Digital Servitization: The Next "Big Thing" in Manufacturing Industries

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Abstract. Manufacturing firms increasingly produce and provide services along with their traditional physical products. This process, better known as servitization, is a mature theme in the literature, flourishing in recent years. Digital disruption is propelling manufacturers to move on towards digital transformation and deliver digital services. Prior research investigated the impact of servitization measured by the traditional services. However, the role of digital technologies in manufacturing is neglected. This paper intends to shed light on the impact of digital service portfolio antecedents on firm performance. Our analysis used the Serbian dataset of 240 manufacturing firms from the European Manufacturing Survey conducted in 2018. The empirical results show that, in manufacturing firms, digital services can significantly increase the turnover ratio. Results indicate that management in manufacturing companies should utilize digital services such as Web-based services for customized product design and Web-based offers for product utilization to maximize firm's turnover ratio and upgrade current service business model.

Keywords: Digital services · Servitization · Financial performance

1 Introduction

A paradigm shift in business models is occurring in the manufacturing industry [1]. Durable goods manufacturers choose to innovate their offerings by providing services to accompany their existing products throughout the life cycle [2]. However, with the advent of new technologies (i.e. information technologies), traditional services such as maintenance and repair [3] are not enough. Digital disruption is propelling manufacturers to move on towards digital transformation and deliver digital services. For example, latest report from McKinsey shows that manufacturing firms are introducing on average eight digital services [4]. However, this number varies widely by country. The literature has looked at the impact of servitization measured by the traditional services on performance [2], [5–8], however the role of digital technologies in service business transformation is under-investigated [9]. This paper investigates and offers an understanding on how digital services affect the turnover in manufacturing firms.

This study relies on a unique dataset from the European Manufacturing Survey (EMS) with a sample of 240 industrial firms from Serbia. Our analysis shows that digital services have positive influence on firm's turnover ratio. Two out of five digital

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services (i.e. web-based services for customized product design and web-based offers for product utilization) positively affect firm performance.

2 Background and Related Work

2.1 Digital Manufacturing Services

In the literature, service strategy has a long presence through wide terminology such as servitization [10], servicizing [11], product–service systems [12], or even open service innovation [2], et cetera. Today, the presence of digital technologies has brought the transformation of service business models [9] and formed something that is called digital services. The provision of digital services, or 'Digital servitization', has become a sub-stream of service business model [13]. Digital servitization is defined as "the provision of IT-enabled (i.e. digital) services relying on digital components embedded in physical products" [13]. Digital services are different from traditional since the marginal cost of digital services is near zero and they are substitutes for traditional products [14].

Digital technologies such as Internet of things, cloud computing and predictive analytics [9] are considered a key elements of the fourth industrial revolution [15]. Cambridge Service Alliance provided research regarding servitization with the participants from Capital Equipment Manufacturers and academics [16]. They identified top five service technologies in manufacturing sector and all of them are digital based services: predictive analysis, remote communications, consumption monitoring, and two aspects of mobile communication platform [16]. Furthermore, the all of these digital services are in line with digital services presented in this study. For instance, Digital McKinsey [4] report shows that two thirds of manufacturing firms worldwide say that digital solutions in manufacturing are one of their highest priorities. Technological development potentially offers a variety of benefits for firms able to utilize it and seamlessly embed them in business models and products to improve market competitiveness [15] and provide more accurate information sharing inside and outside the boundaries of the firm [17]. While broadening the perspective from product-related services to digital services is fundamental to the servitization debate, its impact on a firm's performance remains in question. This is partly due to the fact that the possibility to charge for digital services that had previously been free represents a challenge to managers [18].

Certainly, the concept of servitization could enhance the competitiveness of a manufacturing firms while simultaneously advancing economic conditions, resulting in a higher turnover from selling digital services [19]. Studies that deal with the assessment of whether adding additional services, even digital, improves the financial performance of a firm are scarce and more empirical research is needed in this area [2, 20, 21]. To shed more light on this important area of production research, we investigate how specific digital service portfolio choices influence firm's financial implications.

2.2 Research Questions

Based on literature review, the following research questions were proposed in attempt to identify the different effects of digital services on manufacturing firm's turnover:

- RQ1: The deployment of digital services will positively impact firm's turnover ratio?
- RQ2: Which digital services, if any, increase firm's turnover ratio?

