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The effects of digital servitization on business competitiveness: A case study of Spanish manufacturers

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Abstract

In recent years, interest has grown in servitization strategies as business models for selling combined packages of goods and services to create competitive advantage to provide great customer value. Various studies have examined the benefits servitization offers to both businesses and their customers; however, there is very little research on the moderating role played by the digital enablers of Industry 4.0 on servitization. It is this research gap that the present study aims to fill. Using a framework developed from the extant literature, case studies, with an exploratory objective, were conducted to the aim of identifying and analyzing the challenges and opportunities that could be presented in those companies that decide to develop digital servitization. To achieve it, this study focuses on a deep analysis of the experience in five manufacturing companies, and, from that, we draw significant conclusions (both for further research and for business practice) about the strategy of servitization and the moderating role of Industry 4.0 on business competitiveness. We first carried out detailed interviews with key personnel from companies, complementing that with additional information from various sources before analyzing the results to identify emerging topics. The qualitative study allowed us to highlight how the different kinds of digital technologies supported servitization and product innovation. In addition, it provides empirical evidence about the different servitization strategies and Industry 4.0 digital enablers, which, in combination, allows companies achieving increased competitiveness, generate greater returns, find new customers, access new markets, and develop new business ideas.

Keywords Business competitiveness · Case study · Digitalization · Industry 4.0 · Digital servitization · Strategy

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Introduction

The industrial sector is currently dealing with a dual problem. On the one hand, the importance of industrial production is declining, while on the other, and for some years now, the activity of companies that provide services has been growing. Faced with that, various companies have realized that it is not enough to solely offer goods—they need to provide additional services demanded by their customers, which properly complement the goods they offer (Vandermerwe and Rada 1988).

In this regard, Baines and Lightfoot (2013) suggest that offering services would be a good idea for any company, because by offering more complete products (goods with services added), they would be adding value to their products and therefore to their customers (greater benefits) (Baines et al. 2009b, 2011, 2017; Biotto et al. 2012; Davies et al. 2007; Gebauer and Fleisch 2007; Johnson and Mena 2008; Koudal 2006; Lindman et al. 2016; Raddats et al. 2019; Tischner et al. 2002; Tukker and Tischner 2006), improving their competitive advantage (Grant 1991; Slack et al. 2004). Wise and Baumgartner (1999) state that adding services to the initial offering of tangible goods does not require great asset investment compared to manufacturing goods but, instead, provides consistent returns and improved profit margins (Biotto et al. 2012; Davies et al. 2007; De la Calle and Freije 2016; Gebauer and Fleisch 2007; Johnstone et al. 2009; Koudal 2006; Martín-Peña et al. 2017; Raddats et al. 2019).

It is clear therefore that a company that limits itself to only producing goods may struggle in terms of profitability faced with such a competitive market. Wise and Baumgartner (1999) note that goods do not provide sufficient competitive advantages for manufacturers, meaning that they are finding new sources of value in services. In other words, companies see commercial possibilities in the inclusion of services with the goods they traditionally offer (Martín-Peña et al. 2017), through which they seek a competitive advantage by meeting their customers' needs via the combination of goods and services (Davies et al. 2007; Grant 1991; Kowalkowski et al. 2017; Lindman et al. 2016; Mont 2002; Ostrom et al. 2010). Because of this, if companies wish to remain in the market, they may need to redesign their current business models (Barquet et al. 2013; Martín-Peña et al. 2017, 2018; Sandström et al. 2008; Tukker 2015) and include ever-more innovative services to their product offerings (Davies 2004; Davies et al. 2007; De la Calle and Freije 2016; Favoretto et al. 2022; Gebauer and Fleisch 2007; Kans and Ingwald 2016; Koudal 2006; Lee et al. 2014; Martín-Peña et al. 2017; Mont 2003; Naik et al. 2020; Paiola and Gebauer 2020). This is the situation that drives companies along the path toward servitization.

According to Kamp and Alcalde (2014), servitization not only benefits the company in terms of their customers but also internally, for example, by lengthening the life of machinery (by producing more durable, better quality products), as well as improving processes by making them more efficient (optimizing materials and costs) (Ayala et al. 2019; Oliva and Kallenberg 2003). Similarly, when companies start to use digital technologies (Industry 4.0 enablers), servitization

is a powerful ally when it comes to offering new, innovative goods and services (Ayala et al. 2019; Davies et al. 2007; Eggert et al. 2011; Favoretto et al. 2022; Gebauer and Fleisch 2007; Ibarra et al. 2018; Kans and Ingwald 2016; Kohtamäki et al. 2019, 2020b; Koudal 2006; Lee et al. 2014; Martín-Peña et al. 2018; Mont 2003; Naik et al. 2020; Navarro and Sabalza 2016; Paiola and Gebauer 2020; Paschou et al. 2020; Santamaría et al. 2012; Tian et al. 2022).

That said, Gebauer (2008), Mathe and Shapiro (1993), Mathieu (2001), Neely et al. (2011), and Visnjic and Van Looy (2013) state that in order for an organization to introduce servitization, it must be aware of everything involved, both from a business point of view—the need to innovate in services, to transform the initial business idea, to generate new value proposals, and to face possible obstacles to change—and from the customer perspective —customers who are unwilling to change, unable to adapt to advances in technology, or who have a culture of ownership or interest in possessing "things." For this reason, the company that embarks on a servitization strategy must make this change in a planned, well-structured manner (Kamp 2016a; Tuli et al. 2007); otherwise, they will probably not be as successful as they wish (Benedettini et al. 2015).

Bearing all of this in mind, the aim of this paper is to use case studies to show the advantages servitization offers to companies as part of their activity and as a competitive strategy (Davies et al. 2007; Grant 1991; Koudal 2006; Reim et al. 2015), and how working together with digital technologies can enhance these advantages. To do that, empirical evidence is provided about the different servitization strategies and possible tools—such as Industry 4.0 digital enablers—which, together, allow businesses to reap various benefits such as finding new customers, opening new markets, developing new business ideas, being more competitive, and increasing profitability (Davies et al. 2007; Gebauer and Fleisch 2007; Johnstone et al. 2009; Khanra et al. 2021; Koudal 2006; Martín-Peña et al. 2017; Mont 2003; Naik et al. 2020; Paiola and Gebauer 2020; Paschou et al. 2020; Raddats et al. 2019; Tian et al. 2022).

The paper is structured as follows: the second section covers the theoretical framework for the study, based on the literature on servitization (as a concept and as a strategy), product-service systems (PSS), Industry 4.0, and how servitization and Industry 4.0 digital enablers can help revitalize manufacturing industry. The third section identifies the research aim/objective and the research questions. The fourth section presents the study methodology. The fifth section describes the results of the case study. The final section presents the main conclusions and limitations of the study and future lines of research.

Theoretical framework

Servitization

Santamaría et al. (2012) indicate that development and supply of services have become a significant part of the growth of the economy and in productivity—in the case of Spanish companies, the development and supply of services are changing

manufacturing companies' structures, making them more like service companies, occasionally leading to many of them making significant changes to their businesses—growth that has gained momentum through the use of advanced technology (Ayala et al. 2019; Favoretto et al. 2022; Ibarra et al. 2018; Kohtamäki et al. 2019; Lee et al. 2014; Martín-Peña et al. 2018; Paiola and Gebauer 2020; Sandström et al. 2008; Tian et al. 2022; Tukker 2015). The modern customer seeks customized services that can meet their needs (Mont 2002). In response, businesses have to supply high-quality goods and services tailored to customer expectations and requirements (Kohtamäki et al. 2020b; Lee 2018; Martín-Peña et al. 2018; Ostrom et al. 2010; Vargo and Lusch 2008).

Baines et al. (2009a, 2011), De la Calle and Freije (2016), Johnson and Mena (2008), Lindman et al. (2016), and Mathe and Shapiro (1993) indicate that various types of businesses have already begun to develop and supply services as part of their offerings in order to achieve their strategic goals (competitive advantage) (Grant 1991; Koudal 2006; Reim et al. 2015), financial goals (greater profitability) (Davies et al. 2007; Gebauer and Fleisch 2007; Johnstone et al. 2009; Khanra et al. 2021; Koudal 2006; Martín-Peña et al. 2017; Raddats et al. 2019), and marketing goals (product differentiation, customer loyalty) (Durugbo 2014; Gaiardelli et al. 2014; Saccani et al. 2014; Vandermerwe and Rada 1988; Verstrepen et al. 1999). Along similar lines, Lay et al. (2009) also note that manufacturing companies are becoming service organizations (Bustinza et al. 2015).

