

# ARE SMART SERVICE MANUFACTURING PROVIDERS DIFFERENT IN COOPERATION AND INNOVATION FLEXIBILITY, IN INNOVATION PERFORMANCE AND BUSINESS PERFORMANCE FROM NON-SMART SERVICE MANUFACTURING PROVIDERS?

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## ABSTRACT

To overcome the challenges posed by increasing competition, many traditional manufacturing companies are moving from the mere production of manufacturing goods to the integration of services that are more or less integrated into the product, which is also due to the constant development of the industry. Moreover, many manufacturing companies offer products that use smart technologies. This paper focuses on the importance of smart service provision for cooperation and innovation flexibility, innovation performance and business performance in small and medium manufacturing companies. The paper aims to find out if smart service manufacturing providers are different in cooperation and innovation flexibility and innovation and business performance from non-smart service manufacturing providers. To better understand the issue, research was undertaken in 112 small and medium manufacturing companies of the Czech Republic. The problems of smart service provision were investigated in the first empirical research held among the electric engineering companies (CZ-NACE 26 and CZ-NACE 27) in the Czech Republic. The findings show that smart service manufacturing providers are better in internal cooperation flexibility, innovation flexibility related to product and to accompanying services and in business performance than non-smart service manufacturing providers. Theoretical implication contributes in two specific ways: first, in the presentation of the interconnection of smart services and cooperation flexibility, innovation flexibility, innovation performance and business performance; and second, in the identification of the impact of smart services in manufacturing SMEs and in finding out which areas affect the provision of smart services. The findings can have a positive influence in several areas; therefore, they can be important factors for many manufacturing companies which still need some persuasion to offer smart services.

## KEY WORDS

**smart services, cooperation flexibility, innovation flexibility, innovation performance, business performance, manufacturing companies**

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## INTRODUCTION

In the last few years, many manufacturing companies have been offering products and related services, including services using smart technologies,

which can monitor product operations, inform the customer about their status and transmit this information to manufacturers. The manufacturer can further process this information and use it for monitoring

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the operation of the equipment, remote repair, predictive maintenance or innovation of existing products. Manufacturers financially support digitalisation to reduce data processing costs by automating data collection, warehousing and diagnostics (Wamba et al., 2017). Thanks to these new possibilities, the importance of this area has been growing in recent years.

Despite the rapidly growing development of smart technologies, research in this area in small and medium enterprises (SMEs) is still in its infancy. Smart technologies have great potential; however, their success requires a deep understanding of customer expectations, behaviour and also an understanding of the current situation of manufacturing companies. The fundamental influence of digitisation is often perceived as its influence on companies, up and downstream operations, networks and ecosystem (Porter & Heppelman, 2015). Moreover, digitalisation helps to support new innovative services, business models and pricing models, which are crucial for gaining the value from digitalisation (Kohtamäki et al., 2019).

The issue of accompanying services using smart technology, including the identification of its impact on industrial small and medium-sized enterprises, has not yet received much attention in the Czech Republic, explaining the need for this research. It focused on manufacturing SMEs, which make up the majority of today's businesses and are crucial for the economy. Producers of electric equipment and electronic components from Czech SMEs were respondents in the research. They are essential representatives of the manufacturing industry and subcontractors of many other economic sectors. The growth of Czech exports is also related to the increase in new orders, for which the flexibility of producers and suppliers is necessary.

The competitive advantage of SMEs often lies in the development of specialisation, which allows them to take advantage of greater flexibility in innovation in a changing business environment. Today's businesses are forced to find flexible ways to respond to uncertainty and meet customer demands effectively. This is especially true for SMEs, which often depend on the ability to adapt quickly to the customer. The issue of smart servitisation is specific to SMEs, where the implementation of smart technologies is more demanding due to the often limited financial and personnel capacities. The implementation of digitalisation is challenging for current manufacturing companies. They can invest, but they have problems

with creating and appropriating value from these investments (Kohtamäki et al., 2020). Cooperation between companies is becoming increasingly more critical today. The need for resources and capabilities is enormous, and companies hardly manage by themselves, requiring the competencies to manage the ecosystem of suppliers, complementors and stakeholders (Kohtamäki et al., 2019). Likewise, the importance of flexibility is growing, which is increasingly recognised in product innovation as essential for building sustainable competitive advantage.

