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Digitally enabled product–service systems and sustainability: a semi-systematic review of IoT, B2B platforms, and digitalization & servitization

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Abstract
This study examines how digital technologies enable sustainable value creation in industrial Product–Service Systems (PSS). Focusing on the Internet of Things (IoT), Business-to-Business (B2B) platforms, and digitalization and servitization, the paper synthesises findings from a semi-systematic review of 123 publications. The analysis identifies key benefits and barriers associated with each technological domain and highlights how they collectively support data-driven coordination, service-based value creation, and resource-efficient operations. At the same time, the review reveals fragmented treatment of sustainability and a lack of methods capable of assessing environmental, economic, and social impacts, especially in the early stages of PSS design. The study integrates insights across previously disconnected research streams and shows that sustainability outcomes cannot be understood through single technologies alone but emerge from their interaction within broader socio-technical systems. On this basis, the paper outlines implications for theory and practice and identifies priorities for future research, including integrated assessment approaches, improved modelling of dynamic system behaviour, and stronger consideration of social impacts.

Keywords Servitization, PSS, B2B platforms, Digitalization, Sustainability, IoT, Systematic literature review

Introduction

Growing environmental pressures and increasing sustainability expectations (e.g. European policy initiatives) have intensified the search for business practices that enable more resource-efficient and circular forms of value creation (Tecchio et al., 2017). Product–Service Systems (PSS) have attracted considerable attention in this context, as they shift the focus from selling physical products to delivering integrated product–service offerings that can extend asset lifetimes (Bressanelli et al., 2018; Zhang et al., 2022), reduce material/energy consumption (Bressanelli et al., 2018; Doni et al., 2019; Paiola et al., 2021), and enable new modes of use (Tukker, 2004). Such models can be utilised as mechanisms for advancing

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the Circular Economy (CE), where value creation is decoupled from resource throughput and supported by possible environmental benefits of PSS (Bressanelli et al., 2018; Kjaer et al., 2019). To achieve sustainable benefits, it is essential to explicitly integrate the economic, environmental, and social dimensions into the design, development, and delivery of a PSS (Vezzoli et al., 2017). This necessity also highlights that sustainability challenges are not only technical but also conceptual, relating to how value creation is understood. Vargo and Lusch (2004) contrasts the traditional Goods-Dominant Logic (GDL) with the Service-Dominant Logic (SDL). In GDL, which reflects the linear way of thinking, the producer is viewed as the sole creator of value, while the consumer is seen as destroying value through use. According to Vargo (2021) this mindset lies at the heart of the sustainability problem. SDL, by contrast, shifts the focus from goods to the provision of services and value co-creation between providers and users. Adopting SDL enables business models that move beyond linear thinking and reduce the reliance on CE interventions as the only path to sustainability.

While these conceptual and business model shifts define the foundations of sustainable PSS, their practical realisation increasingly depends on digital technologies that enable data-driven coordination, monitoring, and service delivery (Bressanelli et al., 2018). Digital technologies, particularly the Internet of Things (IoT) (Boehmer et al., 2020; Ingemarsdotter et al., 2020; Senthil & Easwaran, 2019), industrial Business-to-Business (B2B) platforms (Ehret & Wirtz, 2017; Zhang et al., 2022), and digitalisation in general (Langley, 2022), play an increasingly central role in enabling these shifts. IoT solutions provide real-time visibility into product usage, condition, and performance (Nižetić et al., 2020; Senthil & Easwaran, 2019), unlocking opportunities for predictive maintenance (Ingemarsdotter et al., 2020; Paiola et al., 2021), optimised operations (Paiola et al., 2021), improved tracking and record-keeping of in-use and post-use products (Ingemarsdotter et al., 2020; Nižetić et al., 2020), more accurate estimations of remaining product lifetime, and better-informed design decisions aimed at enhancing durability (Ingemarsdotter et al., 2020). B2B platforms expand these capabilities by coordinating multi-actor ecosystems (Kohtamäki et al., 2019; Lusch & Nambisan, 2015; Matzner et al., 2021), facilitating value co-creation (Friedrich et al., 2025; Veile et al., 2022) as well as enabling new forms of service delivery and personalization (Kohtamäki et al., 2019; Zhang et al., 2022). At the same time, digital servitization has emerged as a major transformation pathway in manufacturing, reshaping provider–customer relationships and enabling service-oriented business models through data-driven capabilities and advanced analytics (Baines and Lightfoot 2013a, b; Kowalkowski and Ulaga 2017; Ziaee Bigdeli et al. 2018). Despite the rapid growth of research in these domains, the intersection between IoT, B2B platforms, digital servitization, and sustainability remains fragmented. Existing studies often focus on individual technologies, specific business model elements, or isolated sustainability outcomes, making it difficult to understand how the interplay between IoT, B2B platforms, and digitalisation & servitization collectively shape sustainability outcomes, rather than producing isolated or technology-specific effects. The literature also reveals inconsistent findings: while several contributions highlight environmental and operational benefits, others point to potential negative environmental effects (e.g. through a possible rebound effect (Alfarisi et al., 2024; Grybauskas et al., 2022; Nižetić et al., 2020; Schöggl et al., 2023), data governance challenges (Langley, 2022; Müller et al., 2018), and organisational resistance (Hallstedt et al., 2020; Peillon & Dubruc, 2019) as sources of unintended negative consequences. This conceptual dispersion underscores the need for a systematic and cross-domain review.

This paper conducts a semi systematic literature review (Snyder, 2019) of 123 publications at the intersection of IoT, B2B platforms, digitalization/servitization, and sustainability. Following PRISMA principles (PRISMA, 2020) and applying a structured coding approach, the review synthesises reported drivers, barriers, and sustainability implications across the three domains (Braun & Clarke, 2006). This study integrates previously fragmented insights and provides an updated understanding of how digital technologies shape sustainable value creation in PSS.

The remainder of the paper is structured as follows. Section "Research methodology" describes the methodological approach, including the search strategy, screening procedure, and data analysis steps. Section "Analysis of IoT, B2B Platforms, and Digital Servitization: Benefits, Drivers, Challenges, and Barriers" reports the findings by domain, outlining benefits (drivers), challenges (barriers), and thematic sustainability insights. Section "Contribution of the review" synthesises cross-domain contributions derived from the review. Section "Considerations and concluding remarks" discusses theoretical and practical implications, outlines limitations, and proposes avenues for future research.

Research methodology

The literature review in this paper follows the PRISMA guidelines (PRISMA, 2020) while drawing on the structured review approach outlined by Xiao and Watson (2019). The eight original steps outlined in the literature review process: (I) formulating the research problem; (II) developing and validating the review protocol; (III) searching the literature; (IV) screening for inclusion; (V) assessing quality; (VI) extracting data; (VII) analysing

and synthesizing data; and (VIII) reporting the findings are, however, condensed into seven steps as screening for inclusion and quality assessment were done together.

Formulate the problem

The research problem addressed in this study concerns the fragmented and multidisciplinary nature of existing literature on digital servitization, IoT, and sustainability, resulting in a dispersed and partly inconsistent body of knowledge. To address this fragmentation, a Systematic Literature Review (SLR) was chosen as the methodological approach. SLRs enable the synthesis of dispersed evidence across diverse disciplines and provide structured insights that can guide both academic understanding and practical decision-making (Snyder, 2019; Tranfield et al., 2003). The literature review in this paper follows the PRISMA guidelines (PRISMA, 2020) while drawing on the structured review approach outlined by Xiao and Watson (2019). Given the interdisciplinary nature of the research topics, the study adopts a semi-systematic literature review approach as described by Snyder (2019). Such an approach is particularly suited to research fields that are conceptually diverse and methodologically fragmented, where an exhaustive review of all available publications is neither feasible nor necessary (Wong et al., 2013). It combines systematic search and selection procedures with an interpretative synthesis aimed at identifying thematic patterns, benefits and challenges, and research gaps (Snyder, 2019). This hybrid methodology thus ensures both methodological stringency and analytical flexibility, enabling a transparent yet comprehensive understanding of how digital technologies contribute to sustainable value creation in PSS. Many of the functionalities that characterize PSS (see Bressanelli et al., 2018) are enabled by digital technologies such as IoT and B2B platforms. Digitalization and servitization were examined together because they jointly build upon IoT and B2B platforms. Understanding the role of these technologies is therefore essential for assessing how PSS can create sustainable value. This topic also represents a central research focus within the IoT Sustainability Lab, which provides the context for this paper. Accordingly, the following research questions guide the review:

(I) What benefits/drivers and challenges/barriers have been identified in the literature regarding the adoption and implementation of IoT, B2B platforms, and digitalization/servitization in industrial and business contexts?
(II) In which ways do IoT, B2B platforms, and digitalization/servitization influence sustainability outcomes (environmental, economic, and social) according to existing research?

To enable a structured synthesis of the findings, a thematic coding approach was adopted for the extracted data. Reported benefits (drivers) and challenges (barriers) related to digitalization/servitization, IoT, and B2B platforms were categorized into successive thematic orders (first, second, and third) to identify recurring patterns and conceptual relationships. A similar coding process was applied to research questions (see Appendix A). This approach allows the clustering of insights into higher-level categories, facilitating an understanding of how the literature conceptualizes opportunities, constraints, and knowledge gaps across the investigated domains (Braun & Clarke, 2006).

Develop and validate the review protocol

The review protocol defines the procedural foundation of this study. The protocol specified the thematic scope of IoT, B2B platforms, and digitalization/servitization in relation to sustainability, as well as the search strategy, inclusion and exclusion criteria, and quality assessment procedure. An initial unstructured exploratory search was conducted on Google Scholar to refine the search terms and identify relevant combinations of keywords. The refined protocol was subsequently discussed and validated with academic supervisors and domain experts from the IoT Sustainability Lab to confirm its relevance, completeness, and methodological soundness. All steps were carefully documented to ensure transparency and allow for replication. The finalized protocol thus provided a systematic basis for the subsequent literature search, screening, and synthesis stages.

Search the literature

The structured search was conducted primarily in Web of Science (WoS), complemented by Google Scholar to ensure comprehensive coverage of relevant publications across disciplines. The following search strings were applied:

- (I) ("IoT" OR "Internet of Things") AND "Sustainab*"
- (II) ("B2B platform*" OR "business-to-business platform*" OR "industrial platform*") AND "Sustainab*"
- (III) ("digitalisation" OR "digitalization") AND "Sustainab*", ("Servitiz*" OR "Service infusion") AND "Sustainab*", and ("Product service system*" OR "PSS") AND "Sustainab*" (three different strings)

Although Scopus was initially considered, the combination of broad search terms and multidisciplinary scope generated an excessive number of results with limited incremental value compared to WoS. Therefore, WoS was selected as the primary database because of its robust indexing of peer-reviewed journals and consistent

metadata quality, while Google Scholar served to identify potentially missing publications. In addition to database searches, snowballing techniques (backward and forward citation tracking) were applied as suggested by Thomé et al. (2016), and relevant publications already known from previous work in the IoT Sustainability Lab were also included. The literature search covered publications up to July 2025, which marks the cutoff date for this review. Given the exploratory and integrative aims of this study, the goal was not to perform a comprehensive bibliometric analysis, but rather to capture representative and thematically relevant contributions. To maintain analytical depth and manageability, an initial pre-selection in WoS and Google Scholar was conducted based on relevance, citation impact, and recency, prioritizing highly cited and recent papers.

Screen for inclusion and assess quality

The inclusion and exclusion of publications followed predefined criteria to ensure consistency and transparency. In line with the methodological recommendations of Greenhalgh et al. (2005), publications were required to contribute to at least one of the previously defined research themes: (I) IoT; (II) B2B platforms; or (III) digitalization and (digital) servitization in the context of sustainability. When a publication addressed more than one thematic area, these were recorded in order of prominence within the paper (primary, secondary, tertiary). In addition, it was noted whether each study identified or discussed drivers and/or barriers related to the respective topic (yes / no / unclear). This initial step was intentionally inclusive to reflect the exploratory nature of the review.

Screening was conducted in two stages, abstract screening and full-text screening, each performed independently by two researchers to minimize subjectivity.

Stage 1: Abstract screening

During the first stage, abstracts were reviewed according to a single primary criterion:

1. The publication explicitly or potentially addressed at least one of the three research themes (IoT, B2B platforms, digitalization/servitization in relation to sustainability).

Each abstract was independently assessed by both researchers, and disagreements were resolved through discussion. This stage reduced the initial dataset from 173 to 134 publications (39 excluded).

Stage 2: Full-text screening

In the second stage, the remaining 134 publications were read in full by both researchers. At this point, a study was retained if it:

1. Provided scientific or practical insights into at least one of the three thematic areas, and
2. Met common academic quality standards, evaluated as follows:

    - Journal articles were included if published by a publisher listed in the Academic Publishers Directory (Publishers Global). When this was not the case, inclusion was allowed if the journal appeared in SCImago rankings.
    - Monographs and book chapters were included if published by an academically recognized publisher (Academic Publishers Directory) or by an established research institution (e.g., university or research institute).