In this regard, Levitt (1972) states that there is no, or that there should be no, exclusive demarcation between goods and service sectors, maintaining that goods and services exist in both sectors in different proportions. For this reason, it is impossible for there to be an industrial sector without some part of its activity dedicated to services, even if that activity is mainly focused on production of goods. Similarly, Albrecht and Zemke (1991) note that the economy in which companies operate is a service economy, and for that reason, they must include services if they wish to continue competing in the market.

The concept of servitization was defined for the first time by Vandermerwe and Rada (1988), who observed many companies seek greater competitiveness following the trend of adding services to their businesses in order to differentiate themselves from their competition (Ayala et al. 2019; Davies et al. 2007; Durugbo 2014; Gebauer and Fleisch 2007; Koudal 2006; Wise and Baumgartner 1999). Baines et al. (2011), Johnson and Mena (2008), Lindman et al. (2016), Martín-Peña et al. (2017), and Ren and Gregory (2007) define servitization as the action of offering services in combination with goods, with the aim of providing greater added value to the customer (Davies 2004; Davies et al. 2007; Gebauer and Fleisch 2007; Koudal 2006; Lindman et al. 2016; Raddats et al. 2019). This would mean companies need to redefine their business models (Barquet et al. 2013; Martín-Peña et al. 2017; Tukker 2015)—made up of the strategies they implement, the operations the business carries out, and the value chain they pursue (Martin Peña and Ziaee 2016)—toward innovation (De La Calle and Freije 2016; Manzini and Vezzoli 2003; Martín-Peña et al. 2018; Mont 2003; Sandström et al. 2008; Tukker 2015), with the objectives of discovering, analyzing, and understanding the services that they aim to offer their customers (Davies 2004).

Similarly, Bustinza et al. (2015), Cusumano (2008), Kowalkowski et al. (2017), and Martín-Peña et al. (2017) note that more and more manufacturing companies are beginning to offer services in addition to their traditional product portfolios, which is a characteristic of a servitization strategy. In addition, Johnson and Mena (2008) highlight that the new trend of servitization has given the services provided a more important role, elevating them to being thought of as generators of undoubtable added value for the customers (Davies et al. 2007; Gebauer and Fleisch 2007; Raddats et al. 2019).

Subsequently, Baines et al. (2011) proposed a new concept of servitization: the process of generating competencies or capabilities of added value that manufacturing businesses need (Adrodegari and Saccani 2017; Baines and Shi 2015; Gaiardelli et al. 2014; Gebauer et al. 2005; Grant 1991; Khanra et al. 2021; Kreye et al. 2015) in order to offer new services and solutions to their customers (Brady et al. 2005; Brax 2005; Davies 2004; Kans and Ingwald 2016; Kohtamäki et al. 2020a; Manzini et al. 2001; Neely et al. 2011; Nordin and Kowalkowski 2010; Ostrom et al. 2010; Tuli et al. 2007; Vandermerwe and Rada 1988; Windahl and Lakemond 2010; Wise and Baumgartner 1999) goods beyond simply producing (Kohtamäki et al. 2020a; Tuli et al. 2007). In other words, servitization consists of innovating current capabilities, which will allow companies to maintain their competitive advantage (Barney 1991; Brax and Jonsson 2009; Grant 1991; Kreye et al. 2015; Manzini et al. 2001; Santamaría et al. 2012) in order to go from only selling goods to selling goods in combination with services, thus adding value to what they offer (Brady et al. 2005; Davies et al. 2007; Gebauer and Fleisch 2007; Koudal 2006; Lindman et al. 2016; Raddats et al. 2019). Nonetheless, these capabilities should be distinct from those of their competitors (Kimita et al. 2022; Raddats 2011; Winter 2003) and sustainable over time (Barney 1986; Raddats 2011).

Benedettini et al. (2015) and Neely et al. (2011) define servitization as making changes within companies (Baines et al. 2017; Gebauer and Fleisch 2007; Gebauer and Kowalkowski 2012; Kohtamäki et al. 2019; Manzini et al. 2001; Mathieu 2001; Mont 2003; Parida et al. 2014; Tuli et al. 2007; Zhang and Banerji 2017), mostly manufacturing companies, in order to produce competences that will be useful in providing their customers with new alternatives in their offerings (Baines et al. 2009b; Brax 2005; Davies 2004; Gaiardelli et al. 2014; Kans and Ingwald 2016; Windahl and Lakemond 2010), creating integrated systems of goods and services (Lindman et al. 2016). In the same way, Bustinza et al. (2015) and Kamp (2016a) state that manufacturing companies have faced and are facing rapid changes in their business structures, all focused on the implementation of services within their organizations (Baines et al. 2017; De La Calle and Freije 2016; Gebauer and Kowalkowski 2012; Kohtamäki et al. 2019; Kolagar et al. 2022; Manzini et al. 2001; Manzini and Vezzoli 2003; Mathieu 2001; Mont 2003; Parida et al. 2014; Raddats et al. 2019; Zhang and Banerji 2017). Along these lines, Baines et al. (2009b, 2011), De la Calle and Freije (2016), Johnson and Mena (2008), Lindman et al. (2016), and Kamp (2016b) note that a company that decided to put servitization into practice would see benefits in creating new forms of profitability (new business opportunities) (Davies et al. 2007; Gebauer and Fleisch 2007; Johnstone et al. 2009; Khanra et al. 2021; Koudal 2006), improvements to efficiency in product implementation

(Brax and Jonsson 2009), differentiation from the competition (Ayala et al. 2019; Ibarra et al. 2018), and creating barriers to entry for new competitors (Durugbo 2014), understanding customer needs and tastes (Mont 2002; Ostrom et al. 2010), and improving the B2C (business to customer) experience, increasing trust and credibility (Davies et al. 2007; Gebauer and Fleisch 2007; Koudal 2006).

The study of servitization is not very recent, the first definitions having appeared over 30 years ago. Nonetheless, Baines and Lightfoot (2013) and Martín-Peña and Ziaee (2016) state that the interest it has generated led many businesses to begin to apply it to their entire organizations (management, marketing, and operations, among others). Kamp (2016b) and Ward and Graves (2005) provide an analysis of servitization as a joint effort and not as an independent concept. In other words, they indicate that servitization is systematic, the objective of which is to create relationships between suppliers and customers (encouraging participation between them) (Ceci and Masini 2011; Kohtamäki and Partanen 2016; Paiola et al. 2013; Neely 2008), focused mainly on the provision of services rather than providing physical goods. This definition seeks joint cooperation (Durugbo 2014; Ward and Graves 2005), such that the customers are the protagonists for the company's actions, and there is a commitment to share the risks and benefits of using the products (Khanra et al. 2021; Ren and Gregory 2007). The objective is to have constant feedback, which companies will find useful for possible redesign of their goods in order to adapt to their customers' real needs (Mont 2002; Ostrom et al. 2010).

Rabetino et al. (2017) show that companies must consider three fundamental aspects in developing a servitization strategy: the content of the chosen strategy (what to change), the change process that shows various content alternatives (how to change), and the context triggering the change for the company (why change). Santamaría et al. (2012) note three approaches for a company to consider if they wish to implement a servitization strategy: the services to offer (what approach should be taken for the manufacturer's customers), understanding current resources and capabilities (what resources and capacity will be needed to enact the desired change) (Adrodegari and Saccani 2017; Baines and Shi 2015; Khanra et al. 2021; Kreye et al. 2015), and the activities to be performed (what internal changes need to be made in order to implement the servitization strategy) (Gebauer and Kowalkowski 2012; Mont 2003; Tuli et al. 2007; Ziaee et al. 2018).

However, Benedettini et al. (2015) indicate that the risks of incorrect adoption of a servitization strategy will be greater if the companies that attempt it, faced with the need to reorganize their internal structure and gain new resources and capabilities to develop their new offerings, do not take the necessary time to carry out the respective analyses of their current reality, leading them to make poor decisions. In contrast, Dyer and Singh (1998) show that any company can achieve greater returns as long as they work in relationship with one or more other companies (external strategic partnerships). On similar lines, various researchers (Ayala et al. 2017; Dyer and Singh 1998; Spring and Araujo 2013) have stated that, when it comes to servitization, given the difficulty of developing truly attractive offerings within this strategy (Bastl et al. 2012), manufacturers of goods are strengthened by complementing their capabilities with other organizations (Kindström and Kowalkowski 2014; Martínez et al. 2010; Spring and Araujo 2009) in order to be able to cope with the

demands of their potential markets, and in this case, that would mostly mean service providers (Ayala et al. 2017; Ceci and Masini 2011; Paiola et al. 2013; Spring and Araujo 2013).

