Future Trends in Digital Services and Products: Evidence from Serbian Manufacturing Firms

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Abstract. The concepts of Industry 4.0 trigger the transformation of manufacturing firms. Digital technologies upgrade traditional products and services to increase the satisfaction of customers. In this paper, the authors investigate digital products and services in manufacturing firms. Additionally, the authors challenge relations between digital products and services and their share in the gross annual turnover of manufacturing firms. The data for this research are obtained through the Digital Servitization Survey coordinated by the IFIP WG5.7 Special Interest group on Service Systems Design, Engineering, and Management. We used the Serbian dataset from 136 manufacturing firms. The results show that 68% and 42% of manufacturing firms use digital technologies for product creation and digital services, respectively. Moreover, results demonstrate products have the 90% of the share in gross annual turnover in manufacturing firms. However, the prediction of the production managers for the next two years shows that services will reach a 30% share in gross annual turnover of firms.

Keywords: Product-service systems · Servitization · Digital services · Digital products · Survey

1 Introduction

In the last decade, the research community has given significant attention to advanced services in manufacturing firms [1]. Furthermore, the employment of Industry 4.0 concepts and digital technologies in firms support the transformation of products and services [2, 3]. To further develop their business, manufacturing firms need to find an appropriate way to transform it from traditional to digital [4]. Therefore, Product-Service Systems (PSS) could help production to provide the sustainability of organizations by achieving economic, environmental, and social benefits [5]. The transformation from traditional PSS to smart PSS depends on organizational and technological changes [4]. From a technology perspective, manufacturing firms need to buy or develop technologies such as the Internet of Things, Big Data, Augmented or Virtual Reality, and others [6, 7].

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Moreover, production need to make a strategy on how to employ these digital technologies in the products and services offered [8, 9]. The driving role of digital technologies for PSS is also a part of the organization's changes [10].

The main challenges from an organizational perspective could be divided into organizational structure and performance metrics, human resource requirements, and supply network relationships [11]. In product-centered organizations, a measure of the firm's success is represented through financial performance; on the other side, service-oriented soft performance indicators are difficult to measure [11]. In this way, the performance measurement in PSS is very difficult for production managers. Furthermore, communication and networking skills are required for frontline employees to facilitate or sell PSS to customers [10, 12]. Thus, production needs to make a set of training for their employees to understand the value of PSS and how to communicate them to customers. The shift to PSS challenges the organization of value and supply chains. Production needs to move the focus from stable intra-firm transactional flows of physical materials to multiple, dynamic relationships and dual-way flows of materials and information with their suppliers [13]. According to these challenges, the transformation from traditional to smart PSS represents a very difficult process for manufacturing firms [4]. Moreover, the research community gives an overview that firms from developed countries easier achieve the advanced level of PSS than firms from developing countries [14]. Along with the different organizational and technical capacities, previous research shows the different shares of industry sectors in developed and developing countries [15]. In the share of total industry, high-tech firms (i.e. electrical equipment, machinery, etc.) have a higher share in developed countries [15]. On the other hand, in the share of total industry, low-tech firms (i.e. food production, textile, etc.) have a higher share in developing countries [16]. However, the integration of digital products and services is a growing trend among manufacturing firms which could together provide value chains for firms from developed and developing countries [17]. Furthermore, manufacturing firms from developing countries need to prepare themself to become a part of the value chain of manufacturing firms from developed countries via smart PSS [11]. This paper has the aim to fill the literature gap on findings from the use of smart PSS in developing countries. Moreover, with these findings manufacturing firms from developed countries could achieve new insights into the digitalization level of their partners from developing countries. Based on the literature background, the authors proposed following research questions:

- *RQ1: What is the share of products and services of gross annual turnover in Serbian manufacturing firms?*
- *RQ2: What is the level of smart PSS in Serbian manufacturing firms?*

2 Literature Review

The term PSS could be defined as a combination of products and services capable of jointly fulfilling a customer need at the market [18]. Furthermore, it enables manufacturing firms to be more sustainable and to make a better impact on the environment [19]. Additionally, a PSS business model allows manufacturing firms to increase their competitiveness at the market with the creation of better relations with customers [20].

