

Design of product-service systems in SMEs: a review of current research and suggestions for future directions

Product-service systems

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Abstract

Purpose – Despite increasing focus among scholars and practitioners on the design of product-service systems (PSS), there exists no compilation of current knowledge on the role played by small and medium-sized enterprises (SMEs) in designing such systems. Thus, this paper sets out to identify and organise the existing research and suggest questions for future research.

Design/methodology/approach – A systematic literature review was performed to identify and provide in-depth details on key themes in the literature addressing the design of PSS in SMEs.

Findings – This paper identifies five themes in the literature on the design of PSS in SMEs: motives, challenges, SME characteristics, methods and digitalisation. The themes are interrelated, and SME characteristics seem to be at the core as they are related to all the other themes. Gaps in the current knowledge are identified, and questions for future research are suggested.

Originality/value – The suggestions for future research provide a starting point for expanding the research on PSS design and devising practical support for SMEs.

Keywords PSS design, Small and medium-sized enterprises, Systematic literature review, Business models

Paper type Literature review

1. Introduction

The product-service system (PSS) has received increasing attention given its potential to redefine the strategic focus of businesses (Li *et al.*, 2020; Barravecchia *et al.*, 2021; Tukker, 2015) by representing a shift from a product-centric focus to offering customers a combination of products and services (Goedkoop *et al.*, 1999; Mont, 2002; Vargo and Lusch,

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2004; Smith *et al.*, 2014). Tukker and Tischner (2006, p. 1552) define PSS as ‘tangible products and intangible services designed and combined so that they are jointly capable of fulfilling final customer needs’. PSS not only provides new business opportunities but is also recognised as a way to reduce natural resource consumption and foster a sustainable society (Kühl *et al.*, 2022), even though it does not automatically support the dematerialisation of the economy (Corvellec and Stål, 2017). As a result of the increasing interest in PSS, the research field has expanded over the years and covers various academic disciplines (Li *et al.*, 2020). A sign of this expansion is that several review articles have been published (e.g. Tukker, 2015; Beuren *et al.*, 2013; Raddats *et al.*, 2019; Li *et al.*, 2020; Barravecchia *et al.*, 2021).

However, while small and medium-sized enterprises (SMEs) constitute a significant proportion of companies globally, the literature does not offer a compilation of the current knowledge about the role SMEs have in providing and designing PSS. This is surprising considering that within the European Union, for instance, there are approximately 25 million SMEs, constituting 99.8% of all companies (European Commission, 2019). These companies employ almost 70% of the European workforce (European Commission, 2022) and contribute to 42% of the total value added in the manufacturing sector (European Commission, 2017). The neglect of SMEs in the literature is at odds with the imperative to ensure the alignment of the PSS design process with the unique characteristics of SMEs, including limited resources (Garetti and Taisch, 2012), competency constraints (de Jesus Pacheco *et al.*, 2019b), strategic orientation and innovation patterns (Kumar *et al.*, 2012) and their role in the supply chain. Given the absence of an overview of research addressing PSS design in SMEs, the objective of this article is to identify and organise existing research and propose questions for future research. The study is conducted as a systematic literature review guided by the following review questions:

- (1) Which prominent themes emerge from the current literature on PSS design in SMEs?
- (2) What future research on PSS design in SMEs is needed based on the identified themes?

The paper is structured as follows. Next, PSS design is explored, following which the research methodology is presented. Thereafter follows the results section, which includes a descriptive analysis and the themes identified. The paper ends with conclusions, implications and limitations.

2. PSS design

PSS design is a topic that addresses a real-world problem with the ambition to generate knowledge that can be used in practice. Hence, research on PSS design resembles design science research as discussed by van Aken and Romme (2009). According to Sakao (2011), PSS design refers to design that creates value for stakeholders by utilising various alternatives—either a product or a service. He argues that PSS, therefore, provides more freedom that cannot be achieved when designing purely physical products. As design activities play a crucial role in a company’s ability to offer PSS, scholars have dedicated efforts to developing different approaches to PSS design. The approaches serve, according to Manzini and Vezzoli (2003), as a means to conceive, structure and develop a comprehensive solution that integrates tangible products with related services to meet the specific needs and preferences of customers. In their study of five heavily cited generic models of PSS design, Marques *et al.* (2016) found that the models have distinct differences in what they address. Some models focus more on technical aspects of PSS design (e.g. Aurich *et al.*, 2006), whereas others emphasise financial evaluation (e.g. Alonso-Rasgado and Tompson, 2006). Other models of PSS design have also been proposed by Clayton *et al.* (2012), Liedtke *et al.* (2015),

Tukker (2015) and Vasantha *et al.* (2012). Because the models are different, Marques *et al.* (2016) emphasise that companies who decide to establish their own models of PSS design should pick elements of the generic models and adjust those to fit the characteristics of the individual company.

3. Research methodology

This study was conducted as a systematic literature review (Tranfield *et al.*, 2003; Grant and Booth, 2009), following the procedure suggested by Jesson *et al.* (2011): mapping the field through an initial search; a comprehensive search; a quality assessment; data extraction; synthesis; and a write-up.

