Proceedings of the 8th European Conference on Industrial Engineering and Operations Management
Paris, France, July 2-4, 2025

Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/EU08.20250268
Published: July 2, 2025

Spreading digital Servitization in the Machinery Industry Sector: Preliminary Results from an Empirical Survey

Marco Ardolino, Federico Adrodegari, Nicola Saccani and Laura Scalvini
RISE Research Laboratory
Department of Mechanical and Industrial Engineering, Italy
marco.ardolino@unibs.it, federico.adrodegari@unibs.it, nicola.saccani@unibs.it, laura.scalvini@unibs.it

Andrea Gozzi
Digital Industries World, Italy
andrea.gozzi@digital-industries.it

Abstract

Manufacturing is going through a major shift, as services are becoming increasingly central to gaining a competitive edge. This change—often called digital servitization—is all about using digital tools to improve service offerings, helping manufacturers shift away from purely selling products toward building business models centered around services. The trend is especially important for Engineer-To-Order (ETO) companies, where every project is shaped around the specific needs of the customer, requiring a lot of flexibility and the ability to customize. In the machinery sector, where products are typically complex and built to last, digital technologies are essential to delivering more advanced services. Things like predictive maintenance, remote monitoring, and data-driven innovations are made possible by these tools, which not only open up new ways to generate revenue but also help companies build stronger, longer-lasting relationships with their clients. This paper shares the results of a study involving 160 manufacturing companies in the machinery field. The focus was on how digital technologies are supporting servitization efforts. One key takeaway is the clear divide between large companies and SMEs: big firms tend to be further along, both in terms of experience and structure, while smaller businesses often face significant challenges when it comes to adopting and making the most of digital service models. These insights shed light on the broader changes happening in manufacturing today and point to the need for tailored support strategies that can help SMEs successfully embrace servitization.

Keywords
Digital servitization, Manufacturing, Machinery, and Survey.

1. Introduction

The convergence of digitalization and servitization has given rise to digital servitization, a paradigm that enables manufacturing firms to move from product-centric to service-oriented business models through the adoption of digital technologies (Paschou et al., 2020; Kowalkowski et al., 2017). With the integration of digital tools, manufacturing companies can enhance value co-creation, improve efficiency, and unlock new revenue streams (Lusch & Nambisan, 2015; Parida et al., 2019). In this context, the machinery sector plays an essential role, as machine tools are crucial in several manufacturing processes (Chavez et al., 2023). Given their long lifespan, the adoption of digital servitization can provide significant advantages, transforming traditional machinery into intelligent assets through Cyber-Physical Systems (CPS), IoT, and advanced data analytics (Liu & Xu, 2017; Akyazi et al., 2020). In addition, digital technologies can enable predictive intelligence, network connectivity, and real-time decision-making, incentivizing the shift toward service-based value propositions (Farsi & Erkoyuncu, 2021). Nevertheless, despite its potential, digital

servitization presents challenges, particularly for SMEs, which often face difficulties in integrating digital services due to financial resources constraints and system interoperability issues (Copani, 2014; Berić et al., 2018). Moreover, manufacturers may encounter the so-called digitalization paradox, where the high costs of developing smart services outweigh the expected financial returns (Kohtamäki et al., 2019; Kamp et al., 2023). Moreover, legal uncertainties and the reluctance on the part of customers and suppliers to share data might impede adoption, underscoring the need for robust governance models (Polova & Thomas, 2020). As industries increasingly rely on digital ecosystems, understanding the implications and strategies for successful digital servitization remains critical for sustaining competitive advantage in a rapidly evolving and turbulent market (Wirtz & Kowalowski, 2022). Although digital servitization offers significant potential in the machinery sector, services have historically been perceived as a secondary necessity rather than a strategic priority. Only in recent years they have gained credit as valuable assets, even if they sometimes remain closely linked to the physical product. In addition, several companies in the manufacturing industry continue to face challenges in fully embracing service-driven business models like XaaS (Scalvini et al., 2023). Shifting towards a more service-centric approach requires a fundamental transformation in corporate culture, moving away from a traditionally engineering-focused and product-centric mindset toward a stronger customer-oriented perspective. The objective of this study is to explore the current landscape and future outlook of digital servitization in the machinery industry, specifically assessing the awareness and maturity of machinery manufacturers in Italy on these issues. To achieve this, a descriptive survey was conducted, analyzing data from 160 Italian companies operating in the machinery sector. The study aims to provide an in-depth understanding of the trends, challenges, and opportunities within the industry. The main objectives are to map the current landscape, evaluate the digital maturity of firms and their evolution, and identify the most effective practices for successfully adopting digital servitization. The research aims to answer the following questions:

- How much is the machinery sector investing in digital servitization?
- What role will digital services and new business models will play in the future in the manufacturing industry?

The paper is structured as follows. After a description of the research and context for the research in section 2, section 3 presents the methodology. Section 4 shows survey results while Section 5 discusses critically discusses the main results with a specific focus on the differences between large enterprises and SMEs.

2. Research and context background

2.1 Digital servitization

Servitization is the process through which manufacturing companies improve their value by increasing their service offerings (Vandermerwe & Rada, 1988). The scientific literature has primarily focused on firms across various industries that have integrated services to increase overall value, revenues, and profits (Baines & Lightfoot, 2013; Cusumano et al., 2015; Neely, 2008).

Bundling services with physical products is considered a key factor in improving product technical performance and strengthening competitive advantage within the supply chain in a globalized context (Matthyssens & Vandenbempt, 2008; Vandermerwe & Rada, 1988). In addition, the shift toward servitization promotes innovation in capabilities, enabling value creation for customers by offering a balanced combination of products and services (Visnjic & Van Looy, 2013).

At the same time, digital disruption among industries and ecosystems is blurring boundaries and shifting established interdependencies (Skylar et al., 2019). Digitalization, in fact, involves socio-technical processes that create new value and revenue opportunities (Lusch & Nambisan, 2015). It is essential for companies aiming to differentiate themselves in an increasingly digitized world (Carr, 2003).

For example, in servitized strategies, acquiring strategic customer data is crucial (Ulaga & Reinartz, 2011). Therefore, digital technologies play a key role in managing relationships in service ecosystems, asking firms to develop strong organizational capabilities for digital servitization (Cenamor et al., 2017; Eloranta et al., 2021).