In accordance with Tukker's classification, PSSs can be divided in the three periods of transformation, from product-oriented to service-oriented business models [19]. Specifically, product-related services refer to solutions closely related to product characteristics (i.e. maintenance, spare-parts), use-oriented services include product renting or leasing, while results-oriented services concern services such as pay per service units or long-term maintenance contracts [19, 21]. For the transformation from traditional to smart PSS, manufacturing firms need to understand how digital technologies make an impact on the products and on all of these three groups of services [22]. In the study of smart PSS, Lerch describes three different roles of digital technologies on the transformation of PSS [23]. In the first period, manufacturing firms involve digital technologies in product creation, after that firms involve digital technologies in service creation and finally digital technologies become an intelligent component of smart PSS [23]. The rapidly changing global market supports the transformation from traditional to smart PSS [24].

Smart PSS is known as an intelligent-linked system, with a combination of smart products and internet-based services [25]. Furthermore, a previous study divided the smart PSS into four layers: smart devices, network, data management, and software [25]. Smart PSS enables better providing of solutions (i.e. smart products and services) based on the customer needs [25]. To achieve smart PSS manufacturing firms need to pass challenges in the application of digital technologies [26]. Also, firms need to understand technical competence of digital technologies, ability to use digital technologies in a meaningful way, ability to evaluate digital technologies critically, and motivation to participate and commit in the digital culture of the firm [27, 28]. Manufacturing firms use digital technologies for the creation of digital products and services to make environmental, social and economic benefits [29]. There are many benefits to the application of digital products and services such as: simplifying mechanical components or replacing them with software, developing remote services to supplement or replace traditional services performed on-site, reducing transport of physical products, optimizing service tasks and travel routes by applying apps, synchronizing the supply chain of product and services [30]. Furthermore, smart PSS easier connects all actors in the PSS environment including PSS providers and suppliers, PSS customers and end-users, and the broad society in which it operates at the same digital platforms [30]. Also, previous research from developed countries shows that IoT combined with Big Data and Analytics techniques overcomes the PSS challenges and make more financial benefits for manufacturing firms [31]. Additionally, research from developed countries shows that easy-to-implement digital technologies produce a direct effect on firm financial performance with a low cost of their deployment [32]. On the other hand, the high quality of digital technology with the high cost of investments should be supported by other organizational capabilities of firms to achieve positive financial performance [32]. According to the findings from developed countries, this study investigates the future trend of digital products and services in the creation of smart PSS in developing countries (i.e. Serbian manufacturing firms). Moreover, this study investigates technology challenges (implementation of digital technologies in product and service creation) and organizational challenges (share of the gross annual turnover from products and services, market share, and structure of the industry sector).

3 Methodology

This study was based on data from the Digital Servitization Survey, research conducted in Italy, Germany, Sweden, Mexico Switzerland, and Serbia, and structured in two main areas: (1)The first area is aimed at understanding the offering of service and digital services of the companies. After an introductory section on the firm's distinctive characteristics, several questions are proposed to analyze both the industry 4.0 and the digital service offerings, (2)The second area aims at understanding the dynamics behind the digital servitization path starting from the output of Pirola et al. [33]. In particular, for those firms that in the first part of the survey present a digital service offering, their approaches towards Digital Servitization strategy, PSS design methods, Knowledge management, Assessment tools, and Sustainability issues are investigated. In particular, this research used a Serbian data set from 136 manufacturing firms obtained in 2022, and it is focused on the first part of the survey. The research was based on the analysis of manufacturing firms (NACE Rev 2 codes from 10 to 33). The data sample for this research was obtained by the method of determining the stratified sample in relation to the industrial sector and the size of the company in Serbia. The research was conducted within manufacturing firms with at least 20 employees. The questionary was sent online via Survey Monkey. The response rate was 15%. The result of the sample depicts that about 39% of the manufacturing firms in the sample are small, having between 20 and 49 employees, another 40% of the manufacturing firms have between 50 and 249 employees, and 21%, have more than 250 employees. Table 1 reports the distribution of manufacturing firms by sector.

