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Quality Management Practices in Manufacturing Enterprises in the Context of Their Performance

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Abstract

This research paper examines the issue of quality management practices (QMPs) as a supporting tool for managing and improving the performance and competitiveness of enterprises. The aim of the paper is to present the interconnection of the practical use of QMPs concerning the performance in the Slovak manufacturing enterprises. One of the main causal factors that may influence the different utilization of QMPs is the capital structure of the surveyed enterprises. The consequence factor is the achieved performance, parameterized in this research through Return on Sales. During the period 2020 to 2021, 364 manufacturing enterprises were interviewed through a questionnaire. In order to keep the population, the industrial structure stratified sampling method was applied and the sample representativeness was assessed by using the Chi-square goodness-of-fit test. Pearson's chi-square test, interval estimates of proportions, and analysis of contingency were implemented to test the stated research hypotheses. The results of performed analyses revealed the existence of significant relations among capital structure, the scale of the use of QMPs and performance measured by Return on Sales. The survey results also point to differences in the practical use of quality management within the analysed industries. The difference factor is the size of the enterprise, the industry itself, and partly also the technology and performance of the industry given by the added value. At the same time, space for the implementation of selected approaches and concepts related to quality management in manufacturing enterprises that have the potential for more effective management has been identified to increase competitiveness.

Keywords: quality, quality management practices, competitiveness, manufacturing enterprises, return on sales, performance
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1. INTRODUCTION

The current globalized market economic environment, which involves national economies in global economic ties through the growing use of communication technologies, increases the

demand for competitiveness. Intensifying competition requires a high degree of readiness for change within management. This is also evidenced by the recent impact of the economic shock caused by the global pandemic SARS COV2 COVID 19, where companies faced the pressure of flexible responses to current problems. However, the pressure on the operation of manufacturing enterprises in the market environment is created not only by the need to respond to the current situation but in terms of quality, especially from competitors, customers and suppliers. The consequences of the impact of inflation, the lack of part of the input components, have caused problems that require responses. In the case of successful multinational companies, there is a clear trend to change the approach of building supplier-customer relationships to strengthen the regularity and quality of supplies of components and raw materials. To eliminate the effects of possible economic shocks, be able to remain competitive and, in particular, to meet the requirements of their customers, companies are constantly looking for the potential to increase the overall approach to quality. Thus, quality remains an important part of management, and its essence is given by the level of approaches through a relatively wide portfolio of methods, tools and concepts of quality management.

Many studies declare that quality is one of the tools that companies use to fulfill their strategy and increase their competitiveness (Sahoo, 2021; Liu et al., 2020; Kotásková & Rozsa, 2018; Benčiková et al., 2021). For several years, there has been a trend to change the orientation of the essence of quality from the control of production to its comprehensive perception within the management system (Al-Dhaafri & Alosani, 2020; Kafetzopoulos et al., 2021). The change focuses on striving for continual improvement, strengthening workers' empowerment and respecting customer preferences. Quality is still an important tool for measuring business performance (Liu et al., 2021), while improving the level and organization of work and corporate culture (Bencsik et al., 2018). This study presents the link between the level of utilization of quality management practices (QMPs) in Slovak manufacturing enterprises in terms of possible relationship to capital structure and business performance measured by Return on Sales (ROS) in comparing NACE classification of industries. The contribution of this research is not only to determine the scale of the portfolio of the use of QMPs in the industrial sphere of enterprises but also their connection to financial results, pointing to the impact of performance through the economic shock caused by the pandemic. The scientific studies on the subject issue published so far mainly focus on examining the scale of QMPs in terms of their use in various industries without a comprehensive link to their impact on performance. An example is a study by Garza-Reyes et al. (2015), who pointed out the scale of QMPs in the automotive industry. In the conditions of the textile industry, Attia (2016) dealt with this issue. The services sector was analysed by Marcysiak (2021), Kelić et al. (2020), Mira et al. (2018). A more comprehensive current issue regarding determinants of QMPs in manufacturing enterprises was analysed by Agarwal et al. (2013). Similar research in the conditions of manufacturing enterprises was carried out by Gambi et al. (2021). However, in all the above-mentioned studies, the scale of analysed QMPs portfolio was often focused only on a selected concept, method, or approach without a more comprehensive view of their use and impact on the entire industrial sector. It is the area of identifying the portfolio of use of QMPs in relation to the capital structure and performance of the manufacturing enterprises, as well as the discovery of possible differences within the industries that can be considered original for the research.