Based on the above, we can say that servitization has been, is, and will be key for customers' loyalty, as it allows businesses to understand and satisfy their customers' specific needs and requirements (Mont 2002; Ostrom et al. 2010; Saccani et al. 2014). That said, it is important to consider that the development of a servitization strategy will vary by sector and environment and, as such, will depend on various internal (technological capabilities and qualified personnel, among other things) and external factors (e.g., innovative markets and environments with moderately stable economies) (Kolagar et al. 2022). Table 1 summarizes the most important definitions of servitization.

Servitization strategy

The strategy of servitization is a new concept that reflects manufacturing companies taking the decision to permanently offer services (Bustinza et al. 2015) or have departments that offer them. For Oliva and Kallenberg (2003), servitization is a strategy that is characterized by a customer focus. In this regard, and in order to offer a suitable service, the company's main task is to understand what is expected when acquiring customers with goods and/or services. Once they have this information, the company should increase the value of its products by offering additional services that complement the use, function, or implementation of those products.

Kamp (2016a) states that many businesses tend to believe that adopting a servitization strategy is very complicated. However, there are companies that have employed servitization in their organizations for more than 40 years and have been abundantly successful.

De La Calle and Freije (2016), Kowalkowski et al. (2017), and Martín-Peña et al. (2017) show that a servitization strategy does not consist solely of changing what a company offers its customers (simply offering new services and nothing more). Instead, it means a significant change to how the company itself operates (Sandström et al. 2008; Tukker 2015); in order to achieve success, this internal strategic process must be properly designed and implemented (Zhang and Banerji 2017). Given this, a servitization strategy is considered a competitive strategy as long as it is correctly applied (Reim et al. 2015).

In this regard, Manzini et al. (2001) and Mathieu (2001) note that the development of a servitization strategy needs certain changes to be made that would probably not be easy. Because of that, they advise companies not to focus on current capabilities but, rather, to add new capabilities and skills to what they already have (Adrodegari and Saccani 2017; Baines and Shi 2015; Gaiardelli et al. 2014; Gebauer et al. 2005; Khanra et al. 2021; Kreye et al. 2015), and this develops a change to their business mentality (transition from thinking of goods to thinking of goods and services). Nonetheless, they warn that this transition process can lead some companies to neglect their main sources of income: producing tangible goods that are the core of their activity (Gebauer et al. 2005; Kohtamäki et al. 2020a).

Table 1 The most important definitions of servitization

Author	*Definitions of servitizatión*
Levitt (1972)	*"They [service companies] must think of themselves as performing manufacturing functions […] only then will they begin to make some significant progress in improving the quality and efficiency of service"*
Vandermerwe and Rada (1988)	*"…is the increased offering of fuller market packages or 'bundles' of customer focused combinations of goods, services, support, self-service and knowledge in order to add value to core product offerings"*
Verstrepen et al. (1999)	*"…consists in a move towards product services by 'adding additional service components to core products"*
Wise and Baumgartner (1999)	*"It is that tendency to add services within their businesses, in order to differentiate themselves from their competition"*
Robinson et al. (2002)	*"…is a concept which goes beyond providing additional services to consider the total offering to the customer as an integrated bundle consisting of both the goods and the services"*
Bart et al. (2003)	*"A trend in which manufacturing companies are increasingly adopting service components in their offerings"*
Slack et al. (2004)	*"…is a strategy that seeks to change the way in which product functionality is delivered to markets (by way of marketing the capability rather than the product)"*
Ward and Graves (2005)	*"Increasing the range of services offered by a manufacturer"*
Baines et al. (2007)	*"The innovation of the capabilities and processes of a manufacturing organization to move from selling products to selling an integrated offering of products and services that generates value in use"*
Davies et al. (2007); Gebauer and Fleisch (2007) *y* Koudal (2006)	*"The servitization strategy is a very useful tool to face the competition, in order to achieve business objectives and higher profitability"*
Ren and Gregory (2007)	*"A change process where in manufacturing companies embrace service orientation and/or develop more and better services, with the aim to satisfy customer's needs, achieve competitive advantages and enhance firm performance"*
Cusumano (2008)	*"The servitization strategy is characterized by starting to offer services as an addition to their traditional package of goods"*
Johnson and Mena (2008)	*"…is a competitive strategy that involves the bundling of products and services. Servitization involves a customer proposition that includes a product and a range of associated services"*
Baines et al. (2011)	*"…is the innovation of an organization's capabilities and processes so that it can better create mutual value through a shift from selling products to selling Product Service Systems"*
Neely et al. (2011)	*"…is the phenomenon in which manufacturing firms move beyond manufacturing and offer services and solutions, often delivered through their products, or at least in association with them"*
Baines and Lightfoot (2013)	*"…is a change in business model from selling products to selling capabilities, or the combination of products and services that enable the desired outcomes for customers"*
Benedettini et al. (2015)	*"Manufacturers are experiencing an increasing trend towards the integration of product and service offerings called servitization"*

Table 1 (continued)

Author	*Definitions of servitizatión*
De la Calle and Freije (2016)	*"…constitutes an opportunity to enhance competitiveness in today's business and markets and to open new business areas. However, it implies significant transformations to the companies involved, as they will have to add services and new intangible elements to their offer"*
Kamp (2016a)	*"It is a different conception of the relationships between asset suppliers and their users. A new conceptual mechanism for relationships between users and suppliers of assets, based more on providing services than on the delivery of physical goods as such. With synergistic cooperation between the parties involves, in order to share the risks and rewards of using the assets provided*
Brax and Visintin (2017)	*"…is a change process whereby a manufacturing company deliberately or in an emergent fashion introduces service elements into its business model"*
Kowalkowski et al. (2017)	*"The transformation process of moving from a product-focused business model and logic to a service-focused approach"*

Source: Authors' collation of work from various other authors

In addition, Kamp (2016b) and the annual report from the World Economic Forum (2016) state that twenty-first century companies must consider the following topics, apart from innovation in business models, for the proper creation of a competitive strategy in the environments noted above: the digital agenda, advanced manufacturing, the analysis of big data, and the co-creation of value (or shared value creation). However, Kamp (2016a) notes that the development of a suitable competitive strategy would allow the company to gain advantages over current market trends—facilitating the link between their offerings and demand, being able to find new value proposals for the market—to make maximum use of resources and capabilities (achieving efficiency and efficacy), and to be aware of and ready to cope with the arrival of new competitors, the appearance of new technologies, and the use of new production and product distribution methods, among other challenges (Ayala et al. 2019; Khanra et al. 2021).

Lastly, Durugbo (2014) and Sakao et al. (2008) note that the development of servitization strategies would necessarily have to involve the customization of each product and need co-creation from both parts (business and customers) (Kohtamäki and Partanen 2016; Kohtamäki et al. 2020b; Martín-Peña et al. 2018). On similar lines, Vargo and Lusch (2016) state that, nowadays, customers place greater value on feeling as though they are participants of the co-creation of shared objectives; they need to feel part of the creative processes of the different goods and services that they aim to consume.

Product-service systems (PSS)

More and more companies are changing their business ideas through innovation in business models (Kindström and Kowalkowski 2014; Mont 2003; Visnjic et al.

2014), moving from being purely manufacturers of goods to being businesses that produce goods and services in combination (Brax and Visintin 2017) in order to provide better functionality to their customers (Manzini and Vezzoli 2003). That said, companies that want to make such a change to their business should first ensure they have the knowledge and capabilities that will allow them to make this transition in the best way possible (Baines et al. 2009b).

Manzini and Vezzoli (2003) and Mont (2003) define PSS as a company's strategic innovation that consists of restructuring the focus of the business—in other words, undertaking the process of transitioning from solely offering goods to offering a mix of goods and services. The objective is to meet a specific customer need rather than simply to provide a product that serves a function. Baines et al. (2017) and Tukker and Tischner (2006) agree on defining PSS as a strategy that allows companies to maintain or improve competitiveness, consisting of the combination of goods and services. On similar lines, Tischner et al. (2002) define PSS as a strategy based on the design and combination of tangible products and intangible services with the goal of meeting specific needs.

