

# Determinants of the implementation of the quality management systems in SMEs

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**Abstract:** The implementation of the quality management systems using quality improvement methods, tools and approaches is considered one of the significant aspects to increase the performance of enterprises in the market environment and growing competition. Most of the authors studied the impact of any of the available quality management tools or philosophies on the performance of enterprises only on a case-by-case basis. The aim of the paper is, however, to examine the effect of implementing a larger scope of tools, approaches or concepts of quality management on the performance of the enterprise more comprehensively from the perspective of their implementation and the assumption of achieving higher enterprise performance. The paper presents the results of the survey, which was carried out from 2020 to 2021. The survey was focused on the implementation of quality management approaches and techniques in small and medium-sized manufacturing enterprises in Slovakia. A total of 313 small and medium-sized manufacturing enterprises were addressed through questionnaires. The representativeness of the sample was tested using the chi-squared goodness-of-fit test. Pearson's chi-squared test and analysis of contingency were implemented to test the established research hypotheses. Through the results of the analyses, it can be claimed that there are significant relationships between the use of quality management approaches and techniques and the performance of enterprises measured through return of costs. At the same time, the most common reasons for implementing quality management approaches were analysed, which confirmed the hypothesis about the reasons for improving product quality and increasing customer satisfaction, which were based on theoretical assumptions verified in practice. The results also show the significant differences between the researched industries, which gives an opportunity for increasing the level of quality in individual segments.

**Keywords:** Quality, quality management system, SMEs, performance, return of costs.

**JEL Classification:** M11, M21.

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## Introduction

Many changes have occurred in the area of quality management in recent years. The reason for these changes is the dynamic development of the economic and political situation. It is about the quality of the enterprises as a whole, which forces enterprises to focus

on establishing quality management systems, which have become a necessary prerequisite for their success.

The current period, which is affected by many rapidly changing factors, is extraordinary challenging for business management. Despite some macroeconomic indicators, such

as increasing inflation, which cannot be eliminated on the corporate level, there are tools that can strengthen the competitiveness and performance of enterprises. According to Sainis et al. (2022), the sustainable way of thinking, planning and acting is getting increasingly integrated into the corporate strategies of an organization, and that is because it has an impact on economic well-being, competition and corporate reputation. Modern organizations make choices that will benefit the planet and society, and lead to economic growth and long-term survival (Osvaldová & Vrabcová, 2021). The use of quality management approaches and techniques is a way how to eliminate the risks associated with business failure. Several studies present that the application of quality management principles leads to the increase of the competitiveness of companies, customer satisfaction and improvement of the quality parameters of products, which ultimately contributes to increasing the performance and efficiency of the company. The aim of the paper is to obtain answers to the following research questions (RQ).

*RQ1: Is it possible to measure the impact of using quality management approaches and techniques through ROC?*

*RQ2: Does the use of quality management approaches and techniques have an impact on the performance of enterprises?*

This is particularly important in the conditions of small and medium-sized enterprises, which, according to Mohammadi et al. (2022), face lack of both the financial and human resources and inadequate technical knowledge of quality management and employee indifference, therefore the intention is to find out whether there are specifics in using quality management approaches and techniques for small and medium-sized enterprises. Several authors point to the importance of quality and its positive effects on the performance of enterprises (Parast & Safari, 2022; Potjanjaruwit, 2021; Rey Sánchez et al., 2022). According to Permana et al. (2021), in the present-day market situation and complex business environment, organization must be able to deliver the customer's requirement and the expectations which are critical to the satisfaction such as high product quality, fast delivery and competitive cost. Quality and the application of quality approaches lead to many positive effects and bring various benefits to enterprises. Several

authors point to the contribution of quality to the competitiveness of organizations (Fonseca et al., 2022; Osvaldová & Vrabcová, 2020; Park & You, 2019; Pinandhita & Latief, 2020).

This paper presents the impact of the use of quality management approaches and techniques on organizational performance measured through Return of Costs and at the same time deals with the main reasons for the implementation and use of quality management approaches in small and medium-sized manufacturing enterprises in Slovakia. In this paper, ISO 9000 standards and TQM philosophy are considered quality management approaches, while quality management techniques are represented by Six Sigma methodology and preventive quality management methods QFD and FMEA. These approaches and techniques have been selected for their intensity of utilization, suitability also for small and medium-sized enterprises and for their complexity. The benefit of this research is not only to point to the impact of quality management on performance in the conditions of small and medium-sized enterprises comprehensively, not only by sector, but also to verify what are the most common reasons for the use and implementation of quality management approaches in these enterprises.