Any disagreements regarding inclusion were resolved through discussion. This stage resulted in the exclusion of 14 publications, primarily due to insufficient thematic relevance and, to a lesser extent, quality concerns (e.g., conference papers or questionable publishers). In addition, snowballing during full-text reading identified three further relevant publications, which were added to the dataset. This yielded a final sample of 123 papers for analysis.

Quality considerations and publisher assessment

In addition to the general quality criteria, attention was given to the credibility of publishers. Given the growing debate around predatory publishing practices, notably in certain open-access outlets, each included paper was individually assessed for publication integrity. Indicators such as unusually short review times (e.g., less than one month from submission to published) were interpreted as potential quality risks and led to further review before inclusion. This evaluative step helped ensure that only studies meeting reasonable scientific standards were retained. A summary of the inclusion process is presented in the PRISMA flow diagram (Fig. 1) below, illustrating the number of records identified, screened, and included at each stage.

Extracting data

For each publication included in the final sample, relevant information was systematically recorded in a structured database. The database listed all papers according to their primary thematic area (IoT, B2B platforms, or digitalization and (digital) servitization), to ensure traceability across categories.

Each paper was read in full, and the following information was extracted:

- research aims and research questions;
- relevant conceptual and theoretical foundations (content of the literature section);

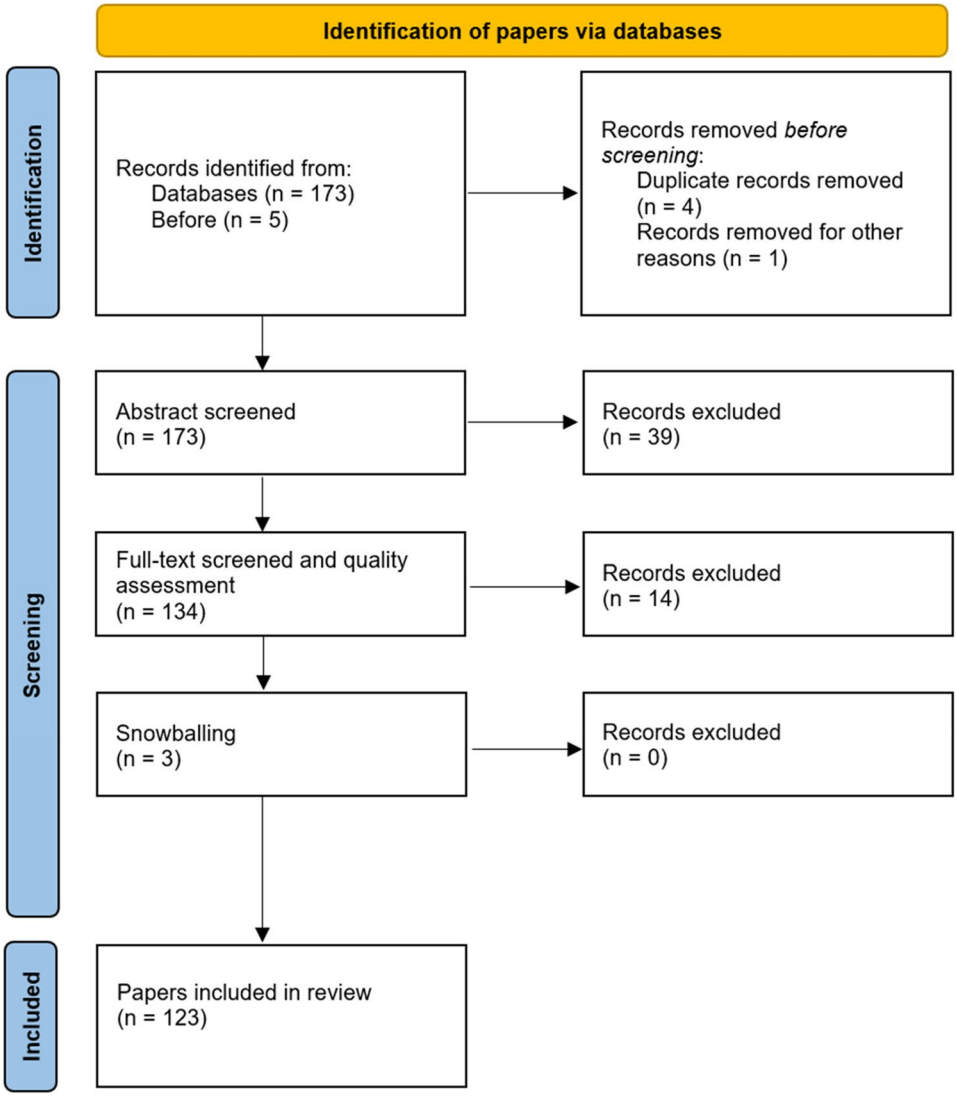

Fig. 1 PRISMA flow diagram adapted from Page et al. (2021)

- empirical results, including identified benefits (drivers) and challenges (barriers);
- notable insights from the discussion and conclusion sections;

This structured extraction provided a comprehensive overview of the current state of research and served as the foundation for the subsequent thematic coding and synthesis.

Analysing and synthesising data

Following data extraction, the synthesis focused on organizing and refining the identified drivers, barriers, and research questions. For benefits and challenges, all extracted entries were consolidated and cleaned to remove duplicates and redundancies. Commonly recurring issues, such as "data security" within IoT-related challenges, were merged to avoid repetition. The occurrence of numerous duplicate entries indicates that the review reached a sufficient level of coverage to capture the most relevant drivers and barriers. The refined first-order categories were then used to develop second- and third-order thematic clusters, which grouped conceptually related factors into broader analytical categories. This hierarchical coding process was initially carried out by one researcher with the help of Artificial Intelligence (AI) and subsequently reviewed and refined through discussions with domain experts within the IoT Sustainability Lab. A similar approach was applied to the research questions from the literature. However, in this case, no additional refinement or clustering was performed on the first-order coding to preserve the original phrasing and intent of each study. The resulting thematic structures enabled a systematic

synthesis of the literature, highlighting key conceptual relationships and emerging knowledge gaps within the fields of IoT, B2B platforms, and digitalization/servitization in the context of sustainability.

Report findings

The final step of the systematic review involves the structured presentation of its findings. In accordance with the PRISMA framework (PRISMA, 2020), this section summarises the key descriptive and analytical outcomes of the review. First, a quantitative overview of the dataset is provided, including the development of publication activity over time, the distribution of studies across journals, the thematic allocation of papers, and the research methods employed in the selected literature.

Review of time distribution

Figure 2 shows the publication years of the 123 studies included in this review. The earliest publication in the dataset is from 2011, and only a small number of studies appear in the years up to 2018. From 2019 onward, the number of included publications is higher, with 2022 showing the largest count (26). The numbers for 2023 and 2024 remain comparatively high within the context of our dataset. The lower count for 2025 (five publications) results from the timing of the literature search, which was conducted until July 2025 and therefore does not cover the full year. Because this work follows a semi-systematic review approach (Snyder, 2019) based on predefined search strings and relevance criteria, the distribution reflects the outcome of the applied selection process rather than the full capture of potentially available publications.

Review of journal distribution

Table 1 presents the distribution of publications across journals, including only outlets with more than three publications. The results show that research on IoT, B2B platforms, and digitalization/servitization in relation to sustainability is primarily published in management and business-oriented journals. The Industrial Marketing Management journal accounts for the largest share with 16 papers, followed by the Journal of Business Research (12 papers) and the Journal of Cleaner Production (8 papers). Other frequently represented outlets include Technological Forecasting and Social Change (6 papers), Journal of Business & Industrial Marketing (5 papers), Springer book Chaps. (5 papers), Journal of Service Management (4 Papers) and Technovation (4 papers). This distribution underlines the interdisciplinary nature of the research domain, which spans marketing, innovation management, and sustainability studies.

Review of themes

Figure 3 shows the thematic distribution of all reviewed publications. Since each paper could be assigned to up to three thematic categories, the counts represent the total number of thematic allocations across the full sample. The category Digitalization + Servitization is by far the most prominent, appearing in 89 publications. This

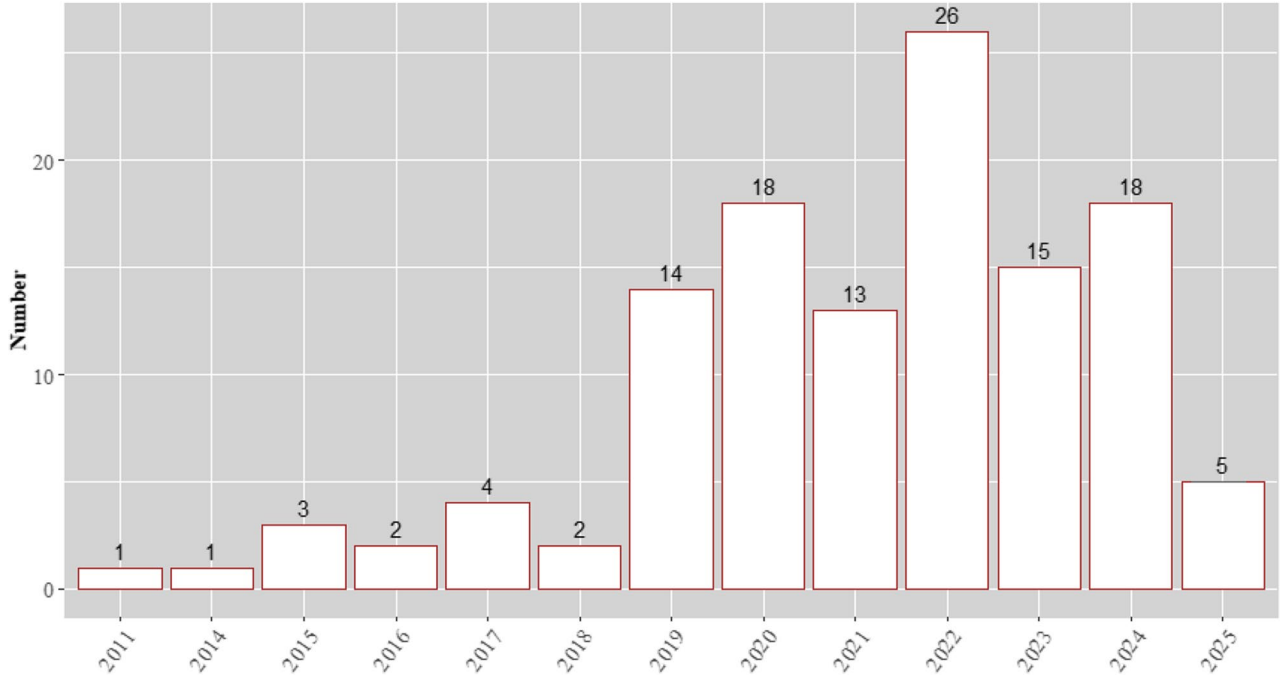

Fig. 2 Publications by year

Table 1 Distribution of articles in journals

Journal	Number of articles
Industrial Marketing Management	16
Journal of Business Research	12
Journal of Cleaner Production	8
Technological Forecasting and Social Change	6
Journal of Business & Industrial Marketing	5
Springer book chapters	5
Journal of Service Management	4
Technovation	4
Others	63
Total	123

reflects the strong academic interest in digital transformation, service-oriented business models, and their implications for industrial value creation. The themes IoT (44) and B2B Platforms (37) also occur frequently, underlining their importance as technological and organisational enablers within data-driven ecosystems.

Review of research methods

The methodological distribution of the 123 reviewed publications shows a relatively balanced mix of theoretical and empirical research (see Table 2). In total, 57 papers (46.3%) are theoretical, comprising conceptual contributions (33; 26.8%) and literature reviews (25; 20.3%). The remaining 66 papers (53.7%) are empirical, dominated by qualitative studies (43; 35%), followed by quantitative approaches (20; 16.3%) and a small number of simulation-based studies (2; 1.6%). This distribution highlights that the field is driven primarily by conceptual development and qualitative inquiry, while quantitative and model-based research remains comparatively limited.

Analysis of IoT, B2B platforms, and digital servitization: benefits, drivers, challenges, and barriers

This chapter synthesizes key findings from the literature IoT, B2B platforms, and digitalization/digital servitization. It integrates benefits and drivers with corresponding challenges and barriers to provide a holistic understanding of how these technologies shape industrial transformation. The analysis is structured into three main sections: IoT, B2B platforms, digitalization and digital servitization. After these we conclude with a view on Sustainability aspects of the main findings. The first ordering of the respective benefits and drivers, as well as the challenges and barriers, can be found in Appendix B, while the figures presented in the main text reflect the second and third ordering.