Baines and Lightfoot (2013) state that goods manufacturers who want to implement PSS strategies in their organizations should engage in an internal business transformation in order to produce the resources and capabilities needed (Adrodegari and Saccani 2017) to achieve the desired returns (Baines and Shi 2015). However, Benedettini et al. (2015) note that executing a PSS strategy may also involve certain risks for the business. This is because changing the business model may affect the company's performance, as this transformation brings with it the need to deal with new, challenging scenarios for goods manufacturers, such as the possible and necessary organizational changes during the implementation of a PSS strategy, changes that may be internal or external (Gebauer and Fleisch 2007; Gebauer and Kowalkowski 2012; Kolagar et al. 2022; Mont 2003; Parida et al. 2014; Raddats et al. 2019; Zhang and Banerji 2017). With regard to external changes, Alghisi and Saccani (2015) refer to having external partners such as service providers with whom to face the challenges presented by customers' needs and desires (Ceci and Masini 2011; Neely 2008; Paiola et al. 2013; Spring and Araujo 2009; Ziaee et al. 2018).

The magnitude of these challenges will depend on the strength of the impact of the change from traditional production to the new business structure that includes goods production and the added services, with one of the main gaps in knowledge on goods manufacturers, being how to innovate in what services are being offered (Ayala et al. 2017). Oliveira et al. (2015) and Tukker and Tischner (2006) note that companies who opt to implement a PSS could achieve results including maintaining and improving customer relationships (customer loyalty), developing new markets (seeking business sustainability), reducing environmental impact (reducing resources used), better speed and flexibility in responding to customer needs (customer satisfaction), reduced costs (economic savings), and brand positioning.

On similar lines, Kamp (2016a) states that this new vision of doing business would not only encourage the appearance of a new business feature within the organization, but that it would also encourage the development of new quality standards. In this regard, Manzini et al. (2001) note that when a customer acquires a product

from a PSS, he/she is not acquiring just the product alone but the benefits and satisfaction produced by this acquisition. This leads to a new commercial alternative for many companies as the end goal is no longer the sale of goods but, rather, getting them into customers' hands, producing a new business model: renting out the use of the product. In this way, the company will benefit from the placement, and it is the customer who will have the benefit and satisfaction from using the product (but will not necessarily acquire it).

In general, PSS not only benefit the companies that implement them but also their customers, and not only in new offerings of goods and services; PSS also increase companies' abilities to accept new technologies (Schmidt et al. 2016). However, the benefits for manufacturers of goods will depend exclusively on the servitization strategy implemented and the model of PSS that they decide to use (Matthyssens and Vandenbempt 2010).

There are countless classifications of PSS. Ayala et al. (2017) consider two types of PSS focus: product-focused PSS and service-focused PSS. The first type focuses on maintaining and growing the current roster of customers in order to sell the goods being manufactured (Galbraith 2002), without ignoring the offering of services (post-sale service, maintenance, customer service, extended warranty, delivery of spare parts, among others). The objectives are to increase the range of what they offer and encourage greater use of their products (Kowalkowski et al. 2017). For Ayala et al. (2017), a manufacturing company can have different PSS models within their product portfolios, giving different returns depending on the model used. Moreover, the companies using this kind of strategy will have profits based on the sales of the manufactured goods that may also benefit from the services offered. Offering services allows these companies to collect a lot of information from the provision of services, which can be useful for them in developing new products (Kans and Ingwald 2016; Kowalkowski et al. 2017) to acquire more new customers and to enter new markets (Gebauer et al. 2011).

The second type of PSS, in contrast, focuses on the customer and leads to highly customized offerings, which need significant customer participation in decisions related to improvements in product design, product promotion, and distribution, among other things (Cusumano et al. 2014). The function of the services these companies offer is to assist and encourage customer use of products (Kowalkowski et al. 2017), with the services offered not necessarily limited by the goods in and of themselves. For companies using this strategy, the returns will be in retention of current customers, and they will seek to encourage that loyalty by offering novel products based on customers' needs and wants (Gaiardelli et al. 2014; Galbraith 2002; Saccani et al. 2014; Santamaría et al. 2012; Vandermerwe and Rada 1988), in search of greater added value (Matthyssens and Vandenbempt 2010).

In addition, it is worth highlighting the classification proposed by Tukker (2004) and Tukker and Tischner (2006), who note three strategies for moving from a traditional business to a PSS-style business, with varying impacts of the change. They are product focused (services added to goods sold), use focused (the customer does not acquire goods as property, only the use of them), and results focused (the final result of using the goods). These strategies are not incompatible with one another; they may all be implemented and achieve their own results (Rabetino et al. 2017;

Reim et al. 2015). Benefits include greater profit margins, increased income stability, and better differentiation from the competition (Ayala et al. 2019; Davies et al. 2007; Gebauer et al. 2011).

Industry 4.0

One of the main drivers of business and economic growth is technological development. For Lee (2018), Lee and Lim (2018), and Paiola and Gebauer (2020), advanced digital technologies are among the main spurs toward organizational innovation and allow the development of new forms of value creation (Ibarra et al. 2018; Kohtamäki et al. 2019; Tian et al. 2022).

Baines et al. (2017), Kohtamäki et al. (2020b), Naik et al. (2020), Paiola and Gebauer (2020), and Paschou et al. (2020) note that part of organizational change also lies in considering the use of Industry 4.0 digital enablers as a significant moderating factor in the development of a servitization strategy. Along similar lines, Lee et al. (2014), Navarro and Sabalza (2016), and Paiola and Gebauer (2020) indicate that a company seeking to be more competitive in the market should follow the principles of Industry 4.0, such as making best use of information technology, using the most advanced robotics, designing and producing products according to customer needs and tastes, producing in small or individual quantities, having zero warehousing costs, and delivering the product directly to the customer (Tian et al. 2022).

Kagermann et al. (2013) state that development of the Internet of Things (IoT) and services in the production environment are what mark the path toward the fourth industrial revolution, also known as Industry 4.0, based on intelligent, connected systems that are constantly driven by the Internet of Things and big data. The aim of Industry 4.0 is to manage businesses through digital technology, creating connections between all of areas and actors in the company such as equipment, systems, production, distribution, products, clients, and suppliers, continuously producing information from all areas and for all areas in real time (Ardito et al. 2018; Frank et al. 2019; Wang et al. 2016).

For Kagermann et al. (2013), Tao and Qi (2017), and Wang et al. (2016), Industry 4.0 is based on the concept of advanced manufacture, or smart manufacturing, which is a flexible system allowing production processes to be adjusted automatically for many product types and changing conditions, leading to increased quality, productivity, flexibility and, consequently, the sustainable manufacture of customized products on a large scale with the best use of resources (Dalenogare et al. 2018; Kohtamäki et al. 2020b; Martín-Peña et al. 2018; Rabetino et al. 2015).

Dalenogare et al. (2018) and Kagermann et al. (2013) state that, in this fourth industrial revolution, companies would function in global networks connecting the whole organization—during the complete product life cycle and through various activities in the supply chain—via cyber-physical (CPS) systems. In other words, this would be convergence between the physical and virtual worlds. Similarly, Blanco et al. (2017) and Wang et al. (2016) note that these systems would be characterized by constantly collecting and storing information from all areas of the business and throughout the value chain (inbound logistics, marketing, outbound

logistics, and service), giving rise to a more flexible, more controllable production system that would allow the company to correct potential errors before they happen (Rabetino et al. 2015).

In this regard, Frank et al. (2019) and Kagermann et al. (2013) state that companies who aim to be intelligent businesses will benefit from the capacity to manufacture goods with different characteristics for each customer, which will be profitable for the company. Similarly, the employees in those intelligent businesses will benefit from not having to spend time on repetitive tasks (Stock et al. 2018) and from being able to focus on other, more creative activity. Lastly, the resulting product from intelligent companies, also called *intelligent products* (Dalenogare et al. 2018), may be able to provide feedback for the development of new, improved products, providing new services and solutions for the customer (Kans and Ingwald 2016; Kohtamäki et al. 2020a; Paschou et al. 2020; Porter and Heppelmann 2015; Rabetino et al. 2015; Tao and Qi 2017; Tian et al. 2022), promoting the appearance of new business models such as PSS (Ayala et al. 2017).