3.1 Mapping the field through an initial search

The questions formulated served as the basis for defining inclusion and exclusion criteria (Jesson *et al.*, 2011). In accordance with the review focus, the search terms presented in Table 1 were used to identify the literature. In the search string, ‘design’ was excluded to avoid missing out on articles that potentially addressed design-related issues but did not explicitly use the term ‘design’ in abstracts, titles, keywords or topics.

3.2 Comprehensive search

The Scopus and Web of Science (WOS) databases were searched due to their demonstrated relevance in the PSS field (Beuren *et al.*, 2013; da Costa Fernandes *et al.*, 2020; Barravecchia *et al.*, 2021) and their suitability for evidence synthesis in the form of systematic literature reviews (Gusenbauer and Haddaway, 2020). Both databases cover high-quality primary publication sources, including top-ranked journals in various research fields, such as engineering and management (Harzing and Alakangas, 2016).

As was mentioned previously, the search covered abstracts, titles, keywords and topics. Literature published up until 23 October 2023 was included. All types of articles (e.g. original research, reviews and conceptual articles) published in peer-reviewed journals and published in English were included. Conference papers, books and other publications were excluded as they usually do not meet the same quality criteria as peer-reviewed journal articles. The search resulted in 39 hits in Scopus and 35 hits in WOS; after removing duplicates and articles not addressing PSS design-related issues, 27 articles remained.

3.3 Quality assessment

At least two researchers read all the article abstracts to identify articles addressing PSS design-related issues. As mentioned previously, the results generated a collection of 27 studies. Two additional articles were identified via backward snowballing, resulting in 29 studies for full-text assessment. A low number of additional articles may be an indication of saturation (Irvine *et al.*, 2022). After the eligibility check, these 29 articles were included in the review. Figure 1 presents a PRISMA (2021) flowchart of the search and screening process.

‘product-service system*’
OR
PSS

AND

‘small and medium-sized’
OR
SME
OR
‘small firm*’

Source(s): Authors work

Table 1.
Search string used in the study

3.4 Data extraction

All the authors participated in extracting data from the 29 articles, and at least two independent researchers read each article in full. A pre-designed Excel template was used to extract the data. It was developed based on the research questions and included cells addressing topics such as type of study, PSS issues addressed, key findings and arguments and suggestions for future research.

3.5 Synthesis

A qualitative content analysis was performed (Seuring and Gold, 2012), which is ‘a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes and patterns’ (Hsieh and Shannon, 2005, p. 1278). The content analysis summarises the study’s findings and the frequency of occurrences using thematic headings (Dekkers *et al.*, 2022). The content analysis technique

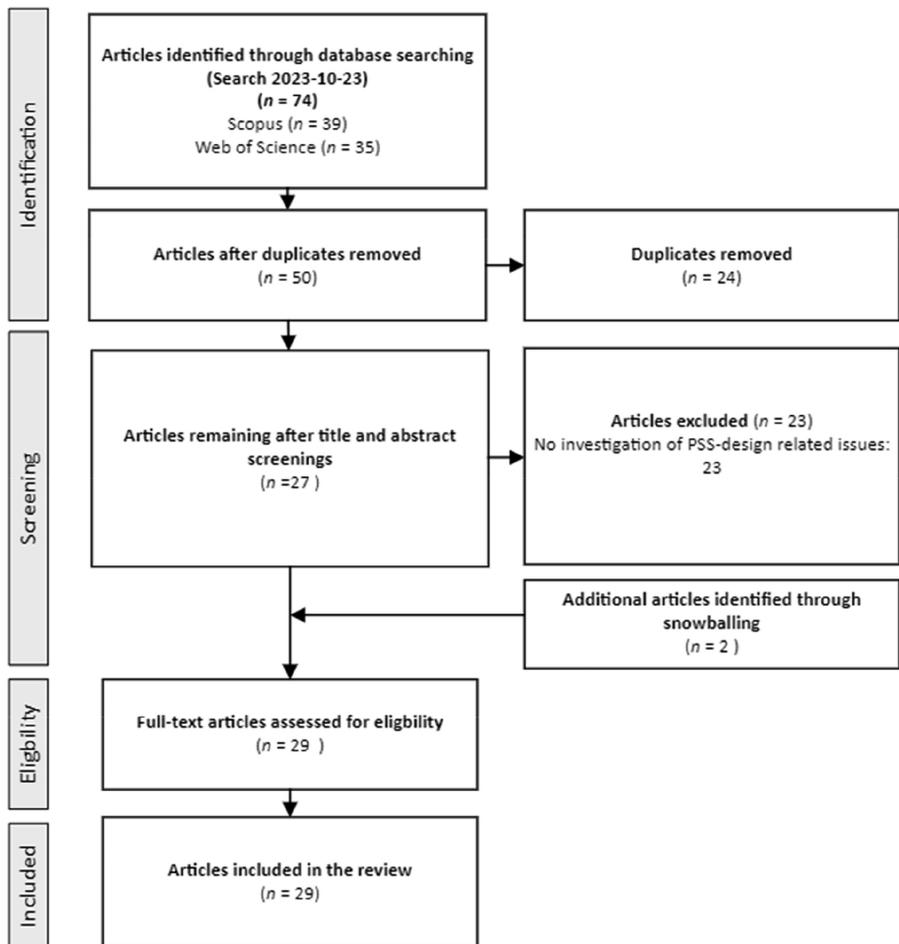


Figure 1. PRISMA flowchart of the systematic literature search and screening process

Source(s): Authors work

guides researchers through systematically and transparently conducting literature reviews and generating highly valid and reliable findings (Seuring and Gold, 2012). The analysis was performed using an inductive approach, following the procedure suggested by Seuring and Gold (2012). The analysis was carried out in iterative cycles to build categories on common terminology in the identified articles. The presented keywords for each article initially guided the identification and grouping of the data into categories. These categories were then refined during iterative cycles, in which notes and data from each article were entered into a spreadsheet. Mind mapping techniques were also used to identify and group the data into the final themes.