Internet of Things (IoT)

Benefits and drivers of IoT adoption

The adoption of IoT technologies generates operational, strategic, relational, and sustainability-oriented benefits (Fig. 4) that drive digital transformation across industries. At the operational level, IoT enables connected and remote management, allowing automated supervision, real-time visibility of assets and inventory, and enhanced facility safety (Nižetić et al., 2020; Senthil & Easwaran, 2019). These capabilities support quality control, downtime reduction, and deep manufacturing insights, including production and packaging optimization (Paiola et al., 2021; Senthil & Easwaran, 2019). Centralized dashboards and scalable IoT management further streamline workflows and enable data-driven decisions (Senthil & Easwaran, 2019).

IoT strengthens proactive and predictive maintenance, improving equipment reliability while reducing unplanned failures and associated costs (Ingemarsdotter et al., 2020; Paiola et al., 2021; Senthil & Easwaran, 2019). Enhanced data analysis contributes to measurable returns on investment by increasing efficiency and reducing operational risk (Senthil & Easwaran, 2019). In logistics, IoT enhances supply chain optimization through improved tracking, coordination, and resilience (Nižetić et al., 2020; Senthil & Easwaran, 2019), while in retail it supports efficient e-business processes such as accurate inventory management and improved customer experiences (Shoukry et al., 2019).

Sustainability-related drivers include cleaner production, reduced energy consumption, and minimized environmental impact, aligning ecological responsibility with economic performance (Paiola et al., 2021). IoT also enables servitized business models through post-use tracking, lifetime estimation, and insights that inform product design and durability (Ingemarsdotter et al., 2020; Nižetić et al., 2020).

Relational and governance-related benefits emerge through enhanced information exchange and collaboration between partners (Boehmer et al., 2020). IoT-based transparency can guard against opportunism within buyer–supplier relationships and enable trust mechanisms and mutual dependence (Boehmer et al., 2020). Altogether, IoT functions as a foundational enabler of modern industrial value creation.

Challenges and barriers to IoT implementation

Despite significant potential, IoT adoption faces extensive challenges (Fig. 5) across security, integration, data management, interoperability, organizational readiness, and sustainability.

A primary concern involves security vulnerabilities across connected devices and networks (Senthil & Easwaran, 2019). These risks extend to data confidentiality and privacy, where sensitive information may be intercepted or misused (Kumar, 2019; Ng & Wakenshaw, 2017). Maintaining cyber-physical system integrity is critical, as compromised components can directly affect safety and reliability (Kumar, 2019; Rejeb et al., 2022).

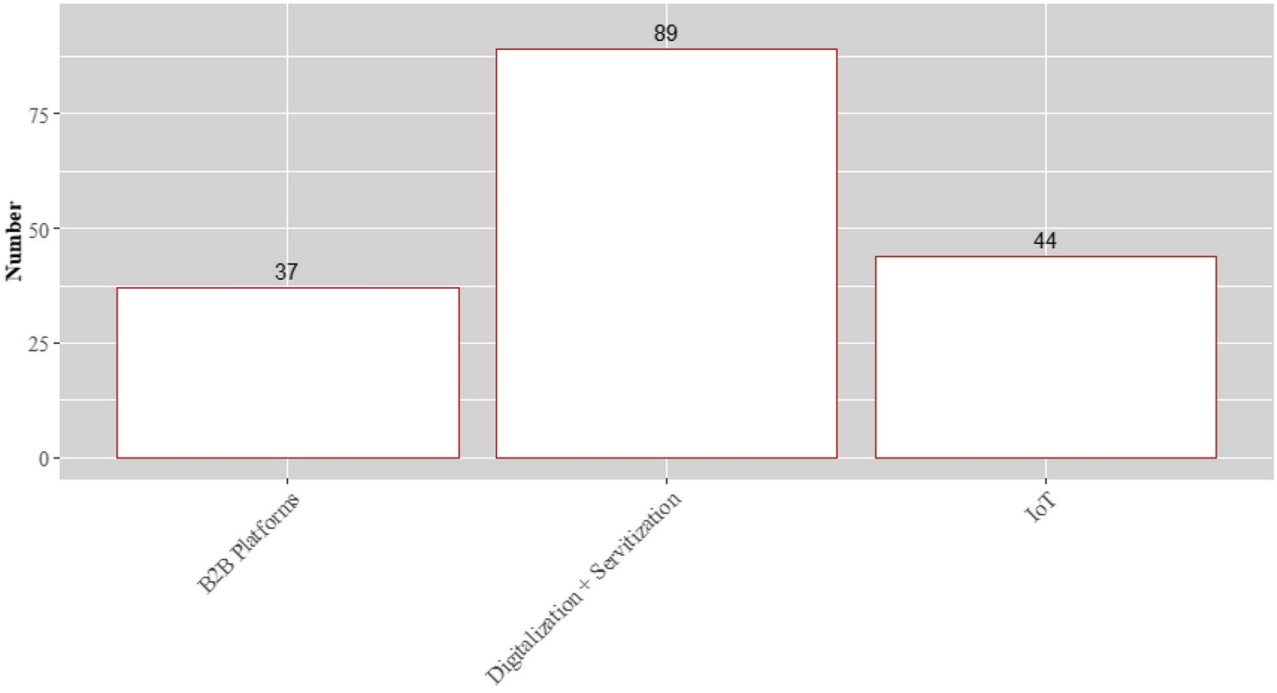

Fig. 3 Distribution of thematic areas

Table 2 Research methods

Paper type	Method	Total	Percentage %
Theoretical	Conceptual	33	26.8%
	Lit. Review	25	20.3%
Empirical	Qualitative	43	35%
	Quantitative	20	16.3%
	Simulation models	2	1.6%

Technical barriers, including integration with legacy infrastructures, weak connectivity, and device pairing complications, hinder effective deployment (Kumar, 2019; Rejeb et al., 2022; Senthil & Easwaran, 2019). Broader system-level challenges arise from compatibility issues and the need for interoperability across heterogeneous IIoT systems (Alcayaga et al., 2019; Rejeb et al., 2022).

Data-related barriers include managing large data volumes, ensuring data quality, and building the infrastructure and expertise required for big data analytics (Ingemarsdotter et al., 2020; Khan et al., 2020). Decentralized architectures introduce further complexity through distributed management requirements and specialized operating systems (Khan et al., 2020).

Design-oriented challenges stem from fragmented standards and fast technological change, making it difficult to design interoperable and upgradable IoT-enabled products (Ingemarsdotter et al., 2020; Rejeb et al., 2022). The coexistence of multiple wireless technologies and protocols further complicates system stability (Khan et al., 2020).

Trust barriers—both in the technology and between collaborating firms—limit adoption and increase perceived risk (Demestichas & Daskalakis, 2020; Rejeb et al., 2022). Public concerns about safety reinforce these issues (Khan et al., 2020). Organizational barriers include skill shortages, high perceived costs, inadequate infrastructure, and uncertainty due to insufficient legislation (Falkenreck et al., 2023; Rejeb et al., 2022).

Sustainability-related challenges involve energy consumption, e-waste, and complex supply chains (Rajput & Singh, 2021; Rejeb et al., 2022). Finally, achieving value integration across partners is difficult in industrial ecosystems (Alcayaga et al., 2019; Rejeb et al., 2022). These multifaceted challenges highlight the complexity of effective IoT deployment.

B2B platforms

Benefits and drivers of B2B platforms

The literature identifies significant functional, strategic, and relational benefits (Fig. 6) that explain the growing importance of B2B platforms in digital transformation. Digitalized and interactive platforms improve coordination, information exchange, and service delivery (He & Zhang, 2022; Pauli et al., 2025). They also enable contextualization and personalization based on real-time data (He & Zhang, 2022).

A major strategic driver is servitization, as platforms support embedded services, recurring revenue models, and stronger customer relationships (Ehret & Wirtz, 2017). Modular digital infrastructures reduce innovation

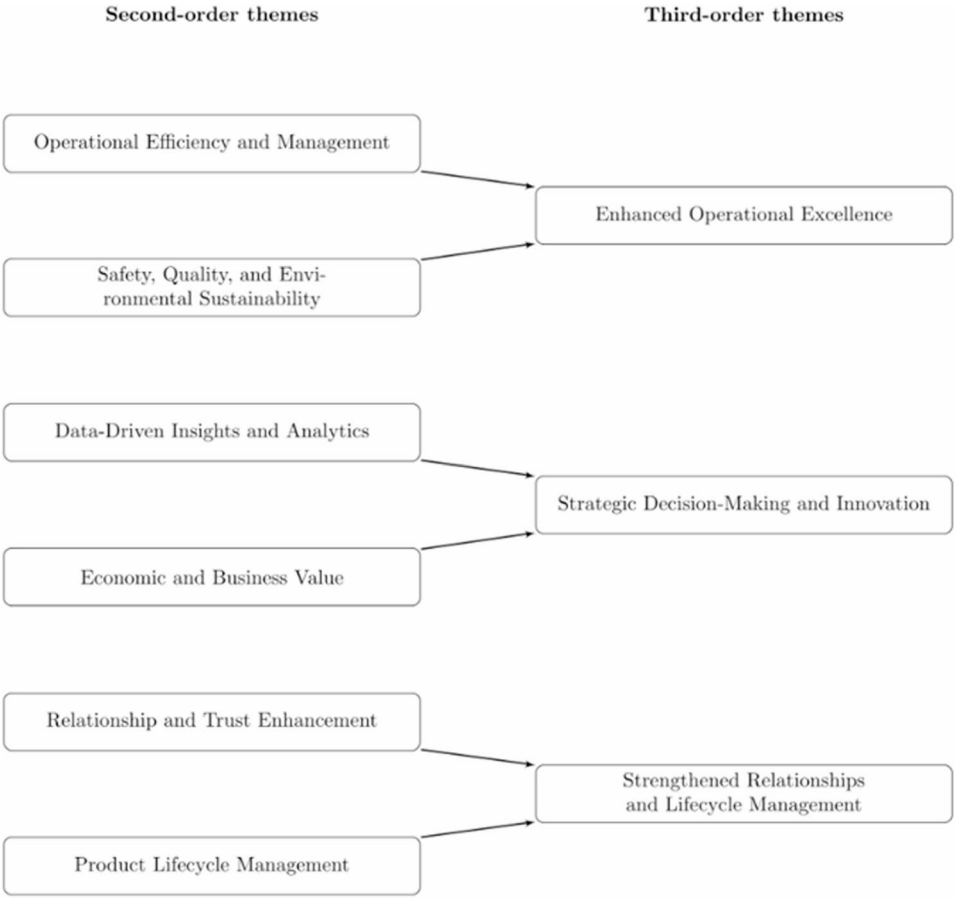

Fig. 4 IoT-ordering benefits/drivers

costs and accelerate service innovation (Lusch & Nambisan, 2015). Platforms also promote value co-creation, reduce transaction costs, and generate strong network effects as participation grows (Friedrich et al., 2025; Veile et al., 2022). These dynamics contribute to high market valuations for platform-based firms (Matzner et al., 2021).

Collaboration is increasingly necessary for digital innovation, and platforms provide a foundation for integrating specialized expertise and complementary technologies (Matzner et al., 2021). Platforms thereby reshape industry structures and competitive dynamics (Matzner et al., 2021).

Finally, platforms are viewed as attractive business models due to their scalability, multi-sided value creation, and data-driven growth potential (Ehret & Wirtz, 2017; Lusch & Nambisan, 2015; Matzner et al., 2021). These advantages position B2B platforms as central enablers of modern digital business.

Challenges and barriers in B2B platforms

B2B platforms face a complex set of barriers (Fig. 7) related to technological heterogeneity, strategy, ecosystem dynamics, customer requirements, and data security.

A major challenge stems from the complexity and diversity of B2B environments, which span multiple industries and technological contexts. This heterogeneity leads to limited data availability, poor accessibility, and insufficient domain knowledge for platform development (Mourtzis et al., 2021). B2B markets require sophisticated marketing approaches but often experience slower innovation and academic attention (Mourtzis et al., 2021). Globalization introduces further cross-border regulatory and cultural challenges.

Strategic challenges concern structuring value creation, delivery, and capture mechanisms in multi-sided ecosystems (Böttcher et al., 2022; Friedrich et al., 2025; Ritala & Jovanovic, 2023; Volberda et al., 2021). Ecosystem dependencies raise concerns about competitive relationships, bargaining power, and value-sharing conflicts (Friedrich et al., 2025; Pauli et al., 2025; Ritala & Jovanovic, 2023).