Over the past few years, the streams of digitalization and servitization have become increasingly interconnected, culminating in the emergence of a new paradigm known as digital servitization (Paschou et al., 2020). This paradigm reflects the growing convergence of digital technologies and service-oriented business models, enabling firms to innovate and adapt in ways that were previously not possible. Indeed, digital servitization refers to the use of digital tools to transition from a product-centric to a service-centric business model (Kowalkowski et al., 2017). Research on

this shift has explored key aspects such as the organizational separation of products and services (Oliva et al., 2012), local responsiveness (Kowalkowski et al., 2011), internalization (Salonen & Jaakkola, 2015), externalization (Paiola et al., 2013), and organizational design configurations (Raja et al., 2018).

Digitalization may act as both a driver and enabler of servitization, fostering innovation and new business models in manufacturing (Parida et al., 2019; Vendrell-Herrero et al., 2017). It allows firms to transition from product-based models to high-value digital service offerings (Adrodegari & Saccani, 2017; Ardolino et al., 2018). Additionally, digitalization can reshape value propositions and enhances value co-creation with customers by transforming processes and capabilities (Iansiti & Lakhani, 2014; Lenka et al., 2017).

Digital servitization has also been extensively scrutinized in developed countries at the forefront of servitization research. Its increasing importance highlights its potential as a competitive advantage for manufacturing firms (Paschou et al., 2020; Wirtz & Kowalowski, 2022). However, also emerging economies have started enabling manufacturers to innovate their business models and capitalize on digital servitization (Weerabahu et al., 2024).

In this sense, digital servitization presents both opportunities and challenges for companies. On one side, the rapid pace of digital innovation often outstrips traditional processes, requiring new co-creation approaches in provider-customer relationships (Iansiti & Lakhani, 2014). Digitalization affects in fact co-creation in complex ways due to numerous enabling technologies (Barrett et al., 2015; Hasselblatt et al., 2018).

On the other side, while digital technologies improve efficiency and quality, they also demand significant investments and higher maintenance costs (Porter & Heppelman, 2014). Therefore, research on digital servitization has explored various challenges, including growth trajectories (Coreynen et al., 2017) and digital platforms (Cenamor et al., 2017). Key areas of study also include organizational capabilities (Lenka et al., 2017; Sjödin et al., 2016; Jovanovic et al., 2019) and big data utilization (Opresnik & Taisch, 2015). Additionally, researchers have examined business models (Parida et al., 2019) and supply chain interdependencies (Vendrell-Herrero et al., 2017).

2.2 Digital servitization in the machinery sector

The machinery sector is an industry primarily focused on process design, development, manufacturing, delivery of customized equipment, and technical support (Cannas et al., 2019). Moreover, it plays a crucial role, as machine tools are essential across multiple phases of manufacturing processes (Chavez et al., 2023). Given that machine tools have a lifespan of decades, adopting a digital servitization approach can offer significant advantages (Farsi and Erkoyuncu, 2021).

From a technological standpoint, the digital servitization of machine tools encompasses integrated product-service solutions, including advanced data analytics and visualization, high-precision simulation and forecasting, intelligent decision-support systems, human-machine interaction, and various value-added manufacturing services (Chavez et al., 2023). The latest generation of machine tools is characterized by the extensive integration of Cyber-Physical Systems (CPS), the Internet of Things (IoT), sensors, and advanced computing technologies (Liu and Xu, 2017). These innovations improve network connectivity, foster adaptability, enable predictive intelligence, and support real-time responsiveness. Moreover, the emergence of data-driven manufacturing is turning machine tools into intelligent assets, accelerating their evolution toward both digitalization and servitization (Akyazi et al., 2020; Wang et al., 2023).

Smart machinery systems can detect improper machine usage, mitigate human errors, and reduce downtime and workplace accidents (Akyazi et al., 2020). Furthermore, they enhance process control, improve traceability, and support more sustainable production environments (Arrazola et al., 2013). The adoption of digital technologies in the machine tool industry accelerates industrial transformation, enabling rapid quality improvements while reducing costs (Akyazi et al., 2020). Moreover, a digitally connected machine tool sector reshapes the market by facilitating more agile responses to customer demands and improving service quality and sustainability (Zhou et al., 2016).

Servitization, driven by digital services, provides machinery manufacturers with opportunities to strengthen customer relationships, unlock growth in mature markets, and mitigate economic fluctuations by diversifying revenue streams (Davies, 2003). It also enables value monetization (Coreynen et al., 2017) through business models that shift from equipment ownership to performance- or outcome-based payments (Allmendinger and Lombreglia, 2005). By leveraging cloud-based technologies, service-oriented architectures facilitate the sharing and distribution of real-time machine tool data, optimizing the delivery of manufacturing services via the cloud (Shi et al., 2016). Consequently,

machine tool manufacturers must evolve from being mere equipment providers to becoming strategic partners in their customers' manufacturing processes (Rafael et al., 2020).

The combination of digitalization and servitization in machine tools enhances product quality, production efficiency, and reduces both machine downtime and machining costs (Liu et al., 2023). However, despite these benefits, the scientific literature highlights the potential risk of a paradox between service and digitalization (Kohtamäki et al., 2019; Gebauer et al., 2020). In particular, if the cost of developing and delivering a smart service exceeds the revenue generated from value capture, suppliers may encounter a smart service paradox. Indeed, achieving a return on investment in smart service business development requires three key components: providing a clear value proposition to users, ensuring effective value delivery, and enabling the supplier to capture value through appropriate pricing mechanisms (Kamp et al., 2023).

This transition remains in its early stages, particularly among Small and Medium-sized Enterprises (SMEs) (Copani, 2014; Adrodegari et al., 2018). Digital servitization entails several risks, primarily related to communication, data sharing, and system integration. A critical risk is legal, as partners may struggle to agree on terms for digital services, potentially disrupting product lines due to misalignment in goals and business models (Polova and Thomas, 2020). Additionally, effective communication and trust among stakeholders are essential, as building resilient value chains remains a challenge. Additional risks include integration difficulties with existing ERP and MES systems, which can take months or even years to resolve, delaying benefits and limiting adoption (Berić et al., 2018). Furthermore, issues such as machine unavailability, data gaps, and challenges in simulating failures can undermine expected outcomes (Linde et al., 2020).

