

LITERATURE REVIEW

# Analysis of product-service system logistics strategies in e-commerce: a literature review

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## ABSTRACT

**Goal:** The main objective of this work is identifying product-service system logistics strategies present in e-commerce. In addition, this research aims to address two main research questions: (i) What are the product-service logistics strategies in e-commerce and how are the strategies applied? and (ii) What are the future research opportunities from the literature?

**Design / Methodology / Approach:** This paper performs a systematic literature review using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) method. Using this method, we established criteria for inclusion and exclusion of papers as well as better filters that, after applied during the literature review, we reached the final papers that will be included in the analysis.

**Results:** The main opportunity for applying PSS in e-commerce is related to the migration of logistics services to platforms, in which asset sharing between partners is a potential implementation being tested by start-ups and technological companies. Concerning the results related to the association of PSS and e-commerce, this is still a lack in the literature since many papers are more theoretical and fail to assess the benefits of practical adoption.

**Limitations of the investigation:** Research limitations of this research are according to the structure of the systematic literature review methodology.

**Practical implications:** The results may provide guidance for e-commerce retailers that choose to implement PSS strategies associated with logistics in their sales channels.

**Originality / Value:** This paper originality deals with the study of PSS strategies in e-commerce, since the combination of these approaches is still a research gap. Findings point out that e-commerce is still focused on physical products and the adoption of PSS strategies is not a common topic addressed in this context.

**Keywords:** Product-service system; Logistics; E-commerce; PSS.

## 1. INTRODUCTION

Retailers are facing the challenge of reinventing the traditional supply chain for the e-commerce era (Schweitzer De Souza et al., 2022; Brandao et al., 2021; Jones et al., 2021; Yadav et al., 2021; Aktas et al., 2020). Therefore, product and service information are available in real-time, resulting in a quick comparison between products for customers' purchase decisions (Jones et al., 2021; Seghezzi et al., 2021; Yang and Zhang, 2020; Pereira and Frazzon, 2019).

In this e-commerce scenario, data starts to be collected and processed to enable decisions and the development of organizational strategies. These data need to be analyzed so that they can be

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translated into new actions that enable the enhancement of the consumer experience during and after the purchase, for example in the logistics process (Seghezzi et al., 2021; de la Calle et al., 2020; Grant, 2019).

The product-service system (PSS) concept emerges in online commerce as the addition of service during product marketing (Souza, 2022; Kang et al., 2019). Through this strategy, a company starts being able to provide the customer besides the offer of a product, other complementary solutions that can attract them to the digital channel (Dain et al., 2019; Pan, 2019). Actually, logistics studies are consolidated for the product context, but there is still an insufficient exploration of the connection between logistics and PSS (Seghezzi et al., 2021). Since there may be a combination between those concepts to add value to the end user of e-commerce's channels (Grant, 2019), the practical examination of how the customers react to this possibility of strategy adopted by industries become a potential topic to be addressed in the literature.

Among these solutions and approaching logistics processes, the logistics product-service system (LPSS) is defined by Kang et al. (2019) as a systematic package in which logistics intangible resources are combined and associated with logistics services to complete various logistics activities. However, it still needs to be consolidated as a new concept in the literature (Kang et al., 2019; Luiz Schweitzer de Souza et al., 2019).

Logistics is a field that has a great opportunity for mitigation to provide services that can be translated into significant revenues for a retailer combined with PSS strategies (Souza et al., 2020; Premkumar et al., 2020; Souza et al., 2020; Stradioto Neto et al., 2020). However, this requires identifying possibilities for innovation in logistics businesses and which solutions have already been practiced or are under development (Kong et al., 2021). The PSS strategies can bridge the connection of logistics services with innovation since most of the strategies in PSS are created with the customer, enabling more precise solutions-oriented for daily problems (Kang et al., 2019).

There is still a research gap in the literature regarding the combination of product-service system strategies with logistics processes (Sousa and da Silveira, 2020; Altuntas Vural, 2017; Santos and Fukushima, 2017). In this context, retailers need to combine PSS strategies with logistics in order to become more profitable and increase the level of customer service (de la Calle et al., 2020). Thus, increasing the customer's attractiveness to the online sales channel and optimizing their rewards is necessary to create a quality comparison and minimize the impact on sales (Bayram and Cesaret, 2020).

Aiming to develop an analysis of the most suitable solution to integrate logistics processes in e-commerce environments combined with PSS strategies, this paper objective is to identify product-service system logistics strategies in e-commerce by performing a systematic literature review. In addition, this research is addressed by the following research questions: (i) What are the product-service logistics strategies in e-commerce and how are the strategies applied? and (ii) What are the future research opportunities from the literature?