The paper has the following structure. Section brief literature review evaluates the current state of the research topic from an international viewpoint. This is followed by a section on methodology, where a description of the research design, sample size, data collection and used statistical evaluation methods is presented. The research results are presented and discussed with a comparison of other international results in the further section, followed by conclusions. They also include suggestions for future research directions.

2. THEORETICAL BACKGROUND

The quality of each product can be measured in terms of performance, reliability and durability. This is a key parameter that distinguishes a company from its competitors. Quality management tools ensure changes in systems and processes, which ultimately lead to higher product quality and building a competitive position. Within quality approaches, companies have a relatively broad portfolio of quality management methods, tools and concepts that can be presented as a scale of QMPs (Santos et al., 2021; Kuhn et al., 2018). In this sense, the concept of Total Quality Management, Kaizen philosophy, Six Sigma method, ISO standards 9000, process management approach, and quality management tools are considered QMPs in this study. Other authors (Wu, 2020; Saleh et al., 2018) also name them. It is up to enterprises to implement the right scale of QMPs. The portfolio of these practices is relatively broad. Kuhn et al. (2018) state that "Traditional QMPs showed to be inefficient when applied in the context of complex processes". The future direction of the quality movement will have to take into account the quality of products manufactured in the era of the digital economy (Popkova, 2019). Carnerud (2018) specifies trends in quality management, emphasizing the importance of some of them as more important (Six Sigma, ISO standards, Lean and Innovation) than others. The following part of the paper presents the essence of selected concepts of QMPs.

Six Sigma (SS) is a method of improving the productivity, performance and quality of implemented products (Uluskan, 2020). The essence of this method is based on a thorough understanding of customer requirements and expectations while applying proven tools to eliminate defects in processes. The purpose of Six Sigma (6σ) is to achieve a state in which the value of the standard deviation σ would acquire such a size that would guarantee the coverage of the entire tolerance area of the monitored parameter. In practice, this means taking measures that would significantly eliminate the variability of processes and thus significantly increase their stability (Sordan et al., 2020). Six Sigma ultimately reduces the number of defective products with a consequent increase in revenues and greater customer satisfaction (Yadav et al., 2019). Mueller & Cross (2020) and Aparisi (2019) dealt with using the SS method in manufacturing enterprises. However, the aim of these studies was mainly the area of presentation of conceptual models of implementation of the method without identifying the range of its use in the industrial sphere in the context of other QMPs. Total Quality Management (TQM) is a concept focused on improving all activities of the organization. It is a dynamic tool for managing and improving performance to gain a competitive advantage in terms of quality, productivity, customer satisfaction, and profitability (Kiseľáková et al., 2020). TQM is widely used in manufacturing, education, hospitals, government, and service industries, as well as space and science programs. Yanya & Mahamat (2020) studied the TQM concept in manufacturing enterprises. However, the

aim of these studies was to highlight the nature and advantages of TQM in various industries without a comprehensive view of the entire industry sector and their impact on performance. The continuous improvement techniques applied in quality management have their origins in the Japanese Kaizen philosophy, which Deming described as "Improving initiatives that increase success and reduce mistakes" (Berhe, 2021). Kaizen is characterized by an effort to constantly improve the processes, activities of employees and their cooperation. The basis of the philosophy is dissatisfaction with the current state, constant search and elimination of waste. Studies about the use of Kaizen in the industrial sector (Berhe, 2021; Janjic et al., 2019) are again focused on pointing out the advantages in specific conditions of industries without a more view of use in combination with other QMPs. ISO 9001 is a certifiable international standard issued by ISO (International Organization for Standardization, 2015), focused on continuous improvement (Ribeiro et al., 2019). The purpose of applying standards is to create a unified approach to the implementation of quality management systems, higher satisfaction of customer requirements, the competitiveness of the company and the achievement of better economic results. Several authors addressed the use of ISO standards in manufacturing enterprises. ISO standards with industrial productivity improvement have been investigated (Dahar & Roudies, 2021; Mura et al., 2021).

If several QMPs are applied to one production or service process, it leads to higher product quality. At the same time, the opposite is true that if one QMP is applied to several production and service processes, it also leads to higher product quality. It would be ideal if the same set of QMPs was applied to all production and service processes. However, research has not yet shown whether certain financial factors affect the set of QMPs used. The basic possible causal factor that creates space for research and influences QMPs utilization is the capital structure of the enterprise. At the same time, it is necessary to examine whether there is an indicative parameter that could indicate the size of the set of QMPs used concerning performance. In the presented research, ROS was chosen as an indicative parameter. The selected methods, tools and concepts of quality management described above have an undeniable contribution to increasing the level of management and performance of manufacturing enterprises. Available review articles on using QMPs seem insufficient and address only specific aspects of the partial analysis of their essence and possible effects. This study aims to examine the interconnection of the practical use of QMPs in relation to the performance measured by ROS in the manufacturing sectors.