The digital services presented in the model were identified based on exploratory interviews with practitioners and group discussions with experts in the field. All EMS consortium members were involved in this process which resulted in a universal transversal list of digital services so that all manufacturing sectors can apply it regardless of the product offered. Identified digital services are: (1) Web-based offers for product utilization, (2) Web-based services for customized product design, (3) Digital (remote) monitoring of operating status, (4) Mobile devices for diagnosis, repair or consultancy, and (5) Data-based services based on big data analysis. Consequently, these digital services were included in the EMS questionnaire. We use the turnover ratio as our dependent variable. In the same manner, early studies show that share of turnover was defined as the share of company turnover in the market [8, 22, 23]. Moreover, the turnover ratio was defined as the annual turnover of the firm in the year 2017 divided by the annual turnover of the firm in the year 2015 [24].

Figure 1 depicts the proposed research framework.

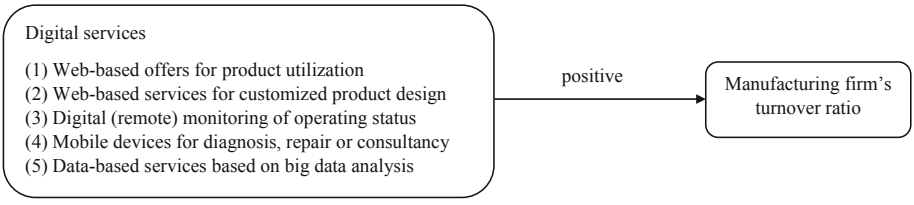

Fig. 1. Research framework.

3 Data and Methodology

Data for this empirical study derive from the European Manufacturing Survey, a survey on manufacturing strategies, application of innovative organizational and technological concepts in production, and questions of digital servitization in the European manufacturing industry [25]. The EMS is administered by the Fraunhofer Institute for Systems and Innovation Research [26]. The objective of this regular, triennial questionnaire is to systematically monitor the innovation behavior of European manufacturing enterprises at the firm level. The concepts, constructs and questions are well-tested and have been agreed upon in the EMS consortium. The six-page questionnaire includes questions on innovation activity, firm and industry characteristics, and general firm data. The survey is sent out repeatedly to senior managers of firms with 20 or more employees and designed to be representative of all regions, industrial sectors covered,

and enterprise sizes. The survey is conducted among manufacturing firms, addressing manufacturing sites (NACE Rev. 2 codes from 10 to 33). A non-response analysis is conducted to ensure that the sample is representative of the population. The analytical dataset includes 240 observations of manufacturing firms from Serbia. The dataset in our research is from the 2018 survey edition. The comparison of data regarding firm size and industry sector distribution between Serbian subsample, and those of other EMS countries (e.g. Croatia, Germany, Lithuania, Slovakia, Slovenia) shows no significant size bias.

With regard to descriptive statistics, the sampled firms report, on average, a firm size of 124 employees (SD = 207). In total, 110 companies are small firms (fewer than 50 employees), 103 companies are medium-sized (between 50 and 249 employees), and 27 firms are large enterprises (more than 250 employees). Firms belonging to the food products (39 firms), fabricated metal products (36 firms), and rubber and plastic products (21 firms) sectors account for the most prominent observations in the sample. Tables 1 and 2 depict the sample distribution regarding size and industry sector.

To analyze the relationships between digital services and financial implications we employed a multivariate data analyzes.

Table 1. EMS database – distribution of firms by size.

Firm size	n	%
20 to 49 employees	110	45.8
50 to 249 employees	103	42.9
250 and more employees	27	11.3
Total	240	100.0

Table 2. Classification on manufacturing sectors according to share on total sample.

NACE Rev. 2	Manufacturing industry	Share on total sample (%)
10	Manufacture of food products	16.3
25	Manufacture of fabricated metal products	15
22	Manufacture of rubber and plastic products	8.8
27	Manufacture of electrical equipment	6.3
28	Manufacture of machinery and equipment	6.3
14	Manufacture of wearing apparel	5.8
16	Manufacture of wood and of products of wood and cork	4.6
23	Manufacture of other non-metallic mineral products	4.6
29	Manufacture of motor vehicles, trailers and semi-trailers	4.2
	Others	28.1

4 Results and Discussion

Table 3 presents linear regression model, for a dependent variable (turnover ratio), used to test research questions.