This paper is organized as follows. Section 2 describes the research approach for the review. Section 3 presents the results by dividing them into a bibliometric analysis and a content analysis. Finally, Section 5 draws some concluding points for this work.

## 2. RESEARCH DESIGN

In order to achieve the main objective of this paper, a systematic literature review (SLR) was performed using the "Preferred Reporting Items for systematic review and meta-analysis" (PRISMA) method, proposed by Moher et al. (2010). The method consists of four main steps: (i) paper's identification, (ii) screening, (iii) eligibility, and (iv) inclusion. As the 'paper's identification' is the initial stage in an SLR (Uhlmann and Frazzon, 2018), it begins with a search for papers using the selected databases and the strings related to the subject. Scopus and Web of Science databases were chosen for data collection. Table 1 summarizes the research protocol for the systematic literature review.

**Table 1** - Literature review research protocol

Items	Description
Search string	((("logistic*" OR "marketplace*") AND ("product service system*"))
Document type	Articles published in peer-reviewed journal
Language	English
Research area	No limitation

Time span	Until December, 2022
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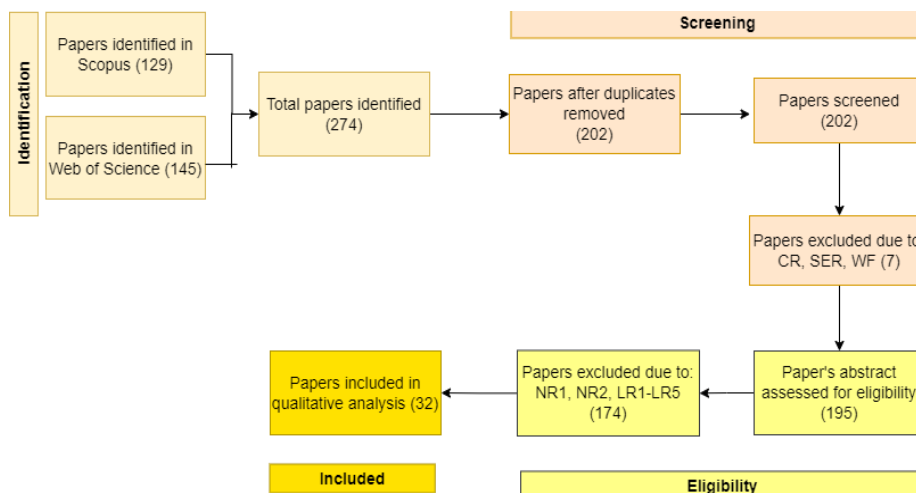
**Source:** Constructed by the authors based on the literature review criteria.

After the first step, software R® was applied to identify and remove duplicated papers, which were identified in both databases. In addition to the screening phase, other papers were discarded such as those did not have the full text in English (only part of it) and those that were not available for download. In the eligibility step, two authors read the title, abstract, and keywords of the selected papers aiming to select the ones according to the Closely related (CR) criteria of inclusion (see Table 2). the selection was then double-performed, considering the view of more than one author considering to the text content analysis and the CR criteria. Finally, after disconsidering the non-selected papers, the final portfolio consisted of 32 papers selected for full reading to extract data that can contribute to this research. Figure 1 depicts a diagram of the PRISMA method, including the number of papers in each step.

**Table 2 - Eligibility criteria**

Principle	Criteria	SLR
Inclusion	Closely related (CR)	The research content is explicitly dedicated to logistics strategies of product-service system
Exclusion	Search engine reason (SER)	Only a part of the paper is available in English, but not the full text
	Without full text (WF)	The full text of a paper is not available
	Non-related (NR)	NR1: Papers that are not academic article; NR2: Papers not in line with "logistics strategies of PSS"
Exclusion	Loosely related (LR)	LR1: "Logistics strategies" or "PSS" are only used as an example; LR2: "Logistics strategies" or "PSS" are used only to point to future research opportunities; LR3: PSS is used as a cited expression; LR4: "Logistics" or "marketplace" or "PSS" are used only in keywords and/or references; LR5: "Logistics" or "marketplace" studied outside the PSS context

**Source:** Constructed by the authors based on the literature review criteria.



**Figure 1 - Phases followed in the SLR based on the PRISMA method**

In terms of data analysis, a double review of the paper full-text was performed by two authors. The purpose was to extract relevant information to address the two research questions that guide this work. Using coding and the Mendeley® software enable to highlight the useful data from the publications. In order to do so, the main topics (e.g., logistics services platform and sharing economy service) of each paper, as presented in more details in Section 3, were categorized and analysed. In addition, by organizing the reading sequence indexed by the year of publication made possible to identify issues (e.g., research gaps) cited in the older publications were addressed in more recent studies.

