ORIGINAL ARTICLE

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Impact of cooperation flexibility on innovation flexibility in SMEs

Abstract

Research background: Flexibility has become a possible means for manufacturing companies to better compete in competitive markets. Furthermore, innovations are perceived as an important factor in company strategy, which can differentiate the company from the competition.
Purpose of the article: This present study investigates the problems of cooperation flexibility and innovation flexibility in manufacturing companies among electrical engineering companies in the Czech Republic. The aim of this paper is to identify the impact of cooperation flexibility on innovation flexibility in small and medium-sized manufacturing companies.
Methods: A questionnaire addressed to SMEs in the form of the Likert scale was prepared to gather information about cooperation flexibility and innovation flexibility. All parts of the questionnaire were tested using Cronbach Alpha. Spearman correlation and regression analysis were used for analysis.
Findings & value added: The results of the research show that external cooperation flexibility and internal cooperation flexibility is related to innovation flexibility in SMEs. Results of the research show that there is a positive relationship 1) between external cooperation flexibility and innovation flexibility and 2) between innovation flexibility and business performance at SMEs. The findings of the research contribute to an understanding of the relationship between cooperation flexibility, innovation flexibility and also innovation performance. The novelty value of this paper lies in its perception of flexibility as having two parts, namely external (with suppliers and

customers) and internal cooperation flexibility. In addition, innovation flexibility was investigated in two fields, product, and accompanying services to products. The view mentioned provides a complex view of flexibility.

Introduction

A changing environment brings new approaches to management. Managers are confronted with a high level of complexity and continual technological changes in a globalised world. New technologies bring new opportunities for companies. However, it is an administrative challenge as well. Kovacova and Lăzăroiu (2021) show the need to increase digitisation of administrations for reducing corruption. Companies try to use more developed best practices or training practices because of their ability to facilitate higher business performance. Companies have to change their behaviour because they have to be in accordance with the business environment (Ionescu, 2021). Smith and Machova (2021) stress that current research focuses especially on Internet of Things-based decision support systems, industrial big data analytics, and autonomous production processes in sustainable smart manufacturing.

Gaining competitiveness is an important topic and more widely business success for a lot of present companies (Zadykowicz *et al*., 2020). Cooperation, innovation, and flexibility are often mentioned in these new approaches. Zinecker *et al.* (2022) focused their research on the area of cooperation between business angels, where a high level of cooperation between business angels was found. Bhatti *et al*. (2020) adopted in their research three dimensions of organisational culture: innovative, supportive, and bureaucratic, where innovative culture is also known as an exciting and dynamic culture.

Pellicelli (2018) notes that flexibility is more important than ever, as relationships with suppliers are managed through networked companies and multinational global supply chains. Flexibility enables the establishment of a global supply chain. Beraha *et al.* (2018) noticed a positive association between innovation and strategic flexibility. Companies with high coordination flexibility are likely to foster radical innovation under high uncertainty together with resource acquisition, rather than with resource accumulation (Li *at al*., 2017).

Innovation and flexibility are often mentioned with respect to SMEs. According to Shahmandy *et al*. (2012) or Sykes *et al*. (2014), all companies put more effort into research and development, commitment to top management and employee training and development. Trimi (2008) highlights that SMEs are more flexible and agile than larger companies. With a higher

level of flexibility, SMEs can offset their relative lack of financial resources. Kumar (2013) and Maditinos *et al.* (2014) stress the importance of new and flexible software to support innovation. Li (2015) notes that flexible new technologies and strategic management based on innovation are necessary to systematically improve overall competitive advantage. According to Martínez-Sánchez (2019), flexibility options have the potential to increase capabilities, which are important to innovate. To gain the level of flexibility that customers value (e.g., quick delivery), companies must manage different types of flexibility. Wall (2021) stresses factors which are important for improving SMEs performance. They are business strategy, process, product and organisation innovations.

A research gap exists in the current research. Many authors focus solely on innovation, innovation flexibility or cooperation. Contrary, this study offers a combination of these approaches. It is supposed that cooperation flexibility and innovation flexibility are crucial for tangible products and services as well, as both are included in company offers. For this reason, innovation flexibility is divided into the part connected with products and the part connected with accompanying services to products. The part concerning accompanying services was added by the authors of the article due to the growing importance of services, possible competitive advantage, and the impact of services on the innovation itself. The aim of this study is to find out if cooperation flexibility influences innovation flexibility in SMEs. A questionnaire with application of the Likert scale was prepared to gather information about cooperation flexibility and innovation flexibility. Two categories of industry CZ-NACE 26 (Manufacturer of computer, electronic and optical products) and CZ-NACE 27 (The Production of Electrical Equipment) were selected for research as representatives of hi-tech manufacturers.

The paper consists of five parts: a literature review, describing mainly the problems of flexibility from different viewpoints with hypothesis development; description of methodology; results and their discussion, conclusions with implications and limitations.

Literature review

According to Kaschel and Sánchez y Bernal (2006) flexibility is a complex, multidimensional and hard to capture concept. From a management point of view, flexibility refers to the capability to change with the goal to facilitate creative responses. Flexibility promotes gaining and sharing of knowledge, innovation, offering of products according to requests and wishes of cus-

tomers and ability to respond to market changes (Perry-Smith & Mannucci, 2017; Kumar & Singh, 2019; Shukla & Sushil, 2020).