3.6 Write-up

In the final step, an initial draft of the themes was compiled, which was revised during the synthesis step and further refined during the write-up, resulting in the final themes identified in the literature on PSS design in SMEs and a table showing suggestions for future research.

4. Results

This section presents the results. Descriptive data are outlined, followed by a presentation of the themes that emerged from the literature.

4.1 Descriptive analysis

The earliest publication included in the review was published in 2009. However, approximately 79% of the articles were published in the last eight years (2016–2023). Most of the articles used a single case study design (31%), a multiple case study design (17%) or a mixed-method study design (14%). The remaining articles used other research methods, such as systematic literature reviews, conceptual analysis and surveys. The articles have appeared in various journals in different research fields, including manufacturing, engineering and sustainability. This shows that research on PSS design in SMEs is published in various journals representing different academic fields. It indicates that the subject is interdisciplinary and can be studied from different perspectives. Only four journals have published two or more articles on PSS design in SMEs. Three of these journals are *Journal of Cleaner Production*, *Sustainability* and *Business Strategy and the Environment*. This is congruent with the findings by Baines *et al.* (2007) that many scholars focussing on PSS seem to represent the disciplines of environment, sustainability and economics. Apart from *Production Planning and Control*, the other journals have published just one article each (see Table 2 for the distribution of articles by journal). Interestingly, few journals represent the service discipline, which could have been expected given that PSS constitutes integrated solutions in which products and services are combined.

4.2 Identified themes

The analysis revealed five prominent themes in the studied literature, as shown in Table 3. The most extensive themes identified from the literature are challenges to engage in PSS design (addressed in 26 articles) and SME firm characteristics influencing PSS design (addressed in 20 articles). In descending order, then followed motives to engage in PSS design (addressed in 16 articles), methods for PSS design (addressed in 12 articles) and digitalisation and PSS design (addressed in 10 articles). A complete overview of the identified themes and the articles that address the themes is presented in Table 3. In the following sections, more details about the themes are presented.

4.2.1 Theme 1: motives to engage in PSS design. The first identified theme describes the motives that encourage SMEs to engage in PSS design activities. Motives are discussed in

Journal	Articles
Annals of Operations Research	1
Building Research and Information	1
Business Strategy and the Environment	2
Environment Development and Sustainability	1
IEEE Transactions on Engineering Management	1
Industrial Marketing Management	1
International Journal of Internet Manufacturing Services	1
International Journal of Production Economics	1
Journal of Business and Industrial Marketing	1
Journal of Business Research	1
Journal of Cleaner Production	4
Journal of Decision Systems	1
Journal of Manufacturing Technology Management	1
Journal of Open Innovation: Technology, Market and Complexity	1
Journal of Small Business Strategy	1
Production Planning and Control	2
Service Business	1
She Ji—The Journal of Design Economics and Innovation	1
Sustainability	4
World Patent Information	1
WSEAS Transactions on Business and Economics	1
Source(s): Authors work	

Table 2.
Distribution of articles
by journal (listed in
alphabetical order)

several of the reviewed articles (see Table 3), but none focusses on the theme by analysing different motives in detail. Instead, the articles primarily list various reasons SMEs should engage in PSS design. The motives include the pursuit of a competitive edge (Adrodegari *et al.*, 2017; Tonelli *et al.*, 2009; Blümel *et al.*, 2022), a desire for increased profitability (Hernández-Pardo *et al.*, 2013; Tonelli *et al.*, 2009), the exploration of new market opportunities (Hernández-Pardo *et al.*, 2013) and the aim of enhancing customer loyalty and satisfaction (Le-Dain *et al.*, 2023). As argued by Hernández-Pardo *et al.* (2013), Le-Dain *et al.* (2023) and Blümel *et al.* (2022), PSS design serves as a means for SMEs to distinguish their offerings, potentially leading to sustained long-term growth (Tonelli *et al.*, 2009). Embracing a PSS mindset can also instigate the development of a service-oriented culture within an organisation, consequently improving overall organisational performance (Adrodegari *et al.*, 2017) and ensuring compliance with relevant legislation (Hernández-Pardo *et al.*, 2013).

The literature also points out motives linked to enhanced sustainability performance (Adrodegari *et al.*, 2017; Kühl *et al.*, 2022), given that PSS is frequently associated with sustainability considerations (Feng *et al.*, 2022; Tseng *et al.*, 2023). While SMEs generally demonstrate a limited understanding of the concept of sustainability (Hernández-Pardo *et al.*, 2013), they persist in their motives, driven by the belief that engaging in PSS could result in improved sustainability performance (Hernández Pardo *et al.*, 2012; Hernández-Pardo *et al.*, 2013; de Jesus Pacheco *et al.*, 2019b) through reduced environmental impacts. However, as argued by Rittershaus *et al.* (2023) and de Jesus Pacheco *et al.* (2019b), SMEs engaging in PSS design must be aware that PSS alone does not automatically translate into sustainable solutions, despite being a promising approach for influencing sustainable manufacturing and consumption patterns and reducing environmental impacts.