Full-paper reading enables to interpret the contents related to the PSS strategies applied to PSS in e-commerce in addition to potential research opportunities. Firstly, data related to solutions for PSS strategies in the e-commerce context were extracted and organized. Then, an attempt was carried out to identify the practical implementation of each strategy, i.e., to find out real-life examples of PSS application in e-commerce. Finally, each research opportunity was categorised for further discussion considering the context of this study.

### 3. FINDINGS

This section firstly addresses a descriptive analysis, and secondly content analysis is presented based on the research questions in Section 1.

#### 3.1 Descriptive and key-word analysis

Table 3 shows the organized paper portfolio according to the year of publication and the papers per year. Even though the time horizon was not limited, the older study was published in 2011. The majority of papers were published in the past four years (from 2019 to 2022), evidencing an increased number of articles. This indicates that the combination of PSS with e-commerce is relatively new in the literature, possibly in its infancy stage of research.

**Table 3** - Final set of articles by the year of publication

Year	Publications
2022	Almunawar and Muhammad (2022); Lerch and Heidi (2022); Moro and Cauchick-Miguel, 2022; Moro et al. (2022); Pei et al. (2022); Tahi et al. (2022)
2021	Gaudenzi et al. (2021); Inna et al. (2021); Moro et al. (2021); Muller and Knitschky (2021); Tokarz et al., (2021); Vendrell-Herrero et al. (2021)
2020	de la Calle et al. (2020); Liu et al. (2020); Sousa and da Silveira (2020)
2019	Dain et al. (2019); Grant (2019); Hwang and Hsu (2019); Junge (2019); Kang et al. (2019); Lin C. and Lin M. (2019); Pan (2019); Pan et al. (2019); Sousa and da Silveira (2019)
2018	Aminoff and Hakanen (2018); Boojihawon and Ngoasong (2018); de Oliveira and Zotes (2018); Oláh et al. (2018)
2017	Altuntas Vural (2017)
2016	Gudergan et al. (2016); Zhang et al. (2016)
2011	Seliger (2011)

Source: Constructed by the authors based on the SLR development

A key-word analysis of the 32 publication was carried out by using the software VosViewer®. Figure 2 exhibits key-words relationship and uses colors according to the publication date (yellow: papers published since 2019; green: 2017-2019; light blue: 2015-2017; dark blue: before 2015).