3. RESEARCH OBJECTIVE, METHODOLOGY, AND DATA

The purpose of the research is to identify a portfolio of the use of available QMPs in Slovak industrial enterprises based on selective factors analysis. The examined causal factor that may affect the different utilization of QMPs is the capital structure of companies. A possible consequence factor is the achieved performance, parameterized through ROS in this research. The major research method was primary quantitative research using a traditional questionnaire technique. The questionnaire survey was conducted during the last two years, 2020 and 2021, through the platform docs.google.form. The current questionnaire link is https://docs.google.com/forms/d/e/1FAIpQLSfp0H8V5dEf1UTZlF2YjK_wDjLTH9lZ8U0qgd-dPZd4H6HClQ/viewform. The enterprises were addressed via e-mail and telephone, while the questionnaire

consisted of questions of a selective nature (company size, capital structure, business area) and especially questions aimed at determining the range of ROS and the use of QMPs. The results presented in this paper analyse a specific group of small, medium-sized, and large manufacturing enterprises of all industries which employ 10 or more employees. Their location is in the Slovak Republic with different levels of capital structure. Register of the Statistical Office of the Slovak Republic for the year 2020 was the information database to determine the population of manufacturing enterprises and also for contacting companies. According to the European Commission Directive No. 2003/361/EC (2003), the enterprises were divided into size categories and, according to NACE codes (European Industry-standard classification system, section C Manufacturing), into industries. At the time of completion of the survey sample, according to the Statistical Office of the Slovak Republic, the population size was 2,504 enterprises.

To determine the necessary sample size, a formula for a population of the finite size according to Yamane Taro (Lind, 2020) was followed.

$$n=N/(1+N\cdot E^2) \tag{1}$$

With a population size of 2,504 units and the selected error E=0.05 was solved for n:

$$n=2504/(1+2504\cdot 0.05^2)=345$$

To get a research sample that is truly representative of the population, stratified sampling was applied. The questionnaire was distributed by individual e-mail contacts to 2,504 manufacturing enterprises located in Slovakia. The following industries, according to NACE codes (European Industry-standard classification system, section C Manufacturing), were selected through the stratified sampling (Table 1). Out of the total number of respondents, the return rate of the questionnaires represented 14.54%, which is 364 manufacturing enterprises.

To evaluate the representativeness of the research sample according to the industries and enterprise size, the Chi-square goodness-of-fit test was used to check evidence of minor differences from the target population. The Pearson chi-square test was also applied as the most common test for the significance of the relationship between two categorical variables. The measure is based on the observed and expected frequencies – frequencies that we would expect if there was no relationship between the variables (Box et al., 2005):

$$\chi^2 = \sum \frac{(f_o-f_e)^2}{f_e} \tag{2}$$

The chi-square test becomes increasingly significant as the numbers deviate further from this expected pattern. The only assumption underlying the Chi-square statistics is that the expected frequencies are not very small (below five). The coefficient of contingency measures the relation between two categorical variables with a scale from 0 to 1, where 0 means complete independence. For estimation of population proportions, 95% confidence intervals (commonly used in practice) were constructed according to the formula (Lind, 2020):

$$p - z_{\frac{\alpha}{2}} \cdot \sqrt{\frac{p(1-p)}{n}} < \pi < p + z_{\frac{\alpha}{2}} \cdot \sqrt{\frac{p(1-p)}{n}} \tag{3}$$

When estimating the population proportion π in the case of samples with a sufficiently large range (n>30), based on the central limit theorem, the random variable has an approximately

normal distribution X ~ N (nπ; nπ (1-π)) and normality testing is not a necessary condition for interval estimates.

To test the difference between two population proportions, a test criterion based on the z statistics was used (Box et al. 2005):

$$|z| = \sqrt{\frac{n_1 n_2}{n_1+n_2}} \cdot \frac{|p_1-p_2|}{\sqrt{p(1-p)}} \quad (4)$$

where $p=(p_1.n_1+p_2.n_2)/(n_1+n_2)$, p_1 and p_2 are the sample proportions, and n_1, n_2 are the sample sizes.

Based on the literature review, the following hypotheses (H1, H2) and a research question (RQ) were formulated following the research question concept:

H1: It is assumed that there is a difference between manufacturing enterprises with a different capital structure in the scope of the use of quality management practices.