Finding 1: The literature shows that SMEs are motivated to engage in PSS design activities to gain a competitive advantage, increase profitability and enhance customer value. Motives also include improved sustainability performance in terms of reduced environmental impacts.

Author(s)	Year	Motives to engage in PSS design	Challenges to engaging in PSS design	SME firm characteristics influencing PSS design	Methods for PSS design	Digitalisation and PSS design	Product-service systems
Adam <i>et al</i>	2018		xx	x			
Adrodegari <i>et al</i>	2017	x	x	x	xx	x	
Bhamra <i>et al</i>	2018	x	xx	x			
Blümel <i>et al</i>	2022		xx	x	x	x	
Chalal <i>et al</i>	2015		xx	x			
Clegg <i>et al</i>	2017		xx				
Coreynen <i>et al</i>	2017		xx			xx	
Dahmani <i>et al</i>	2016		xx				
de Jesus	2019a		xx	x	x		
Pacheco <i>et al</i>							
de Jesus	2019b	x	xx	x	xx		
Pacheco <i>et al</i>							
Dey <i>et al</i>	2020	x	xx	xx		x	
Feng <i>et al</i>	2022	x		x	xx		
Fornasiero and Sorlini	2010			x	xx		
Hernández-Pardo	2019	x	xx	xx			
Hernández-Pardo <i>et al</i>	2012	x	xx	xx			
Hernández-Pardo <i>et al</i>	2013	x	xx	xx		xx	
Kühl <i>et al</i>	2022	x	xx	x	x		
Le-Dain <i>et al</i>	2023	x	xx	x		xx	
Lelah <i>et al</i>	2012		x		x	xx	
Pardalis <i>et al</i>	2020	x	xx	xx			
Rapaccini <i>et al</i>	2023	x	xx			xx	
Rittershaus <i>et al</i>	2023		xx	x	x		
Rizos <i>et al</i>	2016	x	xx	xx			
Tauqeer and Bang	2018		x	x		xx	
Toker and Görener	2023	x	xx	xx			
Tonelli <i>et al</i>	2009		x	x	xx		
Toxopeus <i>et al</i>	2021	x	xx	x			
Tseng <i>et al</i>	2023	x	x		xx	xx	
Wu <i>et al</i>	2016			x	xx		
<i>Total</i>		16	26	20	12	10	

Note(s): x = refers to the theme, xx = focusses on the theme
Source(s): Authors work

Table 3.
 Identified articles and their relation to the five themes

4.2.2 *Theme 2: challenges to engaging in PSS design.* The second theme describes the challenges that restrict the PSS design activities in SMEs. SMEs' limited ability to define a service strategy and lack of formal business strategies (Hernández-Pardo *et al.*, 2013) are examples of challenges that restrict them from engaging in PSS design. SMEs also face financial challenges, including lack of financial resources (Hernández-Pardo *et al.*, 2013; Fornasiero and Sorlini, 2010; Toxopeus *et al.*, 2021) and financial vulnerability (Hernández-Pardo *et al.*, 2013; de Jesus Pacheco *et al.*, 2019b). Another challenge related to financial constraints is that PSS design tends to cause higher initial costs and a more extended payback period than traditional sale transactions (Rizos *et al.*, 2016; Toxopeus *et al.*, 2021).

Therefore, as argued by [Toxopeus et al. \(2021\)](#), SMEs need access to external funding sources because of delayed income revenues. However, it is difficult for SMEs to obtain external financing, which represents another challenge that SMEs face.

Other challenges relate to limited human resources ([Adrodegari et al., 2017](#); [Fornasiero and Sorlini, 2010](#)) and managerial competencies ([Chalal et al., 2015](#); [Dahmani et al., 2016](#)). For example, [de Jesus Pacheco et al. \(2019b\)](#) report that SMEs have a limited understanding of the PSS concept, and [Hernández-Pardo et al. \(2013\)](#) mention lack of expertise in designing PSS. Another challenge involves management decision making. While managers may perceive PSS as a business opportunity, they associate PSS with uncertainty and risk taking, given the profound changes and new resources and capabilities that PSS demands ([Chalal et al., 2015](#); [Coreynen et al., 2017](#)).

Another challenge related to human and competence resources is the follower mentality in organisations and the resistance to change ([Hernández-Pardo et al., 2013](#); [Le-Dain et al., 2023](#)) as PSS requires adopting a service mindset. Therefore, [Le-Dain et al. \(2023\)](#) highlight the importance of involving employees and making them aware of their importance in the transition, thereby putting more pressure on senior management and leadership.

In addition, SMEs lack the infrastructure and tools needed for PSS delivery channels ([Fornasiero and Sorlini, 2010](#); [Clegg et al., 2017](#)). They also typically lack the methods, models and technology needed to design PSS ([Lelah et al., 2012](#); [Fornasiero and Sorlini, 2010](#); [Clegg et al., 2017](#)). For instance, the use of information and communication technologies is perceived to make SMEs' processes more efficient. Several scholars ([Hernández-Pardo et al., 2012, 2013](#); [Adrodegari et al., 2017](#); [Rapaccini et al., 2023](#); [Coreynen et al., 2017](#); [de Jesus Pacheco et al., 2019b](#)) argue that information and communication technology can be useful when PSS is designed. It is unfortunate, though, that many SMEs are unfamiliar with how to utilise this technology in their PSS design efforts ([Hernández-Pardo et al., 2012, 2013](#); [Coreynen et al., 2017](#)).