3. Methodology

Survey research was selected as the most suitable methodology to systematically collect reliable and representative information from a large population. This study employs a descriptive survey approach to investigate the significance of digital servitization and assess its level of diffusion within the machinery sector. Descriptive surveys are especially valuable in contexts where the phenomenon under examination is already well understood, as they enable a structured and detailed analysis of key variables, industry trends, and contextual factors (Forza, 2002). Unlike exploratory research, which seeks to formulate new theoretical frameworks, this study primarily aims to measure the impact of digital servitization on industrial practices, offering empirical insights into its adoption and evolution over time.
The research was conducted over a six-month period, from October 2023 to March 2024, involving a sample of 160 Italian original equipment manufacturer (OEM) companies operating within the machinery industry. The study was made possible through the collaboration of the ASAP Service Management Forum (https://www.asapsmf.org), which played a crucial role in facilitating the distribution of the survey and ensuring broad participation from relevant industry stakeholders. Additionally, the study was designed in collaboration with the Digital Industries World community, an international association dedicated to fostering digital transformation in industrial sectors, with a particular focus on the Italian manufacturing landscape.

To maximize reach and efficiency, the survey was administered online using a web-based questionnaire (Couper, 2000; Shih & Xitao, 2008). This method was chosen due to its numerous advantages over traditional face-to-face or email-based surveys. Unlike face-to-face interviews, web surveys eliminate the need for manual data entry, reducing the risk of transcription errors and significantly improving data accuracy. Additionally, they offer a cost-effective solution compared to other distribution methods, minimizing logistical expenses while allowing for a faster response rate. One of the key benefits of an online survey is the higher level of anonymity it provides to respondents, which helps mitigate potential interviewer biases and encourages participants to provide more candid and accurate responses. The questionnaire was structured into seven key sections, each designed to capture specific dimensions of digital servitization within the participating companies:

1. Survey Sample – Gathering general information about the responding companies, including size, industry classification, and geographical distribution.
2. Turnover Composition – Analyzing revenue streams and the relative weight of service-based income versus product sales.
3. Strategy and Business Organization of Services – Examining how companies' structure and manage their service-related activities, including strategic priorities and internal governance models.
4. Service Portfolio – Identifying the range of services offered by companies and their degree of servitization.
5. Digital Services – Exploring the extent to which companies provide digitally-enabled services, and the types of solutions implemented.
6. Role of Technology in Services – Investigating how different digital technologies contribute to service innovation and business transformation.
7. IT Systems and Platforms – Assessing the adoption of digital platforms, enterprise IT solutions, and emerging technologies that support servitization efforts.

The structured nature of the questionnaire ensures a comprehensive and systematic analysis of digital servitization, enabling researchers to capture both the strategic and operational dimensions of this transformation within the machinery sector. By segmenting the survey into distinct thematic areas, the study offers a granular understanding of the factors driving or inhibiting digital servitization, ultimately contributing to a more nuanced assessment of its implications for industrial players.

4. Results

4.1 Survey sample description

Figure 1 presents a description of the survey sample, with a particular focus on company size. The survey involved 160 Italian machinery manufacturers, of which 75% were small and medium-sized enterprises (SMEs)—defined as companies with an annual turnover of up to 50 million euros—while the remaining 25% were large companies, with revenues exceeding 50 million euros.

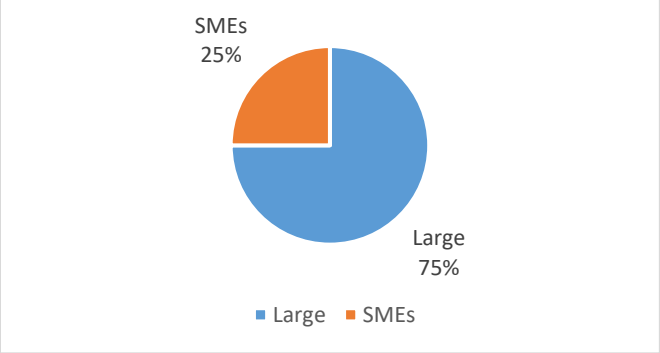


Figure 1. Sample description – Company dimension

In terms of industry representation, the sample reflects the diverse nature of the machinery manufacturing sector. The most represented category is packaging machinery, which accounts for 35.0% of the surveyed companies. This is followed by manufacturers of plastic processing machinery (15.6%), metal forming machine tools (14.4%), and wood processing machinery (8.8%). Other relevant sectors include composite material processing machinery (5.0%), textile processing machinery (3.8%), energy production machinery (3.8%), machinery for the construction and mining industries (1.9%), rubber processing machinery (1.9%), paper production machinery (0.6%), and glass processing machinery (0.6%). Additionally, 8.8% of the companies fall into the "other" category, which includes niche applications not explicitly listed. A detailed breakdown of the sectoral distribution is provided in Table 1

Table 1. Sample description – Company industry sector

Industry Category	Percentage of Surveyed Companies
Packaging machinery	35.0%
Plastic processing machinery	15.6%
Metal forming machine tools	14.4%
Wood processing machinery	8.8%
Composite material processing machinery	5.0%
Textile processing machinery	3.8%
Energy production machinery	3.8%
Machinery for construction and mining industries	1.9%
Rubber processing machinery	1.9%
Paper production machinery	0.6%
Glass processing machinery	0.6%
Other (niche applications)	8.8%

This distribution ensures a broad and representative view of digital servitization adoption across different manufacturing domains, allowing for a comprehensive assessment of how digital transformation is shaping the machinery sector. The predominance of packaging machinery manufacturers, followed by key industrial segments such as plastics, metalworking, and wood processing, highlights the relevance of digital servitization in highly automated and technology-intensive industries. The presence of smaller yet specialized sectors, including textile, energy, paper, and glass machinery manufacturing, further enriches the analysis, providing insights into the varying degrees of digital technology adoption across different fields.