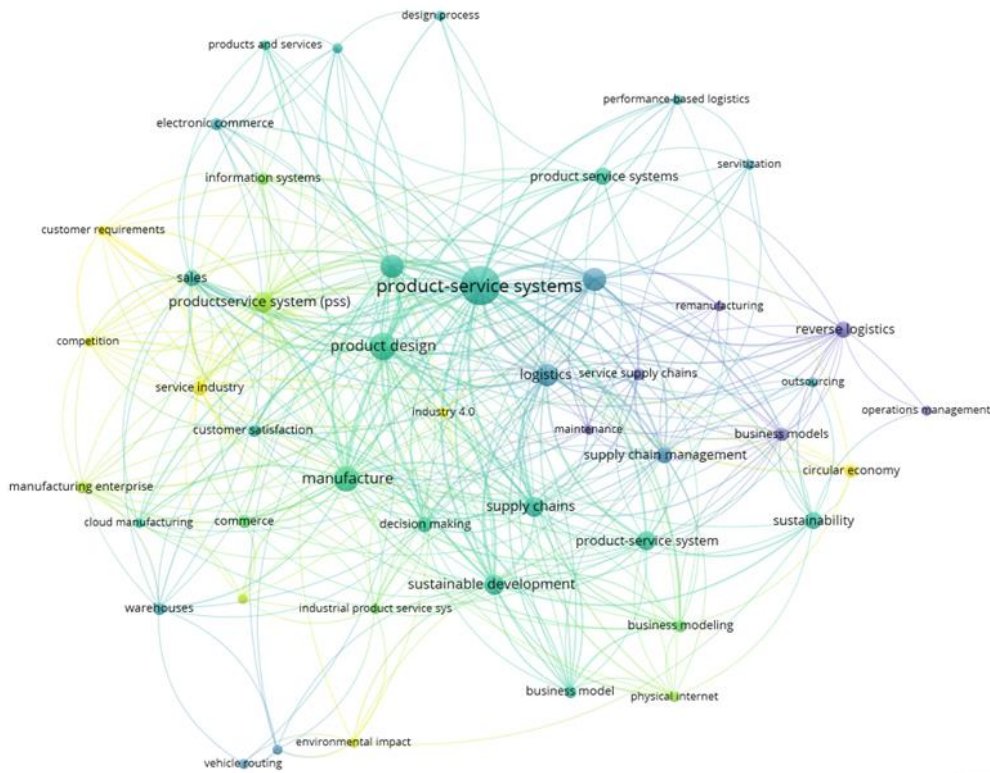


Figure 2 - Key-words when associating PSS with e-commerce

The analysis of Figure 2 shows that the most recent papers addressing PSS are being studied in the context of Industry 4.0, focused on customer requirements to the development of customized and individual solutions, and measuring the environmental impact of changing the traditional role of product-oriented industries to a PSS. In addition, product design and design process are topics being associated with PSS, which indicates studies comparing approaches and estimating the benefits of implementing a PSS to different categories of companies.

Based on the keywords analysis, this work locates the research topic of this study about PSS related to information systems, supply chain management, commerce, business modeling, and decision making. Considering that the main focus of this work is on e-commerce operations associated with PSS strategies, there are different areas (e.g. digital platforms, smart industries, last mile) and topics (e.g. product design, customer requirements, sharing economy) as research background to visualize the PSS subject in the context of e-commerce.

### 3.2 Content analysis

This section is dedicated to addressing the main research questions that guided this review: (i) What are the product-service logistics strategies in e-commerce and how are the strategies applied? and (ii) What are the future research opportunities from the literature?

#### 3.2.1 Findings on product-service logistics strategies in e-commerce

Figure 3 shows the frequency of strategies adopted in the context of this study. For instance, these strategies can be related to initiatives that are addressed as solutions for the context of product-service logistics strategies in e-commerce. The analysis considered strategies for the implementation of PSS pointed by the publications. Therefore, more frequently in the publications, Logistics Services Platform Integration and software-as-a-service (SaaS) is the most cited strategy.

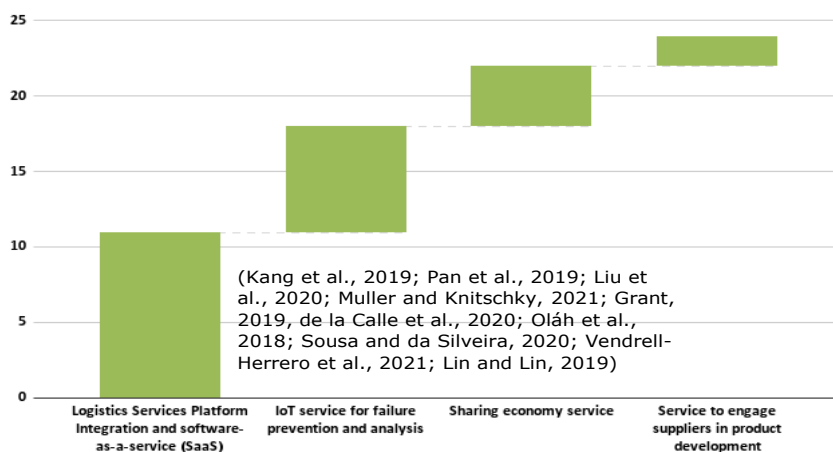


Figure 3 - Product-service logistics strategies

Recent studies (e.g., Almunamar and Muhammad, 2022; Muller and Knitschky, 2021; and Vendrell-Herrero et al., 2021; de Oliveira and Zotes (2018)) indicate that digitization-based strategies are important and that the key players providing this type of service for e-commerce retailers are startups. This may be explained due to the fact that startups are usually based on innovative services and therefore, they have the know-how for the development of these solutions.

Almunamar and Muhammad (2022) described the process of expansion of digital marketplace performed by startups, highlighting that their main differential is to offer attractive values to costumers and enable orchestrated collaboration. Junge (2019) also reviewed the digital transformation, but focusing on a sustainable perspective, in which the use of technologies in logistics processes and the digitalization provided in the sector is used to enable optimizing distribution distances and logistics resources, generating a positive impact on sustainable indicators.