Vokurka and O'Leary-Kelly (2000) offered fifteen types of flexibility. Eleven types are based on research by Sethi and Sethi (1990), which includes distinct dimensions, namely: machine, material handling, operations, process, routing, product, volume, expansion, program, production, market. Vokurka and O'Leary-Kelly (2000) added four new types to the eleven existing ones. These new types are automation, new design, delivery, and labour. Types of flexibility are divided into categories, which signify their dependence. According to Kumar and Sharma (2014), the independent variables are machine, material handling and labour flexibilities; the dependent variables are production, volume, and product flexibilities. Kumar *et al*. (2017) divided types of flexibility into four categories and described them as a pyramid. There are many people at the bottom of the pyramid who are involved in flexibility. As we move up from the base of the pyramid, the number of people involved in flexibility decreases.

The current literature offers various types of flexibility measurements. The first type of flexibility measurement is focused on strategic flexibility (Brozovic, 2018). The second type of flexibility measurement is based on supply chain flexibility (Das, 2011). The third one is related to information systems (Kumar & Stylianou, 2014). The last one, the fourth type, is related to manufacturing flexibility (Pinheiro *et al*., 2020, Gaviria-Marin *et al*., 2021). The fifth type of flexibility analyses human resource flexibility (Way *et al*., 2015). Vokurka and O'Leary-Kelly (2000) noted that flexibility is influenced by four dominant factors, namely organisational attributes, strategy, technology, and environmental factors.

Some authors define flexibility according to its benefits. According to Todorut (2008), flexibility enables creativity, innovation and speed, and all these are contained in processes of coordination and organisation. Di Sivo and Cellucci (2013) stress that a local supply chain is based on the willingness of all stakeholders to initiate virtuous cooperation. According to Ivanov *et al*. (2018) the four main flexibility triggers include the following: firstly, risks of disruption, resilience, redundancy, and slowdown in the supply chain; secondly, digitisation, smart operations, and e-supply chains; thirdly, sustainability and sensitivity; and fourthly, supplier integration and flexibility of behaviour.

The relationship between flexibility and cooperation has been analysed in many studies. Faems *et al*. (2005) noted that flexibility keeps innovation options open and inter-organisational cooperation is beneficial for innovative performance. Wilson and Nielson (2001) offer four types of cooperative behaviour: Information sharing, flexibility, harmony between compa-

nies and joint working between companies. Mesquita and Brush (2008) present three cooperative behaviours, namely shared planning, flexibility, and response. Cooperation and flexibility are mentioned in research between a company and its partners e.g., Jong and Woolthuis (2008) or Franco *et al.* (2014). As Jong and Woolthuis (2008) show, cooperation and flexibility are based on decreasing the cost of coordinating activities and increasing the level of knowledge transfer. Franco *et al.* (2014) detected that cooperation with geographically closer partners of the company increases its potential absorptive capacity. In any case, human capital positively enhances the innovation impact of potential absorptive capacity. Nordan and Tolstoy (2011) note that flexibility and cooperation with foreign customers are key strategic factors for SMEs´ technological innovation in foreign markets.

The relationship between flexibility and innovation has been the subject of numerous studies. Sanchez (1995) or Beraha *et al*. (2018) confirm the positive relationship between strategic flexibility and innovation. According to Parker (2001), in the entrepreneurial economy, innovation and flexibility are more important than control and stability. Innovation is critically important for SMEs, whereas SMEs are important in radical innovations in new industries (Carlsson, 1996). Zhou and Wu (2010), Fan *et al*. (2013), Wei *et al.* (2014) or Kamasak *et al*. (2016) found out that strategic flexibility has a supportive role in product innovation. There are some studies dealing with flexibility and innovation in foreign markets. Faroque *et al.* (2017) identify that both forms of networking (personal and inter-firm) directly impact business process innovativeness and export performance.

From the literature review, it is evident that there are many types of flexibility, which were mostly reached via research undertaken by authors focused on this topic. It is evident that the relationship between flexibility and innovation and flexibility and cooperation was analysed by authors. In studies dealing with analysis flexibility, innovation, and cooperation are missing. However, it is possible to suppose that there are some relationships among flexibility, cooperation, and innovation. For this reason, this paper tries to fill this gap. Moreover, it is expected that cooperation, flexibility, and innovation will lead to higher business performance. The research presented in different studies does not confirm this conclusion. Brito *et al.* (2014) state that cooperative behaviour of flexibility does not have any significant impact on profitability. By contrast, Connor *et al*. (2020) stress that cooperation improves a supplier´s performance regarding major customers and overall marketplace. Nham Tuan *et al.* (2016) or Jin and Choi (2019) state that innovations have a positive impact on business performance, in contrast to Yam *et al*. (2010), who reported that innovation

activities may not necessarily have a positive effect on business performance. Business performance, effects of flexibility, innovation and cooperation differ as presented in the previous research. From this reason, we can suppose that the relationship among flexibility, cooperation and innovation will be more complicated, and we hope that our research can extend knowledge about this topic.