Each company in the survey is represented by a single respondent (Table 2), selected based on their role within the organization to ensure expertise and relevance in addressing the topics covered. Most respondents (35%) hold the role of managing director or CEO, reflecting a strong representation of senior management in the study. This is followed by 13.8% of respondents working in administration, finance, and control functions, and 12.5% in marketing and sales. The service and after-sales sector accounts for 10.6% of respondents, while research and development (R&D) makes up 10% of the sample. The engineering function has the smallest representation at 5%, whereas 13.1% of respondents fall into the "other" category, indicating a diverse range of additional roles within the companies surveyed. This distribution highlights the involvement of key decision-makers and professionals across various corporate functions, ensuring a comprehensive perspective on digital servitization and its impact across different business areas.

Table 2. Sample description – Respondent company role

Role	Percentage of Respondents
Managing director / CEO	35.0%
Administration, Finance and Control	13.8%
Marketing and sales	12.5%
Service and After sales	10.6%
Research and Development (R&D)	10.0%
Engineering	5.0%
Other	13.1%

To understand the composition of turnover, companies were asked to provide the percentage of revenue allocated to six different categories (Figure 2): 1) sales of new products; 2) sales of spare parts, consumables, and accessories; 3) sales of annual or multi-year service contracts; 4) rental and other "as-a-service" sales models of the product; 5) sales of software and connectivity; 6) sales of other services. The majority of turnover in the surveyed companies comes from sales of new products (72.4%), confirming the strong reliance of the machinery sector on product-based revenue streams. The second most significant category is sales of spare parts, consumables, and accessories (16.1%), which represent an essential component of after-sales business. Following this, sales of other services account for 7.6% of total turnover. The remaining categories contribute to a much smaller portion of revenue, with sales of annual or multi-

year service contracts (2.4%), rental and other "as-a-service" models (1.1%), and sales of software and connectivity (0.5%), which together make up less than 5% of total turnover.

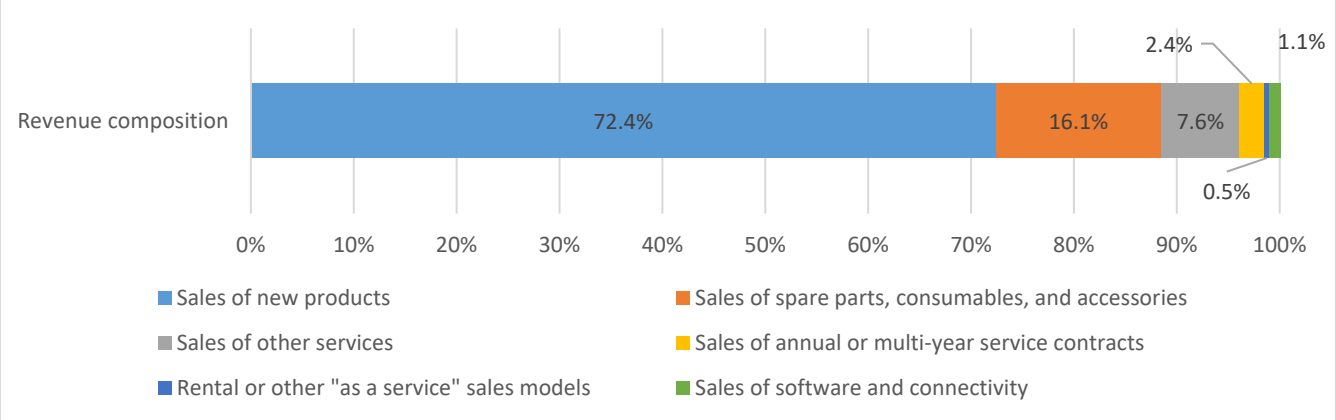


Figure 2. Sample description – Company revenue composition

4.2 Survey results

To analyze the adoption of digital technologies in service activities, respondents were asked to evaluate a series of statements using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). To ensure a meaningful interpretation of the results, only responses with a score of 4 (agree) or 5 (strongly agree) were considered for analysis.

The primary objective was to assess whether companies are leveraging digital technologies to enhance existing services and/or develop new ones (Figure 3). Additionally, the survey aimed to determine whether companies have a structured strategy for the growth of digital services.

The findings indicate that just over half of the surveyed companies (55%) are currently using digital technologies to improve existing services, while a slightly lower percentage (53%) is employing them to develop new service offerings. However, these initiatives appear largely unstructured, as only 40% of respondents report having a clear strategy for digital service development.

This suggests that, while digital technologies are increasingly integrated into service-related activities, their adoption often lacks a cohesive and strategic approach, potentially limiting long-term benefits and scalability.

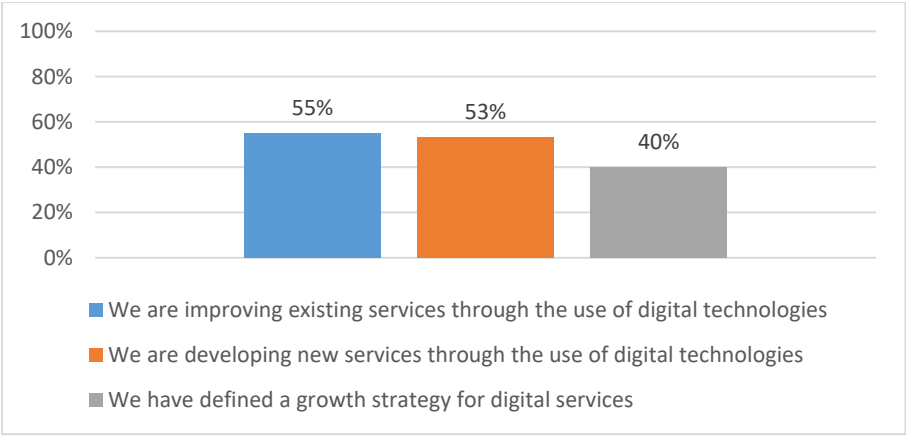


Figure 3. Digital technologies for existing and new services

To further investigate the impact of digital services on customer behavior, respondents were asked to evaluate two statements assessing the influence of digital services on purchasing decisions—both in the present and in a projected future scenario (Figure 4). The findings present a clear and striking contrast between the current situation and future expectations.