Incumbent firms struggle to implement platform business models and face difficulties orchestrating ecosystem stakeholders, managing openness, and ensuring platform leadership (Matzner et al., 2021). Unclear ownership of

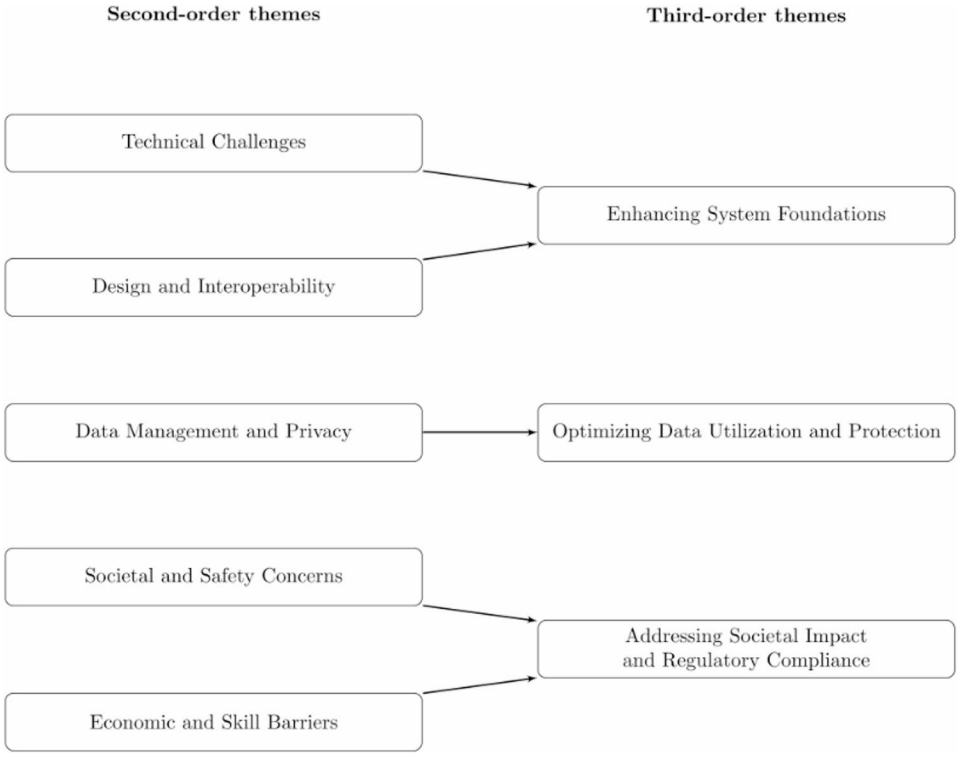

Fig. 5 IoT-ordering challenges/barriers

products and services further complicates governance structures (Matzner et al., 2021).

Customer-related barriers include inhomogeneous and highly personalized requirements, which increase complexity and hinder scalability (Friedrich et al., 2025; Matzner et al., 2021; Pauli et al., 2025). Data security and privacy concerns remain persistent issues due to the sensitive nature of industrial data (Friedrich et al., 2025; Mancuso et al., 2024).

Overall, these barriers reflect the multi-layered complexity of B2B platform development and highlight the need for sophisticated governance and long-term ecosystem management.

Digitalization and digital servitization

Benefits and drivers

Digitalization and digital servitization offer extensive environmental, operational, economic, and strategic benefits (Fig. 8). Digital solutions support optimized energy consumption, cleaner production, and improved environmental performance (Alfarisi et al., 2024; Asif et al., 2024; Beducci et al., 2025; Doni et al., 2019; Ghobakhloo et al., 2024; Schwanholz & Leipold, 2020), contributing to sustainable manufacturing models (Bressanelli et al., 2018; Ye et al., 2024).

Remote capabilities and automation improve visibility into product conditions, reduce manual intervention, and streamline system-wide coordination (Boehmer et al. 2020; Kowalkowski et al. 2024; Nybacka et al. 2010a). Predictive maintenance reduces downtime and enhances product availability (Goncalves, 2022; Grubic, 2018; Paiola et al., 2021; Rashid et al., 2025). These improvements support risk mitigation and more predictable operations (Chirumalla et al., 2023; Ziaee Bigdeli et al., 2018).

Digital servitization enhances value creation through new digital service offerings and improved customer usage performance (Agarwal et al., 2022; Brenner, 2018; Kowalkowski et al., 2024; Mourtzis et al., 2021). Economic and competitive advantages include differentiation, new revenue streams, and stronger customer relationships (Baines et al., 2009; Broccardo et al., 2023; Demirkan et al., 2015; Kowalkowski et al., 2013; Linde et al., 2023; Martinez et al., 2017).

Ecosystem and organizational enablers—such as governance structures, business model alignment, and Industry 4.0 capabilities—play a critical role (Chirumalla et al., 2023; Müller et al., 2018). External pressures (market saturation, competition, customer requirements) and internal motivations (expertise leverage, relationship strengthening) further drive digitalization (Kamalaldin et al., 2020; Ulaga & Kowalkowski, 2022).

Digital servitization also generates social and cultural benefits, contributing to societal value creation and social sustainability (Ghobakhloo et al., 2024; Lindström et al., 2018).

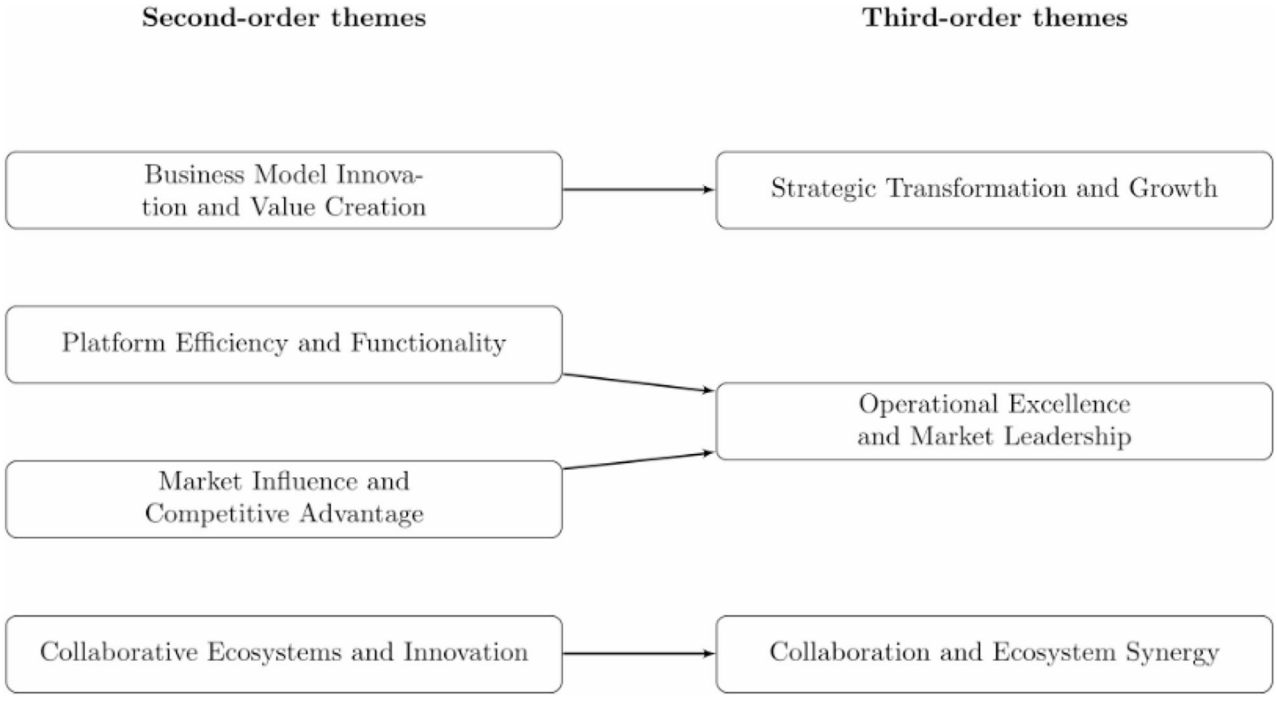

Fig. 6 B2B platforms-ordering benefits/drivers

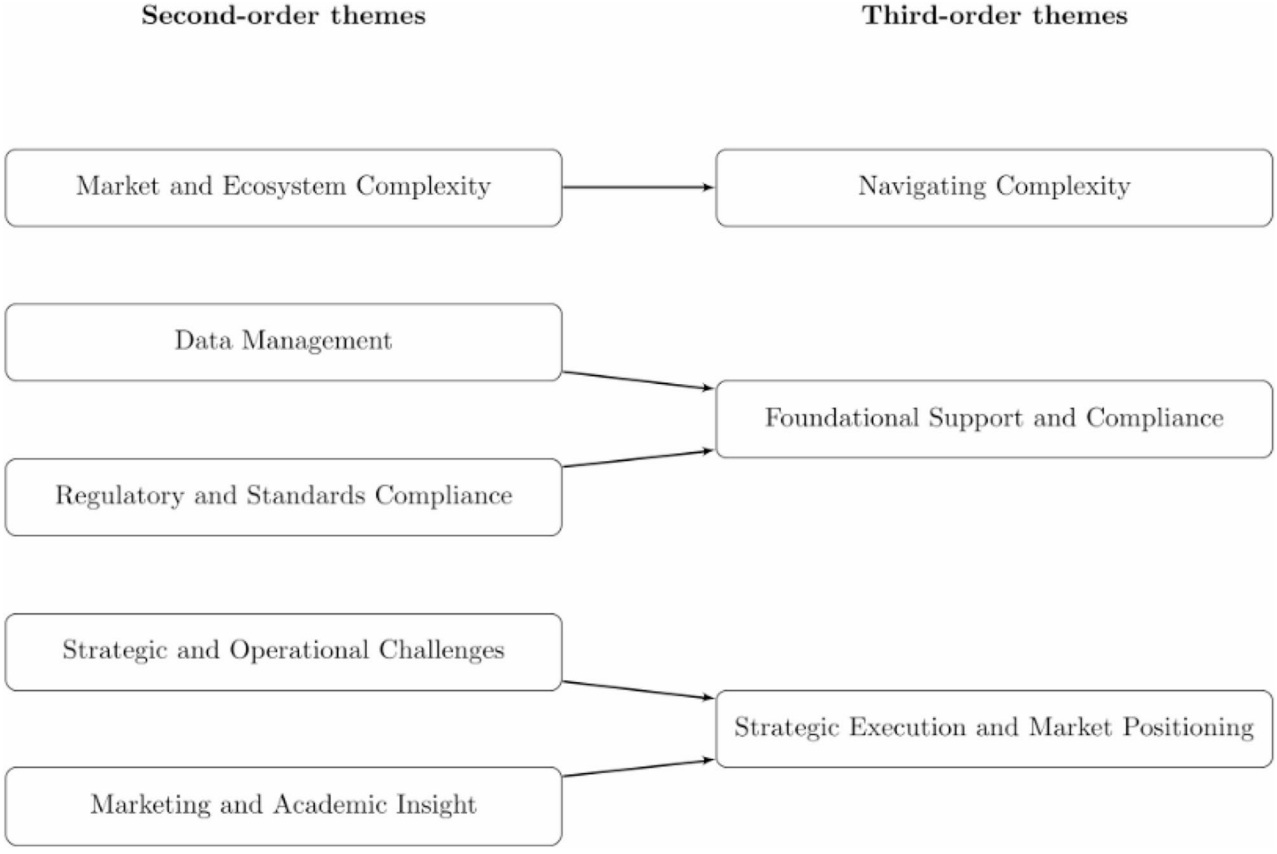

Fig. 7 B2B platforms-ordering challenges/barriers

Challenges and barriers

Digitalization and digital servitization face challenges (Fig. 9) across strategic understanding, technology, organization, human resources, customers, operations, business models, ecosystems, and sustainability.

Strategic challenges include limited understanding of customer value and profit formulas (González Chávez et al., 2023; Langley, 2022; Müller et al., 2018; Rymaszewska et al., 2017). Technological barriers involve interoperability, data integration issues, capability gaps, and concerns about data reliability, sovereignty, and security (Asif et al., 2024; Ferrari et al., 2022; Hallstedt et al., 2020; Müller et al., 2018; Peillon & Dubruc, 2019).

Organizational barriers such as capability shortages, cultural misalignment, and complex decision-making impede transformation (Hallstedt et al., 2020; Kamalaldin et al., 2020; Lamperti et al., 2024; Peillon & Dubruc, 2019). Human-related challenges include competence gaps and inadequate training (Asif et al., 2024; Ferrari et al., 2022).

Customer-related barriers arise from privacy concerns, access restrictions, and increased expectations for support and customization (Kilinc et al., 2025; Kohtamäki et al., 2019; Langley, 2022; Müller et al., 2018; Peillon & Dubruc, 2019). Operational constraints include CRM and ERP integration issues, internal data process management, and production-related limitations (Asif et al., 2024; Müller et al., 2018; Peillon & Dubruc, 2019).