This study focuses on flexibility connected with innovation and flexibility related to cooperation. Flexibility is a means of expressing competitive advantage in an unstable environment. The term "cooperation flexibility" is not usually used. Authors stress that flexibility is one of the types of cooperative behaviour. Heide and Miner (1992), for example, propose four types of cooperative behaviours. According to them, flexibility assesses the level to which purchasers adjust their own behaviour to accommodate the needs of others. Johnston *et al.* (2004) measure three different cooperative behaviours: shared planning, flexibility, and response. Mesquita and Brush (2008) also use three cooperative norms: information exchange, flexibility, and solidarity. Brito *et al.* (2014) deal with cooperative behaviour of flexibility and its influence on performance. Their attitude to cooperative behaviour of flexibility is based on results by Heide and Miner (1992). They mentioned that the cooperative behaviour of flexibility does not have any significant effect on financial profitability. The term "cooperation flexibility" is based on cooperative behaviour of flexibility by the above mentioned authors and extended it. Cooperation flexibility is divided into two parts — internal and external. The internal part involves activities which relate to management and employees. The external part involves activities which relate to customers and suppliers.

Stonebraker and Leong (1994) mentioned that process related to flexibility deals with changeover flexibility (the ability of the process to respond quickly to different production set-ups required for various products), scheduling flexibility (production lot sizes and variation in the sequence to accommodate required production volumes) and innovation flexibility (identification and implementation of new technologies in production processes with minimal disruption). Liao *et al.* (2010) stress that product innovation flexibility is crucial for building a sustainable competitive advantage in an increasingly turbulent marketplace. According to Liao and Barnes (2015) an effective external knowledge acquisition plays an important role in creating product innovation flexibility. Liu and Chan (2017) conclude that innovation flexibility is one of the key dimensions for Project-Based Enterprises organisational flexibility. Dai *et al.* (2018) inform that the ability to innovate is a component of flexibility capabilities. Ni *et al.* (2021) agree with Lund (1998) and use the term "innovative flexibility", which is

defined as the ability to develop new products or services to rapidly implement them in the market with low costs. According to Pinheiro *et al*. (2021) innovation flexibility is defined like innovation reliability and variability strategies. Summary, innovation flexibility is flexibility with an emphasis on innovation; and is divided into two parts. The first one relates to the product and the second one is connected with accompanying services to products.

Research method

SMEs can exploit opportunities and overcome limitations arising from their small size via cooperation with external partners, especially customers and suppliers (Hanna & Walsh, 2002; Parida *et al*., 2012). Forslund *et al*. (2021) stress supplier flexibility. According to them, supplier flexibility is suppliers´ ability to fulfil changed customer demand. Landström *et al*. (2016) state that large companies in quantitative measurement do not apply measurement of supplier flexibility. It is interpreted that the companies do not know how to measure supplier flexibility.

SMEs adopt an open innovation approach, which is characterised by involving employees in this process (Singh & Agrawal, 2017). Creative ideas are increasingly generated by joining external and internal sources (Scuotto & Shukla, 2015; Santoro *et al*., 2016). Companies have openly approached innovation through cooperation with the external environment (Vanhaverbeke *et al*., 2008). The hypothesis was determined as follows:

H: *Cooperation flexibility is related to the impact on innovation flexibility in SMEs.*

The research was undertaken to better understand the issue of flexibility in small and medium manufacturing companies. The online questionnaire consisted of seven parts focusing on external cooperation flexibility (with customers and suppliers) and internal cooperation flexibility, innovation flexibility (relating to both products and accompanying services), innovation performance and business performance. General information about the manufacturing companies was placed in the final part of the questionnaire and in questions detecting smart service provision as well.

The items used in the questionnaire were inspired by Tomášková (2005), Liao and Barnes (2015), Obeidat *et al*. (2016). The items relating to innovation performance were based on Liao and Barnes (2015) and Obeidat *et al.* (2016). Items 1–3 measure the use of marketing performance items

and items 4–5 measure financial performance in the business performance section. The section focused on smart service provision was based on authors Grubic and Peppard (2016) and Bjerke and Johansson (2015) and on findings from previous qualitative research in seven electrotechnical companies (Kaňovská & Tomášková, 2018). Individual items of innovation and cooperation flexibility are measured on the ordinal scale, Likert scale 1–5. The variables innovation and cooperation flexibility were created as an average of the relevant items falling into these areas.

An analysis of the relationship between external cooperation flexibility, internal cooperation flexibility and innovation flexibility was carried out for the first time. No similar study has been conducted so far. Parts of the questionnaire were taken from other studies (see previous paragraph). The questionnaire created in this way was used for the first time. The use of statistical methods (correlation and regression analysis) to analyse the relationships of individual areas, the quality of which is determined by the questionnaire, is based on the theory of relationships and the properties of the variables analysed.

All parts of the questionnaire were tested using Cronbach Alpha: The level of reliability for external cooperation flexibility for customers was 0.792; for external cooperation flexibility for suppliers, 0.812; for internal cooperation flexibility, 0.814; for innovation flexibility, 0.919; for innovation flexibility relating to product, 0.832; for innovation flexibility relating to accompanying services, 0.890; for innovation development, 0.677 and for performance development, 0.673.

Items of the questionnaire are mentioned in Table 2. Only companies of one certain size and related to only one industry were analysed in the research, therefore it is not possible to include variables on the size and industry of the company in the model. In examining interfunctional coordination, this area was very interesting and showed a high correlation with business performance.

Before conducting the main body of research, a pre-research study in 10 manufacturing companies was undertaken (in April 2019) to check the adequacy and intelligibility of the questionnaire for respondents. Some minor modifications were made to improve the intelligibility of the questionnaire. After that, the main body of research was ready to start. The data was collected from July to October 2019.