Today, there is no consensus about the digital-enabling tools of Industry 4.0. Nonetheless, the preliminary report "Digital transformation in Spanish industry" [*La transformación digital de la industria española*] from the Spanish Ministry of Industry, Energy, and Tourism (2015) notes nine digital tools classified in three groups: intracompany/intercompany management, communications and data handling, and hybridization of the physical and digital worlds. Blanco et al. (2017) and Smit et al. (2016) consider nine technologies as the basis for Industry 4.0, and Ardito et al. (2018) note eight digital-enabling tools. With these classifications as a reference, below, we detail the most representative digital enablers: big data, data analysis and customer profile analysis, cybersecurity, cloud computing, additive manufacturing, the Industrial Internet of Things, augmented reality, virtual reality or simulation, autonomous robots and cyber-physical systems (CPS or vertically and horizontally integrated systems), and collaborative platforms.

Navarro and Sabalza (2016) note that one should not assume that development in Industry 4.0 consists only of technological innovations and advances. Although it does bring those about (innovations in processes and products) (Ayala et al. 2019; Favoretto et al. 2022), it also heralds non-technological innovation and progress such as innovation in new business models, in relationships between providers and customers, in organizational structure with service-oriented activities (design, RD&I, branding, post-sale service, and user-training, among others), and in the co-creation of bi-directional value in B2B (business to business) and B2C. In other words, Industry 4.0 is about making maximum use of investment in technology (innovative processes and products) through investment in services. It is in this situation that servitization strategies would allow commercial potential to be realized: knowing what customers want and, therefore, creating more attractive offerings for them (Favoretto et al. 2022; Kohtamäki et al. 2019; Naik et al. 2020; Paiola and Gebauer 2020; Paschou et al. 2020; Rabetino et al. 2015; Tian et al. 2022).

As one might appreciate, the development and use of Industry 4.0 technologies (also known as "digital enablers" as they allow digital transformation) will make it possible for both manufacturers and service providers to provide new ranges of offerings to the customer. This will change not only their products and services but

also their business models, moving from traditional products to connected digital products, and from selling goods to selling the use of goods (Ibarra et al. 2018; Martín-Peña et al. 2018; Naik et al. 2020; Paschou et al. 2020).

Industrialization and digital servitization

Manufacturing industries are facing an uncertain scenario of deindustrialization, which grew more severe during the global economic crisis beginning in 2008, affecting thousands of companies. Construction was one of the sectors that were most affected by this crisis, a disaster that swept away numerous manufacturers of bricks, cement, and ceramics, among others—according to the World Bank (2010), global GDP fell 5.1% between 2009 and 2008. Although industrial activity has been gradually recovering, the last 2 years have seen another significant fall due to the pandemic. According to the International Monetary Fund (2021), global GDP fell 4.6% in the fourth quarter of 2020 and was negative in every quarter in that year.

Faced with this situation, servitization may be one route to strengthen industry, helping to increase the added value that these companies can offer to their customers. More and more manufacturing companies are adding services as added value within their offerings, with the aim of maintaining or recovering their market positions.

In addition, Kamp (2016b) states that just like China and Germany, other countries should invest in technology in order to revitalize their industries. The recommendation is for that investment to focus on increasing RD&I spending, improving digitalization, encouraging the use of big data, developing ultrafast communication, promoting cloud computing, developing 3D printing, implementing massive roboticization, developing artificial intelligence, and using the digital agenda, among other things—in other words, investing in technologies underlying Industry 4.0.

On similar lines, Ayala et al. (2019), De la Calle and Freije (2016), Favoretto et al. (2022), Ibarra et al. (2018), Kans and Ingwald (2016), Lee et al. (2014), Naik et al. (2020), Paschou et al. (2020), and Tao and Qi (2017) indicate that technological developments will, in turn, lead to the development of new, innovative products and processes, encouraging companies to differentiate themselves from their competition, standing out in their current markets, and even entering new markets, whether in goods or services or both.

Aim and research questions

As noted above, there have been very few empirical studies that allow for an examination of the literature on servitization over the last almost 50 years. Similarly, and despite the multiple benefits of servitization for businesses being highlighted, it has not been possible to produce rigorous models for adopting it, nor perform empirical validations of how it relates to results. For this reason, and given the need for a comprehensive analysis of servitization, this study examines the adoption of servitization strategies and their impact on businesses' competitiveness.

In general terms, the objective is to increase our understanding of servitization, providing empirical evidence about the different servitization strategies and possible tools—such as Industry 4.0 digital enablers—in order to determine whether companies that implement them do gain various benefits, such as acquiring new customers, entering new markets, developing new business ideas, becoming more competitive, and generating greater profits.

By pursuing this general objective, the study aims to, on the one hand, analyze, consider, and draw conclusions about the experience of Spanish manufacturing companies in terms of executing servitization strategies and implementing Industry 4.0 digital enablers and, on the other hand, determine whether this development, in the reality of those companies, has, in fact, provided the many benefits that the literature indicates. Based on the above, and in order to test what has been said in the literature reviewed, the study examines the following research questions:

- *RQ1: Implementation of a servitization strategy.* How it should be affected by the company's business environment? How it should be the co-creation process in an international context? Which new knowledge and new skills need to be developed to be implemented effectively/successfully? Which benefits can be obtained by implementing the digital enablers of Industry 4.0? Which changes could it involve in the internal structure of the business? Which changes could it involve in the company's business environment (relations with suppliers or strategic partners)? How it could face the challenges and obstacles that arise during the transition process?
- *RQ2: Benefits of developing an effective servitization strategy*. How it provides greater value to the customer? How can product customization be optimized? How it encourages access to new markets? How it promotes gaining new customers? How it allows innovation in ideas or business models? How it allows the development of goods with novel services? How it effectively allows greater returns to be achieved? How it improves competitiveness?

Methodology

Malhotra and Grover (1998) state that, because of the various questions that have been presented about businesses' organizational environments, many researchers have felt the need to use new research methods that allow them to determine the origin of various situations—in other words, methods that provide them with information within the context of the company or the social context in which events occur, with qualitative methods beginning to become more important.

This empirical, case-study–based research was designed with an exploratory objective and a qualitative nature, which is appropriate for constructing theory and answering "how" and "why" questions (Eisenhardt 1989; Voss et al. 2002; Yin 2017). Two similar models from two different authors were used as a reference for this study—Eisenhardt (1989) and Voss et al. (2002)—which both used case-study methodologies as a valid means of theory construction. Using case studies in this research, we aimed to (a) analyze the experience of manufacturing companies who

were implementing servitization strategies and Industry 4.0 digital enablers and draw relevant conclusions and (b) determine whether the true situations of the participating businesses agreed with the theoretical arguments in the literature about servitization and Industry 4.0 digital enablers.

For this reason, once a comparative perspective was chosen, a single case study was discounted, and, instead, a study with multiple cases was selected without subunits (Yin 2017). Although there is no specific reference about the ideal number of cases, Eisenhardt (1989) states that a study of between four and ten cases may be sufficient to allow an exploratory analysis of a new phenomenon. With that in mind, it was decided to use five representative companies from various business sectors. For the sample selection in the present study, two types of controls or parameters to help profile the companies to select were proposed in order to test and replicate the findings (Eisenhardt 1989), improve external validity, and minimize observer bias (Voss et al. 2002): (a) companies that confirmed that they were applying a servitization strategy and (b) companies that were implementing Industry 4.0 digital enablers (or had already implemented them). Because the objective of this study was to demonstrate that applying servitization strategies, along with Industry 4.0 digital enablers, had multiple benefits for the companies that did it, it was decided that the study would not include (a) companies that were not applying servitization strategies or (b) companies that, even if they were applying servitization, were not implementing Industry 4.0 digital enablers.