Table 3. Results of linear regression.

Digital services	Model parameters
Web-based offers for product utilization	.481^{+}
Web-based services for customized product design	.532*
Digital (remote) monitoring of operating status	−.434
Mobile devices for diagnosis, repair or consultancy	.108
Data-based services based on big data analysis	.083
R	0.627
R^2	0.393
F	3.782
Sig.	0.002

Note: $^{*}p < 0.05$; $^{+}p < 0.1$.

In the regression model that tests both research questions, the overall model was significant, $R^2 = .393$, $F = 3.782$, $p < .01$. One predictor had a significant coefficient – Web-based services for customized product design ($B = .532$, $p < .05$), thus supporting the idea to include them in the service portfolio to increase the turnover ratio. The influence of Web-based offers for product utilization on turnover ratio was not significant at $p < .05$, but marginally significant at $p < .1$ ($B = .481$). Hence, manufacturing firms should also include them in the digital service offering. However, manufacturing firms focusing on the development of digital services such as Digital (remote) monitoring of operating status ($B = -.434$, $p > .1$), Mobile devices for diagnosis, repair or consultancy ($B = -.973$, $p > .1$), and Data-based services based on big data analysis ($B = .083$, $p > .1$) show no statistically significant effect on turnover ratio. For RQ1 (*The deployment of digital services will positively impact firm's turnover ratio?*), regression model was tested. In the model that estimates the effect of digital services on firm performance it is shown that the impact is significant and positive. Furthermore for RQ2 (*Which digital services, if any, increase firm's turnover ratio?*) only Web-based services for customized product design and Web-based offers for product utilization into the model show the positive effect on firm performance, providing support to RQ2.

As a major finding, our research indicates that the deployment of specific digital service portfolio choices will exhibit distinct financial performance. For instance, our results indicate that manufacturing firms should provide *web-based services for customized product design* and *web-based offers for product utilization* as digital services to increase firm's turnover ratio. It is not clear from our data, however, whether the success of the two digital services is due to the additional managerial focus these firms received, or if, as we assume, cultural practices of customers in emerging market. These results are in line with previous studies [15, 27, 28].

5 Conclusion

This study examines digital servitization strategies of manufacturing firms. Consequently, this paper provides theoretical and practical implications on how and in what way digital services impact the manufacturing firm turnover. The empirical results indicate that two digital services significantly or marginally influence a firm's turnover ratio. Today, many manufacturing firms are evolving their business strategy from the traditional focus on product offerings toward a new direction, so that business models based on digital services can bring higher performance [29, 30]. Our results indicate actionable insights for managers of manufacturing firms to expand their understanding of how to increase turnover with provision of digital services. Specifically, managers in manufacturing firms should provide digital services such as *web-based services for customized product design* and *web-based offers for product utilization*, to maximize the firm's turnover. Moreover, this findings, support prior study which shows that the framework is applicable to a wide variety of engineered products, especially those that can benefit from customer input during the early stages of the product realization process (i.e. mechanical or electrical engineering) [31]. However, managers should be aware that not all digital service provisions will lead to a service business model. Furthermore, it's very important to find which digital services make the best effects on manufacturing firm performance according to type of industry.

Our sample was collected from all manufacturing industries, and, perhaps due to the industry specificity, results could differ. Also, there are various aspects that should be taken into consideration for the assessment of digital service impact on a firm's turnover (e.g. type of customer served, seasonality, and promotion). This research is limited only with dataset considers in Serbia. Prior study shows important of organizational and innovation concepts in developing countries [32]. For further research, authors could make comparison of results between developing and developed countries in part of digital servitization. Furthermore, EMS consortium must deeper investigate the manufacturing sector in the next data collection round, because of the extremely important topic of digital servitization in development of the Industry 4.0. Moreover, further research is necessary to assess the experience and challenges of firms with a focus on one industry (i.e. the manufacture of fabricated metal products) and to consider different challenges in measuring the impact of digital services provided by manufacturing firms. Development of these ideas could prove especially useful for firms facing the challenges of a particular industry, showing that specific digital services can improve their financial performance [2].

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