International Journal of Production Management and Engineering

https://doi.org/10.4995/ijpme.2022.16719
Received: 2021-11-23 Accepted: 2022-01-24

Evolution of Servitization: New Business Model Opportunities

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Abstract:

The concept of Servitization has been constantly developing since its outset, but in the last decade due to the irruption of Industry 4.0, the complexity of the concept and its typologies of value propositions have evolved considerably, opening up endless opportunities. In this sense, the main objective of this research is to show a summary review of the evolution of Servitization since its beginnings and the new typologies that are emerging due to the digitalization that arises through Industry 4.0. For this purpose, a systematic review of the leading databases in the field of services has been conducted. The results of the literature review show the potential of Servitization and the need to understand each reality in order to adapt to new capabilities that help the companies who become service-oriented benefit from major advantages. Ultimately, it can be concluded that, in the short term, Industry 4.0 and its new business models are the key, however, Servitization will continue to evolve to a point where all organizations will need to adapt to new trends.

Key words:

Servitization, Service Business Model, Industry 4.0, Digitalization, Service oriented.

1. Introduction

In recent years, all manufacturing companies have faced various challenges due to the high competitiveness of a market affected by globalization. For this reason, the need to offer greater value through services rather than the traditional unique selling points (price and quality) is undoubtedly essential to survive in the long term.

The impact of service and manufacturing industries is frequently considered immeasurable. Therefore, they tend to be considered separately, due to their potential influence over national economies, the classification of enterprises and employment, to name a few (Bigdeli et al., 2017; Bustinza et al., 2013; Baines & Lightfoot, 2014). Competing strategically through service delivery is becoming a characteristic feature of innovative manufacturing firms (Baines et al., 2009), boosting manufacturers' competitive strategies and the process through which this is achieved is commonly known as Servitization (Baines & Lightfoot, 2014; Oliva & Kallenberg, 2003; Reim et al., 2015). This strategy can consolidate long-term customer loyalty (Vandermerwe & Rada, 1988; Verstrepen et al., 1999), generate new, safe, steady sources of revenue (Chesbrough & Rosenbloom, 2002; Lay, 2014) and establish major hurdles for competitors (Kinnunen, 2018; Lay, 2014).

In recent years, interest in Servitization has continued to grow exponentially due to the innumerable benefits it brings to its users. The key to success in today's market has shifted towards services, away from the single production model employed by manufacturers (Habegger, 2010). There is no doubt

To cite this article: Ruiz de la Torre, A., & Sanchez, D. (2022). Evolution of Servitization: New Business Model Opportunities. *International Journal of Production Management and Engineering, 10*(1), 77-90. https://doi.org/10.4995/ijpme.2022.16719

that the benefits of Servitization are increasing, e.g., Rolls-Royce earns more than 50% of its income from services (Smith, 2013); environmental energy-efficiency arguments are also decisive, along with the huge opportunities offered by Servitization, such as improved processes and training to mention two (Cohen et al., 2006), continuing to raise industry's interest in Servitization. (In 2015, services' value added accounted for 74% of GPD in high income countries (Buckley & Majumdar, 2018).

Due to this increasing interest in Servitization, several key research challenges that require special attention for advanced Servitization need to be faced. These include opportunities to build the right organizational capabilities and culture (Benedettini & Visnjic, 2011; Brax, 2005; Vandermerwe & Rada, 1988); improve the understanding of how to integrate new business models (Sandström et al., 2008; Tukker, 2015), services, economic profitability (Anderson et al., 2006; Neely, 2008), how to provide solutions (Galbraith, 2002a; Windahl & Lakemond, 2006) how to innovate and design successful offers (Gebauer & Friedli, 2005; Jong & Vermeulen, 2003), the necessary relationships with partners (Galbraith, 2002a; Sandström et al., 2008) and transformation challenges faced by manufacturers seeking to serve (Oliva & Kallenberg, 2003; Roscitt, 1990; Windahl & Lakemond, 2006).

Manufacturing companies that adopt a service-oriented strategy have to develop the necessary organizational structures and processes (Gebauer & Fleisch, 2007; Mathieu, 2001; Oliva & Kallenberg, 2003) and possess different capacities to those of production (Ceci & Masini, 2011; Dachs et al., 2012; Datta & Roy, 2011; Gebauer & Friedli, 2005; Oliva & Kallenberg, 2003). The lack of implementation of these service-related aspects shows why manufacturing companies have not been able to take advantage of the benefits that Servitization strategies offer sooner.

This article presents a qualitative review of the key aspects and new business models that focus on the concept of Servitization to help understand the concept correctly, as well as its management and applicability.

2. Research methodology

The main aim is to present a summary review of how Servitization is evolving in order to understand the beginnings and implementation of this concept, as well as the relevance of its implementation, Figure 1 shows the methodology applied:

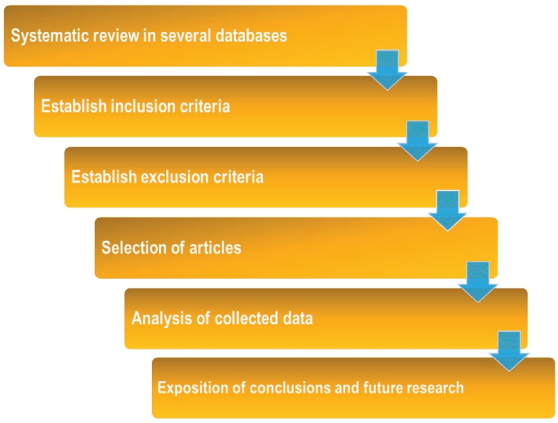

Figure 1. Methodological model.

In this article the main Business for Services data-bases including the articles indexed in Scopus, Web of Science, Engineering Village have been analyzed, as these are the reference data-bases for the topic in question, allowing sufficient critical analysis of collected data to be extracted and, subsequently, certain conclusions and future research opportunities.

3. Theoretical background

Analyzing industry in general, historically it is possible to define 4 different industrial revolutions where the degree of complexity is seen to increase (Bartodziej, 2017; Deloitte, 2015; Vuksanović et al., 2016) over the years up to today.

Finally, the latest industrial revolution currently happening in all industrial businesses refers to a revolution based on a cyber-physical production system, better known as "Industry 4.0", one of the most popular topics drawing attention from both professional and academic fields (Liao et al., 2017; Nicolae et al., 2019).

Cyber-Physical Systems (CPS) are defined as technologies to manage interconnected systems between physical assets and digital systems (Lee et al., 2015; Leitão et al., 2016; Luthra et al., 2020), being a fundamental basis of Industry 4.0 (Kim, 2017; Varghese & Tandur, 2014; Xu et al., 2018). By integrating CPS in different company departments (production, logistics, services, etc.) in today's industrial companies, the aim is to transform the current factory into a smarter factory generating

significant economic potential (Luthra et al., 2020; Negri et al., 2017).