SMEs were selected for the research because large companies in the Czech Republic often have foreign investors; they are in majority foreign ownership under domestic control (Sass & Vlčková, 2019). SMEs are identified according to § 1b Accounting No. 563/1991 Coll. with the number of employees from 11 and 250. The research Manufacturers from SMEs par-

ticipating in the research comply with Czech industry classifications, namely CZ-NACE 26 (Manufacturer of computer, electronic and optical products) and CZ-NACE 27 (The Production of Electrical Equipment) and were contacted by email and asked to fill out a questionnaire. According to the Czech Statistical Office, there are 278 SMEs in CZ-NACE 26 and 575 SMEs in CZ-NACE 27. In total there are 853 SMEs (according to December 2019 data). Small and medium manufacturers were selected from the Amadeus database. The total number of SMEs in CZ-NACE 26 and CZ-NACE 27 was 730, but 22 emails were sent back. These companies had already ceased to exist or were in liquidation or contact emails were missing and the companies were no longer traceable. A total of 112 fully completed questionnaires were obtained. The questionnaire return rate corresponds to 15.8% (see Table 1).

For data analysis, the software package SPSS Version 17 was used. Spearman's rank-order correlation coefficient for the measurement of the correlation of two variables and regression analysis were used. The Spearman correlation coefficient was used as a measure of the dependence between the individual items of the areas that were measured on the ordinal scale. Above all, it was interesting to find out whether (1) the items of cooperation flexibility affect the items of innovation flexibility related to products and (2) the items of cooperation flexibility affect the items of innovation flexibility related to accompanying services.

Regression analysis was used to detect the dependence between cooperation flexibility and innovation flexibility. The regression analysis was calculated from the overall evaluation of the areas, which arose as an average of the relevant items. By calculating the averages, a metric variable was created, which is suitable for regression analysis. The regression analysis was to describe mainly the relationship between areas and not to be used for prediction.

Linear regression was used to determine the effect of cooperation flexibility, innovation development, and business development on innovation flexibility. All these variables were created as an arithmetic average of the items of indicators, so they are numerical variables. The influence of several numerical variables on one numerical variable is solved by multiple linear regression. The analysis has found that only cooperation flexibility has a significant effect on innovation flexibility, so a simple linear regression was used to find the equation of regression function that describes the effect of cooperative flexibility on innovation flexibility. The line model came out best.

$$Innovation\ flexibility = \beta_0 + \beta_1 \cdot Cooperation\ flexibility \quad (1)$$

The relationship between innovation and cooperation flexibility was described using a linear function, because according to the criteria evaluating the quality of the model (F-test, t-tests, residual analysis) it turned out the best of all considered functions.

Results

Cooperation flexibility was analysed from an external point of view and is divided into two sections. The first section focuses on cooperation flexibility with customers; and the second part focuses on cooperation flexibility with suppliers. Internal cooperation flexibility is focused on cooperation flexibility within the company itself.

Table 2 shows the correlation between innovation flexibility related to products and cooperation flexibility found from the research held in manufacturing companies. Table 2 shows the positive relationship in many cases between the items of cooperation flexibility with customers and items of innovation flexibility ($p < 0.05$). The items of cooperation flexibility with suppliers and items of innovation flexibility are often independent. Only the item, "Our main suppliers want to cooperate with us" and all items of innovation flexibility show a high positive relationship ($p < 0.019$). It is obvious that there is a high positive relationship between cooperation flexibility with employees and innovation flexibility ($p < 0.05$); only two pairs of items are independent (firstly, the item "We regularly analyse the comments of our employees" and the item, "The company incorporates technologies into new products", and secondly, the item, "We are able to share all necessary information between all employees in a short time" and the item, "We have the ability to design an extensive variety of new products"). The items themselves do not correlate strongly with each other, but these two areas correlate strongly. The correlation coefficient between the two areas is 0.98.

Table 4 shows the correlation between innovation flexibility related to accompanying services and cooperation flexibility found in the research held in manufacturing companies. Table 4 shows that results are similar to the results mentioned in Table 2. It is possible to detect a high positive relationship between the items of innovation flexibility and the items of cooperation flexibility with customers ($p < 0.05$). Conversely, the items of innovation flexibility and the items of cooperation flexibility with suppliers are often independent. The item, "Our main suppliers want to cooperate with us" shows interesting results with the items of cooperation flexibility with customers (an independent relationship for three items, the highest number

from all items connected with innovation flexibility) in comparison with the results from the same item, "Our main suppliers want to cooperate with us" with the items of cooperation flexibility with suppliers (positive relationship for four items, positive relationship for three items, which is the most of all items connected with innovation flexibility). Results related to cooperation flexibility by employees and innovation flexibility show a high positive relationship ($p < 0.05$). Only one pair of items is independent (the item, "We prefer teamwork" and the item, "We can quickly respond to changes in customer requirements and modify existing services").

To determine the hypothesis H (Cooperation flexibility is related to the impact on innovation flexibility), we proceeded as follows:

The influence of cooperation flexibility on innovation flexibility can be expressed by the equation of regression function:

$$Innovation\ flexibility = 0.852 \cdot Cooperation\ flexibility \quad (2)$$

The regression coefficients calculated and their statistical significance tests are described in Table 3, Table 5 and Table 6.