Bearing the above in mind—the research questions, the parameters, the case selection criteria, and the characteristics of the study—and also based on the literature, we decided to select companies whose manufacturing activities were in sectors such as electronics, machine tools, and metals. Based on that, five companies were selected, all located in Spain, based on the industrial sector they belonged to:

- *Case 1*. With more than 50 years of activity, the company is a world leader in producing steel for the road safety, photovoltaic energy, and automotive sectors. Its experience has allowed it to adapt to the different markets and the diverse needs of its customers, giving added value to all of its products within each of its business lines. Its main activity is the use and processing of steel products, with a production volume of more than 250,000 metric tons per year.
- *Case 2*. This company, with over 25 years of activity, has become one of the most important companies in the world in the design and manufacture of capital equipment and the supply of static equipment for the offshore sector. It is a particular leader in the manufacture of large-scale equipment. Its leadership in integrated industrial projects is due to the quality of its manufacturing and processes, which are based on the knowledge gained from years of experience in engineering and manufacture of high-value capital equipment.
- *Case 3*. A family company with over 70 years of activity. Its main activity is the manufacture of autoclaves, ovens, steam generators, control systems, and all kinds of pressure equipment. Since its founding, it has contributed to the growth of a wide range of sectors and technological processes, from vulcanization to wood treatment, glass lamination, waste management, and the development of compound materials.

– *Case 4*. Since it was founded in 1976, this company has specialized in the design, manufacture, and sale of low-tension electrical connective elements, as well as the manufacture of lighting equipment and apparatus. Its manufacturing processes are highly automated and subject to strict quality controls and have allowed it to develop a broad sales network all over Spain, leading the sector at a national level, and having significant presence internationally.
– *Case 5*. This company began activity in Spain in 1984, when it opened its first factory in the north of the country. Its main activity is the manufacture, sale, and installation of escalators and moving walkways, and it is one of the market-leaders at the national level. The company has a network of more than 70 branches all over Spain and a workforce of more than 2700, dealing with urban mobility projects over their full-life cycles, from installation of new vertical transport equipment to servicing, maintenance, and modernization.

Once the participating companies were selected for this multiple case-study, and following the model from Voss et al. (2002), we created a study protocol. A questionnaire was produced, which covered all of the topics to be examined by the study and which served as a guide during the deep interviews with each company's representative. The following step was deciding who to send the questionnaire to. We chose to interview a single individual, ideally the company's director of operations or equivalent, as they would have the information needed for the study.

In addition, following the indications from Chetty (1996), Miles and Huberman (1994), and Yin (2017), who state that the conclusions of case studies backed by evidence from various sources contribute to increased reliability and validity of the results via triangulation, we identified the need for sources of information in addition to the deep interview (based on the survey), including in situ observation, information from the companies' websites (e.g., historical data about their activity over time, business lines, types of goods and services and innovations in them, management models, and differences in management), information from certified data, and from the press.

The cases were first examined individually—seeking and identifying explanations and causality for each case— then compared with each other—something that is essential for broadening the conclusions (Eisenhardt 1989; Miles and Huberman 1994; Voss et al. 2002). Despite the information from the five companies being collected separately, the combined data were subjected to a comparative analysis without any difficulty. The analysis focused on the similarities and differences between the cases in order to identify benefits and difficulties in applying a servitization strategy, in the implementation and use of Industry 4.0 digital enablers, and in combination.

Once the data was collected, it was documented and codified in order to subsequently demonstrate its internal validity, via methodological triangulation and the triangulation of sources of data, and external validity, via extrapolation of the results.

Nonetheless, it should be borne in mind that the five cases in the study cannot be considered a representative sample of Spanish manufacturers, which means that caution must be used when extrapolating from the results. The study, nevertheless,

allowed preliminary general conclusions to be drawn, which are detailed in the following section, along with the results in the context of the literature on servitization and Industry 4.0.

Results and discussion

The results are focused on providing empirical evidence about the different servitization strategies and possible tools, such as Industry 4.0 digital enablers, which, in combination, benefit the companies in a variety of ways, including achieving increased competitiveness, generating greater returns, finding new customers, accessing new markets, and developing new business ideas.

Table 2 details the main characteristics of the five case studies—their activity, the type of company, and the time for which they have offered services—along with comparisons between them in terms of servitization—the strategy followed for offering services, the reasons leading to the decision to outsource some services, the profile of the personnel who provide services, the staffing levels, and the size, quality, and innovation in the portfolio of services compared to their competitors—and in terms of Industry 4.0—the level of development of Industry 4.0, and the level of implementation of digital enablers.

The patterns that emerged from the data, which were also analyzed in the cases in combination, were grouped into fourteen aspects: (1) time over which services have been offered, (2) type of servitization strategy adopted, (3) profile required for personnel-providing services, (4) reasons for outsourcing services, (5) size, level of innovation, and customization of the service portfolio, (6) integration of products and services, (7) level of importance of the servitization strategy in the company, (8) required resources and capabilities to deal with the transition from goods to goods and services, (9) objectives to achieve with the application of a servitization strategy, (10) benefits achieved from the application of a servitization strategy, (11) difficulties in the transition from goods to goods and services, (12) whether there is an area or department responsible for implementation of Industry 4.0, (13) possible challenges raised by implementing Industry 4.0 digital enablers in each company, and, finally (14) the expected impact of implementation of various Industry 4.0 digital enablers on each company's operational objectives.

The cases exhibited some agreement in terms of the different aspects examined:

- *Time offering services*. The five cases have offered services to their customers for various lengths of time (from 4 years to more than 10 years), seeing it as a way to differentiate themselves from others in their marketplaces. However, only four of the companies noted the importance of innovating in services in order to generate better returns (in Case 4, the provision of services along with products was for complimentary reasons and was not undertaken solely to generate revenue independently of the product).
- *Type of servitization strategy adopted*. The companies followed two paths: one was to extend services to different areas in their organizations based on need; on the other path, companies chose to work with service providers.

Table 2 Comparative analysis of the cases studied

	Case 1	*Case 2*	*Case 3*	*Case 4*	*Case 5*
Activity	Processing steel products	Engineering services applied to the construction of large boiler tanks	Production of steam generators, autoclaves, and all types of pressure equipment	Design, manufacture, and sale of electrical materials and equipment	Manufacture of escalators and moving walkways; manufacture of integrated elevation systems and components
Type of company	Industrial company that places great importance on innovation and offering services	Industrial company that places great importance on innovation and offering services	Industrial company that places great importance on innovation and offering services	Goods company that includes services in its offerings	Industrial company that places great importance on innovation and offering services
Length of time offering services	More than 10 years	6–10 years	More than 10 years	4–5 years	6–10 years
Strategy followed in developing a service offering	The company has extended its current area of services to other parts of the company; similarly, it has developed new, different types of services for areas where appropriate	The company has developed new, different types of services for areas where appropriate	The company has extended its current area of services to other parts of the company; similarly, it has developed new, different types of services for areas where appropriate	The company has developed new, different types of services for areas where appropriate	The company has extended its current area of services to other parts of the company; similarly, it has developed new, different types of services for areas where appropriate
Reasons for outsourcing some services	Very important: to save time Important: increase productivity and competitiveness and reduce costs	Very important: access to resources from the contracted service provider, reduce costs, and reduce the risk of poorly delivered service Important: ensure the quality of the service being offered and increase productivity and competitiveness	Important: access to resources from the contracted service provider, ensure the quality of the service being offered, increase productivity and competitiveness, reduce costs, and reduce the risk of poorly delivered service	Very important: reduce the risk of poorly delivered service Important: save time, ensure the quality of the service being offered, increase productivity and competitiveness, and reduce costs	Very important: increase productivity and competitiveness, and reduce costs Important: access to all kinds of resources from the contracted service provider

Table 2 (continued)

	Case 1	*Case 2*	*Case 3*	*Case 4*	*Case 5*
Profile of personnel providing services	Mid-level or high-level university degrees or specific professional training They value qualities and knowledge including ease of working in teams, problem-solving abilities, the ability to work under pressure and previous experience in delivering the relevant service	Mid-level or high-level university degrees or specific professional training They value qualities and knowledge including ease of working in teams, flexibility and adaptability, the ability to work under pressure, and previous experience in delivering the relevant service	Professional training and, depending on the service, appropriate additional qualifications. They value qualities such as customer orientation, ease of working in teams, and problem-solving abilities	Mid-level or high-level university degrees and specific professional training. They value qualities such as customer orientation, ease of working in teams, empathy, adaptability, and problem-solving abilities	Mid-level or high-level university degrees and specific professional training. They value qualities such as customer orientation, flexibility, adaptability, problem-solving skills, the ability to work under pressure, and ICT knowledge
Size, quality, and innovation of service portfolio compared to competitors	The company thinks that, compared to its competitors, its portfolio of services is very large, is high quality, and is moderately innovative	The company thinks that, compared to its competitors, its portfolio of services is large, high quality, and moderately innovative	The company thinks that, compared to its competitors, its portfolio of services is large, it is of moderate quality, and is highly innovative	The company thinks that, compared to its competitors, its portfolio of services is moderately large, is high quality, and is highly innovative	The company thinks that, compared to its competitors, its portfolio of services is large, is higher quality, and is more innovative
Level of service customization	The company offers a high level of customization of its engineering and assembly services. It offers some customization in manufacturing, post-sale service, and logistics	The company offers a high level of customization in its consulting service and services of design and development. It also offers some customization in its equipment installation service	The company offers high levels of customization in its on-demand production services, on-demand technical assistance, and engineering services. It also offers some customization in its financial and consultancy services	The company offers a high level of customization in its design and development services	The company offers a high level of customization in its predictive maintenance service. It also offers some customization in the following services: equipment installation, corrective and preventive maintenance, user safety management, and equipment monitoring