H2: It is assumed that manufacturing enterprises that use a wider scale of quality management practices also achieve a higher level of performance measured by the Return on Sales indicator.

RQ: Are there differences in the use of quality management practices within the industries of manufacturing enterprises in Slovakia?

All statistical analyses were performed using STATISTICA 12 software. Due to the categorical character of all variables, selected tools of descriptive and inferential statistics were concerned with proportions. In the H1 and H2 hypotheses, testing the Chi-square statistic was involved. An alpha level of 0.05 was traditionally used in similar studies as the decision rule was applied. The output tables were edited in the Microsoft Excel spreadsheet editor. For better clarity, some results were also presented graphically using a line graph and bar chart, or 3D sequential chart.

4. RESULTS AND DISCUSSION

The next part of the study presents the results of the questionnaire survey in the context of the research question and verification of hypotheses. The dataset used for the research are relevant from the point of view of testing the possible dependence of the practical use of the portfolio scope of QMPs, the capital structure of manufacturing enterprises and their level of performance measured by ROS. The fact that the research sample represents the same proportions of industries as that of the whole population was confirmed by the results of the Chi-square goodness-of-fit test (Table 1). Representativeness according to the enterprise size was tested similarly. In this respect, the research sample does not differ significantly from the distribution of enterprises in the population ($\chi^2 = 2.18$; $p = 0.336$).

Tab. 1 – Results of testing for representativeness by industry. Source: own research

Industry	Percentage in the target population	$\chi^2 = 22.85$, degree of freedom = 15, p = 0.087			
		observed (Oi)	expected (Ei)	E - O	(E-O)2 (/O)
NACE 10+11	12.03%	44	44.77	-0.77	0.01
NACE 13+14	7.11%	24	25.88	-1.88	0.14
NACE 15	1.76%	8	6.40	1.60	0.40
NACE 16	4.91%	20	17.88	2.12	0.25
NACE 17	2.00%	8	7.27	0.73	0.07
NACE 20	2.08%	7	7,56	-0.56	0.04
NACE 21	0.68%	7	2.47	4.53	8.30
NACE 22	8.99%	31	32.71	-1.71	0.09
NACE 23	4.55%	15	16.57	-1.57	0.15
NACE 24+25	23.88%	81	86.93	-5.93	0.40
NACE 26	2.84%	9	10.32	-1.32	0.17
NACE 27	6.03%	19	21.95	-2.95	0.40
NACE 28	8.63%	26	31.40	-5.40	0.93
NACE 29	6.23%	19	22.68	-3.68	0.60
NACE 31	3.31%	16	12.07	3.93	1.28
NACE 32*	4.71%	30	17.15	12.85	9.62
Total	100%	364	364.00	0.00	22.85

* NACE 32 also includes NACE 5, 7, 8, 9, 18, 19

At first, it was necessary to identify the practical use of QMPs concerning the scale of their use within the survey population and the Industry-standard classification system, section C Manufacturing (NACE classification). The proportion of investigated manufacturing enterprises that use QMPs is 176 out of 364, i.e., 48.35%. Subsequently, the confidence interval for the population proportion was calculated to show the occurrence of the observed characteristic within the target population with a reliability of 95%. The ratio of enterprises that apply at least two or more proposed QMPs was estimated in the population of Slovak manufacturing enterprises by the interval from 43% to 53%.

Tab. 2 – Use of individual quality management practices in the population of Slovak manufacturing enterprises – 95% interval estimates. Source: own research

Quality management practices	p -point estimate of proportion	n -sample size	95% confid. interval	
			lower limit	upp. limit
Total Quality Management	42.61%	176	35%	50%
Six Sigma method	27.84%	176	21%	34%

Process management approach	46.02%	176	39%	53%
Kaizen philosophy	15.91%	176	11%	21%
ISO standards 9000	94.32%	176	91%	98%
Basic quality management tools	62.50%	176	55%	70%
Preventive methods of quality control	11.36%	176	7%	16%

Table 2 presents 95% interval estimates for the proportions of Slovak manufacturing enterprises that use any of QMP. It is evident that the most frequent is the use of ISO standards 9000, between 91% to 98% of enterprises. Another activity was the use of basic quality tools. It is the application of one or more standard tools for evaluating the quality of production and the quality system: Pareto and Fishbone diagram, Shewart diagram, flowchart, histogram, affinity and interrelationship diagram, and others. These were used in spans from 55% to 70%. This was followed by a process management approach and TQM between 39% to 53%, respectively, 35% to 50% of enterprises. Among the least preferred approaches on a scale of 11% to 21%, resp. 7% to 16% belonged to the Kaizen philosophy and preventive quality methods (Quality Function Deployment method - QFD and Failure Mode and Effects Analysis - FMEA).