This is achieved through easy information exchange and integrated control of products and manufacturing machines acting simultaneously and intelligently in interoperability (Lu, 2017; Ślusarczyk, 2018).

Industry 4.0 is an ongoing revolution and therefore a lot of thinking is necessary to strengthen competitiveness in a more complex environment unknown until recently, where players have to adapt to this type of industry and move away from the classic manufacturing value chain. There are many areas where companies can benefit enormously by digitizing their business. Firstly, streamlined supply chains and smart factories can boost efficiency in the organization (Frank et al., 2019; Nagy et al., 2018; Stock & Seliger, 2016). Secondly, corporate decision-making processes can be improved (Deloitte, 2015; Kamble et al., 2018) and, third and lastly the possibility of developing new businesses (Kans & Ingwald, 2016; Lee et al., 2014; Prause, 2015).

In this article we focus on the last of these opportunities. We then explore the four business model typologies that can generate this type of opportunity.

3.1. Industry 4.0 Business models

Industry 4.0 is a general change of the model established a few years ago, starting from the optimization of physical assets to a totally revolutionary scenario based on the cyber-physical system as a transforming technology in order to manage interconnected systems through advanced data and information gathering, contributing an improved product lifecycle. McKinsey & Company (2015), in its study "Industry 4.0: How to navigate digitization of the manufacturing sector", identifies this data optimization as an end-to-end digital stream, briefly: a "digital thread" running through the entire product lifecycle as its digital representation. To advance this digitalization process, it starts with the digital design of the product, through the transfer of the digitally controlled production process, leading to the digital monitoring of the final product during operation (e.g. for productivity improvement purposes), closing the cycle with the recycling of the product. In each of the phases, the aim of the digital information structure is to enable: the easy exchange of data, the visualization of the controlled processes via digital interfaces/tools (e.g. tablets, virtual glasses) and permit interconnection via digital channels (e.g. teleservice). In addition, the exploitation and exchange of information across this stream will benefit from greater cross-functional integration and closer collaboration across the entire product lifecycle, including different stakeholders, such as suppliers, partners or clients. The focus is evolving from a single production site to production networks spanning multiple sites belonging to the company, including the entire supply chain. Therefore, the goal of digital thread optimization is to make the best use of information.

All Industry 4.0 technologies are similar to each other in that they offer ways of harnessing data to unlock its value potential (McKinsey&Company, 2015). For example, turning information into valuable results through advanced analytics that help decision-makers.

At present, many companies are still at a nascent stage of this revolution. This type of technology has shown that oil rig companies, for example, are losing up to 99% of their data before reaching operational decision makers through information loss. Consequently, it is important to manage data effectively (and incorporate it into the dynamics of business management), as every information leak causes inefficiencies, which would otherwise be valuable in many places along the value chain.

In short, actively managing information to avoid information leakage is the key to seizing the new opportunities offered by digitalization. McKinsey & Company (2015) therefore proposes four basic activities to generate value from data:

1. Data capture and recording.
2. Information transfer.
3. Information processing and synthesis.
4. Converting information into results.

With the correct application of the four tasks described above, Industry 4.0 offers opportunities that can maximize performance and generate profits in traditional manufacturing companies. On the one hand, there is the so called "smart factory" that focuses on the production process itself, using digital tools to make production more efficient and of a higher quality (Bag et al., 2018; Luthra et al., 2020). On the other hand, there is the use of these same technologies to generate new business models,

from innovative proposals to new or potential customers (Ayala et al., 2019; Bartodziej, 2017; Deloitte, 2015; Frank et al., 2019; Ibarra et al., 2018; Müller et al., 2021; Ślusarczyk, 2018). We often say that digital technology enables the emergence of new business models, but we are actually referring more to the creation of innovative value propositions rather than to business models as a whole, of which the first concept is a part. However, it is not at all easy to move from this level of abstraction to more identifiable lines of action.

Accordingly, the contribution of Schaeffer (2017) is quite enlightening. Certainly not for discovering absolutely new things, but for visualizing them in a more clarifying way. For this author, as shown in Figure 2 and applicable to any sector, there are three business models (value propositions in our language) enabled by the irruption of digitalization: "Platforms/ Marketplaces", "Information Value Add Business Model" and "As a Service Business Model".

The first of these, "Platform/Marketplace" is already very recognizable in the consumer world (Airbnb, Uber, etc.), however, it is gaining traction in the industrial world, where six of the world's largest companies (Amazon, IBM, Cisco, General Electric, Microsoft and PTC) are already actively vying to lead this space of opportunity. The second of the models, the "Information Value Add Business Model" (data as a revenue generator), has to do with everything related to predictive maintenance services, for example, those most talked about in our manufacturing environment. Nonetheless, in general it concerns everything that arises from the analysis of data captured from products, services, customer experiences, etc. that allow us to anticipate and personalize value-added services in the marketplace. Finally, we have perhaps the most specific of all, "As a Service Business Model", which revolves around pay-per-use.

With some variations, all sectors are incorporating this logic. Thus, to give just two examples, McKinsey & Company (2015) speaks of four business models, in addition to the three previously mentioned, the possibility of selling knowledge in a consultancy model or selling any type of licenses, as shown in the Figure 3.

In the second example, we can talk about another very important area of opportunity: the circular economy. Experts in this field, such as Könnölä (2017), point to digitalization as a "master pillar" in the take-off of circular economy strategies. Circular economy in the coming years. Here again, a recent report by Accenture strategy (2015) identifies digital business models for the circular economy that will be familiar to us (see Figure 4):