Business model challenges involve transitioning to digital models, managing new risk structures, and adjusting to power shifts (Chirumalla et al., 2023; Langley, 2022). Ecosystem challenges relate to governance, incentives, trust, and partner involvement (Chirumalla et al., 2023; Langley, 2022). Internationalization adds legal and geographical complexities (Langley, 2022; Palafox-Alcantar et al., 2024).

Finally, firms face cost constraints, risk concerns, long-term viability uncertainties, environmental responsibilities, and adoption barriers for smart solutions (Kilinc et al., 2025; Kohtamäki et al., 2019; Lamperti et al., 2024).

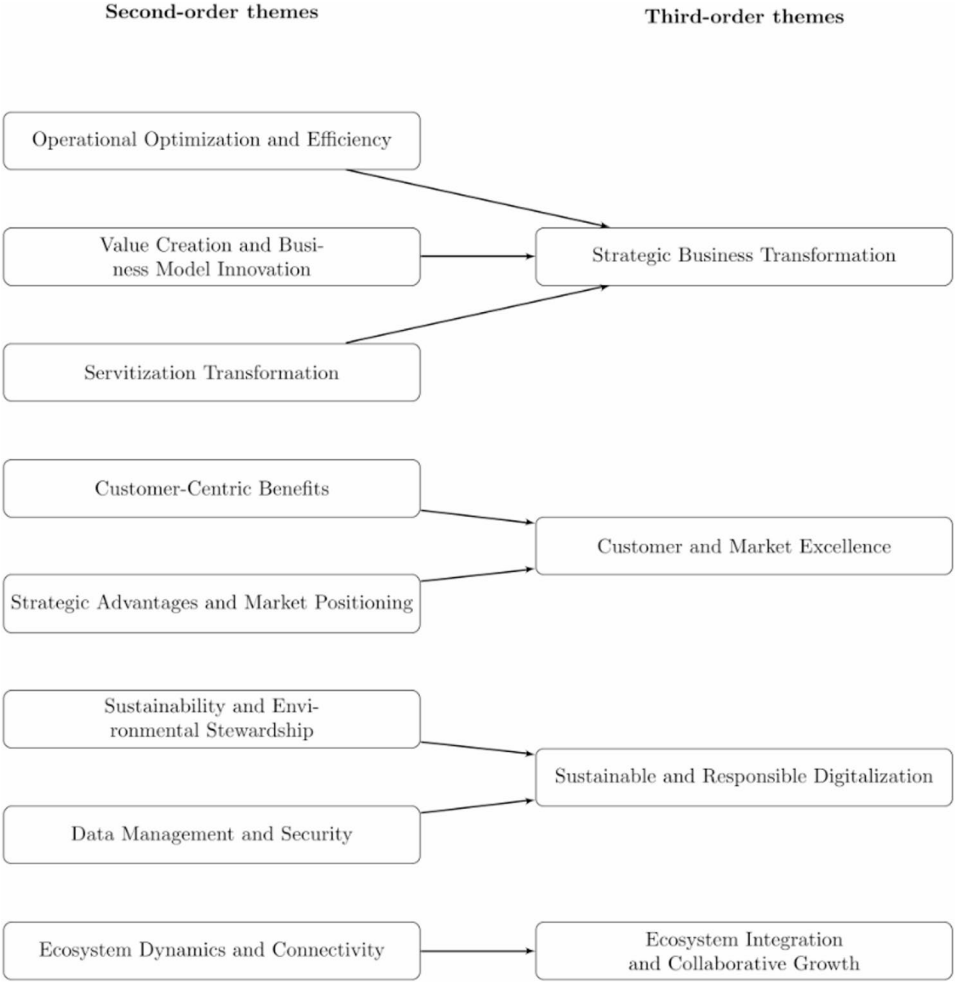

Fig. 8 Digitalization + (digital) servitization-ordering benefits/drivers

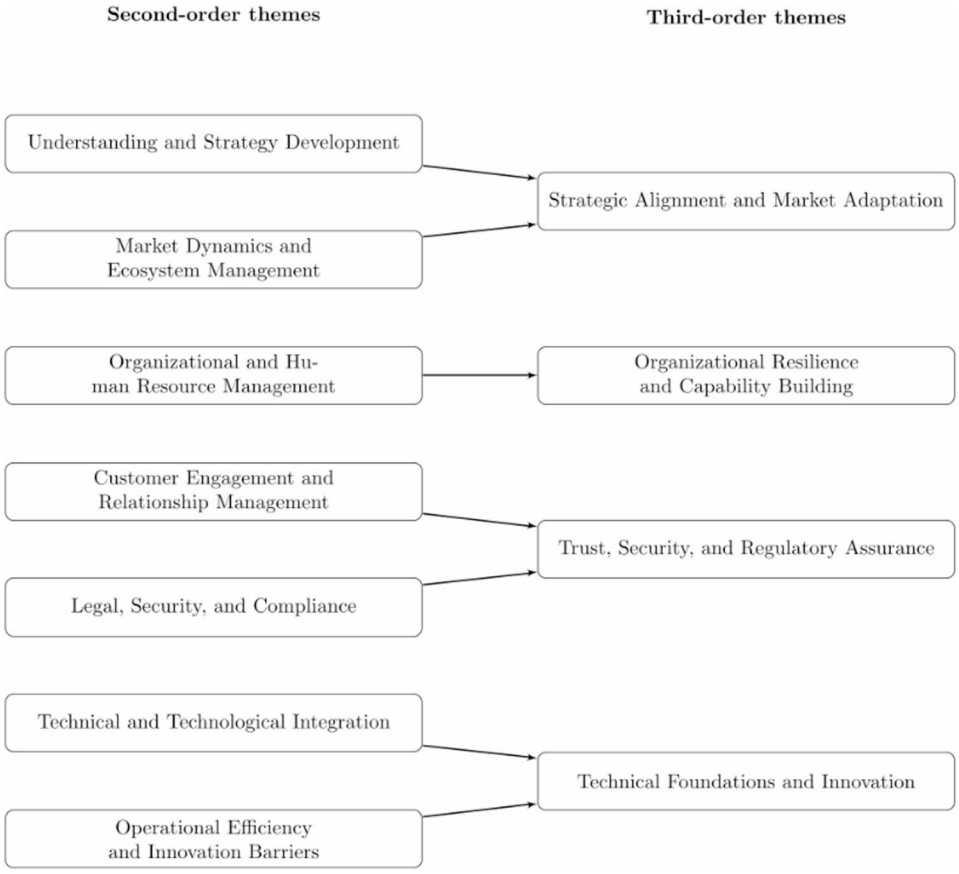

Fig. 9 Digitalization + (digital) servitization-ordering challenges/barriers

These barriers underscore the multifaceted complexity of digital servitization.

Sustainability in IoT, B2B platforms, and digital servitization

The integration of IoT, B2B platforms, and digital servitization significantly influences sustainability across industrial ecosystems. Sustainability considerations encompass environmental, economic, and social dimensions, reflecting both the opportunities and challenges highlighted in literature.

Environmental sustainability

IoT technologies support cleaner production, reduced energy consumption, and minimized environmental impact by enabling precise monitoring, predictive maintenance, and optimized resource utilization (Ingemarsdotter et al., 2020; Nižetić et al., 2020; Paiola et al., 2021). Through post-use tracking, lifetime estimation, and data-driven product design, IoT contributes to circular economy practices and longer-lasting products (Ingemarsdotter et al., 2020; Nižetić et al., 2020). Similarly, digitalization and digital servitization enhance environmental performance by optimizing energy use and promoting sustainable manufacturing practices (Alfarisi et al., 2024; Asif et al., 2024; Beducci et al., 2025; Bressanelli et al., 2018; Doni et al., 2019; Ghobakhloo et al., 2024; Schwanholz & Leipold, 2020; Ye et al., 2024). These technologies enable remote monitoring, automation, and predictive interventions that reduce waste, emissions, and resource inefficiencies (Boehmer et al. 2020; Kowalkowski et al. 2024; Langley 2022; Nybacka et al. 2010a).

B2B platforms indirectly support environmental sustainability by facilitating more efficient coordination and information exchange across supply chains, which can reduce unnecessary transportation, resource use, and overproduction (He & Zhang, 2022; Pauli et al., 2025). Platform-enabled servitization models further encourage product-as-a-service approaches that align consumption with actual demand, reducing material footprint.

Economic and operational sustainability

Sustainability is closely linked with operational efficiency and economic resilience. IoT-driven predictive maintenance and real-time monitoring reduce downtime and equipment failures, lowering costs while simultaneously reducing resource consumption (Ingemarsdotter et al., 2020; Paiola et al., 2021; Senthil & Easwaran, 2019).

Digital servitization and B2B platforms enhance value co-creation and service efficiency, generating recurring revenue streams and strengthening customer relationships (Agarwal et al., 2022; Brenner, 2018; Friedrich et al., 2025; Kowalkowski et al., 2024; Veile et al., 2022). These economic benefits reinforce sustainability by aligning profitability with long-term resource stewardship.

Social and governance dimensions

Sustainability also encompasses relational and social aspects. IoT improves transparency and trust in industrial networks, mitigating opportunism and fostering responsible collaboration (Boehmer et al., 2020). Digital servitization contributes to social sustainability through improved service quality, societal value creation, and strengthened human–machine and human–partner interactions (Ghobakhloo et al., 2024; Lindström et al., 2018). Governance mechanisms within B2B platforms and digital ecosystems ensure accountability, incentivize sustainable practices, and promote multi-stakeholder engagement (Friedrich et al., 2025; Pauli et al., 2025; Ritala & Jovanovic, 2023).

Sustainability challenges

Despite the clear benefits, becoming more sustainable remains challenging. IoT devices can increase energy consumption and generate e-waste, particularly if not managed across complex supply chains (Rajput & Singh, 2021; Rejeb et al., 2022). Similarly, digitalization and digital servitization introduce risks related to long-term environmental responsibilities, adoption costs of smart solutions, and operational sustainability under resource constraints (Kilinc et al., 2025; Kohtamäki et al., 2019; Lamperti et al., 2024). B2B platforms face indirect sustainability challenges due to ecosystem dependencies, strategic conflicts, and data governance requirements that may affect responsible value creation (Friedrich et al., 2025; Pauli et al., 2025; Ritala & Jovanovic, 2023).

Moreover, several studies emphasise that sustainability is often treated as a secondary or unintended outcome rather than an explicit objective of digital transformation. For example, Hallstedt et al. (2020) show that many firms perceive sustainability as a "bonus effect" of digitalised or service-oriented solutions, rather than integrating it proactively into development processes. Likewise, Doni et al. (2019) find that while servitization may improve energy consumption and enhance environmental performance, it does not necessarily translate into broader sustainability practices such as corporate sustainability disclosure, environmental assurance, or emissions reduction policies.

Overall, sustainability in industrial digital transformation requires careful alignment of technological adoption, operational efficiency, governance structures, and ecosystem collaboration. IoT, B2B platforms, and digital servitization collectively offer the potential to advance sustainable industrial practices, but deliberate strategies are essential to mitigate associated risks and ensure holistic environmental, economic, and social value.

Contribution of the review

This chapter consolidates the broader insights emerging from "Analysis of IoT, B2B Platform. and Digital Servitization: Benefits, Drivers, Challenges, and Barriers". While IoT, B2B platforms, and digital servitization each offer distinctive benefits and face domain-specific challenges, the review shows that these research streams remain only loosely connected, particularly regarding their sustainability implications. The following sections summarise these fragmented perspectives, outline cross-domain patterns observed across the three technological areas, and draws attention to a notable gap in the literature: the limited availability of early-stage frameworks and holistic methods for assessing the sustainability of digitally enabled PSS.

Integrating fragmented insights across IoT, B2B platforms, and digital servitization

Section "Analysis of IoT, B2B Platform. and Digital Servitization: Benefits, Drivers, Challenges, and Barriers" demonstrates that IoT, B2B platforms, and digital servitization share several overarching mechanisms yet differ in their focus and types of challenges and benefits. IoT research is primarily concerned with operational and technical value creation, real-time data visibility (Nižetić et al., 2020; Senthil & Easwaran, 2019), predictive maintenance (Senthil & Easwaran, 2019), automation (Nižetić et al., 2020; Senthil & Easwaran, 2019), and efficiency gains (Paiola et al., 2021). Correspondingly, IoT challenges are dominated by interoperability (Alcayaga et al., 2019; Khan et al., 2020; Rejeb et al., 2022; Senthil & Easwaran, 2019), cybersecurity, data quality (Ingemarsdotter et al., 2020), and legacy system integration (Rejeb et al., 2022; Senthil & Easwaran, 2019).