The concept of quality standardization through ISO 9000 standards, the TQM philosophy and also the higher number of applications of the Six Sigma method were identified to a greater extent in the manufacture of motor vehicles (NACE 29), in the manufacture of machinery and equipment (NACE 28), manufacture of fabricated metal products (NACE 25) and also in the manufacture of food and beverages (NACE 10+11). In the companies, NACE 29, 28, 25, process management approaches and basic quality management tools were identified with greater frequency. The necessity to use the ISO standards 9000 in the environment of manufacturing enterprises was highlighted by (Dahar & Roudies, 2021; Siltori et al., 2020). Yanya & Mahamat (2020), Kisel'akova et al. (2020), Sordan et al. (2020) focused their attention on the importance of TQM and SS method in their studies. The survey results also confirmed that the use of a wider scale of QMPs is demonstrable in large and partly medium-sized enterprises with higher levels of total added value. Figure 1 presents the development of value-added indicators in 2009 to 2020 in the selected Slovak manufacturing enterprises with the highest and lowest value. NACE 29, 28, 25, and 22 present the highest value-added and the scale of use of QMPs. At the same time, these are industries with a high level of technology. Conversely, lower utilization rates for QMPs were identified in lower value-added industries (NACE 21, 32, 15). Based on these findings, it can be stated that there are some differences in the use of the scale of QMPs within the sector of manufacturing enterprises in Slovakia, while the difference factor is the size of the enterprise, the industry itself, and partly the technology and performance of the industry measured by value-added.

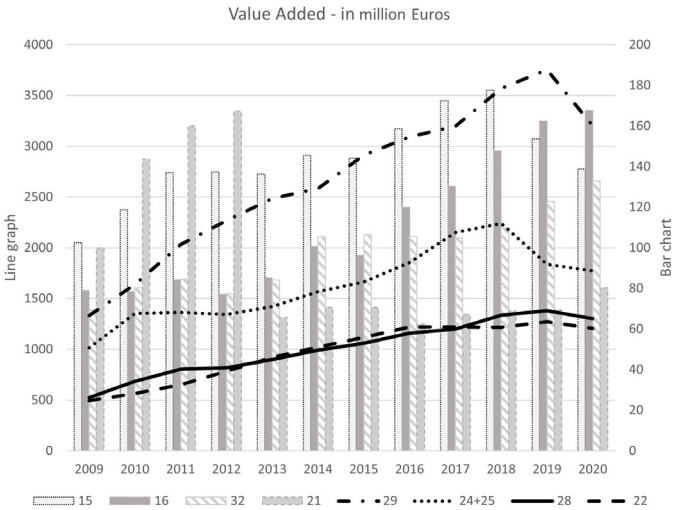

Fig. 1 – Value-added indicator in Slovak manufacturing enterprises. Source: own research

If a company uses two or more approaches as part of its approach to quality management, it is possible to speak of the wider use of QMPs. With each new tool, this utilization rate increases. This assumption was followed when testing hypothesis H1. In terms of H1, the examined sample was divided into two groups based on the capital structure of manufacturing enterprises. The group of enterprises with a predominance of domestic capital included 198 enterprises. The second group was represented by 166 enterprises with a predominance of foreign capital structure. In relative numbers, it was 54.40% and 45.60%.

In each of the two groups of manufacturing enterprises, the share of those that use QMPs was calculated. These practices are applied with 29.80% in enterprises with a predominance of domestic capital and 70.48% in enterprises with foreign capital structure. Based on the given point estimate, the statistical significance of the difference within the respective populations was tested, i. e. within population of manufacturing enterprises with domestic and foreign capital structures applying quality management control. The results of the testing are presented in Table 3. The null hypothesis stating no difference between the two population proportions was rejected (p=0.000). The alternative hypothesis about the significant difference was supported. Table 3 presents the interval estimates, based on which the following can be stated. With 95% confidence, the percentage of Slovak manufacturing enterprises with a domestic capital structure that uses QMPs is between 23% and 36%. In the population of Slovak manufacturing enterprises with a foreign capital structure, the estimate is from 64% to 77%. Manufacturing enterprises in Slovakia with a foreign capital structure are more successful and competitive in the market than enterprises with a domestic capital structure. This is due to a certain level of know-how of a flexible approach in the field of management but also quality. Several authors have confirmed this assumption in their studies (Zandi et al., 2020; Belas et al., 2018). The H1 hypothesis was confirmed by our research.