The current literature either lacks or has limited efforts related to the investigation of the importance of smart services for flexibility in the areas of collaboration, innovation and innovation and business performance. At present, there is no publicly available empirical study on the financial benefits of smart services for electrical engineering companies in the Czech Republic. Even if different companies implemented the same smart services, the benefits would be different for each company, and they would be measured in different parameters depending on the business, business model, management method and current life-cycle stage. Thus, the benefits of smart services can only be measured and demonstrated in a particular company by monitoring the evolution of the parameters that the company wants to improve by implementing smart services.

Therefore, the research also sought to determine how smart services impact the flexibility in cooperation and innovation and the innovation and business performance of industrial SMEs and to try to contribute to a better understanding of the potential benefits of smart services to industrial enterprises. The paper aims to find out if smart service manufacturing providers are different in terms of cooperation and innovation flexibility and innovation and business performance from non-smart service manufacturing providers.

Many authors have focused on smart service offer, their drivers, benefits, including financial, but the view of the impact of smart services on flexibility and performance, even in the field of innovation and cooperation, is a new perspective. The originality of this paper is in another view of smart services, specifically in terms of importance for cooperation and innovation flexibility and for innovation and business performance.

The paper consists of a literature review, methodology, main results, discussions with implications and limitations, and conclusions.

## 1. LITERATURE REVIEW

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The subject of the paper is smart services — the area of services that can use smart technologies and are provided to customers of manufacturing companies. Smart services are a special type of service that is provided to a smart object able to perceive its conditions and its surroundings, thus enabling up-to-date data collection, constant communication and interactive feedback (Allmendinger & Lombreglia, 2005). By using smart services, manufacturers can generate additional revenues (Rachinger et al., 2019) and do it so more stably because long-term contracts replace sales (Rymaszewska et al., 2017). Gebauer et al. (2020) attempted to stimulate a further investigation of revenue growth through digitalisation. The use of smart technologies in the provision of services helps companies to reduce the resources used in the provision of services, such as labour costs because fault diagnosis can be performed remotely. Thus, companies can benefit from reduced operating costs (Hasselblatt et al., 2018). In addition, the adoption of smart technology-enabled services can lead to or maintain closer customer relationships because it allows customers to co-create value with the provider, allowing the provider to offer customer-oriented services (Hagberg et al., 2016). In addition, the incorporation of smart technologies makes it possible to expand the portfolio of products and services (Gerpott & May, 2016). As a result, companies will be able to expand their current business (Rymaszewska et al., 2017). Smart technologies can be used to improve the existing range of services because they can be offered in a way that is perceived as more advantageous for the customer. Smart technologies provide insight into product usage behaviour and resource utilisation rates, companies can use this information to improve resource utilisation (Bressanelli et al., 2018). Companies will also gain a competitive advantage from providing services using smart technologies. This is because the fusion of technology and integrated product service offerings is difficult for competitors to imitate (Porter & Heppelmann, 2015). Smart technologies also allow a constant estimate of their current service delivery to identify optimal customer support, which in turn leads to a profitable portfolio of services.

Digital resources can be a lever for innovation in SMEs (Higón, 2012). Also, they change the way we manage innovation (Yoo et al., 2012) and make companies “more extroverted” (Tambe et al., 2012). Digi-

tal resources face traditional spatial constraints of companies involved in collaborating for innovation (Deltour et al., 2018). According to Pagani (2013), a growing interest in cooperation between companies can be expected, which will be based on smart services, which change traditional business operations and make cooperation the main factor of success.