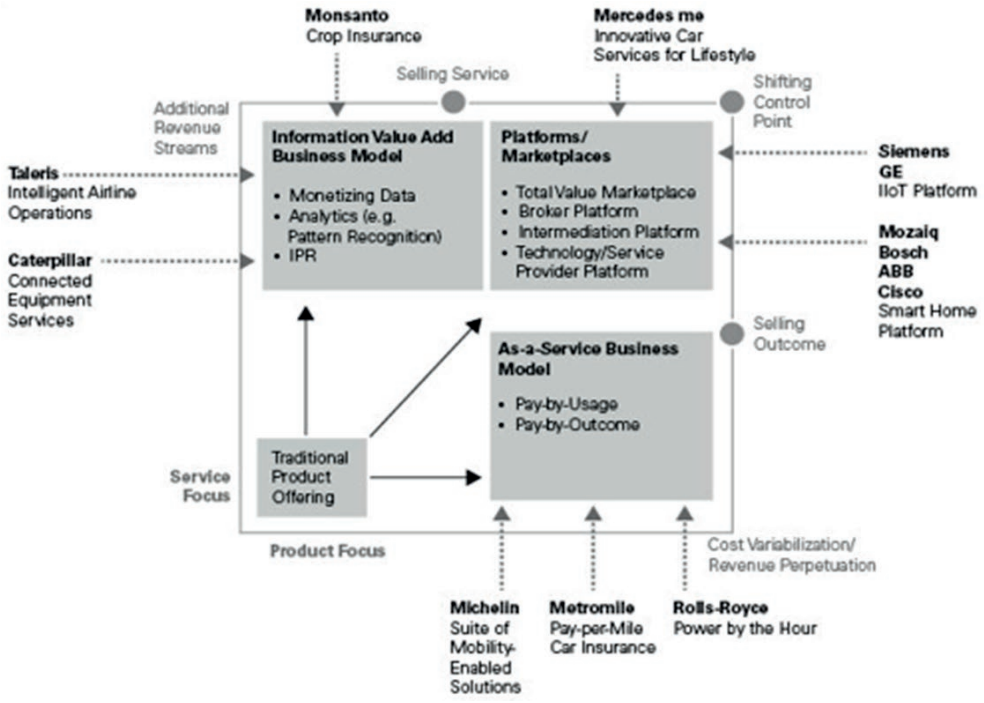

Figure 2. Business model in the digital age (Source: Schaeffer (2017)).

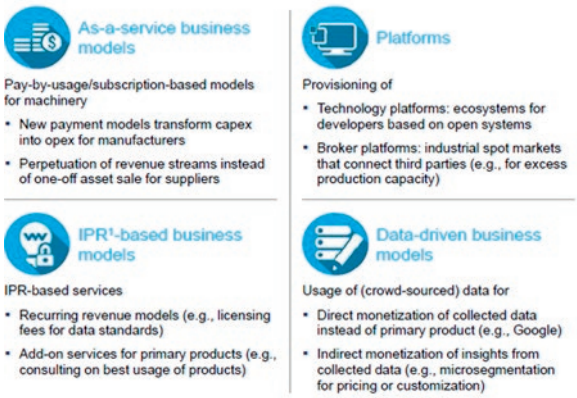

Figure 3. Digital business models for Industry 4.0 (Source: McKinsey & Company (2015)).

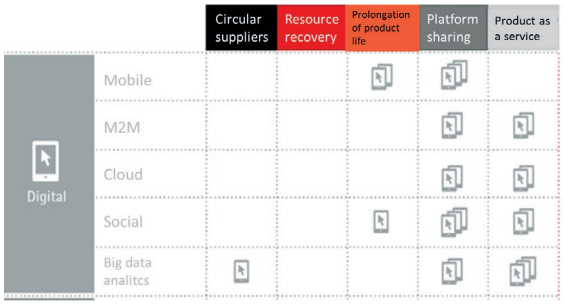

Figure 4. Technologies used by companies pioneering the adoption of circular business models (Source: Accenture strategy (2015)).

In this case, the authors highlight the platform model and the product-as-a-service model that encompasses the "As a Service Business Model" and the "Information Value Add Business Model".

These new business models are leading to a major change from revenues from physical product sales to revenues from more service-based platforms and developer ecosystems, subsequently creating a shift in the ways value is created for both manufacturers and suppliers. While in the manufacturing industry, sales of actual products have traditionally been the largest value group in terms of share of total revenue, this share is likely to decline in favor of new business models in the coming years. For car manufacturers, for example, sources of value are shifting from initial revenues from vehicle sales to recurring revenues based on usage. This is primarily driven by interoperability, with the potential to unleash a significant shift in revenue distribution through five main groups in the sector: vehicle price, connectivity hardware, driver time and attention, maintenance and insurance. Hardware will become more accessible, reducing barriers for new market entrants. Traditional value chains will be dismantled, creating new sources of revenue from value and, therefore, new opportunities. One of the keys to the future is related to being able to offer the new business models described above to harness the potential to create additional value and redistribute existing value sets that Industry 4.0 offer.

Therefore, all businesses that want to make the leap into digital should consider whether they are developing or planning to develop initiatives in any of the digital models presented here, regardless of the sector in which they operate. A digital transformation effort that does not incorporate a change in the business model is not very credible.

In addition to model change, there is a more complex and uncertain landscape. Currently, many of the breakthrough technologies are driven by small, innovative companies that have specialized in a particular field (McKinsey&Company, 2015). These companies are often more agile than large, established firms, consequently, smaller firms can generally implement new business models more easily, while larger firms need to consider about how to become more agile.

Moreover, the number of players is likely to rise, increasing the complexity and multiplicity of interfaces. A likely outcome is the increasing emergence of highly specialized players (Rüßmann et al., 2015). Another consequence of changes in the value chain may be the entry of established operators outside traditional manufacturing, such as telecommunications enterprises providing solutions for machine to machine connectivity or data security. Consequently, traditional value chains are undergoing a radical transformation (McKinsey & Company, 2015; Kohnová et al., 2019). Instead of a company developing and producing a complete product, a higher degree of specialization (value chain disintegration) is likely to occur (Barreto et al., 2017; Gebauer et al., 2013). This can already be seen in the semiconductor industry, for example, where foundries are manufacturing products for other semiconductor companies, also known as "fabless" manufacturing where the focus is on developing and commercializing the technology. This is especially of interest to manufacturing companies with high investment needs for manufacturing workshops and a high level of complexity, such as the aviation

aftermarket. Companies can apply uninterrupted monitoring in order to enhance their maintenance and repair business, reduce the cost generated by services, improve the use of their facilities and their spare parts planning. With such a significant disruption of the value chain expected, there are still many unknown fields (Xu et al., 2018), cybersecurity, for example, where which type of company has the best chance of becoming dominant player remains open to conjecture. Will it be telecommunication companies, IT companies or microchip suppliers, or will a completely new player or supplier develop around the new demand?

Next, due to their importance in the current business context, we would like to briefly review the "Platforms/Marketplaces" and "As a Service Business model" business models following the terminology previously proposed by Eric Schaeffer (2017). The "Information Value Add Business Model" model, which we call SERVITIZATION.

The platform concept has been defined as "Business scale powered by the ability to leverage and orchestrate a global connected ecosystem of producers and consumers toward efficient value creation and exchange". (Choudary et al., 2015). Therefore, in the near future, the scenario in which we may find ourselves is one in which industrial components are connected through the cloud on a platform, where they can dump all the information they collect and also interact with other industrial objects. Customers, suppliers and other partners also interact in this virtual space in order to optimize and make the value chain more valuable. According to the latest reports, in 2018 more than 50% of large companies and 80% of companies with advanced digital transformation strategies would be associated with this type of industrial platforms.