A lack of customer acceptance may also hinder the design of PSS because not all customers are willing to shift to a service-based offering ([Adam et al., 2018](#)). Therefore, a challenge is understanding customers' attitudes and behaviours regarding PSS ([Tonelli et al., 2009](#); [Adam et al., 2018](#); [Tauqeer and Bang, 2018](#)). Indeed, it is essential to have a customer value proposition ([Adam et al., 2018](#); [Tauqeer and Bang, 2018](#)), meaning the degree to which the company can make the value of PSS visible to the customers. SMEs may lack the capability to absorb customers' feedback, leading to a limited ability to engage the right customers and a mismatch between customers' service needs and a company's offerings ([Adam et al., 2018](#)).

SMEs' limited partnerships and networks to engage in PSS design activities is another challenge ([Lelah et al., 2012](#); [de Jesus Pacheco et al., 2019b](#)). Initiating mutual partnerships with other companies, as well as managing and securing these partnerships on a long-term basis, is not easy ([de Jesus Pacheco et al., 2019b](#)), but it is essential to establish with other SMEs and/or large companies for successful PSS transition ([de Jesus Pacheco et al., 2019b](#); [Lelah et al., 2012](#); [Rizos et al., 2016](#)). However, SMEs often lack the resources to build new organisational units for PSS design ([Clegg et al., 2017](#)). Still, they could use the resources within their business network and partnerships to form new constellations, enabling value creation through services ([Lelah et al., 2012](#)). Although partnerships can be profitable, they are not always successful and involve many risks that SMEs must evaluate before starting a collaboration ([Lelah et al., 2012](#)).

Although the literature provides insights into the challenges SMEs experience when engaging in PSS design, there are few studies on how SMEs may overcome challenges and what enablers may exist. For example, [Rizos et al. \(2016\)](#) studied challenges and enablers. [Toxopeus et al. \(2021\)](#) studied how SMEs may access finances when aiming to design PSS. Another example is [Chalal et al. \(2015\)](#), who explored a decision support system to help manage the organisational transition that PSS design requires.

Finding 2: The literature reveals that SMEs are restricted in designing PSS due to various challenges. Some challenges are to be found within the SMEs themselves, including risk aversion, financial constraints, or poor business strategies. Other challenges originate externally from the SMEs; examples are uncertainties regarding customer acceptance and limited access to partnerships and networks.

4.2.3 Theme 3: SME characteristics influencing PSS design. The third theme relates to the SME firm characteristics that influence PSS design. The literature indicates that SMEs should acknowledge their characteristics when designing PSS. SMEs are characterised as flexible because of their size and lack of rigid structures, enabling them to respond quickly to market pressures and adapt to new business conditions (Hernández-Pardo *et al.*, 2013; de Jesus Pacheco *et al.*, 2019b). This organisational capacity is a critical feature for facilitating PSS design (e.g. Tonelli *et al.*, 2009; Blümel *et al.*, 2022), but according to Tonelli *et al.* (2009), it is also the reason why SMEs need a structured and interrelated approach to evaluating and implementing PSS strategies.

Interestingly, the literature shows that SMEs are not convinced about the potential to achieve improved performance, mostly due to their belief that PSS comes with market, customer and financial uncertainty (Hernández, 2019). Thus, many SMEs do not intend to implement product and service re-designs as they often mean changing business models, making investments and rearranging resources, activities seen as risk-taking (Blümel *et al.*, 2022; Le-Dain *et al.*, 2023; Rizos *et al.*, 2016). Furthermore, in SMEs, the propensity for PSS design is significantly shaped by the firm owners as they often take the lead in initiating such activities within the firm (e.g. Pardalis *et al.*, 2020). For example, Pardalis *et al.* (2020) highlight that the controlling nature of SME owners may impact preparations for designing PSS.

Regulations should be improved to make it easier for SMEs to implement PSS practices. Scholars such as Toker and Görener (2023), Kühl *et al.* (2022) and Rizos *et al.* (2016) argue that more policies are needed. Notably, not all SMEs design their products as they are often suppliers to original equipment manufacturers (OEMs) (Dey *et al.*, 2020), and a systematic connection between manufacturers and users may be absent (Wu *et al.*, 2016). SMEs are generally not responsible for their products after delivering them to customers, and their position in the value chain could affect their ability to design PSS as they must adapt to the conditions their customers and end-users set (Dey *et al.*, 2020). Generally, there is low user involvement in SMEs' PSS design processes, leading to poor sales performance (de Jesus Pacheco *et al.*, 2019b).

Finding 3: The literature indicates that the SME characteristics, such as firm size, flexibility, adaptability, propensity to take risks and position in the value chain, influence PSS design.