Technological innovation requires the growing importance of access to resources outside the enterprise (Gebauer et al., 2013), as the impressive expansion of digital technologies in business puts many enterprises at risk and growing uncertainty (Gimpel & Röglinger, 2015; Siderska, 2020; Sachpazidu-Wójcicka, 2017). The lack of digital capacity, especially in established companies, is the main driving force for companies to decide to introduce collaborative development methods. For this reason, a growing number of multi-organisational collaborations based on smart services can be expected, which change traditional business operations and make collaboration a major success factor (Pagani & Aiello, 2013). It is more frequent for a business customer as well as suppliers, to believe that they will participate in innovation project development, including technological innovation. However, it is a serious topic to gain competitiveness and, more widely, business success for many current businesses (Zadykowicz et al., 2020; Župerkienė et al., 2019; Kohnová et al., 2019). Nowadays, the so-called regional servitisation is becoming a current trend, in which companies in a given locality come together and cooperate on projects together. Through collaboration, manufacturers and intermediaries can help overcome any weaknesses in the capabilities of others to provide comprehensive, advanced services to their customers (Story et al., 2017). Story et al. (2017) illustrate how integration between manufacturers and their intermediaries helps to overcome the limitations of mutual capabilities required for value creation. Companies can improve their financial, market or innovation performance by working with competitors (Le Roy & Czakon, 2016). Surprisingly, however, studies have not yet fully focused on research topics that see a challenge for manufacturers to perceive the importance of networking (Martin et al., 2019).

Pellicelli (2018) noticed that flexibility was more important than ever, as relationships with suppliers were managed through networked companies and multinational global supply chains. Flexibility enables to establish a global supply chain. Di Sivo & Cellucci (2013) stressed that a local supply chain was based on the willingness of all stakeholders to activate virtuous

cooperation. Flexibility has become one of the most useful and essential tools in today's competitive markets. Manufacturing flexibility is widely recognised as a critical component for achieving a competitive advantage in the market. Flexibility in product innovation is increasingly recognised as essential for building a sustainable competitive advantage in an increasingly turbulent market (Liao et al., 2010).

## 2. RESEARCH METHODS

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Smart services have “raised high expectations of their potential” (Biehl, 2017) and are widely used to describe a company's innovation. In contrast, the research area of these services is still in its infancy, and it is only in recent years that possible first strategies for their research have emerged (e.g., Wunderlich et al., 2015). Therefore, there is a need for more detailed research to systematise existing knowledge in this area (Grubic & Jennions, 2017).

Nowadays, cooperation between companies is essential as well as innovation and flexibility. As mentioned above, in the field of product innovation, cooperation is increasingly recognised as indispensable for building sustainable competitive advantage. Trying to find out whether companies providing smart services differ in the above areas from companies that do not, can be beneficial for business thinking about the possibility to start or postpone offering smart services.

Therefore, quantitative research also sought to determine how smart services impact cooperation flexibility, innovation flexibility, and the innovation and business performance of manufacturing SMEs, and, thereby, try to contribute to a better understanding of the potential benefits of smart services to manufacturers. This gap is addressed by a research question based on the empirical part of the work.

Research question RQ: Are smart service manufacturing providers different in cooperation and innovation flexibility, in innovation performance and business performance from non-smart service manufacturing providers?

Research question leads to the following hypotheses: H. Cooperation flexibility, innovation flexibility, innovation performance and business performance are higher among smart service manufacturing providers than non-smart smart service manufacturing providers.

To answer the research question and hypotheses, a questionnaire was created to examine the issue of

smart services and flexibility and performance in SMEs. The questionnaire contained four main parts: cooperation flexibility (consisting of external cooperation flexibility with customers, external cooperation flexibility with suppliers and internal cooperation flexibility), innovation flexibility (consisting of innovation flexibility related to the product and innovation flexibility related to accompanying services), innovation performance and business performance. The final part of the questionnaire surveyed general information about the respondents, including a query on smart service provision.

Flexibility items were based on Tomášková (2005), Liao & Barnes (2015), Obeidat et al. (2016); innovation performance items — Liao & Barnes (2015) and Obeidat et al. (2016); provision of smart service items — Grubic & Peppard (2016) and Bjerke & Johansson (2015). Three items of business performance measured the use of marketing performance (items 1–3) and two items measured financial performance (items 4–5) based on Grubic & Peppard (2016) and Bjerke and Johansson (2015). The 5-point Likert scale was used in the questionnaire (1 for “No, I don't agree”, 5 for “Yes, I agree”. For testing all parts of the questionnaire, Cronbach's alpha was used. The levels of reliability for the parts were as follow: external cooperation flexibility for customers (0.792), external cooperation flexibility for suppliers (0.812), internal cooperation flexibility (0.814), innovation flexibility relating to the product (0.832), innovation flexibility relating to accompanying services (0.890), innovation performance (0.677), and business performance (0.673).