Tab. 3 – Results of test concerning the difference between two population proportions. Source: own research

Capital Structure		u-test	p-value	Capital Structure	
Domestic	Foreign			Domestic	Foreign
QMPs are used				Confidence Interval (95%)	
29.80%	70.48%	7.74	0.000	23% - 36%	64% - 77%

The second hypothesis (H2) concerned the potential effect of practical use of the quality. It was assumed that manufacturing enterprises that use a wider scale of QMPs also achieve a higher level of performance measured by ROS. The contingency table (Table 4) presented sample distribution according to two variables - the use of quality management practices and the ROS level. The ROS value was chosen for the performance indicator on the scale of a negative level, positive level up to 2.5%, followed by the level from 2.6% to 5% and more than 5%.

Tab. 4 – Contingency table – relative frequencies for combinations using quality management practices and ROS. Source: own research

QMPs	Contingency table - relative frequencies				
	ROS negat.	ROS up to 2.5%	ROS (2.6% to 5%)	ROS > 5%	Total
is not used	9.62%	31.59%	7.42%	3.02%	51.65%
is used	4.40%	18.41%	17.31%	8.24%	48.35%
Total	14.01%	50.00%	24.73%	11.26%	100.00%

The results of the contingency testing are presented in Table 5. Using Pearson's Chi-square test, the null hypothesis about independence was rejected at the 5% significance level. The relationship between the two examined variables was evaluated as significantly dependent (p=0.000) with a moderate strength of contingency coefficient of 0.32.

Tab. 5 – Results of Pearson Chi-square test for hypothesis (H2). Source: own research

Quality management practices versus Return on Sales				
Contingency	Chi-square test	degree of freedom	p-level	Contingency coefficient
	42.59	3	0.000	0.32

Residual frequencies are presented in Table 6. Cells with large deviations between observed and expected frequencies were detected and highlighted in bold.

Tab. 6 – Contingency table – residual frequencies for combinations using quality management practices and the level of Return on Sales. Source: own research

QMPs	Contingency table – residual frequencies			
	ROS negative	ROS up to 2.5%	ROS (2.6% - 5%)	ROS > 5%
is not used	8.66	**21.00**	-19.48	-10.18
is used	-8.66	-21.00	**19.48**	**10.18**

Based on the presented results, it can be argued that manufacturing enterprises using a wider scale of QMPs achieve a ROS level greater than 2.5%. Conversely, those enterprises that apply QMPs to a lesser extent report a ROS level of up to 2.5% or a ROS with a negative value. The given conclusion is also presented in Figure 2. The survey results also confirmed that enterprises that use only one or none of the approaches to quality management rarely achieve a higher ROS value than 2.5%. The hypothesis H2 was confirmed by our research. This is also confirmed by research studies published by Marcysiak (2021), Shafiq et al. (2019), Jimoh et al. (2019) and Janjic et al. (2019). With a wider scale of QMPs, a positive effect of increasing business performance can be expected.

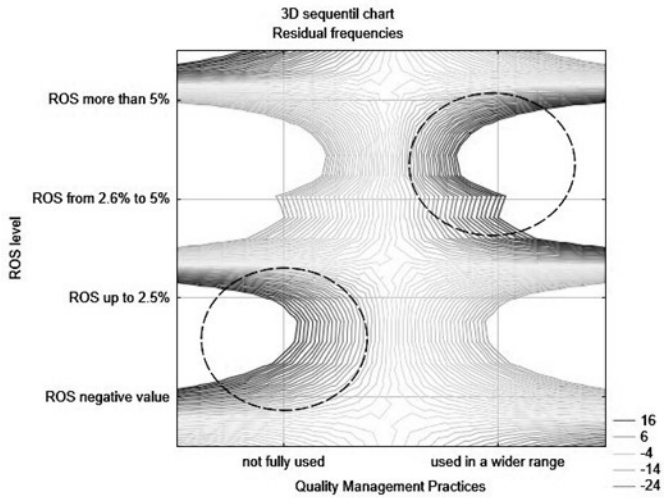

Fig. 2 – Use of quality management practices and the ROS level. Source: own research

Figure 3 presents the development of the ROS indicator in the years 2009 to 2020 in the selected Slovak manufacturing enterprises with the highest and lowest value. A high rate of ROS is reported in the manufacture of rubber products (NACE 22), manufacture of basic pharmaceutical products (NACE 21), and manufacture of paper products (NACE 17). Nevertheless, with a decrease in recent years. In the previous years, ROS values above 2.5% reached NACE with high value-added, NACE 29 and 25 but with some decline in performance during the pandemic crisis.