Table 1. Distribution of sample by industry

Manufacturing industry	Share on total sample
Food production	27%
Production of fabricated metal products, except machinery and equipment	10%
Production of machinery and equipment n.e.c	9%
Production of textile	7%
Production of rubber and plastics	7%
Production of electrical equipment	7%
Production of motor vehicles, trailers, and semi-trailers	6%
Others	27%

4 Results

According to the research question *What is the share of products and services of gross annual turnover in Serbian manufacturing firms?*, Figs. 1 and 2 through a frequency analysis show the share of the gross annual turnover from products and services in Serbian manufacturing firms. Specifically, Fig. 1 reports the current share of gross annual turnover, while the forecast of the share of gross annual turnover for the next two years is presented in Fig. 2.

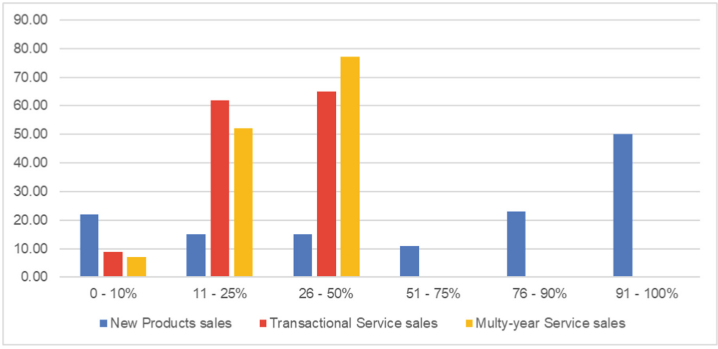

Fig. 1. The share of gross annual turnover in Serbian manufacturing firms

Figure 1 presented the share of gross annual turnover from products and services in 2022 in Serbian manufacturing firms. Results show that about 80 manufacturing firms have about 10% of the share in total gross annual turnover from services. On the other hand, about 50 manufacturing firms have about 90% of the share in total gross annual turnover from products. According to these findings, we demonstrate findings that Serbian manufacturing firms are more product-oriented than service-oriented.

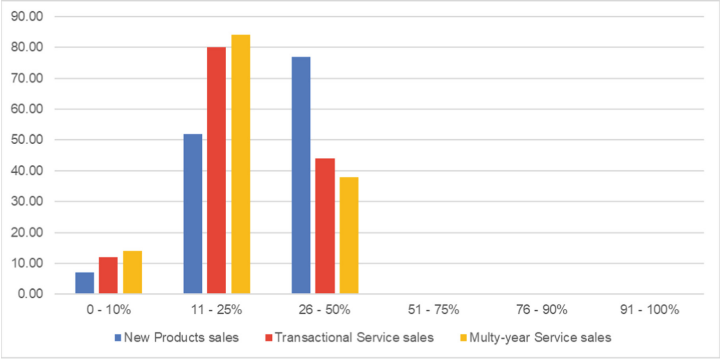

Fig. 2. The prediction of the share of gross annual turnover in Serbian manufacturing firms for 2024

Figure 2 presented the prediction of the share of gross annual turnover from products and services for 2024 in Serbian manufacturing firms. Results make the prediction that about 80 manufacturing firms will have about 40% of the share in total gross annual turnover from services. Additionally, predictions show that about 75 manufacturing firms will have about 50% of the share in total gross annual turnover from products. In comparison with results from the previous Fig. 1, we can demonstrate that Serbian manufacturing firms would like to transform their orientation from product to service-oriented business models. Moreover, according to the research question *What is the level of smart PSS in Serbian manufacturing firms?* results from the Survey show that about 60% of manufacturing firms use digital technologies for product creation. Also, only 10% of manufacturing firms don't use digital technologies for product creation. On the other hand, results from the Survey show that only 17% of manufacturing firms use digital technologies for the creation of product-related services. Furthermore, results show that only 6% of manufacturing firms use digital technologies for the creation of use-related services. Finally, results show that about 20% of manufacturing firms use digital technologies for the creation of result-related services. According to these findings, authors could conclude that digital technologies could be triggers for the transformation of manufacturing firms from product-oriented firms to service-oriented firms. Additionally, results show that 80% of manufacturing firms have less than 10 million euros in gross annual turnovers. The main markets of Serbian manufacturing firms are national for 48% of manufacturing firms and international for 41% of manufacturing firms. Only 11% of manufacturing firms have a local market as the main market.

