Emerging Trends in Industrial Engineering •

Slavko Rakic¹

¹University of Novi Sad

Published on: Oct 11, 2021

License: [Creative Commons Attribution 4.0 International License \(CC-BY 4.0\)](https://creativecommons.org/licenses/by/4.0/)

THE IMPACT OF COVID-19 ON THE USE OF DIGITAL SERVICES IN MANUFACTURING FIRMS IN DEVELOPING COUNTRIES

Slavko Rakic

University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovica 6, 21000
Novi Sad, Republic of Serbia, slavkorakic@uns.ac.rs

Keywords: digital servitization, manufacturing industry, digital technologies.

ABSTRACT:

Digital services change the way how manufacturing firms do their business. The implications of digital technologies transform offers of services from traditional to digital. In the last decade research shows that developed countries successfully employ digital services in their business models. However, the findings from developing countries show the low level of the application of digital servitization in manufacturing firms. According to these trends, this paper investigates the role of digital services in developing countries in the pandemic period. The study obtained data from the 440 manufacturing firms from the Republic of Serbia in the period between 2018 and 2020. The results show that the use of digital services in the pandemic period was increased approximately by 50%.

1. INTRODUCTION

The Industry 4.0 concepts change the application of product-related services in manufacturing firms [1]. Digital technologies such as the Internet of Things (IoT), Big Data Analysis, or Artificial Intelligence are disrupting servitization in manufacturing firms [1].

Increased application of digital technologies in manufacturing firms supplies digital transformations. Recent research suggests that the application of digital technology can greatly improve the range of services associated with products through the offer of new digital solutions [2]. In fact, companies are focused introduce digital technologies to products to increase the efficiency of service delivery and the value of service offerings, while changing processes and business models [3]. Industrial cases such as Rolls-Royce, General Electric, and Kone have shown how new business models and smart services can be delivered with high efficiency and effectiveness [3]. Additionally, research based on digital servitization shows that firms from developed countries employ more services in the offer of traditional products to achieve competitive advantages. For example, the application of product-service systems in the manufacturing firms of the United Kingdom and the United States of Amerika is on the level of 55% [4]. Moreover, China makes the highest progress in the implementation of servitization in manufacturing firms. The application of servitization in manufacturing firms in China in 2007 was only 1%, in 2011 application is increased by 19% and in 2020, 40% of all manufacturing firms employ product-service system as a business model [4]. On the other side worldwide research on servitization, applications show that developing countries employ a low level of services and product-service systems in their manufacturing firms (see Figure 1). In this way, this research would like to investigate how Covid-19 impacts the use of digital servitization in manufacturing firms of developing countries (e.g. Republic of Serbia).

Image 1

Figure 1: Worldwide survey on manufacturing servitization [4]

From this figure, it could be concluded that about 60% of the manufacturing firms in developing countries didn't provide any type of services (traditional or digital). Furthermore, a previous European Manufacturing Survey shows that only 35% of the manufacturing firms in the Republic of Serbia provide one or more digital services along with products [5]. According to this difference between developed and developing countries, author would like to propose following research question:

RQ1: How does Covid-19 impact the use of digital services in manufacturing firms?

The paper is structured as follows: section 2 - literature review, which explains the use of digital services in manufacturing firms. Section 3, methodology, describes the data sample and data analysis. Section 4 shows the study's main results, reflecting the research question, and section 5 discusses the results according to the practical and theoretical implications.

2. LITERATURE REVIEW

The application of digital services requires the fulfillment of certain prerequisites. Prerequisite for the use of digital services related to products represents the existence of a service ecosystem [6]. The mentioned ecosystem of the firms must seek to provide systemic, dynamic, and contextual interaction between the manufacturing firms and their customers [7]. This process of cooperation is characterized great connection between the firms and the costumer. The process encompasses characteristics and effects relationships between manufacturing firms within service ecosystems. Connectivity is a term that refers to economic activity, social actions, and outcomes, which are primarily influenced by firms and customers, but also the structure of the ecosystem [8]. Service ecosystems include internal and external resources of the manufacturing firms. Unique organizational aspects use the capability to use of own resources in order to achieve a strategy related to the delivery of digital service [7]. Firms that rely on their own resources create their strategy competencies of employees, and their knowledge, which can enable manufacturing firms competitive advantage [7]. On the other hand, we could see business models which need support from the other firms in their ecosystems. Manufacturing firms that rely on other firms within the ecosystem must help them realized the possibility for the application of digital services related to products [8]. The mentioned way is a harder way to implement digital services because firms have to rely on other firms in the market [8]. The understanding of the importance of the service ecosystem for manufacturing firms is necessary for the implementation of digital services. The understanding of the importance of the service ecosystem is on a higher level in developed countries than in developing. According to these findings, it could be concluded that manufacturing firms from developing countries need some push from outside of their firms to employ digital services. The digital transformations and Industry 4.0 concepts could be a trigger for the implementation of digital services in manufacturing firms of developing countries. Additionally, efforts to control the spread of the Covid-19 have affected the manufacturing firms that switched traditional processes to digital processes. With all of this extern push from the manufacturing firms, the author would like to investigate did Covid-19 increase the use of digital services in developing countries.