Producers of electric equipment and electronic components from Czech SMEs participated in the research. They comply with the Czech industry classification (CZ-NACE 26 — Manufacturer of computer, electronic and optical products and CZ-NACE 27 — The Production of Electrical Equipment). CZ-NACE 26 and CZ-NACE 27 are important representatives of the manufacturing industry and are subcontractors for many other sectors of the economy. In addition, the electrical engineering industry is a global industry, which means that many Czech companies can have customers around the world, but on the other hand, competitors can also be global. Precisely because of the connection of products with digital technologies, electrical engineering companies were chosen, where some manufacturers are already trying to provide services using smart technologies to their products, and customers also perceive their benefits. The growth of Czech exports is also related

to the increase in new orders, for which the flexibility of producers and suppliers is necessary. Here, about 70% is generated by the automotive, engineering, electrical and electronics industries. It can be said that high flexibility is one of the most important competitive advantages of many Czech industries (Mařík et al., 2016).

Respondents were mainly managers and directors. They were contacted by email and asked to fill out a web-based questionnaire. The research in SMEs was conducted in July–October 2019. Based on the Czech Statistical Office, the Czech industry classification, CZ-NACE 26 contained 278 companies, and CZ-NACE 27 contained 575 companies with 10–250 employees (data of December 2019). In total, 853 companies were located. Small and medium manufacturers were selected from the Amadeus database. CZ-NACE 26 and CZ-NACE 27 had 730 companies in total, 254 SMEs from CZ-NACE 26 and 476 SMEs from CZ-NACE 27. All of them were addressed by email, but 22 emails were sent back because of their probable exit, liquidation or impossibility to trace them (their contact emails were missing). A total of 112 full-filled questionnaires were obtained, which constitutes a 15.8% rate of return. The software package SPSS, Version 17, was used for data analysis.

In order to fulfil the aim of the paper, a research question and hypothesis were set. The Shapiro–Wilk test, the non-parametric Mann–Whitney U test and

the Levene's Test for Equality were used to verify normality.

### 3. RESEARCH RESULTS

At the beginning of the description of research results, it is worth mentioning that smart services were provided by 48% of respondents from small businesses and 42% of respondents from medium-sized enterprises. More smart services (48%) were provided by enterprises whose customers were other enterprises (B2B) than enterprises whose customers were final customers (28.6%) (B2C). The most frequently provided smart services included remote monitoring (34%), remote diagnostics (29%), remote repair (23%) and preventive and predictive maintenance (18%).

The processing of research question to distinguish electrotechnical SMEs that provided and did not provide smart services required determination of the hypothesis H. (H: Cooperation flexibility, innovation flexibility, innovation performance and business performance are higher among smart service manufacturing providers than non-smart smart service manufacturing providers). The processing of hypothesis H is described below. First, it was necessary to verify the normality by the Shapiro–Wilk test, as shown in the following Table 1.

Tab. 1. Results of the Test of Normality

DO YOU PROVIDE SMART SERVICES, SUCH AS REMOTE MONITORING, REMOTE DIAGNOSTICS, REMOTE REPAIR, AND SO ON?		SHAPIRO–WILK TEST		
		STATISTIC	DF	SIG.
External cooperation flexibility with customers	Yes	.790	51	.000
	No	.868	61	.000
External cooperation flexibility with suppliers	Yes	.946	51	.021
	No	.952	61	.017
Internal cooperation flexibility	Yes	.842	51	.000
	No	.930	61	.002
Innovation flexibility related to the product	Yes	.923	51	.003
	No	.942	61	.006
Innovation flexibility related to accompanying services	Yes	.916	51	.001
	No	.968	61	.117
Innovation performance	Yes	.964	51	.129
	No	.969	61	.122
Business performance	Yes	.918	51	.002
	No	.940	61	.005