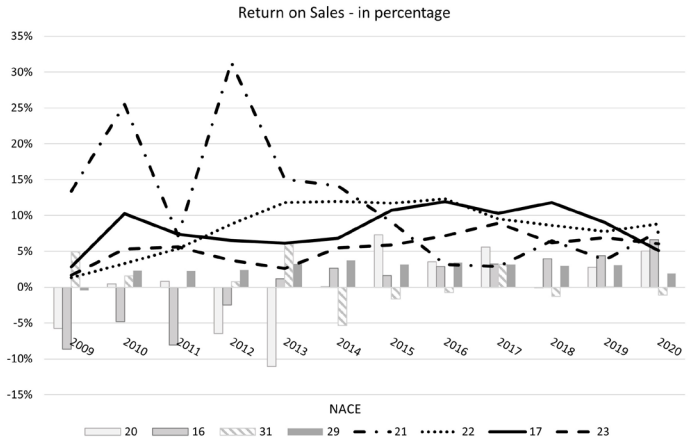

Fig. 3 – ROS indicator in Slovak manufacturing enterprises. Source: own research

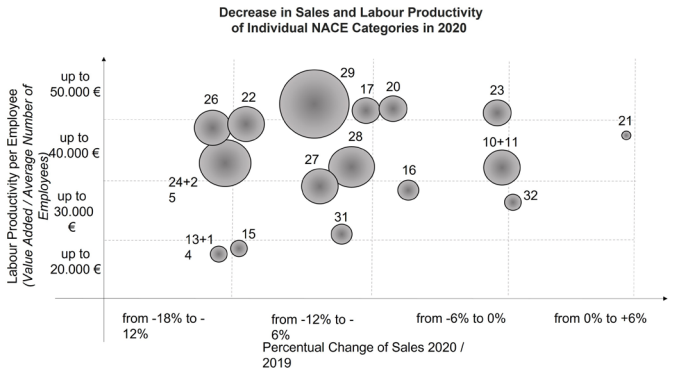

Fig. 4 – Decrease in sales due to the pandemic crisis and labour productivity in Slovak manufacturing enterprises in 2020. Source: own research

The quality management and scale of the use of the QMPs portfolio are also justified in the effort to eliminate economic shocks. An example is the impact of the COVID 19 pandemic. The economic downturn was evident in almost every country and the pandemic has negatively influenced all areas of human life. Figure 4 presents data on the real decline in sales caused by the COVID-19 pandemic crisis in 2020, expressed as a percentage compared to 2019. Manufacturing enterprises are identified by the relevant NACE classification. The size of the ring characterizes the share of the industry's sales within the overall manufacturing industry. At the same time, the industries are classified with respect to the growing value of labour productivity, determined as the ratio value-added/average number of employees. Based on the analysed data from the yearbook of industry 2021, it is possible to confirm that the highest decline in sales with a focus on the level of value-added per employee was recorded in the manufacture of motor vehicles (NACE 29), manufacture of computer products (NACE 26), manufacture of fabricated metal

products (NACE 25) and also in the manufacture of rubber products (NACE 22). Despite the fact that these are mainly industries with higher use of QMPs, the main reason for the decline is the slowdown in production due to pandemic containment measures, which the given practices could not prevent. It will be possible to present this issue more comprehensively, in terms of the possible impact of the use of QMPs on the decline in performance, only after the development of indicators in the next periods. For comparison, the results of the World Manufacturing Report study presented by the United Nations Industrial Development Organization (UNIDO, 2021) are included. UNIDO covers the most recent official data about manufacturing production across the world. The last report shows that production in this sector grew by 2.4 % in the last quarter of 2020 compared to 2019. This annual growth rate confirms that global manufacturing production regained its pre-crisis level during the last quarter of 2020. However, the report also shows how the recovery moves at two speeds. China quickly bounced back, with a year-on-year growth rate of 9.4 percent in the fourth quarter. Other emerging and developing economies have also reached their output levels before the pandemic, although growing at a more subdued pace. Industrialized economies, on the other hand, remain on the negative ground, probably affected by the new wave of coronavirus infections. The impact of the pandemic on the industrial sector was analysed in the work of Dvorský et al. (2021). Abdallah (2021) states, according to the results of his study, that enterprises using a wide scale of quality methods significantly help in achieving pandemic readiness status. He also emphasizes the fact that QMPs help increase business performance.

