For example, Gebauer et al. [102] found that specific strategy-structure configurations (or "matches") are needed to succeed in servitization. Furthermore, Lafuente et al. [134] investigated how sustainable product innovation strategies are conditioned by firms' learning and entrepreneurial orientation, and Bustinza et al. [135] examined the boundary configurations for effective servitization. In fact, these last two examples employed fuzzy-set qualitative comparative analyses (fsQCA), a methodology that combines both qualitative and quantitative assessments to determine the degree to which a case belongs to a set [136]. However, when there is a "mismatch" and the elements do not align well, firms are less likely to succeed, which possibly offers explanations for servitization failure and firms' decision to refocus on the core product business [38]. We extend this configurational view by not only considering firms' strategy, structure and environment [36], but also by including firms' microfoundations.

Finally, the model's fourth dimension (represented by the *t*-arrow in Figure 2) is time. Most qualitative work follows only a few firms over a short period of time. For example, de la Calle et al. [9] interviewed senior managers at four Basque companies over the course of a few weeks. And quantitative studies often only consider the correlation between different factors measured at one point in time. For instance, Kozłowska [62] sent a questionnaire to 150 Polish machinery manufacturers to find what factors influence their PSI process the most. Researchers should continue to follow-up on and collect information about the studied firms' economic and environmental performance, for instance by cooperating with a data provider or by consulting secondary sources on firms' status and updated information over time. This offers several more opportunities for further analysis. For one, how do different strategy-structure-environment fits evolve in the long term? Maybe a firm's dynamic capabilities, such as the ability to explore new service opportunities, are more important for sustainable PSI than operational capabilities. Second, it opens opportunities for field-experimental research. For example, do firms that receive advice and training on servitization perform better, the same or perhaps worse? And what type of training is more effective: strategic training, training on sustainable service development, or personal training? This would lead to true insights on the causal inference of PSI, economic performance, and environmental impact.

#### 4. Conclusions

The aim of this article is to propose a more integrated research approach to move the sustainable PSI field forward. Drawing from prior studies—mostly from the last two decades, which saw a surge in servitization articles—we pinpoint and describe two main shortcomings of the current body of literature: (1) an overemphasis on the firm level, and (2) an overuse of descriptive qualitative studies. To ameliorate these issues and start a new research phase focused on further finding *when* firms actually achieve sustainable PSI growth, we introduce a new Multi-Level, Method and Actionable (MLMA) approach, consisting of four iterative steps: (1) in-depth interviews, (2) quantitative assessments, (3) action research, and (4) data analysis. By applying this approach, we—as a research community—can become *servitized* ourselves by supporting firms and helping them raise their performance and reduce their environmental impact. Also, moving back and forth between these steps offers ample new research opportunities, represented by the four dimensions of the meta-conceptual model, which suggest to (1) extend the firm-level approach to also include the firm's environment and its people, (2) explore new topics through qualitative research while investigating their relationships through quantitative methods, (3) find configurational fits and causal inference between the drivers and conditions leading to sustainable PSI success and failure, and (4) follow up on firms over longer periods of time. Finally, we call on the community to apply this approach not only to large, Western manufacturers, which have been the focus of the past, but also include (smaller)

firms from other industries, sectors and regions where servitization is also taking place, and where the call for a clear sustainability angle is louder than ever.

This suggested approach is not without its own limitations. We address here two, though there are undoubtedly more. First, we urge scholars to extend their focus to different levels but have ourselves ignored the recent expansion into another relevant level, namely that of multiple firms working together. For instance, Kohtamäki et al. [137] defined different concepts to describe distinct inter-dependent systems (i.e., the value chain, value system, ecosystem, networks and platforms). These forms of collaboration are increasingly enabled by technology, and they also have been found to leverage companies' aggregate level of sustainability [9,88,138]. Though the MLMA approach is primarily intended for single firms, researchers can also use it for multiple firms working together, for instance by applying the same methodology within the same network or system. This would unlock several more research opportunities, such as regarding the importance of fit between multiple firms. For instance, should firms match each other (i.e., be similar) in terms of operational capabilities or culture, or should they complement one another (i.e., be different) to achieve sustainable PSI growth? And what types of skills should the people in charge of managing the network have, so firms can *collectively* achieve sustainable growth?

Second, the MLMA approach is an all-encompassing method that requires much (wo)manpower, time and, consequentially, funding. The "Ambitious Entrepreneurship" project to which we referred earlier (see Section 3.3) was budgeted to cover the cost of a team of researchers for a period of four years. This budget did not even include the cost of the professional coaches, who visit and consult the firms. Setting up a similar research project focused exclusively on sustainable PSI would be expensive. Therefore, we suggest the servitization community to pool its resources to set up one shared platform with its own assessment tools, training instruments and database, that researchers can use—in a modular fashion, depending on their needs—for their own research. Of course, clear arrangements will have to be made about who can access the platform (e.g., who contributes should also be able to use it, and *vice versa*), data management (e.g., data engineers should continuously compile and clean the data), and privacy (e.g., firm-specific information should be anonymized). But in the long run, we will have a stronger research community that is able to do more ground-breaking, longitudinal research, which further benefits businesses and societies.

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