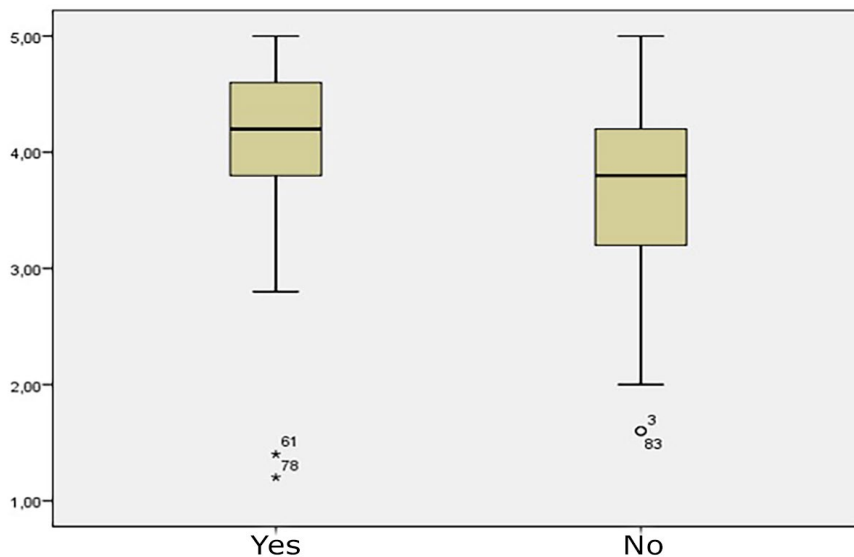


Fig. 1. Verification of extreme and remote observations

The normal distribution is fulfilled if the p-value of the normality test (Sig.) is greater than the selected significance level of 0.05. This is only true for selections marked in bold in Table 1 above. Parametric tests can only be used to compare selections that meet the normal distribution. To be sure, it can be seen whether violations of the normal distribution would cause any outliers or extremes, as shown in Fig. 1. To verify the occurrence of extremes and outliers, a box graph was used. It showed important extremes that distort parametric test results for the internal area only.

Furthermore, the extreme values in the area were removed, and the normality was tried again, see Table 2.

However, neither of these normal distribution selections were achieved (Internal cooperation flexibility NO —  $p < 0.05$ ). The extreme values retained for the test in this file. For all areas except innovation performance, the non-parametric Mann-Whitney U test was used to verify the difference between enterprises that provide and do not provide smart services. For innovation performance, a parametric two-sample t-test could be used in both selections to meet normal data distribution (Table 3).

Based on the mean rank, smart service manufacturing providers achieved higher scores in the mentioned six areas (Table 3 and Fig. 2).

According to Fig. 2, the greatest differences in the mean rank of surveyed areas between smart service manufacturing providers and non-smart service manufacturing providers were in the area of internal cooperation flexibility, innovation flexibility related to the product, innovation flexibility related to accompanying services and business performance. The Mann-Whitney U test (Table 4) was used to ascertain whether this score is statistically significantly different from non-smart service manufacturing provider.

A statistically significant difference was found in the areas of internal cooperation flexibility, innovation flexibility related to the product, innovation flexibility related to accompanying services and business performance ( $p < 0.05$ ). There was no statistically significant difference in the external cooperation flexibility with customers and external cooperation flexibility with suppliers n ( $p > 0.05$ ). In addition, a two-sample t-test was carried out (Table 5), to determine whether smart service manufacturing providers differed in innovation performance from non-smart service manufacturing providers.

Tab. 2. Results of the Test of Normality after the removal of extreme values

DO YOU PROVIDE SMART SERVICES, SUCH AS REMOTE MONITORING, REMOTE DIAGNOSTICS, REMOTE REPAIR, AND SO ON?	SHAPIRO-WILK TEST			
	STATISTIC	DF.	SIG.	
Internal cooperation flexibility	Yes	.956	49	.063
	No	.930	61	.002

Source: elaborated by the author based on obtained data.