The most foreseeable scenario is not that every company will have its own cloud, but that a few winning platforms will connect the vast majority of industrial objects, as is the case today with mobile phones, which are basically connected through two or three platforms. Take the example of "Predix", the IoT platform that General Electric has been rolling out in recent years. The official definition of the platform is already quite striking: "a cloud-based operating system for industrial application [...] The World's First Industrial Internet platform". Predix is a strategic commitment by General Electric, as mentioned at the beginning, to position itself in a privileged position in the digital revolution of the industry.

In this cloud, Predix has created applications that serve its objects or machines of various types, but the interesting thing is that it has created a development environment so that not only Predix but any developer can create services and applications for their particular case. This in turn means that a market of applications, algorithms, etc. will be created for the members of this ecosystem. In fact, there is already a "Predix App Showcase" where you can buy these applications or start developing your own.

Although we have used the example of Predix throughout, this same orientation is repeated in the rest of the companies that want to build this type of platform. Seeing how this platform dynamic has worked in other sectors, it is highly likely that, ultimately, a few of these platforms will account for a very high percentage of all connected industrial objects.

In this context, we can identify two types of value proposition that will emerge. Firstly, those companies that build and succeed with these platforms will be able to monetize their infrastructure through different service channels (by connection, use and sale of applications, etc.), however, due to the very nature of this value proposition, we believe it is very difficult for Basque industrial companies to do so. SMEs, generally detached from the world's large technology conglomerates, have opportunities to play a leading role in this scenario.

Nonetheless, and secondly, there is the part of new value propositions that will be offered to customers once machines and other industrial components of a company's value proposition are within this ecosystem. By connecting to them, companies can have access to entire data networks, find new customers, use or develop new applications, pay-per-outcome value propositions etc. and, above all, build product and service chains with third parties more easily and faster than ever before.

We can highlight two aspects in this challenge. The first has to do with interconnecting this new information ecosystem with the organization's existing systems (ERP, CRM, etc.), which is why the platform should offer openness and ease of integration through modular systems, APIs, etc. and, secondly, selecting the platform to which we will connect our products, a vitally important issue as the range of possibilities that will open up to us will depend to a large extent on this.

3.2. The road to Servitization

3.2.1. Definition

In order to understand Servitization it is necessary to have a clear definition. The following table summarizes some of the most important definitions according to this research.

Within the 4 business models that are generated through Industry 4.0, the business model we will refer to below is the "Information Value Added Business Model" and more specifically the possibilities that open up in the form of Servitization and, as a more concrete example, predictive maintenance. Capital goods companies that want to evolve towards "service-oriented" business models will require fundamental changes in the company, posing them a major challenge. However, there is no doubt that the most competitive and value-added companies will make this leap sooner rather than later. In a survey of 600 manufacturing managers in 13 countries, 86% of them say that the transition from a product-based to a service-based strategy is a key part of their growth (Macaulay et al., 2015). However, when asked about their concrete expectations on the topic over the next five years, these are quite low, as shown in Figure 5 (Macaulay et al., 2015).

Obviously, the situation is explained by the fact that all managers perceive the wave of change, but are not yet very clear on how they are going to "surf" it. Another recent study analyzed how despite the fact that almost all managers understood that digitization was key to the future of their organizations, only 45% of respondents indicated that this topic was a top-level element of importance on their boards (Bradley et al., 2015).

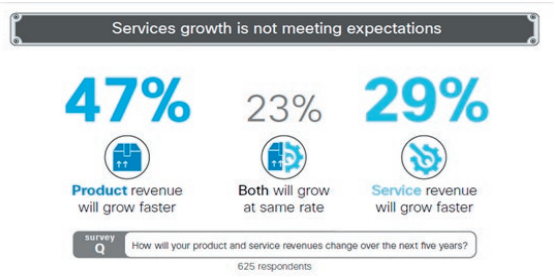

Figure 5. Growth of the service business model (Source: Macaulay (2015)).

These data towards Servitization can also be observed in macroeconomic magnitudes. For example, service-related jobs within manufacturing companies are on the rise, making it increasingly difficult for many manufacturing companies to say whether they are manufacturers of products or providers of services, or in other words "manufacturing is no longer the same as the production of goods". Another very significant fact is that approximately 1/3 of the value of manufactured products consists of services. Seen in reverse, it is estimated that 40% of the output created by the service sector is used as intermediary input by manufacturing firms (Stehrer et al., 2014).

Digitalization is set to boost this trend towards Servitization exponentially in the coming years.

Table 1. Servitization definition (Source: Own elaboration).

Authors & year	Definition
Levitt, 1981	"Servitization, which entails adding extra service components to core products".
Vandermerwe & Rada, 1988	"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".
Bart et al., 2003	"A trend in which manufacturing firms adopt more and more service components in their offerings".
Baines et al., 2007	"The innovation of a manufacturing organization's capabilities and processes to shift from selling product to selling an integrated product and service offering that delivers value in use".
Schmenner, 2009	"The innovations in the supply chains of companies in the latter half of the nineteenth century lead us straight to the Servitization innovations of today; it was then in history where service begins to be bundled with goods and controlled by the same company".
Baines & Lightfoot, 2014	"The Servitization phenomenon that has pervaded manufacturing has resulted in organizations offering complex packages of both product and service to generate superior customer exchange value and thus enhance competitive edge".
Kowalkowski et al., 2017	"The transformational process of shifting from a product-centric business model and logic to a service-centric approach".

As shown in Table 1, the concept of Servitization has been constantly developing over the last 40 years. Although the first references to this term date back to the early 1980s regarding this concept developed by Levitt in the USA, most authors have based their work on the Vandermerwe & Rada (1988) definition, helping Servitization to evolve and acquire different nuances that reflect its importance within different scopes. The term 'product' is generally internalized in the manufacturing industry, however, when defining 'services', many tacitly define this based on what is not a product (Baines et al., 2009). In this paper, we will consider Servitization as "the intangible economic activities that add value to core product".

On the basis of the Vandermerwe & Rada (1988) definition, services began to be considered intangible, beyond production yet needed. After the division of products and services, many authors have presented similar definitions with different connotations over the years.

In addition to the main definitions of the Servitization concept, it has also had variants and contributions implicitly linked to the definition, as shown in the Table 2.

Among the different definitions, variants and contributions it is important to highlight a key factor that was missing in most of the previous cases: taking the customer's needs through services into account. This concept was integrated by a product-service system (PSS) which consists of "tangible products and intangible services designed and combined so that jointly they are capable of fulfilling specific customer needs" (Tukker, 2004). The PSS business model allows organizations to create new sources of added value propositions focused on end users (Baines et al., 2007), increase competitiveness through satisfying customer needs, build stronger relationships and, in turn, provide innovative solutions.