Moreover, IoT service for failure prevention and analysis is the second strategy most cited in the studies. A consensus among various authors (e.g., Vendrell-Herrero et al., 2021; Gaudenzi et al., 2021; de la Calle et al., 2020; and Sousa and da Silveira, 2020) shows that the main strategy is based on providing services that are connected to the retailer's goods so that they can be monitored in real-time. This monitoring can be used for failure prevention, as well as for new strategies based on machine learning, which improve the relationship between the company and the customer by increasing the transparency during the process.

Sharing economy service is the third most mentioned strategy. The sharing economy strategy is directly related to platform solutions since people need to connect their goods to some technological solution in order to be able to provide the logistic service. In addition, there is a win-win relationship in this operation (Lerch and Heidi, 2022; Muller and Knitschky, 2021; Kang et al.; 2019; and Pan et al., 2019). Lerch and Heidi (2022) studied the impact of digital platforms in the logistics sector using the concept of platform economy, and the authors discover that nodes in the supply chain are being created and connected through platforms for product development, to offer product-service or to address digital production.

Service to engage suppliers in product development is another strategy cited in the studies. This strategy represents the provision of services by all players in the supply chain to add value to the e-commerce, thus enhancing the consumer experience (Gaudenzi et al., 2021). In this sense, this strategy is based on supply chain dynamics, integrating processes and information from different actors in the chain to provide a better experience to the final customer.

Based on the review, four main strategies were identified in the literature related to PSS in e-commerce. The results highlight that the use of logistics services platform as a solution that has been adopted and supported by startup solutions, is one of the most important and practical strategies. Examples are well-known companies (e.g., Amazon), and, in general, sharing economy services.

Even though most of the strategies cited about logistics services platform as a solution are still in the initial stage of development and practical results in industries, this work analyzed the contents related to the experience in the implementation stage. Dain et al. (2019) report that the experience with the product-service logistic is strategic and risky for the following reasons: (i) the project requires a long-term partnership where the service quality plays a primary role, and which involves shared risks and benefits; and (ii) the logistical objectives are very ambitious.

Another benefit of product-service logistics is related to customization (Sousa and da

Silveira, 2019). The authors stated that the customization effect takes place even after accounting for the indirect effect of a product via offerings, which means that the interactions with customers during the product design/configuration stages seem to leverage the ability to offer additional solutions associated with customer requirements, beyond the interactions that take place with customers. This process occurs due to fact that interactions in the delivery stages are oriented to the customer's processes of value creation, complementing those that occur more strongly focused on basic product operation (Sousa and da Silveira, 2019).

In the context of manufacturing strategy, Sousa and da Silveira (2020) suggested that highly competitive markets business units may emphasize product and service differentiation to build entrance barriers and develop stronger customer relationships (e.g., long-term service contracts associated with products). In heterogeneous markets, managers may create channel differentiation efforts to satisfy unfilled market niches in technologically dynamic markets.

Manufacturing enterprises are allowed to submit their idle logistics resource or requirement via a cloud platform in a sharing manner (Kang et al., 2019). According to current practices, Pan (2019) presented two types of logistics platforms: (i) warehouses (for cross-docking or inventorying) that are rarely shared between different actors; and (ii) terminals (including railways, waterways, ports, and airports) that are used by different actors for freight transit. Muller and Knitschky (2021) described other platforms as an industrial internet platform for connecting industrial equipment, collecting field data, and facilitating the development of digital services such as remote monitoring and predictive maintenance. The second one is a cloud environment for the low-code deployment of mobile applications.

In this direction, a 3PL can serve as a tangible (physical) smart PSS provider, while the 4PL can be seen as an intangible (informational) smart PSS provider, and the 5PL is adopted as both tangible and intangible provider. Moreover, all of them can be product-data generators as platform solutions (Pan et al., 2019). According to Booiijhawon and Ngoasong (2018), the 4PL and the 5PL are emerging as new digital business models of platform solutions. Grant (2019) highlights that to add product value to product-service logistics, the use of a 4PL in the logistics process is highly positive. This possibility is precisely what makes the study of digital capabilities more likely to foster the development of product-service innovation and servitization as the first stage of the process more relevant (de la Calle et al., 2020). Moreover, the level of service can be increased by aligning logistics and e-commerce, as the customer have a larger range of products, and orders can be simplified and tracked (Oláh et al., 2018).

In this context, once there are technological solutions, the IoT becomes imperative. Computing processes, taken together, serve as fundamental nodes that enable companies to aggregate real-time information from suppliers and customers in developments (Vendrell-Herrero et al., 2021). These processes facilitate the customer integration into co-creation initiatives aiming to develop product-service logistics, as the previous authors defend.