Tab. 3. Average ranking of areas

DO YOU PROVIDE SMART SERVICES, SUCH AS REMOTE MONITORING, REMOTE DIAGNOSTICS, REMOTE REPAIR, AND SO ON?		N	MEAN RANK
External cooperation flexibility with customers	Yes	51	62.05
	No	61	51.86
	Total	112	
External cooperation flexibility with suppliers	Yes	51	61.02
	No	61	52.72
	Total	112	
Internal cooperation flexibility	Yes	51	67.40
	No	61	47.39
	Total	112	
Innovation flexibility related to the product	Yes	51	67.91
	No	61	46.96
	Total	112	
Innovation flexibility related to accompanying services	Yes	51	68.24
	No	61	46.69
	Total	112	
Business performance	Yes	51	65.81
	No	61	48.71
	Total	112	

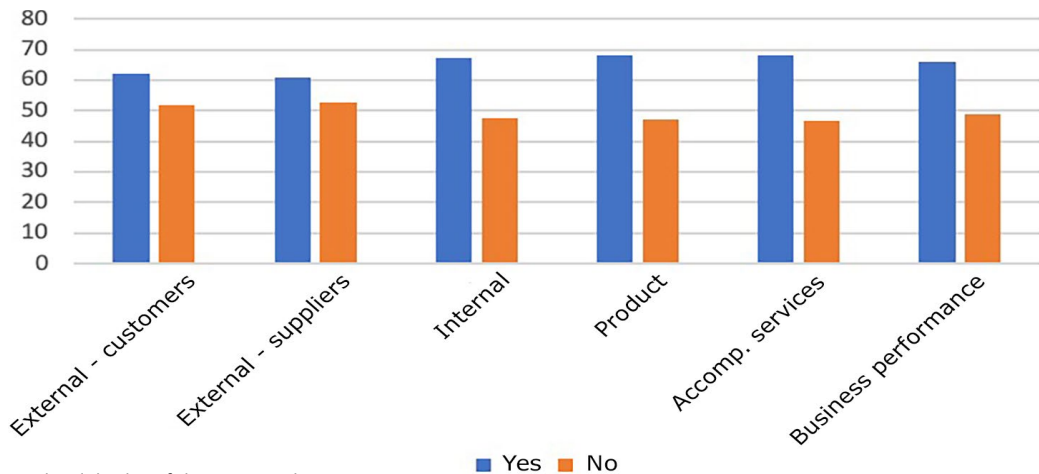


Fig. 2. Graphical display of the mean rank

Tab. 4. Mann–Whitney U test results (Grouping Variable: Do you provide smart services, such as remote monitoring, remote diagnostics, remote repair, and so on?)

	EXTERNAL COOPERATION FLEXIBILITY WITH CUSTOMERS	EXTERNAL COOPERATION FLEXIBILITY WITH SUPPLIERS	INTERNAL COOPERATION FLEXIBILITY	INNOVATION FLEXIBILITY RELATED TO THE PRODUCT	INNOVATION FLEXIBILITY RELATED TO ACCOMPANYING SERVICES	BUSINESS PERFORMANCE
Mann–Whitney U Test	1272.500	1325.000	999.500	973.500	957.000	1080.500
Asymp. Sig. (2-tailed)	.095	.177	.001	.001	.000	.005

Tab. 5. Descriptive statistics of innovation performance according to smart service provision (Grouping Variable: Yes, No)

DO YOU PROVIDE SMART SERVICES, SUCH AS REMOTE MONITORING, REMOTE DIAGNOSTICS, REMOTE REPAIR, AND SO ON?	N	MEAN	STD. DEVIATION
Innovation Performance	Yes	51	3.3490
	No	61	3.1705

Tab. 6. Results of two-sample t-test (Grouping Variable: Yes, No)

	LEVENE'S TEST FOR EQUALITY OF VARIANCES		T-TEST FOR EQUALITY OF MEANS				
	F	SIG.	T	DF	SIG. (2-TAILED)	MEAN DIFFERENCE	STD. ERROR DIFFERENCE
Innovation Performance Equal variances assumed	.522	.472	1.330	110	.186	.17853	.13428

Based on the mean, smart service manufacturing providers achieved a higher innovation performance score. A two-sample t-test (Table 6) was used to determine whether this score was statistically significantly different from that of non-smart service manufacturing providers.