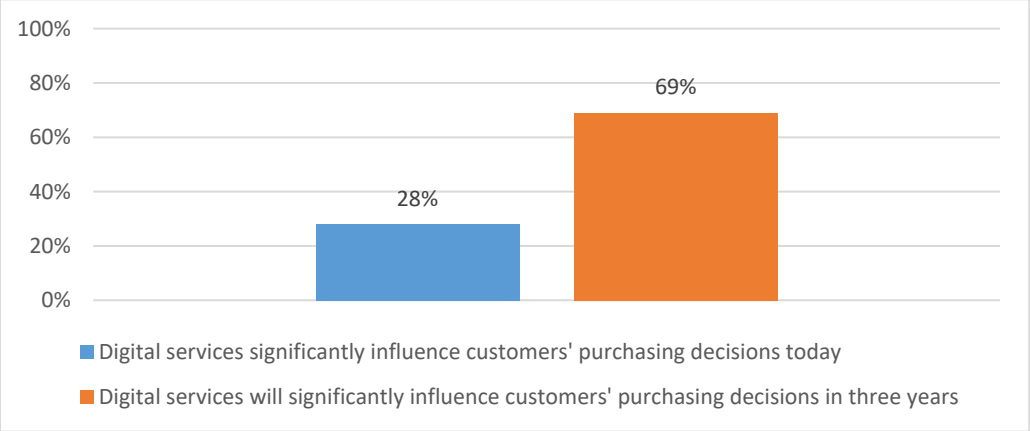


Figure 4. Influence of digital services on customers' purchasing decisions

Only 28% of companies report that digital services influence their customers' purchasing decisions, indicating that, for most firms, digital offerings do not yet play a decisive role in shaping demand. However, when asked about the expected influence of digital services three years from now, this percentage rises significantly to 69%, suggesting a widespread belief that digital services will become a key differentiator soon.

This sharp increase underscores the growing strategic relevance of digital services, as companies anticipate shifts in customer preferences and purchasing behaviors. While digital services may not yet be a primary driver of sales, expectations for the coming years point to a rapid evolution, likely driven by increasing digital maturity, technological advancements, and a stronger focus on service-based business models.

These insights underscore the need for companies to proactively invest in digital service strategies to remain competitive in a landscape where digital value propositions are expected to play a central role in customer decision-making.

To gain a deeper understanding of the technological landscape supporting digital services, companies were asked to indicate which digital technologies they actively use (Figure 5). The results reveal that the most widely adopted technology is the (industrial) Internet of Things (IoT), implemented by 42% of companies, highlighting its pivotal role in enabling connectivity and real-time data exchange. This is followed by cybersecurity and cloud computing, both utilized by approximately one-third of the surveyed companies, underscoring the importance of secure and scalable digital infrastructures. In contrast, more advanced technologies—such as additive manufacturing (3D printing), augmented reality (AR), virtual reality (VR), mixed reality (MR), big data analytics, artificial intelligence (AI) and machine learning (ML), as well as simulation and digital twin technologies—are adopted by roughly one in five companies. These lower adoption rates suggest that while these technologies hold significant potential, their integration into service-related activities remains limited to a smaller subset of firms. Among the least adopted technologies, blockchain stands out, with only 4% of companies reporting its use, indicating that its application in service-driven digital transformation is still in its early stages.

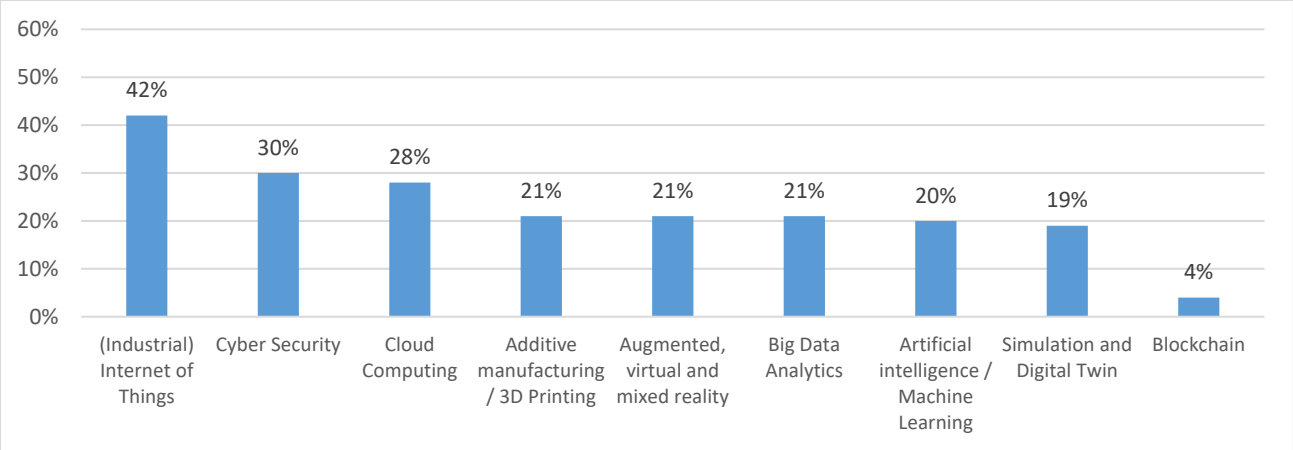


Figure 5. Digital technology adoption in service domain

The survey also investigated the functionalities covered by specific IT platforms and information systems dedicated on service activities. (Figure 6). To evaluate this, respondents were asked whether digital platforms and IT systems enable them to perform specific service-related functions. The options provided included: 1) ordering spare parts for customers or service centers via e-commerce; 2) opening and tracking service request tickets; 3) monitoring the operational status of products; 4) displaying and receiving alarms, fault notifications, and malfunction alerts; and 5) processing data to propose predictive maintenance for components and products.

The results reveal that just over one-third of companies offer an e-commerce solution for ordering spare parts, indicating that online procurement is not yet fully integrated across the industry. In contrast, two-thirds of the surveyed companies have platforms that allow them to open and track service request tickets and process data for predictive maintenance, reflecting a strong focus on optimizing after-sales and maintenance services. Moreover, three out of four companies can monitor the operational status of their products and display alarms, fault notifications, and malfunctions, highlighting the widespread adoption of remote monitoring solutions to enhance service efficiency and equipment reliability.