The existence of an intangible service serves to allow manufacturers to share their idle logistics resources (King et al., 2019). There are platforms that contribute to sharing goods. One of the most famous platforms to share idle resources is called collaborative consumption, which can be simply described as a peer-to-peer (P2P) product or service sharing based on a consumer-to-consumer (C2C) network, e.g., carsharing or crowd-shipping (Pan, 2019).

Consequently, it is important how the sharing of information, services and products can be achieved in the logistics industry. PSS is an innovative model to realize the sharing approach (Zhang et al., 2016). However, the strategies need to be aligned with PSS so that they can be converted into service strategies, either being from the carrier to the retailer, or from the retailer to the customer. Once these logistics PSS solutions are presented in the literature between the actors in the chain and not just for the customer.

The support provided between the actors in the chain is a pre-requisite for cooperative commitment and is highly valued by distributors and results in added value to the customer (Aminoff and Hakanen, 2018). Nevertheless, valuable the support is. Companies seem to lack the resources to develop truly collaborative relationships with a value co-creation approach with existing distributors and they need a partnership, showing dedication and respect.

The logistics PSS strategies in the literature are first connected and interlinked with the use of tooling service between a carrier and a retailer, to later aggregate and enable the retailer to develop PSS strategies for its customers. Thus, the use tools and logistics PSS strategies already established between the actors in the chain for the combination of processes correlating PSS and e-commerce is strongly recommended in these scenarios. From the review of how the strategies are applied, it can be visualized that the logistics context is passing through a digital transformation, in which solutions connecting actors in the logistic channel and enabling the customer to be more active in the business process are being addressed. Moreover, there is an opportunity to mitigate from product-oriented strategies to a PSS strategy, which facilitates the adoption of solutions designed directly to solve a problem identified by a customer. In addition, the PSS strategies can be

implemented in the context of sharing economy, in which different actors use the same system to develop their operations, having financial benefits and minimization of idle resources.

The contents analyzed in the papers were divided into three perspectives, as can be seen in Table 4. The analysis is divided according to the point of view of retailer, carrier, and the customer. The retailer, when using PSS logistics strategies has the most gains compared to carriers and customers since the suggested strategies facilitate daily activities that are already being tested in their context. Simultaneously, these gains are reflected in the customer's experience in their digital e-commerce channel. The carrier that performs the logistical transportation process between these two actors is the one who practices the operation and provides this reduction.

**Table 4** - Perspectives resulting from the content analysis

For retailers	For carriers	For customer
<ul style="list-style-type: none"> <li>- New revenue streams</li> <li>- Reduce costs by sharing idle logistics resource</li> <li>- Use of cheaper logistics resources</li> <li>- Customer retention</li> <li>- Real-time control of the logistic process</li> <li>- Quick solution in platforms</li> <li>- Technological innovation</li> <li>- Freight auction among several carriers</li> <li>- Connection with carrier hubs (4PL)</li> <li>- Establishing a customer experience aligned with expectations</li> <li>- Artificial Intelligence (AI)</li> <li>- Express delivery</li> <li>- Reduction of devolution</li> <li>- Reduction of failed deliveries</li> <li>- Pollutant emission reduction</li> <li>- Optimized routes with vehicle sharing</li> <li>- Real-time tracking</li> <li>- Better relationship with the actors in the logistics chain</li> <li>- Increase in sales</li> <li>- Strategic data analysis</li> </ul>	<ul style="list-style-type: none"> <li>- New revenue streams</li> <li>- Reduce costs by sharing idle logistics resources</li> <li>- Customer loyalty</li> <li>- Technological innovation</li> <li>- Participate in freight auctions with other carriers</li> <li>- Artificial Intelligence (AI)</li> <li>- Connection with hubs</li> <li>- Adaptation to the retailer's needs</li> <li>- Better cargo routing</li> <li>- Pollutant emission reduction</li> <li>- Optimized routes with vehicle sharing</li> <li>- Online monitoring of vehicles</li> <li>- Better price and performance of the freight price</li> </ul>	<ul style="list-style-type: none"> <li>- Freight Price reduction</li> <li>- New logistics services through innovation</li> <li>- Real-time information</li> <li>- Reduction of freight time</li> <li>- Fulfillment of needs</li> <li>- Reduction of customer service contact</li> <li>- Real-time tracking</li> <li>- Increase attractiveness of the digital channel</li> </ul>