4.2.4 Theme 4: methods for PSS design. The fourth theme focusses on methods for PSS design activities in SMEs. As with any development activity, PSS design also relies on the use of various methods (Adrodegari *et al.*, 2017; Hernández-Pardo *et al.*, 2013). Essentially, methods for PSS design rest upon the integrated design of a physical product and services simultaneously. The methods identified in the reviewed literature are primarily of a generic nature, aiming to reduce overall lifecycle costs and facilitate the reuse of elements (Adrodegari *et al.*, 2017). This includes various 'design for X' methods or methods supporting the design of a modular product architecture.

An important issue raised by Hernández-Pardo *et al.* (2013) regarding PSS design methods for SMEs is that such methods should consider SMEs' specific characteristics. Therefore, any PSS design method has less value in guiding SMEs in their PSS design activities if it is not developed to fit their characteristics (de Jesus Pacheco *et al.*, 2019b; Feng *et al.*, 2022). Notably,

the reviewed literature presents only a few methods that consider the simultaneous design of a product and a service offer. As noted by [Hernández-Pardo et al. \(2013\)](#), the reason might be that introducing the service dimension in existing design processes for SMEs is non-trivial as these processes are often focussed on the design of physical products, and SMEs may have less experience addressing the service dimension. To deal with this challenge, [Feng et al. \(2022\)](#) suggest that SMEs can gradually design PSS and achieve better performance by adopting an iterative design method. This design method supports SMEs in designing PSS offerings based on existing products and services instead of creating totally new PSS solutions. However, the authors also note that SMEs with limited technological capabilities may struggle to implement this method successfully. Another method, which uses a different point of departure, is proposed by [Adrodegari et al. \(2017\)](#). In contrast to the method suggested by [Feng et al. \(2022\)](#), their method focusses specifically on the design of new PSS solutions.

Furthermore, [Fornasiero and Sorlini \(2010\)](#) propose a set of methods combined into a support platform that aims to support SMEs in identifying customer requirements and converting them to a solution in the design process, as well as assessing how the ideas of the PSS solutions are coherent with the company strategy. The method is supposed to help managers assess and decide if a PSS solutions should be designed or not and how to balance the product and service dimensions. [de Jesus Pacheco et al. \(2019b\)](#) propose yet another method in the form of a PSS decision matrix to support SMEs in navigating among different PSS solution pathways by considering different competitiveness concerns.

Finding 4: The reviewed literature discusses various methods for PSS design, highlighting their generic nature and the challenges associated with SMEs' characteristics. Notably, there is a scarcity of methods considering the simultaneous design of products and services for SMEs, emphasising the need for more tailored approaches that fit their specific characteristics.

4.2.5 Theme 5: digitalisation and PSS design. The fifth theme refers to the potential of digitalisation to support SMEs in their PSS design efforts. The literature review encompasses studies on how digitalisation may enable companies to expand customer value propositions and improve customer engagement and satisfaction ([Coreynen et al., 2017](#)). The literature points out that digital tools may be used to enable the collection and analysis of product usage, customer behaviour and service interactions ([Coreynen et al., 2017](#); [Le-Dain et al., 2023](#)). The collected data may provide insights that can facilitate personalised service offerings, creating a more tailored and satisfying customer experience ([Rapaccini et al., 2023](#); [Tseng et al., 2023](#)).

The literature also discusses how digitalisation can facilitate PSS design by supporting communication and collaboration between SMEs, manufacturers and customers. Collaboration tools and platforms are highlighted as a means to efficiently coordinate efforts between various stakeholders in delivering and maintaining PSS. [Le-Dain et al. \(2023\)](#) suggest that the integration of digital sensors and Internet of things devices into products to enable remote monitoring of performance and conditions is a way to add value through services. This integration is seen as an asset for addressing maintenance requirements, proactively identifying issues, minimising downtime and ultimately augmenting the overall reliability of the service (e.g. [Le-Dain et al., 2023](#); [Tseng et al., 2023](#)).

Finding 5: The literature explores the potential for digitalisation to support SMEs in crafting customer value propositions by providing digital services. By leveraging digital technologies, companies can optimise their PSS, offering more value to customers while streamlining operations and improving overall efficiency.

5. Discussion and future research directions

5.1 Discussion

Based on the review of the literature on PSS design in SMEs, five themes emerged: motives to engage in PSS design; challenges to engaging in PSS design; SME characteristics influencing PSS design; methods for PSS design; and digitalisation and PSS design.

Various motives to engage in PSS design were identified as a theme. Many of the motives refer to enhanced business performance through improved competitive advantage, increased profitability and enhanced customer value. That motives contributing to business performance are central for SMEs is no surprise as this idea lies at the core of any business. Improved sustainability performance in terms of reduced environmental impacts was also among the motives. This corresponds to the idea that PSS design may contribute to retaining value through extended product lifecycles (Sumter *et al.*, 2020) and also support ambitions to close material cycles. Although the literature mentioned motives for SMEs to engage in PSS design, it did not provide any details regarding how these motivations can be translated into PSS design activities in practice.