There was no statistically significant difference in innovation performance ( $p > 0.05$ ).

In summary, a statistically significant difference among smart service manufacturing providers was demonstrated in the areas of internal cooperation flexibility, innovation flexibility related to the product, innovation flexibility related to accompanying services and business performance ( $p < 0.05$ ). It can be said that if manufacturers provided smart services, they were better at internal collaboration flexibility, innovation flexibility related to the product, innovation flexibility related to accompanying services and business performance.

#### 4. DISCUSSION OF THE RESULTS

As mentioned above, current electrotechnical SMEs that provide smart services do not yet evaluate the potential financial benefits of including them in the offer. The potential has not yet been recognised for more advanced use-oriented or result-oriented services (Kozłowska, 2020a,b). The paper aimed to identify the importance of a smart service for cooperation and innovation flexibility and innovation and business performance, thus trying to contribute to a better understanding of the potential benefits of smart services for manufacturers.

Nowadays, there is no publicly available empirical study on the financial benefits of smart services

for companies in the electrical engineering industry in the Czech Republic. Even if different companies implemented the same smart services, the benefits would be different for each company and measured using different parameters depending on the line of business, business model, management style and current life-cycle stage. The benefit of these services can, therefore, be measured and demonstrated only in a specific company, by monitoring the development of parameters that the company wants to improve by implementing a smart service.

The reasons for not monitoring the financial benefits may be the certainty of the inclusion of smart services in the range of services. Moreover, so far, the manufacturers tended to “tune” the smart services. A longer time horizon is clearly suitable for evaluation in each company. The benefit of these services can, therefore, be measured and demonstrated only in a specific company by monitoring the development of parameters that the company wants to improve by their implementing. Based on the results of quantitative research, there is a statistically significant difference in manufacturing companies providing smart services in the areas of internal cooperation flexibility, innovation flexibility related to the product, innovation flexibility related to accompanying services and business performance ( $p < 0.05$ ).

Similar results related to business performance were shown in some research, where new technologies had a positive impact on business performance (López-Nicolás et al., 2010; Soto-Acosta et al., 2016). Also, Soto-Acosta et al. (2014) informed that SMEs aimed for new technologies that would allow for a better closeness with the external environment. Companies with greater confidence in services clearly achieved better revenue profitability and improved



their value (Fang et al., 2008) and used best practice or training, which contributed to better business performance through the quality of service, productivity, profitability and innovation (Brewster et al., 2016). However, the efficient allocation of resources required the emphasis on the company's innovation strategy (Revilla et al., 2016). The results confirmed a significant difference in both parts of innovation flexibility (related to the product and accompanying services).

The results of this research agree with the outcomes by Bjerke & Johansson (2015) showing that cooperation within a company and the industry stimulates innovation at the company level. These findings demonstrate that the proximity associated with organisational structures and technological relatedness facilitates the sharing of knowledge and ideas. Interestingly, working with partners within the same corporate group has a much stronger positive relationship to the likelihood of innovation than working with companies in the same industry. Companies in the same sector are "neighbours" because they use similar technologies and operate in related markets, and, therefore, face similar technological challenges and similar business challenges (Bjerke & Johansson, 2015). Therefore, if companies belonged to the same sector, they could be assumed having a deeper understanding of the other party's problems and the processes associated with the creation and development of innovative ideas. This information can be related to the findings of this research, showing an impact of smart services on internal cooperation flexibility.

The knowledge shared between collaborating partners can be related, but it can also complement each other (Bjerke & Johansson, 2015). Companies are aware that territorial servitisation is a process linking services and industry and can increase the local impact of production activities on regional competitiveness and, thus, facilitate the dissemination of local knowledge (Lafuente et al., 2017). Servitisation of regions offers local production economies the opportunity to restore growth and maintain long-term competitiveness. However, local benefits of clustering do not always occur (Shearmur, 2012) as companies may prefer interactions with distant partners (Fitjar & Rodriguez-Pose, 2011) because relationships with close actors are not mandatory (Bathelt et al., 2004), and they can use other forms of proximity (Boschma, 2005) or cooperation can take place on several levels (Vissers & Dankbaar, 2016).