Table 2 (continued)

	Case 1	*Case 2*	*Case 3*	*Case 4*	*Case 5*
Development of Industry 4.0	The company has an area or department responsible for implementation of Industry 4.0, which is an important element distinguishing it from its competitors	The company has an area or department responsible for implementation of Industry 4.0, which is an important element distinguishing it from its competitors	The company has an area or department responsible for implementation of Industry 4.0, which is an important element distinguishing it from its competitors	The company has an area or department responsible for implementation of Industry 4.0, which is a very important element distinguishing it from its competitors	The company has an area or department responsible for implementation of Industry 4.0, which is an extremely important element distinguishing it from its competitors
Level of implementation of Industry 4.0 digital enablers	High implementation: additive manufacturing, augmented reality and virtual reality (or simulation) Low implementation: big data, cyber-security, cloud computing, and autonomous robots *Other enablers implemented*[a]	Very high implementation: cloud computing High implementation: autonomous robots Moderate implementation: cyber-security Low implementation: additive manufacturing, IIOT, virtual reality or simulation, horizontal and vertical integration systems (cyber-physical systems)	Very high implementation: additive manufacturing High implementation: cloud computing and autonomous robots Moderate implementation: cyber-security Low implementation: augmented reality and virtual reality or simulation Very low implementation: IIOT	High implementation: big data, cyber-security, cloud computing, and additive manufacturing Low implementation: Industrial internet of things (IIOT)	High implementation: cloud computing, additive manufacturing, and virtual reality or simulation Moderate implementation: cyber-security and augmented reality Very low implementation: big data, IIOT, horizontal and vertical integration systems (cyber-physical systems) *Other enablers implemented*[b]

[a]Sensorics, a system of safety alerts in forklifts and cranes, digitalized warehousing system, digitalized communication panels, remote support based on wearable technology, warnings for logistics personnel through smart watches, dimensional, surface, and thickness quality control, installation of MES (manufacturing execution system), asset management, and maintenance management, among others.

[b]Digitalized information in the plant (portable devices for access to real-time information).

- *Profiles of personnel delivering services*. The companies had been careful to design ideal profiles for those developing and delivering the services. They required certain academic qualifications—mid-level or high-level university degrees, professional training, specific technical training, and prior experience in the service to be delivered—as well as certain qualities depending on the role to be played—customer orientation, empathy, flexibility, the ability to work under pressure, to work well in a team, adaptability, and problem-solving skills.
- *Reasons for outsourcing services.* There were various reasons for contracting service providers. They include reducing the risk of poorly delivered services, increased productivity and competitiveness, reduction of costs, access to the resources of the service provider, and time savings. The service providers' history and experience mean that they are ideal strategic partners for delivering innovative services.
- *Size, innovation, and customization of service portfolio*. Both the development and offering of services by these businesses and their service providers have led the five companies to produce a broad range of high-quality, innovative services compared to their competitors. However, with regard to the capacity to be flexible and adapt their services to customer needs and requirements, only four of the cases indicated that, because they had identified the different customers and sectors they aimed at, they had flexible service portfolios able to deal with those needs. This has allowed them to differentiate themselves from their competition by being able to provide a high level of customization, as well as to develop products which, together with those services, better satisfy their customers' requirements. Only Case 4 indicated that they were not interested in identifying their customers or adapting their services to those customers, as the service they offer is a complement to the delivered product but does not itself produce a return.
- *Integration of goods and services*. All of the companies analyzed stated that part of their organizational strategy was the integration of the goods and services they offer. In other words, both the products and the services offered are delivered in combination rather than independently. Similarly, and because it is possible to clearly identify the returns produced by a company offering services, most of the companies agreed that part of their business policy is that the products they offer should promote the services they offer.
- *The importance of servitization strategies within the companies*. The companies agreed that the services and products they offer are crucial to their business strategies. They also all stated that their priority in adopting servitization strategies was to support the product business rather than generating income. On similar lines, they were aware that services will tend to become more important in the near future as part of the offering to customers. Finally, a constant concern for them as part of their competitive strategy was the need to innovate in services. Table 3 lists all the aspects about the importance of the servitization consulted to the companies.
- *Resources and capabilities needed to deal with the transition from goods to goods and services*. As noted in previous sections, part of the transition process—which may impact any company that is minded to develop a serviti-

Table 3 The importance of servitization strategies within the company

The company has decided to reduce its efforts in offering services, as it does not see the expected returns on the investment in them
Currently, we have the same business focus (there has been no reorientation of priorities)
The need to innovate in services is a constant concern as part of the competitive strategy
Services will tend to be more important as part of the offering to customers in the near future
The priority for my company in adopting a servitization strategy was to support the product business rather than generating income
The services and products we offer are crucial in the company as part of the business strategy

zation strategy—is identifying the resources and capabilities that it does not have but which may be needed to properly adopt the strategy. To analyze this, the companies were asked to identify everything that they might need and which would be helpful to the transition process. The most notable responses were: the capacity to detect new opportunities in the customer (detect new needs to satisfy), understand the customers well, understand "why" the customers acquire the product and "what for," understand their customers' businesses and issues (detect the customers' needs in order to provide early solutions), and the ability to be flexible in the services offered in order to adapt to the customers' needs and wants.

- *Objectives to be achieved by adopting a servitization strategy*. Part of this case study was to discover the objectives that companies wanted to achieve by adopting servitization strategies and compare that with the literature on the topic. To that end, the companies were asked to identify why they started servitization. There were various responses, notably differentiating themselves from their competitors as the competition at the product level was increasing; developing a competitive servitization strategy, which would be sustainable and difficult to copy; seeking new customers through services and gaining loyalty in existing customers; and seeking new revenue sources through offering a broad portfolio of services. Table 4 lists all the aspects related to the objectives sought by adopting a servitization strategy, consulted to the companies.
- *Benefits produced by adopting a servitization strategy*. Once the objectives that the companies had in mind with the adoption of servitization strategies were analyzed, the next step was to identify the benefits it produced and compare that with the literature, which include developing a stimulus toward innovation, increased understanding of customer needs, producing better products, increasing customer satisfaction and loyalty, gaining new customers, increasing market share, and improving the image of the company in the market. The results confirm that the need to have novel services and goods drives companies who adopt servitization toward continual innovation. This innovation, not only in services but also in technology, gives the company tools that allow them to understand their customers' wants and tastes in more detail. Consequently, the companies can develop the ability to create new, higher quality, products that better satisfy their current customers and attract new ones,

Table 4 Objectives sought by adopting a servitization strategy in the company

Adopting a servitization strategy allows us to better understand our customers' needs and wants
To differentiate ourselves from our competitors, it is necessary to innovate in services
Our objective is not only to offer services but also to align the services to the customers' needs and wants
At the product level, competition is increasingly fierce, which is why we need to adopt a servitization strategy to differentiate ourselves
My company's objective is to develop a competitive, sustainable servitization strategy, which is difficult to imitate
Economically, it is interesting and useful for us to offer a varied service portfolio
In order to maintain competitiveness, my company must innovate in services
Through offering a broad range of services, we are looking to generate new income streams for the business
Through services, we seek customer loyalty from our current customers
Through services, we aim to find new customers
Through services, we aim to recover customers we lost in the past

increasing their share of the market. Table 5 lists all the benefits of adopting a servitization strategy consulted to the companies.

- *Difficulties in the transition from goods to goods and services.* Part of the transition process brings with it a number of possible difficulties. The main difficulties highlighted by the companies included resistance to change, poor ability to measure the returns produced by offering services, the difficulty in establishing a price list, high costs of implementing services, the difficulty of adapting the offering to each customer, prioritizing sale of products due to better returns, the need to have specialized personnel, and the client not valuing the service offered and not wanting to pay for it.