The theme that has received the most attention among scholars is the challenges to SMEs engaging in PSS design. This may not come as a surprise because engagement in PSS design means, at least to a certain extent, a redefined strategic focus for businesses, as argued by Li *et al.* (2020) and Barravecchia *et al.* (2021). Such a strategic shift may be particularly intricate for SMEs (Singh *et al.*, 2008) because, as Vos (2005) observed, managers of SMEs have poor skills in strategically reflecting upon their companies. Dealing with various challenges related to SMEs' managerial skills (Chalal *et al.*, 2015), and hence, lack of formal business strategies (Hernández-Pardo *et al.*, 2013), may inhibit them from recognising PSS as a business opportunity. Here, the literature on SME governance and strategic implementation in SMEs may be useful to consult to enhance knowledge and further change. For example, Brunninge *et al.* (2007) found that expanding the circle of individuals involved in decision making, where outside directors are engaged in the board and additional members extend the senior management teams, may reduce risk averseness and facilitate change. Another example is the study of Håkonsson *et al.* (2012), which shows the importance of aligning executive style and strategy for SMEs pursuing change.

The literature indicates that although a salient theme is SME characteristics influencing PSS design, few studies rely on generic SME literature. Prior research on SMEs has emphasised the importance of considering the characteristics of SMEs (Storey, 2016). SMEs are characterised by inherent resource limitations, encompassing restricted capital, time, knowledge and skilled personnel (Bos-Brouwers, 2010; Storey, 2016). SMEs play a significant role in supply chains and constitute a large proportion of existing companies, not the least within the manufacturing industry. According to the reviewed literature, SMEs' position in the value chain may influence PSS design (Dey *et al.*, 2020). However, the literature is not explicit or detailed on whether SMEs are co-designers of PSS solutions as suppliers or whether they provide PSS to customers and, hence, are in complete control of the PSS design efforts themselves. The literature does not discuss how different types of SMEs (e.g. micro, family-owned businesses) can be engaged in PSS design. Only a few studies (Adam *et al.*, 2018; Pardalis *et al.*, 2020; Rapaccini *et al.*, 2023) were transparent about the size of SME they studied. Furthermore, most of the studies were conducted on SMEs in European countries, such as France, Italy and the UK (e.g. Blümel *et al.*, 2022; Chalal *et al.*, 2015), though a few studies were carried out in countries such as Botswana and Colombia (e.g. Bhamra *et al.*, 2018). This suggests that more research is needed on PSS design in SMEs in which the context in terms of factors like geographic location and economic development of the region are accounted for.

The quest for methods for PSS design is evident in the reviewed literature, but there seems to be limited attention given to methods that account for the characteristics of SMEs. Despite the scholarly call for such tailored methods, there has been a noticeable scarcity of efforts in

developing them. Existing methodologies, such as the PSS methodology proposed by [van Halen et al. \(2005\)](#) or the integrated product and service design processes suggested by [Aurich et al. \(2006\)](#), are not given any attention in the reviewed literature as viable alternatives for SMEs embarking on PSS design endeavours. As SMEs possess specific characteristics, methods developed for SMEs must, according to [Kokoschko et al. \(2023\)](#), meet specific criteria. First, the applicability criterion is crucial, reflecting the ease with which a method can be learned and applied for its intended purpose. Second, integrability is a criterion that refers to how seamlessly the method can be incorporated into SME practices. Third, predictability focusses on the resources required to implement a method. Given these considerations, it becomes evident that PSS design methods tailored for SMEs, whether newly developed or adapted from existing ones, should prioritise these criteria to enhance their effectiveness in practical applications.

Finally, the theme of digitisation and PSS design was identified. The literature revealed the potential of digitalisation to facilitate PSS design. It shows that digital advances have given rise to new ways for SMEs to design digital services and access digital tools. For example, digital tool advances have made it easier for SMEs to gather customer information and, through data-driven insights, design PSS that meets customer requirements and contributes to increased competitiveness. Although this theme was addressed in comparatively few articles, the reviewed literature indicates that digital PSS is on the horizon and that the theme will grow in the near future. In general, there is an increased focus on digital transformation and opportunities for companies arising through the development of artificial intelligence ([Kraus et al., 2022](#); [Loureiro et al., 2021](#)), implying that it is also of importance for designing PSS.

5.2 Future research directions

In line with the logic of design science research presented by [van Aken and Romme \(2009\)](#), several questions can be constructed to extend the body of knowledge on PSS design in SMEs and potentially support practice. The findings presented herein provide the basis for recommending further research as more profound knowledge is needed. For SMEs, the motives to engage in PSS design are related to business performance and sustainability performance. However, the literature lacks insight into how PSS can ensure the attainment of performance. The analysis identifies several challenges, and addressing ways to overcome these challenges could help SMEs establish a good foundation for designing PSS. There is also a need for a deeper understanding of SMEs' role as actors in the PSS value chain, considering market characteristics, position in the value chain, firm size and ownership structure. In addition, characteristics of SMEs could help elucidate the complexity of and identify prerequisites for developing suitable PSS design methods. Additional research into digital transformation and the advancement of digital tools could further enhance the understanding of how PSS design could be facilitated in SMEs. [Table 4](#) presents suggestions for future research.