The latest evolution of Servitization is related to Industry 4.0. Today, beyond any doubt, advanced services, digitalization and IoT are considered to be of high added value in the manufacturing industry as a defense against other lower cost economies (Baines et al., 2009; Baumgartner, 1999; Tukker, 2004; Vandermerwe & Rada, 1988), mainly in sectors with a high saturation of marketed products (Baines et al., 2009; Baumgartner, 1999; Windahl et al., 2004). Many authors confuse Industry 4.0 with Servitization, however, Servitization goes further because once Industry 4.0 is established and stabilized in the market, Servitization will continue to evolve due to new competitive strategies.

3.3. Typologies of Servitization

The new classification of formulae to offer services proposed in the work of Adrodegari et al. (2015), is an important starting point to help better understand the shift towards service-oriented business models in manufacturing companies. Truly, one of the innovative keys in the coming years will be the difference in the monetization of certain models from others, above many points to be developed. For these authors, there are five basic forms of service value proposition (see Figure 1) that, starting with the most basic and ending with the most advanced, would be what is shown in Figure 6.

- **Product focused:** The supplier separately sells the product or system and the needs of the customers for services during the product use phase (for example: repairs, maintenance contract, etc.).

Table 2. Servitization variants and contributions (Source: Own elaboration).

Variants & contributions	Authors & year
Performance economy	Stahel, 2010.
Product-Service-Systems	Tukker, 2004.
Service business expansion	Gebauer et al., 2005; Oliva & Kallenberg, 2003.
Service business performance	Fang et al., 2008; Gebauer et al., 2005.
Services growth strategies	Gebauer et al., 2010; Oliva & Kallenberg, 2003; Ulaga et al., 2011.
Service profitability	Kwak & Kim, 2016; Gebauer & Fleisch, 2007.
Solution delivery	Davies et al., 2007; Galbraith, 2002b.
Solution marketing	Tuli et al., 2007
Solutions provision	Davies et al., 2006; Galbraith, 2002b.

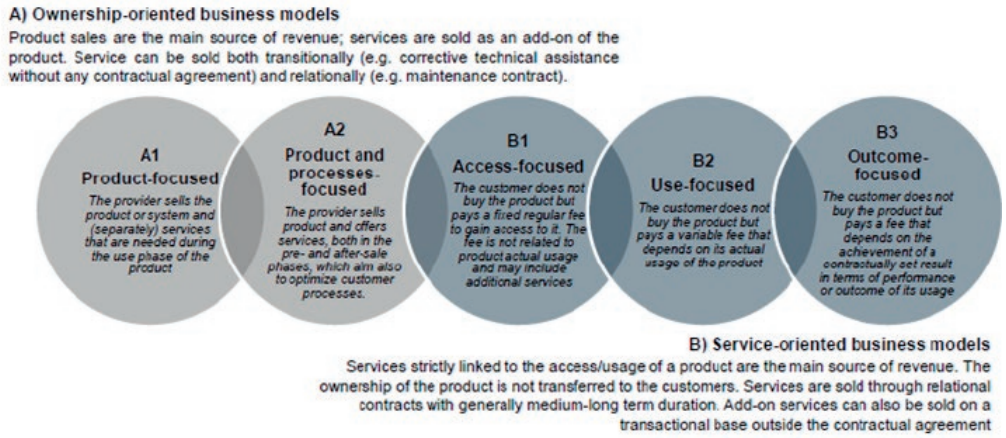

Figure 6. Typologies of service value proposition models (Source: Adrodegari et al. (2015)).

- **Focused on product processes:** The main difference with the previous one is that the company offers services, both in pre-sale and post-sale phases, aimed at increasing the efficiency and effectiveness of customer operations, e.g., system customization, support of use processes, full risk maintenance contracts.
- **Focused on access (availability):** The customer does not buy the product, but pays a regular flat fee to have access to it. The fee is not related to the actual use of the product and may include additional services (for example, maintenance and insurance costs).
- **Focused on use:** The customer does not buy the product or system, but pays a variable rate that depends on the use of the product (pay-per-use time, pay-per-use unit...).
- **Focused on results:** The customer does not buy the product or system, but pays a fee that depends on achieving a contractually established result in terms of product/system performance or the result of its use.

In Figure 7, Baines and Lightfoot, (2014) also explain this same idea of increasing the complexity of an offer of advanced services in a very graphic way.

Therefore, according to Fleisch et al. (2015) we are faced with a scenario in which a connected product is capable of generating data which, when properly analyzed, is capable of being the basis on which to build digital services that add value to the customer. For example, a sensor-based connected machine can generate huge amounts of data which, with proper analysis, are capable of predicting the failure of a machine in advance. This data processing allows for planned maintenance and therefore increases the efficiency of the entire system (simply put, we call this process predictive maintenance). A further step would be pay-per-use or per manufactured unit, i.e., the last stage of Servitization.

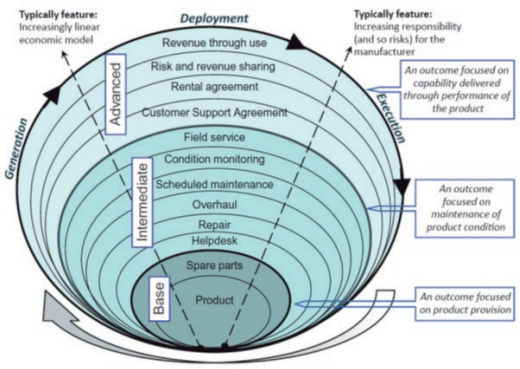

Figure 7. From basic to advanced services (Source: Baines et al. (2014)).

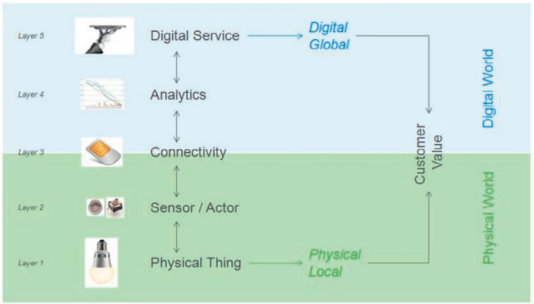

Figure 8. Digital services development process (Source: Fleisch et al. (2015)).

4. Conclusion

As a conducted literature review, it is clear that Servitization has evolved considerably since its creation, ever increasing in potential with respect to products. It is also essential to develop the necessary capabilities to reach the advanced services required to compete in current situations.

On the one hand, nobody doubts the improvements and benefits associated with Servitization that strengthen and retain customer relationships, generate new and constant income streams or establish differentiating competitive advantages with respect to competitors.

On the other hand, obstacles are currently encountered when implementing Servitization. Primarily, furnishing organizations with the necessary capacities to face all the new advanced services linked to Industry 4.0 and the amount of information available due to digitalization and ultimately managing these new proposed product and services business model typologies.