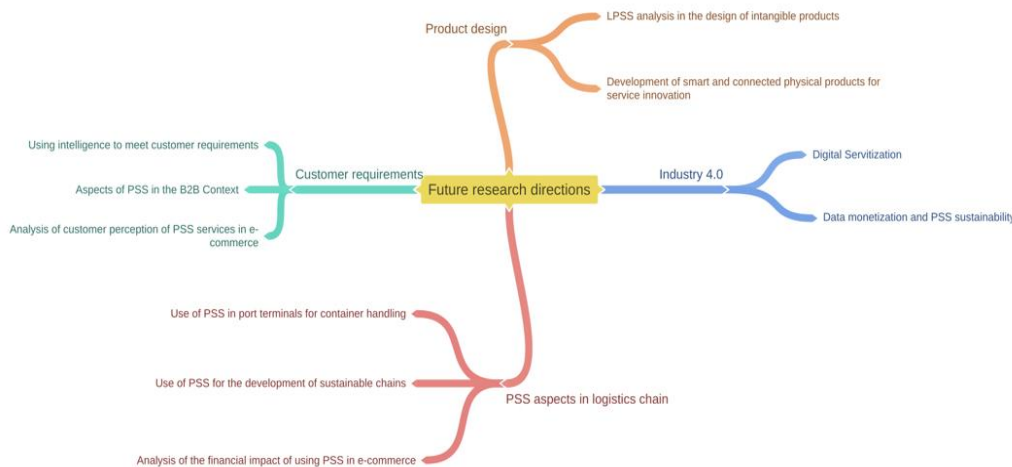
**Source:** Constructed by the authors based on the literature review.

The rise of technology and the consequences for innovation in terms of offering new services is the main focus of this research, since retailing customers in online retail shopping via e-commerce is one of the main focuses of omnichannel retailing. The association of PSS with the solutions visualized for e-commerce attribute many results in terms of technology, costs, and value in the consumer experience. Establishing this association contributes to increased sales. Once the customer is attributed to better logistics services, coming from PSS strategies, the relationship between the carriers treating the retailer as their customer and offering PSS solutions is also a differential that contributes to these results. The PSS strategies in this situation are involved between the retailer and the carrier, causing a positive reflection for the customer. In addition, the retailer can explore and apply more PSS strategies during the logistics process of their deliveries.

### 3.2.2 Opportunities for future research

This review identified future research directions based on the publications. Figure 4 illustrates four main categories ('product design'; 'industry 4.0'; 'customer requirements'; and 'PSS aspects in the logistics chain') that were found out from the content analysis. In addition, those main categories are then deployed in relevant topics in the context of PSS.





**Figure 4** - Categories and topics for future research in the PSS context

Concerning ‘product design’ in Figure 4, this work identified that LPSS analysis in the design of intangible products is a research subject with potential to be explored. According to Kang et al. (2019), the provision of idle logistics resource sharing for promoting LPSS is a challenge for the design of intangible products. Additionally, we identified that the development of smart and connected physical products for service innovation is a prominent topic in the literature, especially considering the implementation and assessment of smart technologies in the context of Industry 4.0, as cited by Pan et al. (2019). The adoption of smart and connected products is being demanded by customers, so the development of products in the context of smart product-service systems seems relevant to reveal practical opportunities for companies.

Digital servitization is receiving more attention in the context of ‘industry 4.0’ in the past few years. Nevertheless, there is still a lack of studies to define the operationalization of this concept in parallel to the use of smart and integrated resources in manufacturing industries (Gebauer et al., 2021; de la Calle et al., 2020). Moreover, a challenging topic in the context of Industry 4.0 is to consider sustainability in the logistics operation management of PSS activities without affecting data monetization (Moro and Cauchick-Miguel, 2022; Gebauer et al., 2021; Junge, 2019). Therefore, the analysis identifies that PSS seems to be a trend in industry 4.0. Furthermore, the combination of PSS with innovative solutions being explored in the literature (e.g., adopting IoT to improve the logistics efficiency in PSS platforms) can promote several gains for the actors involved in this partnership between the provider of technology and the logistics company, and the operational strategy.

Regarding ‘customer requirements’, three main topics that demand further studies can be raised: (i) use of data intelligence to meet customer requirements; (ii) PSS in the Business to Business (B2B) context, and (iii) analysis of customer perception of PSS services in e-commerce. Thus, related to (i), the use of intelligence to automatize and collect data in industries is already a reality in the context of companies operating with PSS. Indeed, achieving customer requirements is of main interest for managers, which creates an opportunity to use intelligent algorithms and technologies to collect and process data and enable the anticipation of trends and customers’ requirements (Lin and Lin, 2019).