First, the regression coefficient was calculated using the least squares (OLS) method in the constant model ($\beta 1 = 0.726$, $p = 0.000$). However, the constant in the model turned out to be statistically insignificant ($\beta 0 = 0.510$, $p = 0.229$), so it was excluded from the model and the regression coefficient for cooperation flexibility was recalculated for the model without constant ($\beta 1 = 0.852$, $p = 0.000$). The resulting regression equation, therefore, has the form Innovation flexibility = 0.852 · Cooperation flexibility. The quality of the model is determined by the overall F-test of the model ($F = 2698.244$, $p = 0,000$). The p-value of the total F-test is less than 0.05, so the model is statistically significant.

Additional variables cannot be added. The addition of variables has been tried, but nothing else significant in relation to innovation flexibility has emerged. They were insignificant based on t-tests of regression coefficients. Both variables in the regression analysis are metric because they are calculated as averages of items that are measured on the Likert scale, so that the conditions for the regression model are met. Multiple regression cannot be created — it was tried, but only this simple model came out.

Table 7 provides the mean value, standard deviation, minimum and maximum for innovation flexibility and cooperation flexibility. For pairwise correlations mean median value, mode, minimum and maximum were placed in Table 8. Since the individual items were evaluated on an ordinal scale, it is given here as the mean median value. For more information, the mode, minimum and maximum are also included.

The value of the determination index describing the quality of the model is equal to 0.96, which means that the model describes 96% of the dependent variable. Residue analysis confirms the suitability of the model because they satisfy the normal distribution, which was verified by the Shapiro-Wilk normality test (S-W = 0.983; p = 0.153). The mean value is approximately 0 and the residue variance is constant (see Table 9).

Graphical verification of residue normality using Q-Q plot (Figure 1) and histogram (Figure 2).

The model can be used to describe the relationship. On the basis of the regression analysis, it is possible to say that with increasing cooperation flexibility, innovation flexibility increases. If the cooperation flexibility rating increases by 1 point, the innovation flexibility rating increases by 0.85 points (See the equation of regression function above). Figure 3 shows view dependency.

Discussion

The authors add to the existing knowledge of literature dealing with flexibility and innovation (e.g., Vanhaverbeke *et al*., 2008; Parida *et al*., 2012; Scuotto & Shuklax, 2015; Santoro, *et al*., 2016; Soto-Acosta *et al*., 2016; Christensen *et al*., 2016; Latifi & Bouwman, 2018).

The aforementioned empirical research confirms the proposed hypothesis H. Firstly, the authors believe that cooperation flexibility has a positive impact on innovation flexibility. Mainly positive relationships between cooperation flexibility with customers and innovation flexibility related to product were detected. A high positive relationship between internal cooperation flexibility and innovation flexibility was detected. Previous studies have shown the positive impact of in-house developing and innovation (Cohen & Levinthal, 1990; Laursen & Salter, 2006) and flexibility on customer value (Liao, 2020). Also, increasing the flexibility of cooperation by one unit will increase the flexibility of innovation, but by less than one unit. It is not a directly proportional relationship.

Our results concur with Dabrowski (2019), according to whom market information from customers positively influences the relationship between technological development and new products' commercial success. Innovation and flexibility lead to higher innovation performance (Fan *et al*., 2013; Wei *et al*., 2014; Kamasak *et al*., 2016). Scuotto *et al*. (2017) noted only a slightly positive relationship between in-house innovation activities and innovation performance whereas it can be caused by the lack of internal resources of SMEs.

The results show that a significant relationship between items of cooperation flexibility with suppliers and items of innovation flexibility at products is only present in half of cases. The research also shows that there is no significant difference in results regarding products and accompanying services. Nevertheless, Parast and Shekarian (2019) mentioned, based on their review of the literature, that the crucial role of flexibility is in enhancing supply chain resilience.

Based on the regression coefficient, it is possible to say that with increasing cooperation flexibility, innovation flexibility increases. As these two areas are significantly affected, it is good to emphasise them. In this sense, our results are consistent with conclusions by Pinheiro (2021), who organised research in 370 manufacturing companies in Portugal, although he focused on innovation and manufacturing flexibility. According to Martínez-Sánchez (2019), flexibility is significant for innovation because companies have to be able to adapt to changes that are sometimes unpredictable. Our results confirm conclusions by Delic and Eyers (2020) that without innovation, which supports flexibility within the supply chain, companies are in a difficult situation. Their research was conducted in 124 medium- and large-sized European Union automotive manufacturing companies. Overall performance in a very competitive industry is lower without changes of product based on changing supply chain and their operations. This approach enables to achieve a competitive advantage in the marketplace (Jain *et al.*, 2013). Jain *et al.* (2013) focused in their literature review on the concept of manufacturing flexibility: its need, dimensions, measurement, performance implications, relationship among flexibility dimensions, implementation of manufacturing flexibility in a company and managing required flexibility. Their research contributes to the conceptual systematisation of the literature focused on manufacturing flexibility.

According to the conclusions from the regression analysis, SMEs analysed should stress cooperation flexibility and innovation flexibility regarding products.

Conclusions

This paper analyses the relationship between external cooperation flexibility, internal cooperation flexibility and innovation flexibility in SMEs. The significance of this paper lies in its perception of flexibility as having two aspects, namely cooperation flexibility and innovation flexibility. It is assumed that cooperation flexibility and innovation flexibility are essential for products, including services. For this reason, innovation flexibility is

divided into the part connected with tangible products and the part connected with accompanying services to products.