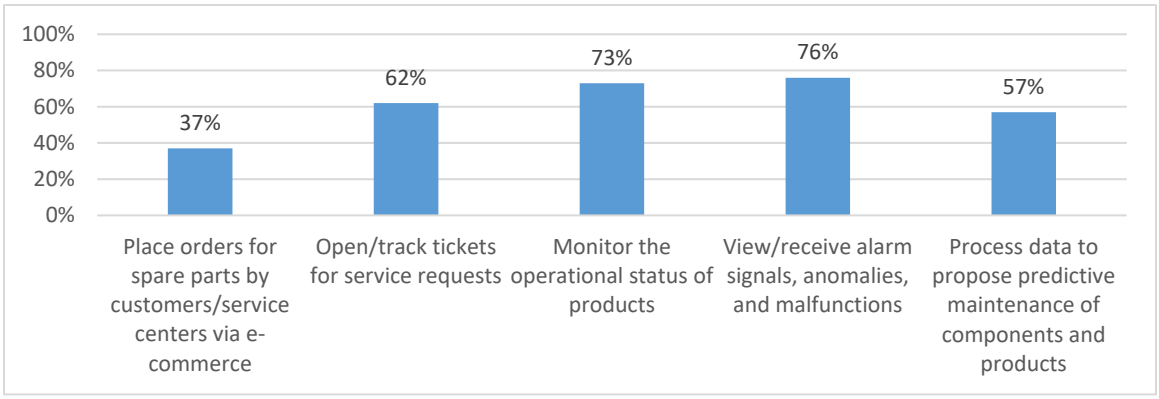


Figure 6. Functionalities by IT platforms and information systems

5. Discussion and conclusion

This section critically discusses some of the key findings presented in the previous section, with a specific focus on the differences between large enterprises and SMEs in their journey toward digital servitization. In particular, this section examines how company size influences the ability to develop and implement digital solutions, highlighting the main opportunities and challenges that characterize each type of organization.

When comparing the revenue composition of large companies and SMEs, notable differences emerge in the weight of various sales components (Figure 7). For large companies, the sale of new products represents 68% of their total turnover, whereas in SMEs, this share is slightly higher, reaching 73.8%. In contrast, revenue from spare parts, consumables, and accessories plays a more significant role in large companies, contributing 17.8% of their turnover compared to 15.6% in SMEs. A similar pattern can be observed in the sales of additional services, which account for 8.6% of the turnover in large enterprises, while in SMEs, this figure stands at 7.2%. This distribution suggests that while SMEs rely more heavily on new product sales, larger companies tend to have a more diversified revenue stream, benefiting from a stronger aftermarket segment.

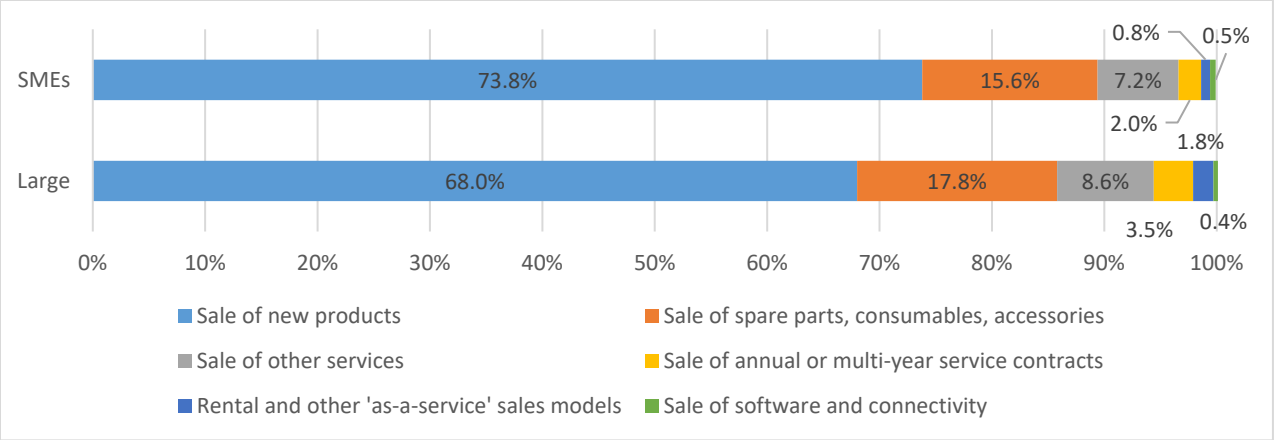
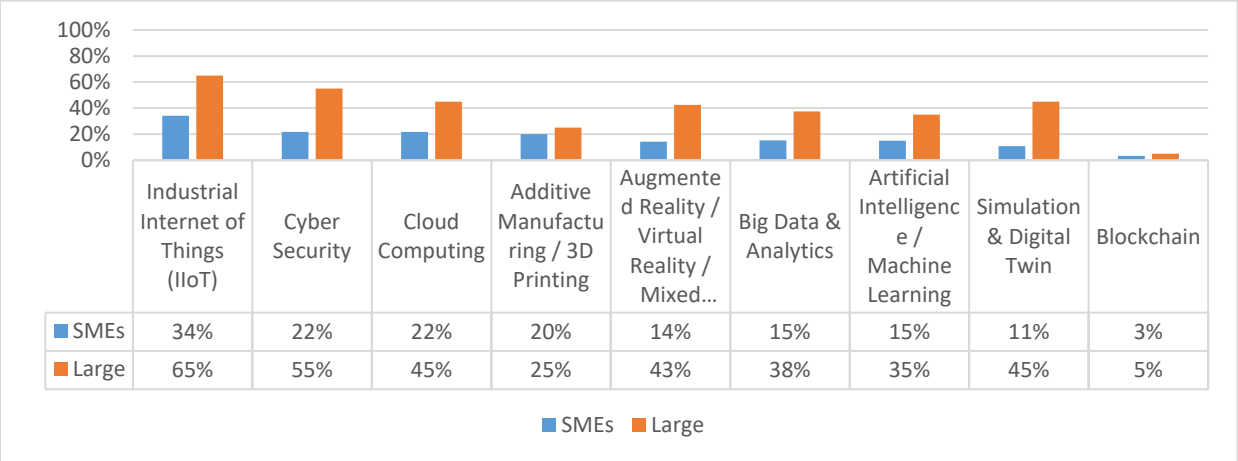


Figure 7. Company revenue composition – Segmentation by company dimension

When analyzing the adoption of various technologies, a clear gap emerges between large enterprises and SMEs (Figure 8). For most of the technologies surveyed, the number of large enterprises implementing a given technology is more than double that of SMEs. This disparity is particularly evident in areas such as cybersecurity, digital twins, and augmented/virtual reality, where large companies show significantly higher adoption rates. In contrast, the use of 3D printing and additive manufacturing appears to be more evenly distributed between the two groups, suggesting that these technologies may be more accessible and scalable regardless of company size.