In contrast, B2B platform literature emphasizes ecosystem-level dynamics. Benefits relate to coordination, value co-creation through network effects (Friedrich et al., 2025; Veile et al., 2022) and scalability (Ehret & Wirtz, 2017; Lusch & Nambisan, 2015; Matzner et al., 2021), while challenges arise from governance (Böttcher et al., 2022; Ritala & Jovanovic, 2023), role ambiguity (Friedrich et al., 2025; Pauli et al., 2025), competitive tensions (Friedrich et al., 2025; Pauli et al., 2025; Ritala & Jovanovic, 2023) and heterogeneous stakeholder requirements (Friedrich et al., 2025; Matzner et al., 2021; Pauli et al., 2025). Here, technological complexity is intertwined with strategic and relational dependencies across actors.

Digitalization and digital servitization, meanwhile, take a broader organizational and business-model perspective. The literature highlights strategic differentiation (Agarwal et al., 2022; Kowalkowski et al., 2013; Paluch

& Wünderlich, 2016; Ulaga & Kowalkowski, 2022; Wan et al., 2017), new revenue streams (Baines and Lightfoot 2013a, b; Demirkan et al. 2015; Iansiti and Lakhani 2014; Kamp et al. 2017; Linde et al. 2023; Paschou et al. 2020; Schuh et al. 2011) and enhanced customer relationships (Mourtzis et al., 2021; Paschou et al., 2020) as key drivers, supported by remote services (Boehmer et al., 2020; Langley, 2022) and advanced product usage insights (Ghobakhloo et al., 2024; Grubic, 2018; Kolagar et al., 2022; Opazo-Basáez et al., 2018; Paiola et al., 2021; Paschou et al., 2020; Ye et al., 2024). Barriers, however, cluster around organizational readiness (Hallstedt et al., 2020; Peillon & Dubruc, 2019), capability gaps (Kamalaldin et al., 2020; Kilinc et al., 2025; Lamperti et al., 2024), cultural resistance (Chirumalla et al., 2023; Palafox-Alcantar et al., 2024), customer trust (Langley, 2022) and the difficulty of shifting from product-centric to service-centric logic (González Chávez et al., 2023; Langley, 2022; Müller et al., 2018; Rymaszewska et al., 2017).

Across all three domains, sustainability is acknowledged as a potential outcome, but it is often treated as a secondary effect rather than a deliberate design objective (Hallstedt et al., 2020). While IoT provides the data foundation for resource efficiency, platforms enable coordination and transparency, and servitization reshapes value propositions, the literature rarely integrates these contributions into a unified sustainability perspective. This thematic fragmentation explains why impacts are often discussed in isolation and why sustainability potential remains difficult to realise in practice. Overall, the insights from "Analysis of IoT, B2B Platform. and Digital Servitization: Benefits, Drivers, Challenges, and Barriers" point to three recurring perspectives within the literature: technical, ecosystem-based, and organizational, each emphasizing different aspects of digital transformation.

The missing link: Lack of early-stage support and assessment methods

Across the reviewed literature, sustainability is frequently acknowledged as a potential outcome of PSS, which often rely on a combination of IoT, B2B platforms, and digital servitization; yet a key question remains unresolved: how can the sustainability contributions of such digitally enabled PSS be intentionally designed and reliably evaluated? Despite their promise, the practical implementation and assessment of PSS remain challenging (Sarancic et al., 2024). Existing assessment approaches are fragmented and fail to provide a comprehensive picture of sustainability performance. For instance, although Life Cycle Assessment (LCA) is the dominant tool for environmental evaluation, its application to PSS has remained scarce compared to individual products, which limits the robustness of environmental insights (Maliqi et al., 2024). Where studies do exist, they are often restricted to later stages of the design process, offering limited support during early development when the potential to shape long-term outcomes is greatest (Sousa Zomer et al., 2024). Moreover, conventional LCA methodologies struggle to reflect the dynamic behaviour of PSS, resulting in inaccurate predictions of long-term impacts and an ongoing difficulty in defining a Functional Unit (FU) that adequately captures system complexity (Alfarisi et al., 2024). The social dimension of sustainability also remains underexplored, with few frameworks integrating it into early-stage assessments despite its recognised importance (Sousa Zomer et al., 2024). Overall, these shortcomings demonstrate not only isolated gaps but also a broader lack of methodological integration. As Arioli et al. (2025) argue, the field still lacks a consolidated, quantitative approach that simultaneously encompasses environmental, social, and economic dimensions from a life cycle perspective. Without such integration, decision-makers risk relying on partial assessments that overlook trade-offs, thereby undermining the ability of PSS to deliver true sustainable value. To achieve such value in practice, all three sustainability dimensions (environmental, social and economic) must be addressed in an integrated manner (Braccini & Margherita, 2018).

Considerations and concluding remarks

Theoretical implications

The literature analysis shows that digital technologies—particularly IoT, B2B platforms, and digital service offerings—trigger fundamental theoretical shifts in how sustainable value creation is understood.

First, the findings reaffirm the relevance of SDL, as sustainable business models increasingly rely on continuous use-phase interactions, data-driven value creation, and the joint integration of resources. However, digital technologies extend SDL by enabling new forms of value coordination, facilitating data-based collaboration, and transforming the mechanisms through which sustainable efficiency improvements emerge. Second, IoT and digital services function as socio-technical enablers of the circular economy. They support not only operational efficiency (e.g., predictive maintenance) but also design-related decision-making and the coordination of entire value networks. This indicates that existing theories of PSS and the circular economy need to be expanded with a stronger ecosystem perspective, in which data access, governance mechanisms, and interdependencies play central roles. Third, the role of B2B platforms highlights that sustainable value creation increasingly arises at the network level rather than solely within individual firms. Platforms act as institutional infrastructures that define role distributions, cooperation rules, and data access arrangements. This requires a theoretical extension of platform and ecosystem research to incorporate sustainability objectives as an integral governance dimension.

Finally, the literature reveals ambivalences within digital sustainability: rebound effects, rising resource consumption of digital devices, and new dependencies create a "digital sustainability paradox." This underscores the need for theories of digital transformation and sustainability to account for both the positive and negative systemic effects of digitalization.

Overall, the analysis demonstrates that sustainable digital business models can only be fully explained through integrated, multi-level, and interdisciplinary theoretical approaches. Sustainability does not emerge from individual technologies but from the interplay of service orientation, digital infrastructures, and coordinated ecosystem design.

Practical implications

Recent literature emphasizes that firms developing Product–Service Systems (PSS) should conceptualize the Internet of Things, digital platforms, and digital servitization not as isolated technological investments but as mutually reinforcing capabilities that jointly enable value creation. Scholars underline that effective digital transformation depends on robust foundations—particularly data governance, interoperability, and cybersecurity—which determine whether digital architectures can scale sustainably. Evidence further suggests that platform-based coordination enhances collaboration among ecosystem actors, reduces transaction costs, and facilitates circular economy practices such as repair loops, lifetime extension, and shared asset usage. However, realizing these benefits requires substantial organizational adaptation, including new digital skill sets, alignment across business units, and updated governance structures. The literature also warns that digitalization can introduce negative sustainability outcomes; therefore, firms must actively monitor energy consumption, data intensity, and potential rebound effects associated with digital solutions. For industrial incumbents, successful implementation of platform and servitization strategies ultimately depends on exercising ecosystem leadership, cultivating trust, and establishing transparent value-sharing arrangements.

Limitations

The semi-systematic review approach, although well suited for synthesizing insights across disciplinary boundaries, inevitably limits the completeness of the evidence base and may overlook relevant studies not captured within the chosen databases or search terms. The resulting corpus is further shaped by publication bias, reflected in the predominance of qualitative and conceptual contributions and the relative scarcity of quantitative or longitudinal assessments of sustainability outcomes. Moreover, the evaluation of study quality relies partly on metadata and publisher credibility, which cannot fully account for methodological rigor at the level of individual papers. While thematic coding was conducted systematically, it necessarily entails interpretive judgment, introducing a degree of subjectivity in the formation of analytical categories. The considerable heterogeneity of research contexts—ranging across industries, technologies, and business models—also restricts the comparability of findings and constrains the generalizability of overarching insights. Finally, many sustainability implications reported in the literature are inferred rather than empirically validated, limiting the extent to which causal relationships can be definitively established.

Future research avenues

The findings of this review reveal several directions for future research that are essential for advancing a more integrated understanding of sustainability in digitally enabled PSS. First, more work is needed on the integration of IoT, B2B platforms, and digital servitization as combined socio-technical systems. While these domains are often studied independently, future research should investigate how their interactions jointly influence value creation, coordination mechanisms, and sustainability outcomes across industrial ecosystems.

Second, the review highlights the need for early-stage assessment methods that can support decision-making before design and business model choices are locked in. Current approaches provide limited guidance during early phases, even though this is when the potential to shape long-term sustainability outcomes is highest (Sousa Zomer et al., 2024). Future research should therefore develop methods that help practitioners anticipate trade-offs and system-level implications at the beginning of PSS development.

A third focus area concerns the quantification of sustainability impacts. Compared to product-focused studies, there is still a scarcity of LCA applications used to assess PSS (Maliqi et al., 2024), and existing approaches struggle to represent dynamic system behaviour or evolving service interactions (Alfarisi et al., 2024). Future studies should extend life cycle–oriented assessment tools to capture PSS-specific characteristics and complement them with quantitative, longitudinal, or model-based approaches capable of reflecting system dynamics.

Fourth, the social dimension of sustainability remains insufficiently developed (Sousa Zomer et al., 2024). Further research is required to better understand these social implications and to embed them within early-stage assessment frameworks together with environmental and economic criteria.

Finally, future work should examine how digital data can systematically support circular product and service design. Usage data, lifetime estimation, and condition monitoring offer substantial potential for improving durability, repairability, and resource

efficiency (Bressanelli et al., 2018). Research is needed to understand how these data streams can be translated into actionable design principles, tools, or decision-support mechanisms for circular PSS development. Together, these research priorities point toward the need for integrated, data-driven, and design-oriented research capable of supporting the evaluation and development of sustainable, digitally enabled PSS.

Appendix A – Coding of research questions

This appendix provides an overview of the coding of research questions for the three thematic domains included in the review: Internet of Things (IoT), B2B Platforms, and Digitalization & Digital Servitization.

Each figure shows how the research questions were categorised, clustered, and assigned to first-order and higher-order themes during the coding process.