After examining all of the elements involved in adopting servitization strategies in each of the case studies, the next step was to assess how well developed Industry 4.0 was in each organization, focusing on the following aspects:

Table 5 Benefits of adopting a servitization strategy

A competitive advantage that is hard to imitate	*Customer loyalty*
Financial gains	*Increased customer satisfaction*
Increased sales	*Reduction in returns or rejections of goods or services*
Increased market share	*Producing better products due to feedback (better product quality, thanks to B2B, B2C)*
Capturing new customers	*A stimulus toward innovation*
Better understanding of the market, being able to rapidly detect new business opportunities	*Increased understanding of customer needs and expectations*
Improved image of the company in the market	*Better customer focus*

- *An area or department responsible for Industry 4.0 implementation.* All of the companies had areas or departments that were responsible for implementing Industry 4.0, which was very or extremely important as an element that differentiated them from their competitors. The digital enablers consulted were big data, cyber-security, cloud computing, additive manufacturing, IIoT, augmented reality, virtual reality or simulation, autonomous robots, and cyber-physical systems.
- *Possible challenges raised by implementing Industry 4.0 digital enablers*. The challenges that stood out include changes in productivity, the quality of production, and the organizational structure, with the latter triggering the development of better co-ordination between areas and departments. The respondents also highlighted the need for liquidity to invest in more technology and the creation of new positions with more qualified profiles.
- *The expected impact of implementation of various Industry 4.0 digital enablers on operational objectives*. The following were expected to have a *very significant impact*: ease of making rapid changes to current designs (modification of characteristics), servitization of products, ease of making rapid changes to current production volumes (go from small batches to large batches and vice versa), and rapid deliveries. In addition, the following were expected to have a *significant impact*: zero-defect product manufacture at reduced cost, on-time delivery, manufacturing a wide range of products, and better durability.

The present study provided empirical findings regarding how digital technologies have allowed five Spanish manufacture companies to enhance the benefits provided by the development of servitization and face in a more bearable way the challenges that could arise during the transition process from being companies that offer goods to being companies that offer goods with services. The core result of our qualitative analysis is the finding that the increased use of digitals enablers of Industry 4.0 has helped companies to improve their servitization and their product innovation.

The analyses showed that the use of digital technologies has a relevant role as a mediator of servitization, allowing to improve the existing direct relationship with product innovation, especially in promoting new products or entering new markets through; it has also always played an important role in promoting customer interactions and business success in terms of creating and capturing value. However, this may depend on the different adoption rates and maturity levels of Industry 4.0 technologies. In addition, it should be taken into account that product innovation requires firms to have technological competences and knowledge of their customers. They require higher levels of digital knowledge and capabilities on the part of those who will operate them, which could limit the successful exploitation of such technologies in terms of product innovation.

Conclusions, limitations, and future lines of research

The present study is one of the first attempts to assess the relationship between servitization and the moderating role that the implementation of the digital enablers of Industry 4.0 can have on it, enabling firms' innovation (servitization and product

innovation) as a response to challenges as globalization, existence of increasing competition at the product level, need for a competitive, sustainable strategy that is difficult to imitate, achieving differentiation through service innovation, and customers that are very changeable in their tastes and needs, among others, for these examined theoretical background of servitization strategies—the reasons for pursuing it, the transition process, difficulties in that transition, and the benefits—and Industry 4.0—possible issues during implementation of digital enablers and the benefits of their use, both for the company and to give greater impetus to adopting a servitization strategy. Theoretically, this article contributes to the literature on the relationship between digital technologies and servitization, a relationship that is still underexplored.

In addition, we performed an empirical, exploratory study based on a case study methodology. This paper presents the results of the analysis of servitization strategies and Industry 4.0 digital enablers in five Spanish manufacturing companies. As the literature review showed, the study of servitization as a strategy is of great interest currently, and, in the future, this will mean that the analysis of servitization strategies and Industry 4.0 and business competitiveness will be an important topic that merits attention. Although it is difficult to generalize from only five cases, the results allowed us to identify some interesting characteristics that give us a better understanding of the relationship between servitization strategies and Industry 4.0 that will help future research.

Our study confirms that more and more companies see the development and provision of services as one way to stand out in their marketplace. Services are becoming more and more important to manufacturers, as it is the customers themselves who are calling for services (and solutions) that are integrated with the products they buy. The objective is to deal with growing competition, as well as to make the most of opportunities to develop new markets in order to achieve a place in the customers' minds and secure their long-term loyalty.

In addition, various analysts agree that manufacturers who decide not to include services within their product portfolios may be risking their market position. The alternative for companies is to adapt their business style, in other words, design and implement new value propositions through creating and maintaining new channels that give them better relationships with their customers. Similarly, companies that do add services to what they offer will differentiate themselves from their competitors and may be able to increase their profit margins (increased returns).

Nonetheless, current competition between companies is not only based on costs, quality, or differentiation of products. It is also influenced by business innovations, and that requires the adoption of a servitization strategy, which, as noted above, is a fundamental tool for innovation in intelligent business models. This gives rise to a closer relationship between Industry 4.0 and servitization strategies and leads to the birth of new industrial services and new business models based on offerings of goods and services.

In a similar way, various analysts have stated that companies who decide to implement one or more of the digital enablers may see benefits with new functions such as virtual simulations of complete production processes, predicting and fixing defects through monitoring, and flexible production. All of that may be possible

without increasing production costs and therefore without increasing the cost of the final product, thus keeping the customer unaffected.

Industry 4.0 technologies as enablers for servitization have unleashed the power of the digital environment in fostering personalized solutions that can help manufacturing companies develop effective strategies in a short time. As revealed by our in-depth interviews, digital technologies have been able to support communication and interaction with markets and customers, allowing firms to understand the changes occurring in terms of demand and response and capture value to innovate their offerings. From this study, a clear strategic direction emerges for firms: By investing in digitalization, firms may be able to transform their competitive behavior not only to react to the new market conditions but also to proactively define their new offerings. Investing in digitalization is a key strategic decision for manufacturing companies to achieve growth and innovation.

In this regard, our research emphasizes how the digitalization and servitization have a mutual influence and a joint effect that facilitate the emergence of new products, finding new value in digital technologies and services. Firms have to provide digital tools and services to capture value from the market and facilitate the tailoring of their products to customer-specific needs, enabling product innovation, increased by servitization. There is evidence in the literature that the appropriate and strategic use of digital technologies can enhance manufacturing companies' competitiveness and performance, highlighting the need for firms to digitalize to identify alternative business opportunities by innovating their services and products.

On the other hand, implementing a servitization process within an organization will necessarily involve restructuring the business model. However, companies that decide not to do that and instead try and compete solely with their products would be risking lost business opportunities and would be leaving the door open to competitors who do apply a servitization strategy, as well as missing out on information about their customers. In contrast, companies who choose to practice servitization will be more likely to generate loyal customers, differentiate themselves from their competition, and find new business opportunities.

As far as managerial implications are concerned, the findings of the study suggest entrepreneurs and managers to focus their attention on digitalization as an effective response to changes and new market demands, as it allows to develop new services and innovate products. Moreover, our research findings suggest that they should pay greater attention to opportunities for customizing services, as a way to develop fruitful interactions with customers, which will have positive effects on their manufacturing companies' performance.

Finally, it is hoped that this study provides useful information about the performance indicators analyzed in the five cases, related to both servitization and to Industry 4.0. One limitation of the strategy of servitization and its various options (PSS), despite it being a competitive strategy, is that there are no effective guidelines supporting companies implementing it. This is because most of the empirical research has been qualitative, and, therefore, it is difficult to design patterns, exact formulas, or standards for the correct implementation of the system.

In addition, the study has its own limitations. Being a case study means there are limitations in terms of generalization. However, the reliability and validity of

this case study may be strengthened through a quantitative study (Borch and Arthur 1995). To that end, and as a future line of research, a quantitative study is envisaged using a survey, which may be an appropriate, effective tool for that type of study. Using a quantitative approach revisiting studies that were originally carried out via case study (qualitative methodologies) will allow hypothesis testing and allow any theories produced to be checked in a much larger sample. This will allow a confirmatory objective to be pursued and allow us to analyze the application of servitization strategies in companies in other sectors and countries.

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Declarations

Conflict of interest The authors declare no competing interests.

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