	Industrial Internet of Things (IIoT)	Cyber Security	Cloud Computing	Additive Manufacturing / 3D Printing	Augmented Reality / Virtual Reality / Mixed...	Big Data & Analytics	Artificial Intelligence / Machine Learning	Simulation & Digital Twin	Blockchain
SMEs	34%	22%	22%	20%	14%	15%	15%	11%	3%
Large	65%	55%	45%	25%	43%	38%	35%	45%	5%

Figure 8. Digital technology adoption in service domain – Segmentation by company dimension

In addition, large enterprises are more likely than SMEs to have digital platforms in place (Figure 9). The most significant difference emerges in the ability to order spare parts via e-commerce: while more than two-thirds of large enterprises provide this service, less than one-third of SMEs do. This gap highlights the stronger digital infrastructure

and customer service capabilities of larger companies, allowing them to enhance accessibility and streamline aftermarket sales more effectively than smaller firms.

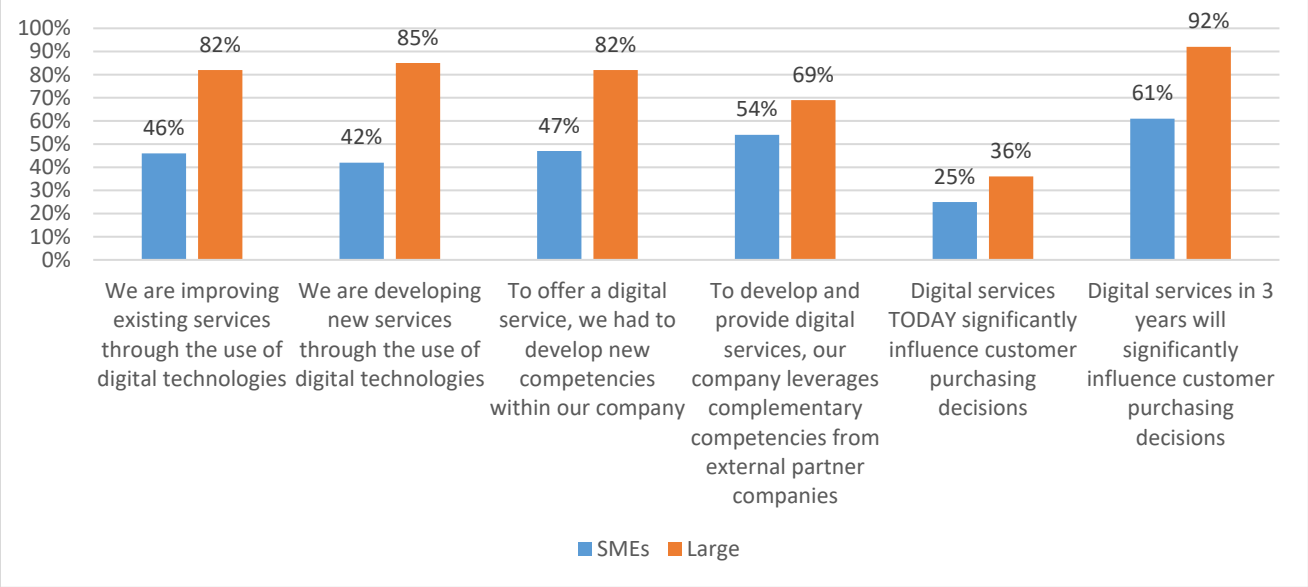


Figure 9. Functionalities by IT platforms and information systems – Segmentation by company dimension

Therefore, the data clearly shows that SMEs consistently lag large companies in adopting and leveraging digital services. In every category, the percentage of SMEs implementing or benefiting from digital technologies is significantly lower than that of large enterprises. This suggests that SMEs may face greater challenges in digital transformation, such as limited resources, expertise, or strategic vision. However, the growing influence of digital services on customer purchasing decisions highlights the urgency for SMEs to accelerate their digital adoption to remain competitive.

Like any research, this study has some limitations. Firstly, since the Italian manufacturing landscape is largely composed of SMEs, the sample is not aligned with the population. Secondly, despite the thorough literature review conducted, no reference model or framework has been introduced. Additionally, given the limited sample size, further data collection is necessary to provide a more complete picture of the situation—first within Italy, and subsequently in other countries as well, to allow for comparison and a deeper understanding of the broader context. Ultimately, the aim is to invest effort in developing both managerial and practical references that can help Italian manufacturing companies strengthen and consolidate their position in the global competitive landscape. Indeed, while the findings contribute to a better understanding of digital servitization strategies, certain aspects require further investigation. Future research should explore the long-term impact of digital servitization on business performance, as well as the specific barriers that SMEs face in adopting these models. Additionally, a deeper analysis of sustainability-driven servitization strategies could provide further insights into how companies can effectively integrate digital and environmental objectives.

Acknowledgements

This paper was supported by the project National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.3 – Call for tender No. 341 of 15/03/2022 of Italian Ministry of University and Research funded by the European Union (NextGenerationEU), Award Number PE00000004, Concession Decree No. 1551 of 11/10/2022 adopted by the Italian Ministry of University and Research, MICS (Made in Italy - Circular and Sustainable) - University of Brescia CUP D73C22001250001.

References

Adrodegari, F. and Saccani, N., Business models for the service transformation of industrial firms, *The Service Industries Journal*, vol. 37, no. 1, pp. 57-83, 2017.

Allmendinger, G. and Lombreglia, R., Four strategies for the age of smart services, *Harvard Business Review*, vol. 83, no. 10, pp. 131, 2005.