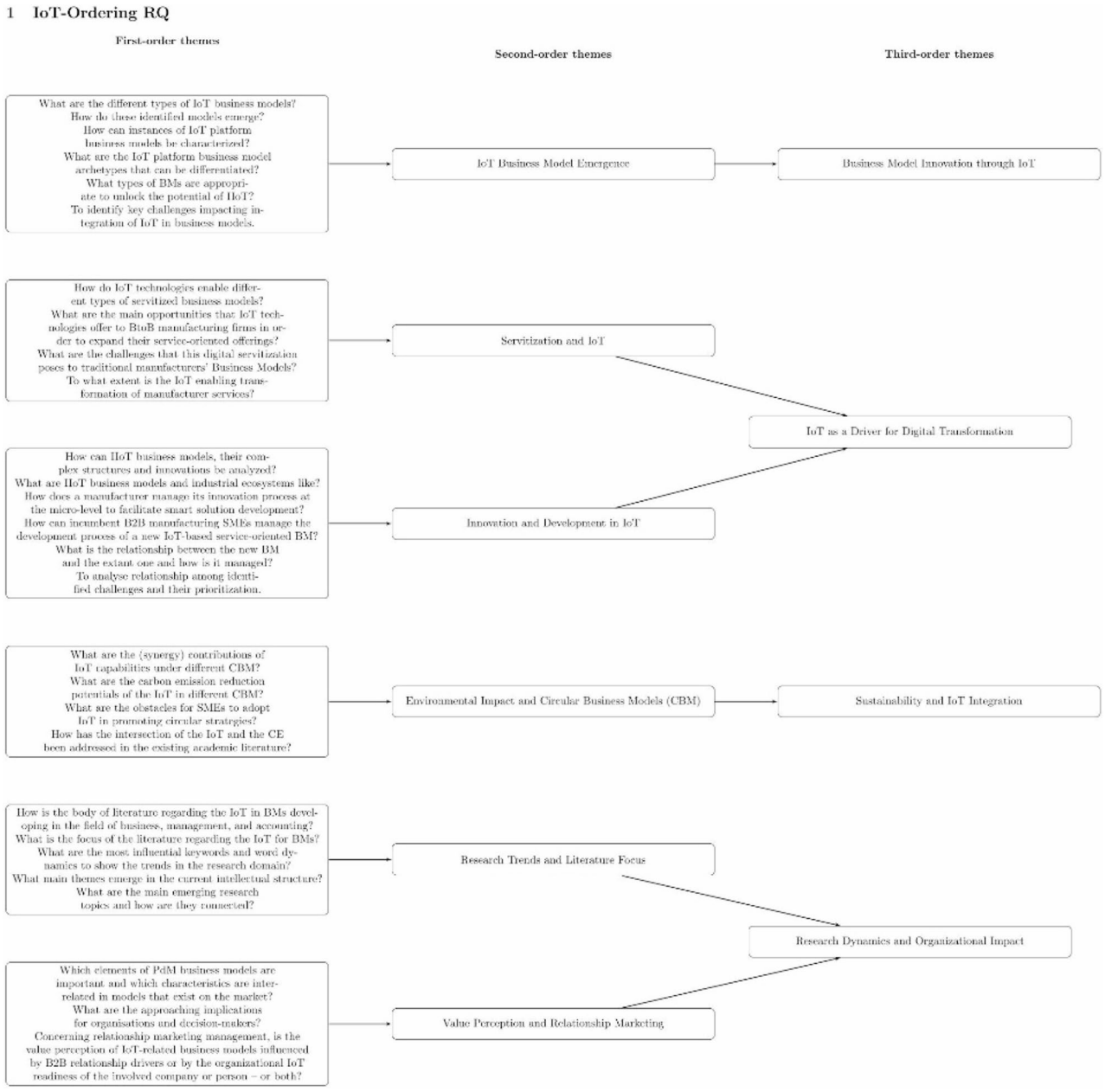

Fig. 10 Coding of research questions for IoT

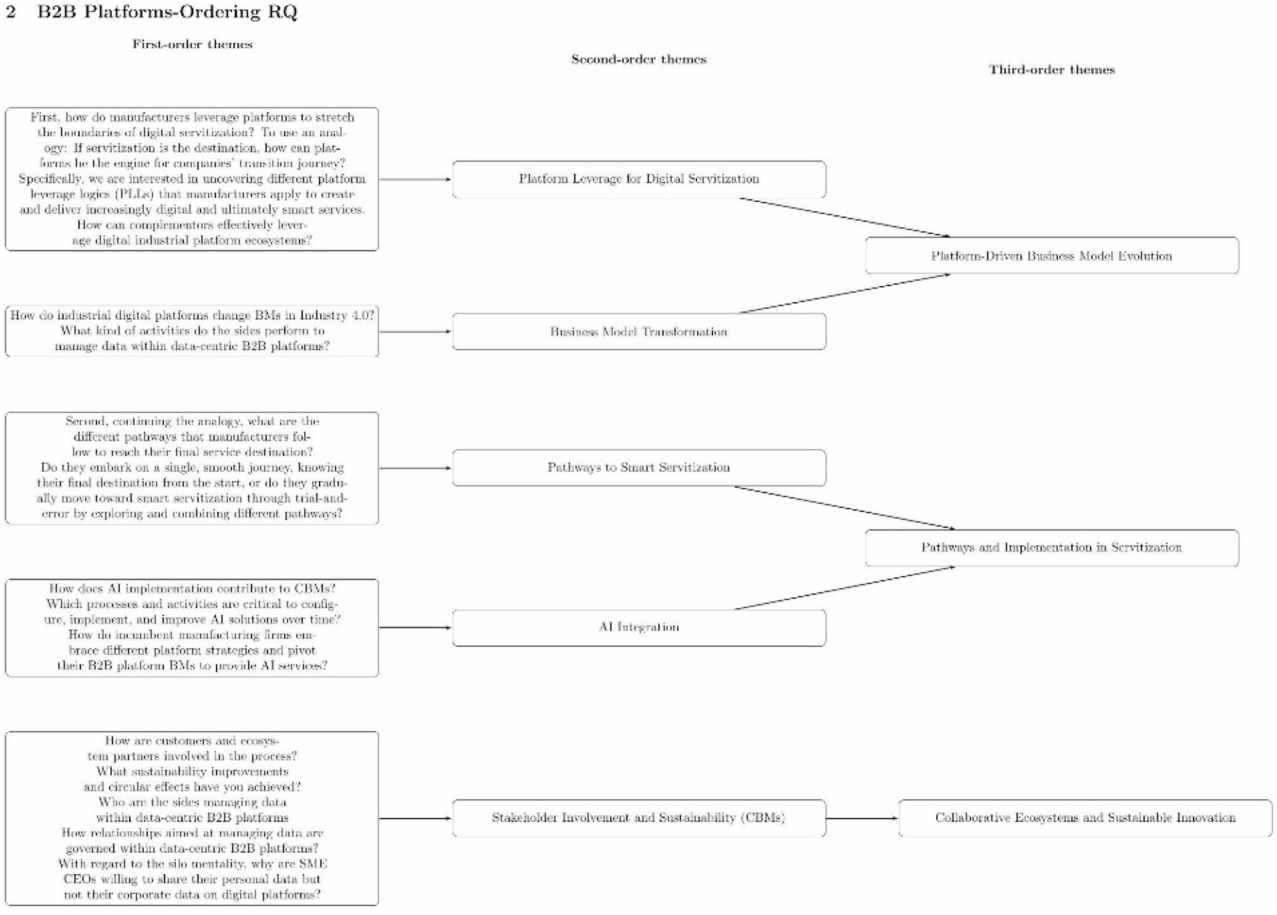

Fig. 11 Coding of research questions for B2B Platforms

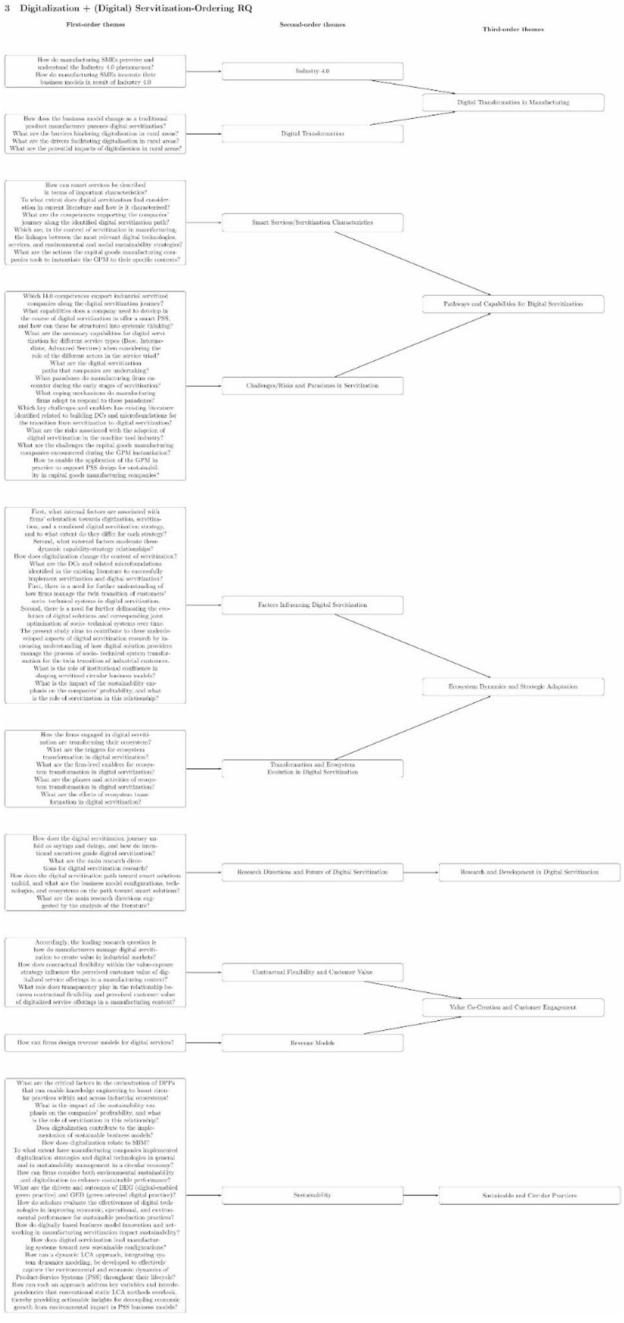

Fig. 12 Coding of research questions for Digitalization & Digital Servitization

Appendix B – First orders

IoT-Benefits/Drivers	References
Digitally Connected and Remote Management	(Nižetić et al., 2020; Senthil & Easwaran, 2019)
Facility Management	(Senthil & Easwaran, 2019)
Auto Supervision	(Nižetić et al., 2020; Senthil & Easwaran, 2019)
Real-Time Asset and Inventory Management	(Nižetić et al., 2020; Senthil & Easwaran, 2019)
Plant Safety and Security	(Senthil & Easwaran, 2019)
Quality Control	(Senthil & Easwaran, 2019)
Reduced Downtime	(Paiola et al., 2021; Senthil & Easwaran, 2019)
Manufacturing Insight and Packaging Optimization	(Senthil & Easwaran, 2019)
Data Analysis	(Senthil & Easwaran, 2019)
Proactive Maintenance	(Senthil & Easwaran, 2019)
Return on Investment	(Senthil & Easwaran, 2019)
Logistics and Supply Chain Optimization	(Nižetić et al., 2020; Senthil & Easwaran, 2019)
Integrated Operations Dashboard	(Senthil & Easwaran, 2019)
Scalable IoT Operations Management	(Senthil & Easwaran, 2019)
Efficient and Cleaner Production Methods (Emphasizes economic and environmental sustainability)	(Paiola et al., 2021)
E-Business Process Efficiency in Retail (Focuses on tracking reorders, inventory items, product stock, and enhancing customer experiences)	(Shoukry et al., 2019)
Support for Servitized Business Models	(Ingemarsdotter et al., 2020)
Improved Tracking and Record Keeping of In-use and Post-use Products	(Ingemarsdotter et al., 2020; Nižetić et al., 2020)
Conditions Monitoring and Predictive Maintenance	(Ingemarsdotter et al., 2020; Paiola et al., 2021)
Improved Estimations of Remaining Lifetime of Used Products	(Ingemarsdotter et al., 2020)
Informed Design Decisions to Improve Product Durability	(Ingemarsdotter et al., 2020)
Amplified Information Exchange in Relationships	(Boehmer et al., 2020)
Safeguard Against Opportunism in Buyer-Supplier Relationship (Increasing potential for relational rents from relation-specific assets)	(Boehmer et al., 2020)
Creation of Formal and Informal Self-Enforcing Safeguards (Economic hostages and trust)	(Boehmer et al., 2020)

IoT-Challenges/Barriers	References
Security Issues	(Senthil & Easwaran, 2019)
IIoT Integration	(Rejeb et al., 2022; Senthil & Easwaran, 2019)
Connectivity and Visibility	(Senthil & Easwaran, 2019)
Data Confidentiality	(Kumar, 2019; Ng & Wakenshaw, 2017)
Cyber-Physical Systems Integrity	(Kumar, 2019; Rejeb et al., 2022)
Pivotal Establishment for Pairing of Devices	(Kumar, 2019)
Device Management	(Kumar, 2019)
Efficient Data Management Schemes	(Khan et al., 2020)
Collaborations between Heterogeneous IIoT Systems	(Alcayaga et al., 2019; Khan et al., 2020; Rejeb et al., 2022)
Robust and Flexible Big Data Analytical Technologies	(Khan et al., 2020)
Trust on IIoT Systems	(Demestichas & Daskalakis, 2020; Khan et al., 2020; Rejeb et al., 2022)
Coexistence of Wireless Technologies and Protocols in IIoT	(Khan et al., 2020)
Enabling Decentralization on the Edge	(Khan et al., 2020)
Emergence of IoT-Specific Operating Systems	(Ingemarsdotter et al., 2020; Khan et al., 2020; Rejeb et al., 2022)
Public Safety in IIoT	(Khan et al., 2020)
Lack of Structured Data Management Processes (to ensure high-quality data collection and analysis)	(Ingemarsdotter et al., 2020)
The Difficulty of Designing IoT-Enabled Products for Interoperability, Adaptability, and Upgradability	(Ingemarsdotter et al., 2020, 2020; Rejeb et al., 2022)
Privacy Concerns	(Kumar, 2019; Ng & Wakenshaw, 2017)
Insufficient Legislation	(Falkenreck et al., 2023)

IoT-Challenges/Barriers	References
Perceived Costs	(Falkenreck et al., 2023; Rejeb et al., 2022)
Data Complexity	(Falkenreck et al., 2023)
Compatibility Issues	(Falkenreck et al., 2023; Ingemarsdotter et al., 2020; Rejeb et al., 2022)
Lack of IoT Skill and Expertise	(Falkenreck et al., 2023)
Gaps in Technical Knowledge	(Falkenreck et al., 2023)
Hardware and Infrastructure Weaknesses	(Falkenreck et al., 2023)
Sustainability issues	(Rajput & Singh, 2021; Rejeb et al., 2022)
Value integration	(Alcayaga et al., 2019; Rejeb et al., 2022)