Some of the findings in this paper are in line with other research studies. According to this research, it can be summarized that the utilization of QMPs is known in theory but not in practice. The authors agree that concepts and approaches to quality are important factors influencing the performance and competitiveness of enterprises. These claims are also confirmed by research studies published by Marcysiak (2021), Liu et al. (2021), Shafiq et al. (2019), Jimoh et al. (2019), which are in line with the conclusions of this study. The results of performed analyses revealed the existence of significant relations between the scale of the use of QMPs and performance measured by Return on Sales. Therefore, the application of QMPs in manufacturing enterprises has been addressed by several authors, including Gambi et al. (2021), Bera & Mukherjee (2018), Agarwal et al. (2013). However, some of them only researched the scale of QMPs in terms of their use in different industries (Garza-Reyes et al., 2015; Attia, 2016; Tarí et al., 2020). The research results presented in this study follow up on previous studies and complement them with a comprehensive view of the utilization of QMPs in the manufacturing sector. Through a scale of approaches, concepts and methods related to quality management, it evaluates their synergistic effect on the consequence factor, which is business performance. The synergistic effect was also confirmed by using a wider scale of QMPs (Wu, 2020; Yanya & Mahamat, 2020). The potential effect of the synergistic effect is given by the assumption of the application of several quality management approaches simultaneously. QMPs are built on the effort of continuous improvement of quality. They offer the effects of cost savings and loss reduction from nonconforming products, but especially a higher level of customer satisfaction to increase competitiveness.

5. CONCLUSION

The aim of the paper was to identify the portfolio of use of available quality management practices in Slovak manufacturing enterprises based on selective factors analysis. The use of statistical tools confirmed the significant contingency between the capital structure of manufacturing enterprises and the scale of use of QMPs, related to the performance measured by the ROS. The causal factor that may affect the different utilization of QMPs was the identified capital structure of enterprises. A higher level of quality management was identified in enterprises with foreign capital structures. There was also determined a higher level of ROS, which was used as a consequence factor. This is also confirmed by the findings that enterprises that used none or only one of the QMPs achieved lower ROS values. These were mostly small and medium-sized enterprises with domestic capital structures. A difference in the use of the QMPs scale within the industries of manufacturing enterprises in Slovakia was also revealed, with the difference factor being not only the capital structure and the size of the enterprise but also the specifics of the industry itself and potentially value-added performance.

The results revealed space for implementing selected approaches, concepts and tools related to quality management in the practice of manufacturing enterprises. Surprisingly, across all industries, there is a particular group of small and medium-sized enterprises with a domestic capital structure, where the implementation of ISO standards 9000 is still absent. The results of the survey also showed that about half of manufacturing enterprises lack the concept of TQM, preventive quality methods as well as some of the basic and additional quality management tools. They include the manufacture of food and beverages, manufacture of electrical equipment, but also other manufacturing sectors. The largest space across all industries (excluding NACE 29) has been identified to implement the Six Sigma method, the process management approach and the Kaizen philosophy. Based on the research results, it is possible to present the following recommendations for the target segment of manufacturing enterprises. There is an increasing need for enterprises to pay attention to available methods, tools and concepts of quality management. In addition to the traditional approaches of ISO standards 9000, basic quality management tools and TQM, the range of QMPs must be supplemented by the implementation of process management approaches, the Six Sigma method and also Kaizen philosophy. These approaches can create the potential to fulfill their strategy and increase competitiveness. The possible future implementation of all the above-mentioned QMPs could improve the quality of production, and process performance, as well as reduce the number of claims and costs for nonconformity products. By expanding the existing scale of QMPs, it is possible to strengthen the overall management system also in terms of crisis readiness, as enterprises face during the current pandemic situation. Quality alone will not solve the problems of the impact of a pandemic in the industrial sector. Still, by its very nature, it can contribute to a higher level of adaptation and anticipation concerning competitiveness and greater management flexibility in times of crisis.

A certain limiting factor of the present research is that the results are obtained by the questionnaire survey in the manufacturing enterprises in one country only. However, the intention was to initiate investigation of current issues in a more comprehensive sense. The presented results could become an information base for comparison with related research studies in the European

business environment. Identifying the causes of the relatively low level of use of QMPs and determining the real benefits of their implementation are becoming the future orientation of research. Future research should include a more extensive comparative survey of selected central European countries to identify the possible dependence of QMPs use on the impact of performance caused by the pandemic.

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