Even though the themes and the questions for future research are presented as separate, there are interdependencies between them. Most notably, the theme of SME characteristics influencing PSS design is intricately connected to the other themes. Specifically, these characteristics have a direct impact on factors such as risk aversion and the willingness to embrace change ([Brunninge et al., 2007](#); [Håkonsson et al., 2012](#)), but these characteristics also underscore the need for tailored methods of PSS design. Further research should address these themes *per se* but also address interdependencies between them. In addition, research on PSS design in SMEs could also take on different theoretical points of departure, e.g. the resource-based view ([Barney, 1991](#)), agency theory ([Eisenhardt, 1989](#)) or actor-network theory ([Latour, 2007](#)). For example, a resource-based approach can be used to explore what

No.	Theme	Questions
#1	Motives to engage in PSS design	<ul style="list-style-type: none"> • How does the design of PSS align with the strategic intentions of SMEs and their efforts to enhance competitiveness? • How does the design of PSS align with SMEs' ambitions to improve the sustainability performance of their operations? • What synergies and conflicting values may arise when aiming to achieve both financial and sustainable performance? • What type of key indicators may be used to keep SMEs motivated?
#2	Challenges to designing PSS	<ul style="list-style-type: none"> • At what performance level may synergies and conflicts arise? • What challenges do SMEs experience in the process of designing PSS? • What is the significance of different PSS challenges? • What conflicting PSS challenges exist? • How should SMEs prioritise to face PSS challenges? • What resources are needed for SMEs to overcome the challenges to engage in PSS design? • Which capabilities are needed for SMEs to overcome the challenges of engaging in PSS design?
#3	SME characteristics influencing PSS design	<ul style="list-style-type: none"> • How do the characteristics of SMEs affect their resources and capabilities to design PSS? • What social relations networks exist for SMEs, and how do the networks support or hinder PSS design? • What similar and conflicting interests, values and goals exist among actors? • How does the power relationship related to OEM customers affect SMEs' role in the PSS value chain? • How can the position and role of SMEs in the value chain influence the implementation of PSS design? • How can SMEs establish collaborations and partnerships needed for PSS design?
#4	Methods for PSS design	<ul style="list-style-type: none"> • What are the limitations of existing PSS design methods regarding their applicability for SMEs? • How can existing methods for PSS design be modified to increase relevance and usability for SMEs? • What is the need for the development of new methods for PSS design? • Which organisational prerequisites must be in place for SMEs to successfully use methods for PSS design?
#5	Digitalisation and PSS design	<ul style="list-style-type: none"> • What are the potentials and challenges associated with artificial-intelligence-assisted design of PSS in SMEs? • What ethical concerns should be considered when using artificial intelligence to assist in the design of PSS in SMEs?

Source(s): Authors work

Table 4.
Future research directions for the design of PSS in SMEs

strategic resources are needed to obtain a competitive advantage through a PSS strategy. A principal-agent approach can shed light on conflicting interests and goals that may occur when designing PSS, and an actor-network approach may help elucidate complex social relationships between PSS actors.

6. Conclusions, implications and limitations

Five themes in the literature on PSS design in SMEs were identified. The identified themes and findings reveal prior research orientations on PSS design in SMEs. The theme of SME

characteristics seems to be at the core as it is related to all the other themes. Still, there is a need for further exploration of the themes. Therefore, the proposed questions for future research can serve as a starting point for expanding the research on PSS design and devising practical support for SMEs. The themes and findings, therefore, serve as a means to contribute to the inadequate research on PSS design in SMEs, as called for by scholars (de Jesus Pacheco *et al.*, 2019b).

6.1 Theoretical implications

This study adds to existing PSS literature by focussing specifically on SMEs as prior reviews of PSS research have mainly focussed on larger companies and omitted SMEs (e.g. Barravecchia *et al.*, 2021; Wang *et al.*, 2011; Beuren *et al.*, 2013; da Costa Fernandes *et al.*, 2020; Tukker, 2015; Annarelli *et al.*, 2016; Li *et al.*, 2020). Some reviews have addressed PSS design in SMEs; however, they only cover specific themes, such as challenges (e.g. de Jesus Pacheco *et al.*, 2019b). Hence, this paper makes an important theoretical contribution by providing added insights into the topic by reviewing existing literature and identifying research themes. The findings could help elucidate the required components and contextual factors affecting SMEs' PSS design efforts (de Jesus Pacheco *et al.*, 2019a, b). The proposed questions for future research could encourage researchers to investigate SMEs' contextual settings and how they influence PSS design.

6.2 Managerial implications

The study also has managerial implications. The themes may be useful for SMEs because they illuminate what to be aware of when intending to design PSS. First, the findings show that several challenges must be overcome to create a good foundation for designing PSS. Therefore, the study creates an awareness of challenges and the preparedness necessary for dealing with these challenges in businesses. Second, identifying the motives related to potential business performance and sustainability performance helps SMEs evaluate how much effort should be invested in designing PSS. Third, the findings imply that SMEs may carefully adopt existing PSS design methods and modify them to fit their specific needs and characteristics. Finally, the study emphasises that SMEs should consider involving customers and using their perspectives to increase the chances of successfully designing PSS.

6.3 Limitations

This systematic literature review has limitations. The first is the sample size, which limits the validity of the themes found; it cannot be ruled out that there might be additional themes in the existing literature. The second limitation is that only articles published in peer-reviewed journals were examined. This approach may have excluded other interesting literature that could have contributed to the themes identified and the proposed questions for future research. Finally, this systematic literature review did not consider, or filter articles based on the impact of the journals in which they were published, meaning that Scopus's Cite Score or the WOS Journal Impact Factor as quality indicators were not considered. However, the literature search contained only peer-reviewed journals and relied on the quality criteria of acceptance by the journals indexed in the databases searched.

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