3. METHODOLOGY

Data for this empirical research are obtained from the Serbian Manufacturing Survey under the European Manufacturing Survey [3]. The final sample collected data from 440

manufacturing firms from the Republic of Serbia in the period between 2018 and 2020. Concerning the descriptive statistics, the sampled firms report, on average, a company size of 320 employees. In total, 184 firms are small firms (less than 50 employees), 186 firms are medium-sized (between 100 and 249 employees), and 77 firms are large enterprises (more than 250 employees). The largest industry in the sample is the Manufacture of Food Production with 16.7%, followed by the Manufacture of Fabricated Metals with 9.5%, and Manufacture of Electrical Equipment with 7,25%. In the third group are the Manufacture of Rubber and Plastic products, Manufacture of Basic Metals, Manufacture of Motor Vehicles, Trailers and Semi-trailers, and Manufacture of Furniture with approximately 5.3% in total share. The remaining manufacturing sectors together have 45.3% of the total sample. To analyze the impact of Covid-19 on the application of digital services author compare results of the implementation of digital services before and in the pandemic period.

4. RESULTS

Accoridng to the research question: *How does Covid-19 impact the use of digital services in manufacturing firms?*, author show results on the Figure 2 and 3. Figure 2 shows the average use of digital services by manufacturing firms in 2018.

Image 2*Figure 2: The use of digital services in manufacturing firms in 2018*

The results show that Digital Services for Product Utilization (DS1) are used by 17.5% of firms, Digital Services for Customized Product Configuration or Product Design (DS2) are used by 22.9% of firms, Digital Monitoring of Operating Status (DS3) is used by 6.7% of firms, Mobile Devices for Diagnosis, Repair or Consultancy (DS4) are used by 11.7% of the firms, Data-based Services based on Big DataAnalytics (DS5) is used by 2.5% of the firms, and 67% of the firms didn't provide digital services. Figure 3 shows the average use of digital services by manufacturing firms in 2020.

Image 3*Figure 3: The use of digital services in manufacturing firms in 2020*

The results show that Digital Services for Product Utilization (DS1) are used by 21.9% of firms, Digital Services for Customized Product Configuration or Product Design (DS2) are used by 22.9% of firms, Digital Monitoring of Operating Status (DS3) is used by 22.9% of firms, Mobile Devices for Diagnosis, Repair or Consultancy (DS4) are used by 14.4% of the firms, Data-based Services based on Big DataAnalytics (DS5) is used by 10% of the firms, and 20% of the firms didn't provide digital services.

5. DISCUSSION AND CONCLUSION

This research investigates how Covid-19 affects the use of digital services in manufacturing firms of developing countries. The results show that Digital Services for Product Utilization are increased their use by 4.4%, Digital Monitoring of Operating Status are increased their use by 16.2%, Mobile Devices for Diagnosis, Repair or Consultancy are increased their use by 2,7%, Data-based Services based on Big Data Analytics are increased their use by 7.5% and, Digital Services for Customized Product Configuration or Product Design are on the same level of the use by manufacturing firms in developing countries. This research support findings from the theory which shows that

digital services will be one of the triggers for the digital transformation of manufacturing firms. Furthermore, these findings show a new perspective of the use of digital services which could be important for production managers to employ new digital-product-services systems to achieve competitive advantages and the highest share of turnover by services. Additionally, results show that the use of digital services in the pandemic period was increased approximately by 50%. This research is limited only to datasets considers in the Republic of Serbia. In such a context, further research could consider datasets from other developing countries to compare results between them.

6. REFERENCES

- [1] R. Rabetino, W. Harmsen, M. Kohtamäki, and J. Sihvonen, “Structuring servitizationrelated research,” *Int. J. Oper. Prod. Manag.*, vol. 38, no. 2, pp. 350–371, Feb. 2018, doi: 10.1108/IJOPM-03-2017-0175.
- [2] T. Grubic, L. Redding, T. Baines, and D. Julien, “The adoption and use of diagnostic and prognostic technology within UK-based manufacturers,” *Proc. Inst. Mech. Eng. Part B J. Eng. Manuf.*, vol. 225, no. 8, pp. 1457–1470, Aug. 2011, doi: 10.1177/0954405410395858.
- [3] C. Lerch and M. Gotsch, “Digitalized Product-Service Systems in Manufacturing Firms: A Case Study Analysis,” *Res.-Technol. Manag.*, vol. 58, no. 5, pp. 45–52, Sep. 2015, doi: 10.5437/08956308X5805357.
- [4] L. Mastrogiacomo, F. Barravecchia, and F. Franceschini, “A worldwide survey on manufacturing servitization,” *Int. J. Adv. Manuf. Technol.*, vol. 103, no. 9–12, pp. 3927–3942, Aug. 2019, doi: 10.1007/s00170-019-03740-z.
- [5] S. Rakic, N. Simeunovic, N. Medic, M. Pavlovic, and U. Marjanovic, “The Role of Service

Business Models in the Manufacturing of Transition Economies,” in *Advances in Production Management Systems. Towards Smart and Digital Manufacturing*, vol. 592, B. Lalic, V. Majstorovic, U. Marjanovic, G. von Cieminski, and D. Romero, Eds. Cham: Springer International Publishing, 2020, pp. 299–306.

[6] M. Ardolino, M. Rapaccini, N. Sacconi, P. Gaiardelli, G. Crespi, and C. Ruggeri, “The role

of digital technologies for the service transformation of industrial companies,” *Int. J.*

Prod. Res., vol. 56, no. 6, pp. 2116–2132, Mar. 2018, doi:

10.1080/00207543.2017.1324224.

[7] B. Edvardsson, B. Tronvoll, and T. Gruber, “Expanding understanding of service exchange and value co-creation: a social construction approach,” *J. Acad. Mark. Sci.*, vol. 39, no. 2, pp. 327–339, Apr. 2011, doi: 10.1007/s11747-010-0200-y.

[8] Granovetter, M. S., “Problems of explanation in economic sociology,” in In N. Nohria, &

R. G. Eccles (Eds.). *Networks and organizations: Structure, form and action*, Boston:

Harvard Business School Press., pp. 25–56.