Moreover, a business strategy followed by many companies is related to B2B, which requires a different perception of PSS development in comparison to Business to Customer (B2C) relationship. Then, the investigation of aspects related to product and service design integrated with the context of B2B is a potential topic to be addressed already raise de la Calle et al. (2020). Furthermore, considering the adoption of PSS combined with e-commerce, the analysis of customers’ reaction and preferences was also addressed by Oláh et al. (2017). This may contribute to the construction of a more realistic model for operating under these circumstances.

Concerning the ‘PSS aspects in the logistics chain’, the first topic is the use of PSS in the operation of ships and port terminals for container handling considering the specificities of the port sector, in addition to the urgency of transport in the e-commerce context (Baines, 2015). Additionally, as seen in the industry 4.0 subject, the development of sustainable operations is a relatively new topic not only for an individual company but also for the entire chain (Liu et al., 2020). Müller et al. (2021) also suggest the analysis of the financial impact of using PSS combined with e-commerce, since the

literature does not have quantitative indicators in this context.

Based on the future research directions, PSS study is evolving with different topics and being explored in different contexts (e.g., e-commerce, logistics, manufacturing, port sector) since the transformation of industry strategies from product offering to a PSS operation is becoming more frequently. Concerning to the application of PSS with e-commerce, there seems to exist a lack of information and performance measures (financial or operational) related to the combination of these approaches, which raise different opportunities to be studied.

### **3.2.3 Practical and research findings**

Thus, after addressing the main points that guide this review, it can be seen that the research findings of this study are related to the logistics strategies used in product-service systems. In this sense, it was identified that startups are the main character responsible for the digitalization in logistics operations, since the startups create the innovative and collaborative environment for companies to migrate from regular operations to the digital using platforms.

Moreover, the implementation of digital platforms in the e-commerce is contributing for the creation of a new node in the supply chain, in which the digital platforms connect stakeholders and enable product-service strategies. In practice, this transformation in the role is being seen in many sectors and the digital enablers offer product-service strategies to industrial and logistics companies to digitalize their processes using digital platforms and explore the e-commerce sector.

One example of product-service system in logistics is presented by Moro and Cauchick-Miguel (2022). The authors detailed the business model perspective of a bike-sharing system implemented in Brazil, and it can be expanded by different sectors or even to the delivery of goods in the last mile using bike-sharing systems by deliveries employees. Thus, the research and practical findings of our study can be summarized as the identification of logistics strategies in the context of product-service systems and the presentation of technologies, platforms and business model to implement PSS in logistics operation.

## **4. CONCLUSIONS**

The main objective of this paper was to analyze the product-service logistics strategies present in e-commerce by performing a systematic literature review by addressing two research questions related to both subjects. In this sense, the paper contribution can be seen in the investigation of PSS strategies in e-commerce, since the combination of these subjects is still a literature gap. This study found out that e-commerce is still focused on physical products and the adoption of PSS strategies is not a common topic addressed in this context.

In addition, based on the two main questions that guided this review, this work identified that the main opportunity for applying PSS in e-commerce is related to the migration of logistics services to platforms, in which asset sharing between partners is a potential implementation being tested by start-ups and technological companies. Moreover, this study identified that PSS is being implemented with the use of smart containers, in which the companies contract only the use of the container and the smart information related to technologies. Thus, when relating the application of PSS in e-commerce services, this work suggests that the strategy should use platform solutions with assets being connected by smart technologies, such as IoT.

The combination of PSS and e-commerce is still a lack in the literature since many papers are more theoretical and fail to assess this relationship. Nevertheless, this work identified that the solutions are related to new revenue streams from sharing economy, integration among actors in the logistics chain, real-time monitoring of cargo, scripting, improvement in the relationship with customers, sharing data with clients to improve the experience, connection of equipment enabled by smart technologies, and data monetization. Furthermore, the future research directions look promising, as discussed by identified categories: 'product design', 'industry 4.0', 'customer requirements', and 'PSS aspects in the logistics chain'.

The method applied to review the literature in this paper was the PRISMA, which demonstrates to be an efficient guide to avoid biases and select the most suitable portfolio of studies to be considered. The results achieved by this review also point out that PSS is evolving with the use of smart and connected technologies, and new topics are emerging to be addressed, such as the application of PSS in the e-commerce environment. Finally, although this work has addressed this research objective, the results would be extended by expanding the review for outside the academic context, through the identification of best practices implemented by companies of e-commerce that are adopting PSS in their operations.

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