This paper contributes to the current debate concerning cooperation flexibility and innovation flexibility. It explains the terms of cooperation flexibility and innovation flexibility. Cooperation flexibility is often described as one type of cooperative behaviour. Cooperation flexibility is divided into two parts — internal and external in this research. The internal part involves activities which relate to management and employees. The external part involves activities which relate to customers and suppliers. Innovation flexibility is one part of flexibility, and it can be defined as having a positive attitude to product innovation and variability strategies. Innovation flexibility is divided into two groups in this research. One relates to the product and the second one is connected with accompanying services to products. More specifically, this paper analyses the relationship between external cooperation flexibility, internal cooperation flexibility and innovation flexibility in SMEs. Previous studies, which focused on flexibility, did not address the two areas of flexibility at the same time, both in innovation (innovation flexibility) and cooperation (cooperation flexibility). There is a benefit from this article in this connection.

The theoretical implications could be seen in four fields. Firstly, there is a positive relationship between external cooperation flexibility and innovation flexibility. Secondly, there is a high positive relationship between internal cooperation flexibility and innovation flexibility. Thirdly, a positive relationship was found especially between cooperation flexibility with customers and innovation flexibility with products. Fourthly, no significant difference between innovation flexibility in products and innovation flexibility in accompanying services was detected.

The practical implications from our results are: (1) It is possible to conclude that SMEs developing new products or developing the provision of new accompanying services should aim to increase cooperation flexibility with external partners, and firstly with customers. Cooperation flexibility of the company with their customers (especially in the field of the exchange of information with their main customers in a short time) can provoke a quick response to changes in customer requirements or introduce a new product in a short time. Cooperation flexibility with customers can bring higher current customer satisfaction and gain new customers. (2) SMEs should try to cooperate with their employees, especially to emphasise teamwork, stress cooperation and share all necessary information in a very short time. These steps can help to achieve higher innovation flexibility. Today, many companies focus mainly on cooperation with customers and unfortunately neglect cooperation with their employees, internally. This small amount of

internal cooperation, especially over the course of time, can prove to be a big problem. It is also a paradox that there is constant talk of how to co-operate with each other in a team, share information, and communicate, but in practice it is often the most complex area where many problems arise in companies. (3) It is important to pay attention to product innovation and innovation in accompanying services. Unfortunately, today it is not possible in most companies to survive without constant innovations. The competition is fierce, and development is usually moving very fast. It is, therefore, necessary to constantly innovate products and shift their parameters, both in terms of technical features and user perception.

Generally, companies react flexibly to the ever-changing business environment. Managers of SMEs must be proactive in their approach and available to organise the attainment of, sharing of and response to all information. Cooperation flexibility and innovation flexibility are key elements for success. However, the study of cooperation flexibility and innovation flexibility are still underexplored.

Limitations of the research: The authors assume that this result may be based on our sample of companies. SMEs in electrical engineering (1) often offer products for medium and large companies; (2) have only a few customers; and (3) the number of suppliers is wider. The sample size of the research is sufficient for statistical analysis. However, if we have more respondents, even from other industries, then the results could describe the reality more precisely. The next restriction is geographical location, i.e., the focus was only on companies in the Czech Republic. For this reason, subsequent research should compare these results with companies in other fields, e.g., in pharmaceuticals, with different company sizes and with those in other countries. Simultaneously, it will be interesting to monitor the relationship between cooperation flexibility and innovation flexibility with suppliers, if they are independent in all sectors, e.g., in the agriculture and food industry. A further interesting area for future research is the analysis of cooperation flexibility in greater detail, e.g., to know the ways companies share information with their main customers and which ways are the most effective, or how companies apply the "individual approach" to customers in their daily activities.

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Acknowledgments

Annex

Table 1. Structure of respondents according to CZ-NACE

CZ-NACE	Theoretical (CSO)		Theoretical (Amadeus)		Empirical (Own research)	
	Absolute	*Relative*	*Absolute*	*Relative*	*Absolute*	*Relative*
26	278	32.6	254	34.8	68	60.7
27	575	67.4	476	65.2	44	39.3
Total	**853**	**100%**	**730**	**100 %**	**112**	**100 %**

Table 2. Innovation flexibility in products and cooperation flexibility

Innovation flexibility related to products	We can quickly respond to changes in customer requirements and modify existing products.	The company incorporates technologies into new products.	We have the ability to design an extensive variety of new products.	We are able to develop new products in a short time.	We introduce new products in a short time.
Cooperation flexibility – Customers					
We have many possible ways of sharing information with our main customers.	0.326 / **0.000**	0.116 / 0.223	0.191 / **0.043**	0.296 / **0.002**	0.331 / **0.000**
We are able to exchange all information with our main customers in a short time.	0.329 / **0.000**	0.227 / **0.016**	0.260 / **0.006**	0.375 / **0.000**	0.360 / **0.000**
We try to apply an individual approach to customers.	0.391 / **0.000**	0.348 / **0.000**	0.144 / 0.130	0.238 / **0.012**	0.388 / **0.000**
We offer products in compliance with new requests and wishes of customers.	0.360 / **0.000**	0.348 / **0.000**	0.243 / **0.010**	0.426 / **0.000**	0.383 / **0.000**
Our main customers want to cooperate with us.	0.299 / **0.001**	0.233 / **0.013**	0.306 / **0.001**	0.116 / 0.221	0.185 / 0.052
Cooperation flexibility - Suppliers					
We have many possible ways of sharing information with our main suppliers.	0.122 / 0.201	-0.079 / 0.407	0.134 / 0.160	0.084 / 0.376	0.198 / **0.037**
We are able to exchange all information with our main suppliers in a short time.	0.083 / 0.386	0.086 / 0.369	0.169 / 0.076	0.139 / 0.143	0.280 / **0.003**
We solve current issues with our main suppliers regularly.	0.115 / 0.230	0.009 / 0.927	0.251 / **0.008**	0.050 / 0.603	0.122 / 0.205
We cooperate with our suppliers in developing new technologies regularly (new components used for our products).	0.220 / **0.020**	0.233 / **0.014**	0.171 / 0.071	0.290 / **0.002**	0.316 / **0.001**