In conclusion, there is a need for further research into new Business Models derived from the arrival of Industry 4.0, with the aim of managing new value propositions based on models focused on customer needs. Managing the correct applicability of these models will be the key to success when implementing advanced services in Servitization. To close, it is important to state that despite Industry 4.0 being key in the short term, Servitization will continue evolving and all organizations will have to adapt to new streams.

References

Accenture strategy (2015). *La ventaja circular: Tecnologías y modelos de negocio innovadores para generar valor en un mundo sin límites de crecimiento*.

Adrodegari, F., Alghisi, A., Ardolino, M., & Saccani, N. (2015). From ownership to service-oriented business models: A survey in capital goods companies and a PSS typology. *Procedia CIRP*, *30*, 245–250. https://doi.org/10.1016/j.procir.2015.02.105

Anderson, J. C., Narus, J. A., & Van Rossum, W. (2006). Customer value propositions in business markets. *Harvard Business Review*, *84*(3), 1–8.

Ayala, N. F., Gerstlberger, W., & Frank, A. G. (2019). Managing servitization in product companies: the moderating role of service suppliers. *International Journal of Operations and Production Management*, *39*(1), 43–74. https://doi.org/10.1108/IJOPM-08-2017-0484

Bag, S., Telukdarie, A., Pretorius, J. H. C., & Gupta, S. (2018). Industry 4.0 and supply chain sustainability: framework and future research directions. *Benchmarking*, *28*(5), 1410–1450. https://doi.org/10.1108/BIJ-03-2018-0056

Baines, T., Lightfoot, H., Peppard, J., Johnson, M., Tiwari, A., Shehab, E., & Swink, M. (2009). Towards an operations strategy for product-centric servitization. *International Journal of Operations and Production Management*, *29*(5), 494–519. https://doi.org/10.1108/01443570910953603

Baines, T., & Lightfoot, H. W. (2014). Servitization of the manufacturing firm: Exploring the operations practices and technologies that deliver advanced services. *International Journal of Operations and Production Management*, *34*(1), 2–35. https://doi.org/10.1108/IJOPM-02-2012-0086

Baines, T. S., Lightfoot, H. W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J. R., Angus, J. P., Basti, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., … Wilson, H. (2007). State-of-the-art in product-service systems. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, *221*(10), 1543–1552. https://doi.org/10.1243/09544054JEM858

Barreto, L., Amaral, A., & Pereira, T. (2017). Industry 4.0 implications in logistics: an overview. *Procedia Manufacturing*, *13*, 1245–1252. https://doi.org/10.1016/J.PROMFG.2017.09.045

Bart et al. (2003). Servitization: or why services management is relevant for manufacturing environments. *Services Management: An Integrated Approach*, 39.

Bartodziej, C. J. (2017). The concept Industry 4.0. *The Concept Industry 4.0*, 27–50. https://doi.org/10.1007/978-3-658-16502-4_3

Baumgartner, P. (1999). Go Downstream: The New. *Harvard Business Review*, *77*(5), 1–18.

Benedettini, O., & Visnjic, I. (2011). The servitization of manufacturing: Abstract. *European Operations Management Association Conference*, *July*, 1–9. Retrieved from https://www.researchgate.net/profile/Andy-Neely/publication/265006912_The_Servitization_of_Manufacturing_Further_Evidence/links/5474eaad0cf29afed60ffc20/The-Servitization-of-Manufacturing-Further-Evidence.pdf

Bigdeli, A., Baines, T., … O. B.-… R. A. I., & 2017, U. (2017). Organisational change towards servitization: A theoretical framework. *Competitiveness Review*, *27*(1), 12–39. https://doi.org/10.1108/CR-03-2015-0015

Bradley, J., Loucks, J., Macaulay, J., Noronha, A., & Wade, M. (2015). *Digital Vortex*. Retrieved from http://gtmtecno.com/wp-content/uploads/2015/11/20151109-2395xx_Digital_Vortex_06182015.pdf

Brax, S. (2005). A manufacturer becoming service provider - Challenges and a paradox. *Managing Service Quality*, *15*(2), 142–155. https://doi.org/10.1108/09604520510585334

Buckley & Majumdar. (2018). The services powerhouse: Increasingly vital to world economic growth. *Deloitte Insights*, *12*.

Bustinza, O. F., Parry, G. C., & Vendrell-Herrero, F. (2013). Supply and demand chain management: The effect of adding services to product offerings. *Supply Chain Management*, *18*(6), 618–629. https://doi.org/10.1108/SCM-05-2013-0149

Ceci, F., & Masini, A. (2011). Balancing specialized and generic capabilities in the provision of integrated solutions. *Industrial and Corporate Change*, *20*(1), 91–131. https://doi.org/10.1093/ICC/DTQ069

Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Academic. Oup.Com*. *Industrial and corporate change, 11*(3), 529-555. https://doi.org/10.1093/icc/11.3.529

Choudary et al. (2015). *Platform scale: How an emerging business model helps startups build large empires with minimum investment.* Platform Thinking Labs.

Cohen, M., … N. A.-H., & 2006, undefined. (2006). Winning in the aftermarket. *Fishmandavidson.Wharton.Upenn .... Retrieved from https://fishmandavidson.wharton.upenn.edu/wp-content/uploads/2016/06/Winning-in-the-Aftermarket_HBR_May_06.pdf

Dachs, B., Biege, S., Borowiecki, M., Lay, G., Jäger, A., & Schartinger, D. (2012). *The Servitization of European Manufacturing Industries*.

Datta, P. P., & Roy, R. (2011). Operations strategy for the effective delivery of integrated industrial product-service offerings: Two exploratory defence industry case studies. *International Journal of Operations and Production Management*, *31*(5), 579–603. https://doi.org/10.1108/01443571111126337

Davies, A., Brady, T., & Hobday, M. (2006). Charting a path toward integrated solutions. In *MIT Sloan Management Review* (Vol. 47, Issue 3, pp. 39–48). https://www.researchgate.net/publication/215915574_Charting_a_Path_Toward_Integrated_Solutions

Davies, A., Brady, T., & Hobday, M. (2007). Organizing for solutions: Systems seller vs. systems integrator. *Industrial Marketing Management*, *36*(2), 183–193. https://doi.org/10.1016/j.indmarman.2006.04.009

Deloitte. (2015). Industry 4.0. Challenges and solutions for the digital transformation and use of exponential technologies. *Deloitte*, 1–30. https://www.academia.edu/download/42978372/Deloittes_study_on_industry_4.0.pdf

Fang, E. (Er), Palmatier, R. W., & Steenkamp, J.-B. E. M. (2008). Effect of Service Transition Strategies on Firm Value: *Journal of marketing*, *72*(5), 1–14. https://doi.org/10.1509/JMKG.72.5.001

Fleisch, E., Weinberger, M., & Wortmann, F. (2015). Business models and the internet of things (Extended abstract). *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *9001*, 6–10. https://doi.org/10.1007/978-3-319-16546-2_2

Frank, A. G., Dalenogare, L. S., & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics*, *210*, 15–26. https://doi.org/10.1016/j.ijpe.2019.01.004

Galbraith, J. R. (2002a). Center for Effective Organizations, Organizing to deliver solutions.