B2B Platforms-Benefits/Drivers	References
Digitalized interactive Platforms provide Functional Value	(He & Zhang, 2022; Pauli et al., 2025)
Improvement in Contextualization and Personalization	(He & Zhang, 2022)
Servitization as a Strategy for Value Capture	(Ehret & Wirtz, 2017)
Service Platforms and Service Innovation	(Lusch & Nambisan, 2015)
Value Co-creation, Transaction Costs, and Network Effects	(Friedrich et al., 2025; Veile et al., 2022)
Platform Companies' Market Value	(Matzner et al., 2021)
Necessity for Collaboration due to Digital Innovations	(Matzner et al., 2021)
Digital Platforms as Disruptors	(Matzner et al., 2021)
Platforms as attractive Business Models	(Ehret & Wirtz, 2017; Lusch & Nambisan, 2015; Matzner et al., 2021)

B2B Platforms-Benefits/Drivers	References
Complexity and heterogeneity in the problem domain	(Mourtzis et al., 2021; Pauli et al., 2025)
Lack of easy data availability and accessibility	(Mourtzis et al., 2021)
Lack of domain knowledge by researchers	(Mourtzis et al., 2021)
Greater need for improved marketing sophistication in B2B versus B2C	(Mourtzis et al., 2021)
Less academic competition in B2B than in B2C	(Mourtzis et al., 2021)
The global nature of B2B markets	(Mourtzis et al., 2021)
Challenges in configuring value creation, delivery, and capture in B2B platforms	(Böttcher et al., 2022; Friedrich et al., 2025; Ritala & Jovanovic, 2023; Volberda et al., 2021)
Competitive relationships and bargaining power with complementary firms	(Friedrich et al., 2025; Pauli et al., 2025; Ritala & Jovanovic, 2023)
Challenges implementing B2B platform business models	(Matzner et al., 2021)
Difficulties for incumbents launching and operating B2B platforms	(Matzner et al., 2021)
Strategic and competitive issues for platform leadership	(Matzner et al., 2021)
Unclear ownership of products and services	(Matzner et al., 2021)
Special requirements of B2B customers	(Friedrich et al., 2025; Matzner et al., 2021)
Inhomogeneous and highly specialized customer landscapes	(Matzner et al., 2021; Pauli et al., 2025)
Data security and privacy concerns	(Friedrich et al., 2025; Mancuso et al., 2024)

Digitalization + (Digital) Servitization-Benefits/Drivers-	References
Improved Energy Consumption and Environmental Performance	(Alfarisi et al., 2024; Asif et al., 2024; Beducci et al., 2025; Broccardo et al., 2023; Doni et al., 2019; Ghobakhloo et al., 2024; Hallstedt et al., 2020; Hernández et al., 2024; Kohtamäki et al., 2024; Kolagar et al., 2024; Kühl et al., 2023; Paiola et al., 2021; Pigola et al., 2025; Schiavone et al., 2022; Schwanholz & Leipold, 2020; Stabler et al., 2024; Vaillant & Lafuente, 2024; Ye et al., 2024; Zhang et al., 2022)
Remote Monitoring	(Boehmer et al., 2020; Langley, 2022)
Product Lifetime Databases	(Langley, 2022)
Remote Control	(Langley, 2022)
Automation	(Kowalkowski et al., 2024; Langley, 2022)
Value Creation via Digital Technology Transformation	(Brenner, 2018; Broccardo et al., 2023; Kowalkowski et al., 2024)
Minimized Downtime and Risk Transfer	(Agarwal et al. 2022; Boehmer et al. 2020; Grubic 2018; Nybacka et al. 2010b; Paschou et al. 2020; Visnjic et al. 2017)
Secure Data Transmission	(Nybacka et al. 2010b)

Digitalization + (Digital) Servitization-Benefits/Drivers-	References
Enhanced Customer Usage Performance	(Agarwal et al., 2022; Broccardo et al., 2023; Kolagar et al., 2024; Paschou et al., 2020; Watanabe et al., 2018; Weinman, 2016; Ye et al., 2024)
Customer Empowerment	(Mourtzis et al., 2021; Paschou et al., 2020)
Reduced Service Delivery Costs	(Allmendinger & Lombreglia, 2005; Paschou et al., 2020)
Enhanced Maintenance Efficiency and Effectiveness	(Boehmer et al., 2020; Goncalves, 2022; Grubic, 2018; Paiola et al., 2021; Paschou et al., 2020; Pigola et al., 2025; Rakyta et al., 2016; Rashid et al., 2025; Wan et al., 2017)
Improved Product Performance and Availability	(Ghobakhloo et al., 2024; Grubic, 2018; Kolagar et al., 2024; Opazo-Basáez et al., 2018; Paiola et al., 2021; Paschou et al., 2020; Ye et al., 2024)
Risk Mitigation	(Chirumalla et al., 2023; Grubic, 2018; Paschou et al., 2020; Ziaee Bigdeli et al., 2018)
Enhanced Competitiveness and New Business Opportunities	(Baines and Lightfoot 2013a, b; Brenner 2018; Bressanelli et al. 2018; Broccardo et al. 2023; Demirkan et al. 2015; Ghobakhloo et al. 2024; Grubic 2014; Kohtamäki et al. 2024; Kowalkowski et al. 2013; Lerch and Gotsch 2015; Linde et al. 2023; Paschou et al. 2020; Vendrell-Herrero et al. 2017; Ziaee Bigdeli et al. 2018)
Generation of New Revenue Streams	(Baines and Lightfoot 2013a, b; Demirkan et al. 2015; Iansiti and Lakhani 2014; Kamp et al. 2017; Linde et al. 2023; Paschou et al. 2020; Schuh et al. 2011)
Sustainable Business/Production Development	(Bressanelli et al., 2018; Georgakopoulos & Jayaraman, 2016; Ghobakhloo et al., 2024; Hernández et al., 2024, 2024; Holler et al., 2017; Mourtzis et al., 2021; Opazo-Basáez et al., 2018; Paiola et al., 2021; Paschou et al., 2020; Ye et al., 2024)
Value Delivery to Society	(Georgakopoulos & Jayaraman, 2016; Ghobakhloo et al., 2024; Lindström et al., 2018; Paiola et al., 2021; Paschou et al., 2020; Zhang et al., 2022)
Competitive, Demand-Based, and Economic Motivations	(Ferrari et al., 2022; Lamperti et al., 2024)
Improved Speed, Reaction Capacity, and Flexibility from Industry 4.0	(Müller et al., 2018)
Enhanced Inter-Company Connectivity	(Müller et al., 2018)
Financial, Strategic, and Marketing Benefits of Servitization	(Baines et al., 2009; Favoretto et al., 2022; Martinez et al., 2017)
Entrepreneurial Mindset and Disciplined Management	(Chirumalla et al., 2023)
Digital Technology Exploitation and Scalability	(Chirumalla et al., 2023)
Governance Structures for Data and Relationships	(Chirumalla et al., 2023)
Business Model Alignment within Ecosystems	(Chirumalla et al., 2023)
Network-Level Change and Transformation	(Chirumalla et al., 2023)
Competitive Advantage Maintenance or Gain	(Agarwal et al., 2022; Kowalkowski et al., 2013; Paluch & Wünderlich, 2016; Ulaga & Kowalkowski, 2022; Wan et al., 2017)
Environmental External Factors: Saturated Markets, Customer Pressure, Competition	(Ulaga & Kowalkowski, 2022)
Internal Company Motivations: Expertise Utilization, Customer Relationship Value, New Market Opportunities	(Ulaga & Kowalkowski, 2022)
Future Competitiveness from Digitalization	(Kamalaldin et al., 2020)
Socio-Cultural value	(Beducci et al., 2025; Ferrari et al., 2022; Ghobakhloo et al., 2024; Hernández et al., 2024; Kolagar et al., 2024; Lindström et al., 2018; Paschou et al., 2020)
Increased transparency	(Broccardo et al., 2023; Strandhagen et al., 2017)

Digitalization + (Digital) Servitization-Challenges/Barriers	References
Limited Understanding: Of customer value	(González Chávez et al., 2023; Langley, 2022; Rymaszewska et al., 2017)
Limited Understanding: Of the value delivery process	(González Chávez et al., 2023; Langley, 2022; Müller et al., 2018; Rymaszewska et al., 2017)
Limited Understanding: Of profit formulas	(González Chávez et al., 2023; Langley, 2022)
Technical/Technological Barriers	(Asif et al., 2024; Ferrari et al., 2022; Peillon & Dubruc, 2019)
Organizational Barriers	(Hallstedt et al., 2020; Peillon & Dubruc, 2019)
Human Resources Related Barriers	(Asif et al., 2024; Ferrari et al., 2022; Hallstedt et al., 2020; Peillon & Dubruc, 2019)
Customer-Related Barriers	(Peillon & Dubruc, 2019)

Digitalization + (Digital) Servitization-Challenges/Barriers	References
Efficient deployment and use of CRM software	(Peillon & Dubruc, 2019)
Monitoring customer equipment usage	(Peillon & Dubruc, 2019)
Addressing concerns about data control	(Langley, 2022; Müller et al., 2018; Peillon & Dubruc, 2019)
Fear of loss of control over information	(Peillon & Dubruc, 2019)
Privacy violations and security concerns	(Hallstedt et al., 2020; Langley, 2022; Peillon & Dubruc, 2019)
Access to production systems	(Müller et al., 2018; Peillon & Dubruc, 2019)
CRM Software Implementation Difficulties	(Peillon & Dubruc, 2019)
Interoperability issues with ERP systems	(Asif et al., 2024; Peillon & Dubruc, 2019)
Internal data access, input, and integration processes	(Peillon & Dubruc, 2019)
Digital Service Introduction Consequences	(Peillon & Dubruc, 2019)
Increased customer expectations	(Kohtamäki et al., 2019; Peillon & Dubruc, 2019)
Demand for continuous support	(Peillon & Dubruc, 2019)
Incentive Challenge in Sustainability Impacts	(Langley, 2022)
Legal Complexity in Flexible Servitization Services	(Langley, 2022)
Data Reliability Issues in Sustainability Gains	(Langley, 2022)
Flexibility	(Langley, 2022)
Transition of business model	(Langley, 2022)
Changing risk structure	(Langley, 2022)
Changing relationships	(Chirumalla et al., 2023; Langley, 2022)
Negotiation of incentives	(Langley, 2022)
Unclear societal response	(Langley, 2022)
Disruption through technology	(Langley, 2022)
Unpredictability	(Langley, 2022)
Changing power dynamics	(Langley, 2022)
Ecosystem governance	(Langley, 2022)
Role of trade associations	(Langley, 2022)
Crossing international boundaries	(Langley, 2022)
Interoperability	(Langley, 2022; Peillon & Dubruc, 2019)
Data-sharing risks	(Hallstedt et al., 2020; Langley, 2022; Müller et al., 2018; Peillon & Dubruc, 2019)
Data sovereignty	(Hallstedt et al., 2020; Langley, 2022; Müller et al., 2018; Peillon & Dubruc, 2019)
Trust issues	(Langley, 2022)
Legal frameworks	(Langley, 2022)
Reliability and validity of data	(Langley, 2022)
Complexity of decision making	(Langley, 2022)
Technological and Lifecycle Mismatches	(Langley, 2022)
Long-Term Viability and Circular Economy Progression	(Kohtamäki et al., 2019)
Environmental Impact Analysis and Responsibility Sharing	(Kohtamäki et al., 2019)
Customization and Novelty Adoption Barriers in Smart Solutions	(Kilinc et al., 2025; Kohtamäki et al., 2019; Linde et al., 2023; Müller et al., 2018)
Internal Capabilities and Customer Management Challenges	(Kamalaldin et al., 2020; Kilinc et al., 2025; Lamperti et al., 2024)
Risk Management Issues	(Lamperti et al., 2024)
Data security concerns	(Hallstedt et al., 2020; Müller et al., 2018)
Obstacles related to small batch sizes	(Müller et al., 2018)
Automation degree variability and machinery lifecycle stages	(Müller et al., 2018)
Commercial use of information gathered through Industry 4.0 technologies	(Müller et al., 2018)
Highly individual customer demands against standardized solutions	(Kohtamäki et al., 2019; Müller et al., 2018)
Partner Involvement and Knowledge Sharing Difficulties	(Chirumalla et al., 2023)
Competence Management and Cultural Gaps	(Chirumalla et al., 2023; Palafox-Alcantar et al., 2024)
Lack of Data Processing and Remote Monitoring Technologies	(Chirumalla et al., 2023)
Challenges in Transitioning to Reciprocal Long-Term Relationships	(Kamalaldin et al., 2020)
Costs	(Asif et al., 2024; Ferrari et al., 2022; Müller et al., 2018)
Geographical barriers	(Langley, 2022; Palafox-Alcantar et al., 2024)

Abbreviations

AI	Artificial Intelligence
B2B	Business-to-Business
CE	Circular Economy
FU	Functional Unit
GDL	Goods-Dominant Logic
IoT	Internet of Things
LCA	Life Cycle Assessment
PSS	Product–Service System
SDL	Service-Dominant Logic
WoS	Web of Science

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests
The authors declare that they have no competing interests.

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