Table 2. Continued

Innovation flexibility related to products	We can quickly respond to changes in customer requirements and modify existing products.	The company incorporates technologies into new products.	We have the ability to design an extensive variety of new products.	We are able to develop new products in a short time.	We introduce new products in a short time.
Cooperation flexibility - Suppliers					
Our main suppliers want to cooperate with us.	0.413 **0.000**	0.395 **0.000**	0.223 **0.018**	0.431 **0.000**	0.309 **0.001**
Internal cooperation flexibility					
We are able to obtain all the necessary information in a very short time.	0.397 **0.000**	0.283 **0.003**	0.211 **0.026**	0.339 **0.000**	0.395 **0.000**
We are able to instantly exchange all important information with all of our employees.	0.266 **0.005**	0.229 **0.015**	0.179 0.059	0.249 **0.008**	0.245 **0.010**
We emphasise teamwork.	0.300 **0.001**	0.315 **0.001**	0.250 **0.008**	0.185 0.051	0.343 **0.000**
We regularly analyse the comments of our employees.	0.270 **0.004**	0.143 0.133	0.249 **0.008**	0.299 **0.001**	0.320 **0.001**
Thanks to our mutual cooperation, we are faster to respond to customer wishes than our competitors.	0.443 **0.000**	0.340 **0.000**	0.323 **0.001**	0.358 **0.000**	0.375 **0.000**

Note: The first value is Spearman's rank correlation: Spearman's rho, the second value is p-value. If $p < 0.05$ then we reject the null hypothesis (H0: items are independent), i.e., accept that the sample gives reasonable evidence to support the alternative hypothesis (HA: items are dependent).

Table 3. The regression coefficients calculated and their statistical significance tests

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Coefficients Standardised Coefficients Beta	T	Sig.
1	Cooperation flexibility	.726	.105	.551	6.917	.000
	(Constant)	.510	.421		1.211	.229

Table 4. Innovation flexibility in accompanying services and cooperation flexibility

Innovation flexibility related to accompanying services	We can quickly respond to changes in customer requirements and modify existing services.	The company incorporates technologies into new services.	We have the ability to design an extensive variety of new services.	We are able to develop new services in a short time.	We introduce new services in a short time.
			Cooperation flexibility – Customers		
We have many possible ways of sharing information with our main customers.	0.188 **0.048**	0.251 **0.008**	0.219 **0.020**	0.254 **0.007**	0.257 **0.006**
We are able to exchange all information with our main customers in a short time.	0.333 **0.000**	0.309 **0.001**	0.332 **0.000**	0.270 **0.004**	0.274 **0.003**
We try to apply an individual approach to customers.	0.231 **0.014**	0.309 **0.001**	0.206 **0.029**	0.158 0.096	0.207 **0.029**
We offer products in compliance with new requests and wishes of customers.	0.309 **0.001**	0.401 **0.000**	0.307 **0.001**	0.342 **0.000**	0.314 **0.001**
Our main customers want to cooperate with us.	0.205 **0.031**	0.181 0.056	0.265 **0.005**	0.089 0.352	0.115 0.225

Table 4. Continued

Innovation flexibility related to accompanying services	We can quickly respond to changes in customer requirements and modify existing services.	The company incorporates technologies into new services.	We have the ability to design an extensive variety of new services.	We are able to develop new services in a short time.	We introduce new services in a short time.
Cooperation flexibility - Suppliers					
We have many possible ways of sharing information with our main suppliers.	0.061 0.526	0.170 0.073	0.105 0.272	0.121 0.205	0.176 0.063
We are able to exchange all information with our main suppliers in a short time.	0.123 0.197	0.248 **0.008**	0.154 0.104	0.092 0.333	0.116 0.224
We solve current issues with our main suppliers regularly.	-0.122 0.203	0.002 0.984	0.130 0.177	-0.021 0.828	0.016 0.865
We cooperate with our suppliers to develop new technologies regularly (new components used for our products).	-0.009 0.922	0.181 0.057	0.120 0.207	0.198 **0.037**	0.203 **0.032**
Our main suppliers want to cooperate with us.	0.152 0.110	0.359 **0.000**	0.283 **0.003**	0.218 **0.021**	0.197 **0.038**