Galbraith, J. R. (2002b). Organizing to deliver solutions. *Organizational Dynamics*, *31*(2), 194–207. https://doi.org/10.1016/S0090-2616(02)00101-8

Gebauer, H,. Fleisch, E., & Friedli, T. (2005). Overcoming the service paradox in manufacturing companies. *European Management Journal, 23*(1), 14-26. https://doi.org/10.1016/j.emj.2004.12.006

Gebauer, H., Edvardsson, B., Gustafsson, A., & Witell, L. (2010). Match or mismatch: Strategy-structure configurations in the service business of manufacturing companies. *Journal of Service Research*, *13*(2), 198–215. https://doi.org/10.1177/1094670509353933

Gebauer, H., & Fleisch, E. (2007). An investigation of the relationship between behavioral processes, motivation, investments in the service business and service revenue. *Industrial Marketing Management*, *36*(3), 337–348. https://doi.org/10.1016/J.INDMARMAN.2005.09.005

Gebauer, H., & Friedli, T. (2005). Behavioral implications of the transition process from products to services. *Journal of Business and Industrial Marketing*, *20*(2), 70–78. https://doi.org/10.1108/08858620510583669

Gebauer, H., Paiola, M., & Saccani, N. (2013). Characterizing service networks for moving from products to solutions. *Industrial Marketing Management*, *42*(1), 31–46. https://doi.org/10.1016/j.indmarman.2012.11.002

Habegger, B. (2010). Strategic foresight in public policy: Reviewing the experiences of the UK, Singapore, and the Netherlands. *Futures*, *42*(1), 49–58. https://doi.org/10.1016/J.FUTURES.2009.08.002

Ibarra, D., Ganzarain, J., & Igartua, J. I. (2018). Business model innovation through Industry 4.0: A review. *Procedia Manufacturing*, *22*, 4–10. https://doi.org/10.1016/J.PROMFG.2018.03.002

Jong, J. P. J., & Vermeulen, P. A. M. (2003). Organizing successful new service development: a literature review. *Management Decision*, *41*(9), 844–858. https://doi.org/10.1108/00251740310491706

Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2018). Sustainable Industry 4.0 framework: A systematic literature review identifying the current trends and future perspectives. *Process Safety and Environmental Protection*, *117*, 408–425. https://doi.org/10.1016/j.psep.2018.05.009

Kans, M., & Ingwald, A. (2016). Business Model Development Towards Service Management 4.0. *Procedia CIRP*, *47*, 489–494. https://doi.org/10.1016/J.PROCIR.2016.03.228

Kim, J. H. (2017). A Review of Cyber-Physical System Research Relevant to the Emerging IT Trends: Industry 4.0, IoT, Big Data, and Cloud Computing. *Journal of Industrial Integration and Management*, *02*(03), 1750011. https://doi.org/10.1142/S2424862217500117

Kinnunen, R. (2018). *Creating customer value using digital tools in scaffolding industry*. Retrieved from https://lutpub.lut.fi/handle/10024/157114

Kohnová, L., Papula, J., Practice, N. S.-B. T. and, & 2019, undefined. (2019). Internal factors supporting business and technological transformation in the context of Industry 4.0. *Ceeol.Com*. https://doi.org/10.3846/btp.2019.13

Könnölä, T. (2017). Totti Könnölä: la digitalización como pilar maestro de la economía circular. *El mundo*: https://www.elmundo.es/economia/innovadores/2017/10/27/59f2f245e2704e5a458b4894.html.

Kowalkowski, C., Gebauer, H., Kamp, B., & Parry, G. (2017). Servitization and deservitization: Overview, concepts, and definitions. *Industrial Marketing Management*, *60*, 4–10. https://doi.org/10.1016/j.indmarman.2016.12.007

Kwak, K., & Kim, W. (2016). Effect of service integration strategy on industrial firm performance. *Journal of Service Management*, *27*(3), 391–430. https://doi.org/10.1108/JOSM-03-2014-0088

Lay, G. (2014). Servitization in industry. In *Servitization in Industry* (Vol. 9783319069). https://doi.org/10.1007/978-3-319-06935-7

Lee, J., Bagheri, B., & Kao, H. A. (2015). A cyber-physical systems architecture for industry 4.0-based manufacturing systems. *Manufacturing letters, 3*, 18-23. https://doi.org/10.1016/j.mfglet.2014.12.001

Lee, J., Kao, H. A., & Yang, S. (2014). Service innovation and smart analytics for Industry 4.0 and big data environment. *Procedia CIRP*, *16*, 3–8. https://doi.org/10.1016/j.procir.2014.02.001

Leitão, P., Colombo, A. W., & Karnouskos, S. (2016). Industrial automation based on cyber-physical systems technologies: Prototype implementations and challenges. *Computers in industry, 81*, 11-25. https://www.sciencedirect.com/science/article/pii/S0166361515300348 https://doi.org/10.1016/j.compind.2015.08.004

Levitt, T. (1981). Marketing Intangible Products and Product Intangibles. *Cornell Hotel and Restaurant Administration Quarterly*, *22*(2), 37–44. https://doi.org/10.1177/001088048102200209

Liao, Y., Deschamps, F., Rocha Loures, E., Felipe Ramos, L., de Freitas Rocha Loures, E., & Felipe Pierin Ramos, L. (2017). Past, present and future of Industry 4.0-a systematic literature review and research agenda proposal. *International Journal of Production Research, 55*(12), 3609–3629. https://doi.org/10.1080/00207543.2017.1308576

Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration*, *6*, 1–10. https://doi.org/10.1016/j.jii.2017.04.005

Luthra, S., Kumar, A., Zavadskas, E. K., Mangla, S. K., & Garza-Reyes, J. A. (2020). Industry 4.0 as an enabler of sustainability diffusion in supply chain: an analysis of influential strength of drivers in an emerging economy. *International Journal of Production Research*, *58*(5), 1505–1521. https://doi.org/10.1080/00207543.2019.1660828

Macaulay, J., Connell, K. O., & Delaney, K. (2015). The Digital Manufacturer Resolving the Service Dilemma. *Cisco*, *November*, 1–20.