Ardolino, M., Rapaccini, M., Saccani, N., Gaiardelli, P., Crespi, G. and Ruggeri, C., The role of digital technologies for the service transformation of industrial companies, *International Journal of Production Research*, vol. 56, no. 6, pp. 2116-2132, 2018.

Baines, T. and Lightfoot, H. W., Servitization of the manufacturing firm: Exploring the operations practices and technologies that deliver advanced services, *International Journal of Operations & Production Management*, vol. 34, no. 1, pp. 2-35, 2013.

Berić, D., Stefanović, D., Lalić, B. and Ćosić, I., The implementation of ERP and MES systems as a support to industrial management systems, *International Journal of Industrial Engineering and Management*, vol. 9, no. 2, pp. 77, 2018.

Cannas, V. G., Gosling, J., Pero, M. and Rossi, T., Engineering and production decoupling configurations: An empirical study in the machinery industry, *International Journal of Production Economics*, vol. 216, pp. 173-189, 2019.

Carr, N. G., IT Doesn't Matter, Harvard Business Review, vol. 81, no. 5, pp. 41-49, 2003.

Cenamor, J., Sjödin, D. R. and Parida, V., Adopting a platform approach in servitization: Leveraging the value of digitalization, *International Journal of Production Economics*, vol. 192, pp. 54-65, 2017.

Chávez, C. A. G., Unamuno, G., Despeisse, M., Johansson, B., Romero, D. and Stahre, J., Analyzing the risks of digital servitization in the machine tool industry, *Robotics and Computer-Integrated Manufacturing*, vol. 82, pp. 102520, 2023.

Coreynen, W., Matthyssens, P. and Van Bockhaven, W., Boosting servitization through digitization: Pathways and dynamic resource configurations for manufacturers, *Industrial Marketing Management*, vol. 60, pp. 42-53, 2017.

Copani, G., Machine tool industry: beyond tradition?, *Servitization in Industry*, pp. 109-130, 2014.

Couper, M. P., Web surveys, Public Opinion Quarterly, vol. 64, no. 4, pp. 464-494, 2000.

Cusumano, M. A., Kahl, S. J. and Suarez, F. F., Services, industry evolution, and the competitive strategies of product firms, *Strategic Management Journal*, vol. 36, no. 4, pp. 559-575, 2015.

Davies, A., Are firms moving "downstream" into high-value services?, *Service Innovation: Organizational Responses to Technological Opportunities & Market Imperatives*, pp. 321-340, 2003.

Eloranta, V., Ardolino, M. and Saccani, N., A complexity management approach to servitization: the role of digital platforms, *International Journal of Operations & Production Management*, vol. 41, no. 5, pp. 622-644, 2021.

Farsi, M. and Erkoyuncu, J. A., An agent-based approach to quantify the uncertainty in Product-Service System contract decisions: A case study in the machine tool industry, *International Journal of Production Economics*, vol. 233, pp. 108014, 2021.

Forza, C., Survey research in operations management: a process-based perspective, *International Journal of Operations & Production Management*, vol. 22, no. 2, pp. 152-194, 2002.

Gebauer, H., Fleisch, E. and Friedli, T., Overcoming the service paradox in manufacturing companies, *European Management Journal*, vol. 23, no. 1, pp. 14-26, 2005.

Hasselblatt, M., Huikkola, T., Kohtamäki, M. and Nickell, D., Modeling manufacturer's capabilities for the Internet of Things, *Journal of Business & Industrial Marketing*, vol. 33, no. 6, pp. 822-836, 2018.

Iansiti, M. and Lakhani, K. R., Digital ubiquity: How connections, sensors, and data are revolutionizing business, *Harvard Business Review*, vol. 92, no. 11, pp. 19, 2014.

Jovanovic, M., Raja, J. Z., Visnjic, I. and Wiengarten, F., Paths to service capability development for servitization: Examining an internal service ecosystem, *Journal of Business Research*, vol. 104, pp. 472-485, 2019.

Kamp, B., Zabala, K. and Zubiaurre, A., How can machine tool builders capture value from smart services? Avoiding the service and digitalization paradox, *Journal of Business & Industrial Marketing*, vol. 38, no. 2, pp. 303-316, 2023.

Kohtamäki, M., Parida, V., Oghazi, P., Gebauer, H. and Baines, T., Digital servitization business models in ecosystems: A theory of the firm, Journal of Business Research, vol. 104, pp. 380-392, 2019.

Kowalkowski, C., Gebauer, H., Kamp, B. and Parry, G., Servitization and deservitization: Overview, concepts, and definitions, *Industrial Marketing Management*, vol. 60, pp. 4-10, 2017.

Lenka, S., Parida, V. and Wincent, J., Digitalization capabilities as enablers of value co-creation in servitizing firms, *Psychology & Marketing*, vol. 34, no. 1, pp. 92-100, 2017.

Lusch, R. F. and Nambisan, S., Service innovation, MIS Quarterly, vol. 39, no. 1, pp. 155-176, 2015.

Matthyssens, P. and Vandenbempt, K., Moving from basic offerings to value-added solutions: Strategies, barriers and alignment, *Industrial Marketing Management*, vol. 37, no. 3, pp. 316-328, 2008.

Neely, A., Exploring the financial consequences of the servitization of manufacturing, *Operations Management Research*, vol. 1, pp. 103-118, 2008.

Parida, V., Sjödin, D. and Reim, W., Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises, Sustainability, vol. 11, no. 2, pp. 391, 2019.

Scalvini, L., Adrodegari, F. and Saccani, N., Moving Towards Everything-as-a-Service: A Multiple Case Study in Manufacturing, *IFIP International Conference on Advances in Production Management Systems*, pp. 199-212, September 2023.

Shih, T.-H. and Fan, X., Comparing response rates from web and mail surveys: a meta-analysis, *Field Methods*, vol. 20, no. 3, pp. 249-271, 2008.

Visnjic, I. and Van Looy, B., Successfully implementing a service business model in a manufacturing firm, Cambridge Service Alliance, vol. 54, no. 6, pp. 1161-1179, 2013.

Wirtz, J. and Kowalkowski, C., Putting the "service" into B2B marketing: Key developments in service research and their relevance for B2B, *Journal of Business & Industrial Marketing*, vol. 38, no. 2, pp. 272-289, 2023.