Table 4. Continued

Innovation flexibility related to accompanying services	We can quickly respond to changes in customer requirements and modify existing services.	The company incorporates technologies into new services.	We have the ability to design an extensive variety of new services.	We are able to develop new services in a short time.	We introduce new services in a short time.
			Internal cooperation flexibility		
We are able to obtain all the necessary information in a very short time.	0.366 **0.000**	0.306 **0.001**	0.231 **0.014**	0.331 **0.000**	0.349 **0.000**
We are able to instantly exchange all important information with all of our employees.	0.498 **0.000**	0.319 **0.001**	0.320 **0.001**	0.199 **0.035**	0.190 **0.045**
We prefer teamwork.	0.146 0.125	0.349 **0.000**	0.328 **0.000**	0.214 **0.023**	0.258 **0.006**
We regularly analyse the comments of our employees	0.188 **0.047**	0.375 **0.000**	0.390 **0.000**	0.336 **0.000**	0.394 **0.000**
Thanks to our mutual cooperation, we are faster in our response to customer wishes than our competitors.	0.357 **0.000**	0.437 **0.000**	0.392 **0.000**	0.387 **0.000**	0.401 **0.000**

Note: The first value is Spearman's rank correlation: Spearman's rho, the second value is p-value. If $p < 0.05$ then we reject the null hypothesis (H0: items are independent), i.e., accept that the sample gives reasonable evidence to support the alternative hypothesis (HA: items are dependent).

Table 5. The calculated regression coefficients and their statistical significance tests

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardised Coefficients Beta	T	Sig.
			Coefficients			
1	Cooperation flexibility	.852	.016	.980	51.945	.000

Table 6. The overall F-test of the model

	Sum of Squares	df	Mean Square	F	Sig.
			ANOVA[a]		
Regression	1305.702	1	1305.702	2698.244	.000
Residual	53.714	111	.484		
Total	1359.416	112			

Note: The independent Variable: Cooperation flexibility. The equation was estimated without the constant term.

Table 7. Mean value, standard deviation, minimum and maximum for innovation flexibility and cooperation flexibility

	Innovation flexibility	Cooperation flexibility
Mean	3.3850	3.9594
Std. Deviation	.82779	.62752
Minimum	1.40	1.40
Maximum	4.80	5.00

Table 8. Mean median value, mode, minimum and maximum for pairwise correlations

	Median	Mode	Minimum	Maximum
Cooperation flexibility – External - Customers				
We have many possible ways of sharing information with our main customers.	4	4	1	5
We are able to exchange all information with our main customers in a short time.	4	4	1	5
We try to apply an individual approach to customers.	5	5	1	5
We offer products in compliance with new requests and wishes of customers.	5	5	1	5
Our main customers want to cooperate with us.	5	5	1	5
Cooperation flexibility – External - Suppliers				
We have many possible ways of sharing information with our main suppliers.	4	4	1	5
We are able to exchange all information with our main suppliers in a short time.	4	4	2	5
We solve current issues with our main suppliers regularly.	4	4	1	5

Table 8. Continued

|	Median	Mode	Minimum	Maximum
Cooperation flexibility – External - Suppliers				
We cooperate with our suppliers in developing new technologies regularly (new components used for our products).	3	2	1	5
Our main suppliers want to cooperate with us.	4	5	1	5
Cooperation flexibility – Internal				
We are able to obtain all the necessary information in a very short time.	4	4	1	5
We are able to instantly exchange all important information with all of our employees.	4	4	1	5
We emphasise teamwork.	4	4	1	5
We regularly analyse the comments of our employees.	4	4	1	5
Thanks to our mutual cooperation, we are faster to respond to customer wishes than our competitors.	4	4	1	5

Table 9. Residuals descriptive statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.1925	4.2591	3.3727	.53453	112
Residual	-1.26406	1.56309	.01238	.69552	112
Std. Predicted Value	-4.079	1.658	**.000**	**1.000**	112
Std. Residual	-1.817	2.247	.018	1.000	112

Note: Dependent Variable: Innovation flexibility. Linear Regression through the Origin

Figure 1. Normal Q-Q Plot of Error for Innovation flexibility with Cooperation flexibility from CURVEFIT
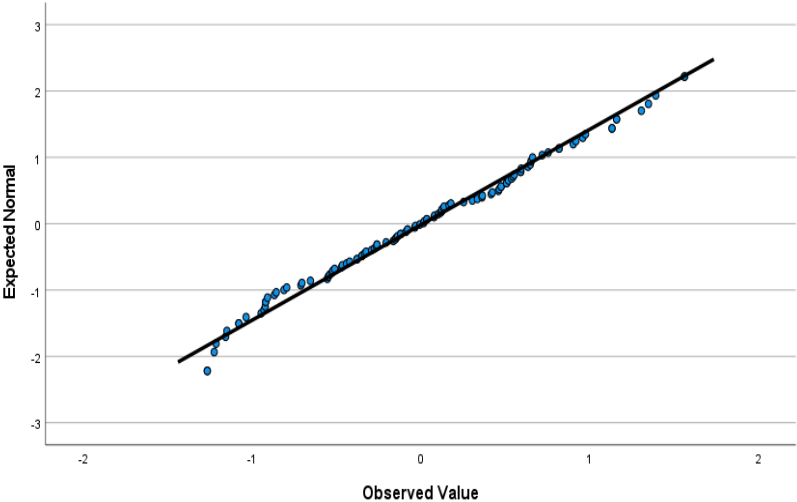
Figure 2. Graphical verification of residue normality using histogram

Figure 3. View dependency