Mathieu, V. (2001). Product services: From a service supporting the product to a service supporting the client. *Journal of Business and Industrial Marketing*, *16*(1), 39–53. https://doi.org/10.1108/08858620110364873

McKinsey&Company. (2015). *How to Navigate Digitization of Manufacturing Sector*. https://www.mckinsey.com/~/media/mckinsey/business functions/mckinsey digital/our insights/getting the most out of industry 4 0/mckinsey_industry_40_2016.pdf

Müller, J. M., Buliga, O., & Voigt, K. I. (2021). The role of absorptive capacity and innovation strategy in the design of industry 4.0 business Models - A comparison between SMEs and large enterprises. *European Management Journal*, *39*(3), 333–343. https://doi.org/10.1016/j.emj.2020.01.002

Nagy, J., Oláh, J., Erdei, E., Máté, D., & Popp, J. (2018). The role and impact of Industry 4.0 and the internet of things on the business strategy of the value chain—the case of Hungary. *Sustainability, 10*(10), 3491. https://doi.org/10.3390/su10103491

Neely, A. (2008). Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research*, *1*(2), 103–118. https://doi.org/10.1007/S12063-009-0015-5

Negri, E., Fumagalli, L., & Macchi, M. (2017). A Review of the Roles of Digital Twin in CPS-based Production Systems. *Procedia Manufacturing*, *11*, 939–948. https://doi.org/10.1016/J.PROMFG.2017.07.198

Nicolae, A., Korodi, A., & Silea, I. (2019). An Overview of Industry 4.0 Development Directions in the Industrial Internet of Things Context. *Romanian Journal of Information Science and Technology*, *22*(4), 183–201.

Oliva, R., & Kallenberg, R. (2003). Managing the transition from products to services. *International Journal of Service Industry Management*, *14*(2), 160–172. https://doi.org/10.1108/09564230310474138

Prause. (2015). Security and sustainability issues. Ministry of National Defence Republic of Lithuania journal of. *Journal of Security & Sustainability Issues*. https://doi.org/10.9770/jssi.2015.5.2

Reim, W., Parida, V., & Örtqvist, D. (2015). Product–Service Systems (PSS) business models and tactics – a systematic literature review. *Journal of Cleaner Production*, *97*, 61–75. https://doi.org/10.1016/J.JCLEPRO.2014.07.003

Roscitt, R. (1990). Strategic service management. *Journal of Business & Industrial Marketing*, *5*(1), 27–40. https://doi.org/10.1108/EUM0000000002735

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. *Inovasyon.Org*. Retrieved from https://inovasyon.org/images/Haberler/bcgperspectives_Industry40_2015.pdf

Sandström, S., Edvardsson, B., Kristensson, P., & Magnusson, P. (2008). Value in use through service experience. *Managing Service Quality: An International Journal*, *18*(2), 112–126. https://doi.org/10.1108/09604520810859184

Schaeffer, E. (2017). *Industry X.0: Realizing digital value in industrial sectors*. Kogan Page Publishers.

Schmenner, R. W. (2009). Manufacturing, service, and their integration: Some history and theory. *International Journal of Operations and Production Management*, *29*(5), 431–443. https://doi.org/10.1108/01443570910953577

Ślusarczyk, B. (2018). Industry 4.0: Are we ready? *Polish Journal of Management*, *17*(1). https://doi.org/10.17512/pjms.2018.17.1.19

Smith, D. J. (2013). Power-by-the-hour: The role of technology in reshaping business strategy at Rolls-Royce. *Technology Analysis and Strategic Management*, *25*(8), 987–1007. https://doi.org/10.1080/09537325.2013.823147

Stahel, W. (2010). *The performance economy*. Springer.

Stehrer, R., Baker, P., Foster-McGregor, N., & Koenen, J. (2014). *Study on the relation between industry and services in terms of productivity and value creation*. https://madoc.bib.uni-mannheim.de/45990/

Stock, T., & Seliger, G. (2016). Opportunities of Sustainable Manufacturing in Industry 4.0. *Procedia CIRP*, *40*, 536–541. https://doi.org/10.1016/j.procir.2016.01.129

Tukker, A. (2004). Eight types of product-service system: Eight ways to sustainability? Experiences from suspronet. *Business Strategy and the Environment*, *13*(4), 246–260. https://doi.org/10.1002/BSE.414

Tukker, A. (2015). Product services for a resource-efficient and circular economy – a review. *Journal of Cleaner Production*, *97*, 76–91. https://doi.org/10.1016/J.JCLEPRO.2013.11.049

Tuli, K. R., Kohli, A. K., & Bharadwaj, S. G. (2007). Rethinking Customer Solutions: From Product Bundles to Relational Processes. *Journal of Marketing*, *71*(3), 1–17. https://doi.org/10.1509/JMKG.71.3.001

Ulaga, W., Reinartz, W. J., Gartmeier, V., Lévèque, L., Orbach, D., van Putten, V., & Lobschat, L. (2011). Hybrid offerings: How manufacturing firms combine goods and services successfully. *Journal of Marketing*, *75*(6), 5–23. https://doi.org/10.1509/JM.09.0395

Vandermerwe, S., & Rada, J. (1988). Servitization of business: Adding value by adding services. *European Management Journal*, *6*(4), 314–324. https://doi.org/10.1016/0263-2373(88)90033-3

Varghese, A., & Tandur, D. (2014). Wireless requirements and challenges in Industry 4.0. *Proceedings of 2014 International Conference on Contemporary Computing and Informatics, IC3I 2014*, 634–638. https://doi.org/10.1109/IC3I.2014.7019732

Verstrepen, S., Deschoolmeester, D., & Berg, R. J. (1999). Servitization in the automotive sector: creating value and competitive advantage through service after sales. In *Global Production Management* (pp. 538–545). https://doi.org/10.1007/978-0-387-35569-6_66

Vuksanović, D., Ugarak, J., & Korčok, D. (2016). Industry 4.0: the Future Concepts and New Visions of Factory of the Future Development. *Portal.Sinteza.Singidunum.Ac.Rs*, 293–298. https://doi.org/10.15308/sinteza-2016-293-298

Windahl, C., Andersson, P., Berggren, C., & Nehler, C. (2004). Manufacturing firms and integrated solutions: Characteristics and implications. *European Journal of Innovation Management*, *7*(3), 218–228. https://doi.org/10.1108/14601060410549900

Windahl, C., & Lakemond, N. (2006). Developing integrated solutions: The importance of relationships within the network. *Industrial Marketing Management*, *35*(7), 806–818. https://doi.org/10.1016/J.INDMARMAN.2006.05.010

Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: state of the art and future trends. *International Journal of Production Research, 56*(8), 2941-2962. https://doi.org/10.1080/00207543.2018.1444806