5 Discussion and Conclusion

This study provides insights into the role of digital products and services in developing countries (i.e. Serbian manufacturing firms). Manufacturing firms from all 24 manufacturing sectors (NACE Rev 2 codes from 10 to 33) were assessed to answer the research question: "*What is the share of products and services of gross annual turnover in Serbian manufacturing firms?"*. Based on the research findings authors conclude that at this moment Serbian manufacturing firms are more product-oriented firms. The results show that 50 manufacturing firms from the sample generate 90% of gross annual turnover from products and 80 firms from the sample generate 10% of gross annual turnover from services. On the other hand, predictions of production managers for the next two years predict transformation from product-oriented to service-oriented manufacturing firms. Accordingly, they predict that 80 firms will generate 40% of gross annual turnover from services. Hence, authors give explanation on this transformation in the answer to research question 2: "*What is the level of smart PSS in Serbian manufacturing firms?"*. Findings show that about 60% of manufacturing firms use digital technologies for product creation. On the other hand, results show that only 17% of manufacturing firms use digital technologies for the creation of product-related services, 6% of manufacturing firms use digital technologies for the creation of use-related services, and that about 20% of manufacturing firms use digital technologies for the creation of result-related services. Based on this finding authors predict that with more employment of digital technologies in service creation manufacturing firms increase their share in gross annual

turnover. Furthermore, according to the organizational challenges this research shows the trends in low-tech firms (i.e. food and textile production have 35% of share in total sample). According to this sample, authors could conclude that the process of digitization will enable low-tech firms from developing countries to become a part of the value chains of firms from developed countries. Additionally, for the transformation from product to service orientation manufacturing firms need to better understand the needs of their customers on the local, national and international levels. They need to develop different packages according to the market specification. From the theoretical implications, this research gives in-depth findings in the level of digitalization in products and service creation. Additionally, this research confirms previous studies which show that manufacturing firms easily transform services which are not closely related to product characteristics. Hence, research results show that training as a service is the most digitized service in the Serbian manufacturing firms. Also, findings confirm the important role of digital technologies in the creation of smart PSS. Future predictions in the share of services in gross annual turnover confirm trends of previous research which show the increasing trend in the use of smart PSS models in manufacturing firms. Also, this research confirms that low-tech firms have a lower level of possibility to employ digital technologies than high-tech firms.

The main contribution of this research from a theoretical perspective is to show how digital technologies could increase the role of services in the creation of gross annual turnover. Moreover, this research gives an overview of the market classification in the firms from developing countries. From the practical perspective, this research gives insights into the gross annual turnover in Serbian manufacturing firms. Moreover, with these findings manufacturing firms from developed countries could achieve new insights on how to make investments in developing countries to make value chains with manufacturing firms. Therefore, this finding shows a different perspective in the creation of gross annual turnover. At this moment results show the product-orientation of manufacturing firms in the process of digitization and in the share of profits generated from the products. In the future, they predict service-orientation of manufacturing firms which will achieve more profits from services with the employment of digital technologies in service creation. With this information, production managers could shape their business model to be more attractive for their customers with the creation of smart PSS. Smart PSS will provide more combinations of digital products and services which have a lower unit cost of creation than traditional products and services. Also, this research gives an overview of the market classification in Serbian manufacturing firms. With this information and with smart PSS manufacturing firms could make more B2B relations with international firms. In this way, manufacturing firms from Serbia could be more competitive in the international market. The major limitation of this paper is in the data set. This research uses the data set from Serbian manufacturing firms which have a high number of low-tech firms. Future research needs to use data sets from different countries which could better explain the general situation in future trends of digital products and services. Furthermore, this research uses more technology challenges in the offer of smart PSS. Future research needs to include more organizational challenges to better explain the creation process of smart PSS. With this information, research could measure

the effect of the technological and organizational components on the financial benefits of smart PSS.

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