SMEs need to extend the source of flexibility across their borders. Similarly, Carlsson (1989) argued that flexibility is not necessarily limited to small businesses. Rather, it stems from the ability of small businesses to develop their capabilities using a variety of factors as sources of flexibility. SMEs are more likely to achieve flexibility through supply chain relationships and collaboration. As a result, for SMEs, flexibility should be promoted and increased by an appropriate supply-chain strategy (Liao et al., 2015).

## CONCLUSIONS

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Smart servitisation is clearly specific to SMEs, where due to frequently limited financial and personnel capacities, the implementation of smart technologies is more demanding. This paper aimed to find out if smart service manufacturing providers were different in cooperation and innovation flexibility and in innovation and business performance from non-smart service manufacturing providers. Smart servitisation requires collaboration across fixed boundaries because smart solutions work with third-party software products and service systems to implement smart autonomous ecosystems (Sklyar et al., 2019). Companies cannot operate separately from customers but must instead operate across fixed borders. Smart solutions must be designed to work and interact with solutions offered by many other manufacturers, used by customers, supplied by distributors, maintained by various service partners, and operated by third parties. Therefore, the integration of smart solutions across fixed boundaries is essential. This rapid transformation requires technological innovation, as well as business models and collaborative innovation, as manufacturers seek to configure their business models and practices to enable smooth collaboration (Kohtamäki et al., 2019).

Although the findings mentioned in this paper cannot be generalised, there are some influences on theory and practice for manufacturing companies. The scientific point of view of this paper contributes in two specific ways: first, in the presentation of the interconnection of smart services and cooperation flexibility, innovation flexibility, innovation performance and business performance; and second, in the identification of the impact of smart services in manufacturing SMEs and in finding out which areas affect the provision of smart services. A statistically significant difference in smart service manufacturing

providers was demonstrated in the areas of internal cooperation flexibility, innovation flexibility related to the product, innovation flexibility related to accompanying services and business performance ( $p < 0.05$ ). Combining servitisation and digitalisation can help a company to be less dependent on travel and human interaction (Rapaccini et al., 2020). However, the transformation needs the development and implementation of digital offerings, which are usually a long-term process (e.g., Tronvoll et al., 2020) that should have an intentional impact on the business model of the company (Paiola & Gebauer, 2020).

The practical point of view can be seen in the evaluation of the impact of smart services on manufacturing SMEs, namely, the impact of smart services on cooperation flexibility, innovation flexibility, innovation performance and business performance. Recently, Suppatvech et al. (2019) identified a series of benefits and factors of smart servitised business model. According to the paper, an advanced, service-oriented business model based on smart technologies needs close collaboration with different stakeholders and the development of innovative offerings that align with customer needs (Paiola & Gebauer, 2020). However, Kohtamäki et al. (2019) noted that current company structures did not seem to be adequately adapted to the use and offering of smart services. Furthermore, Paiola & Gebauer (2020) noticed that only a few “prepared” companies could be evaluated as having the “full” leverage of smart technologies for smart servitisation. The findings can have a positive influence in several areas; therefore, they can be important factors for many manufacturing companies which still need some persuasion to offer smart services. The integration of digital technologies into service innovation is leading to the development of smart services and a new business model (Jaspert & Dohms, 2020).

The limitations of this paper and research are related to the orientation on one specific segment of manufacturing, namely, electrotechnical companies, where only manufacturers of final electrotechnical products (systems) were chosen. These products (systems) can monitor their activities during their operation, keep the customer informed, and also transmit this information to the manufacturer, which exactly corresponded to the concept of smart services in this research. Also, for a higher degree of generalisation, it would be better to have a larger sample of manufacturers.

Future research will be based on the findings mentioned in this paper and is planned to focus on

the issue of operational indicators monitoring the impact of smart services. It would be useful to find out which operational indicators are best to monitor by manufacturers and why, in what time period and based on the findings, try to prepare a possible comparison or methodology for evaluating the impact of smart services.

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