## 1. Theoretical background

According to Alhamd and Yahya (2021), the Total Quality Management, known as TQM, is an integrative organizational-wide management philosophy that is aimed at continuously improving the quality of processes, products and services by focusing on meeting or exceeding customer expectations to enhance customer satisfaction and overall performance of the organization. Total Quality Management is a concept aimed at improving all activities of the organization, which does not adhere to strict standards and procedures, as in the ISO standards of the 9000 series, but prefers informal approaches in the form of creating an environment of responsibility, self-control, improvement and innovation. Total Quality Management (TQM) has been a universally applied management strategy to improve organizational performance and thereby to achieve competitiveness (Babu & Thomas, 2021). It is the most progressive philosophy of modern quality management, where the key criterion is the absolute satisfaction of customers and not only the meeting their requirements. Alawag et al. (2020) states that

Total Quality Management (TQM) practices are well-known to encourage the performance of organizations in terms of procedures, services, and products to meet customers' expectations. In other words, customer satisfaction is reflected in the ability to reduce costs, decrease rejects, increase product quality and improve economic results. The implementation of TQM has been analyzed by Kisel'akova et al. (2020) and Yanya and Mahamat (2020).

Six Sigma Methodology (SSM), initiated by Motorola, is one such methodology used by industries to reduce variability and cost and increase the profitability of the process. SSM will help identify and reduce defects so that the process is standardized (Veena & Prabhushankar, 2020). Six Sigma is a comprehensive management method and is compared to a philosophy that an organization shall adopt. Al-Otaibi (2021) claims that Six Sigma is a process improvement method that aims to discover and eliminate the causes of defects, mistakes, and errors. Six Sigma is a process improvement methodology that focuses on critical processes that result in unacceptable defects to customers. It is focused on ongoing continuous improvement and innovation of the organization by understanding customer needs, using process analysis and standardization of measurement methods. Six Sigma is based entirely on data and results and there is no room for intuition. According to several authors such as Uluskan (2020), Lande et al. (2016) and Antony et al. (2017), Six Sigma emphasizes the financial advantages (reduced production costs and higher profitability) of reducing waste and increasing quality. Yadav et al. (2019) says that innovation in Six Sigma is based on the improvement cycle, which is aimed at looking for weak points, eliminating them and is applied to improve existing processes. The DMADV or DFSS (Design for Six Sigma) methodology is used to design and develop new products or processes.

The ISO 9001 standard specifies the requirements for a quality management system in organizations that want and need to demonstrate their ability to consistently provide products in accordance with relevant regulations and customer requirements, and that strive to increase customer satisfaction. According to Sarb et al. (2019) and Knop (2021), quality management system can be considered "a set of Policies, Procedures, Processes and Resources used to achieve

the organizational objectives and desired results, by managing the interacting processes, required resources and inter-related parts of the business." QMS refers to effective business management and is applicable to all business activities regardless of the scope and subject of the business. The application of a quality management system stimulates organizations to analyze customer requirements, define processes that contribute to the development of a product acceptable to the customer, and keep these processes under control (Su et al., 2020). The basic requirement of the ISO 9001 standard is to establish, document, apply and maintain a quality management system and to continuously improve it (Ribeiro et al., 2019). Several authors (Dahar & Roudies, 2021; Elwardi et al., 2021) dedicated themselves in their studies to the implementation of quality management systems according to ISO 9001.

According to Kirgizov and Kwak (2022), the Quality Function Deployment (QFD) is a systematic method for customer-driven product design. The QFD method is considered an extensive quality planning method. The author of QFD Akao (1994) describes it as follows: "a method for transforming the quality requirements of users into quantitative parameters, deploying quality-forming functions and deploying methods to achieve quality of the design into subsystems and components, and finally to specific elements of the production process." Quality function deployment is an efficient planning and problem-solving method to convert customer requirements into the engineering characteristics of a product or service Liu et al. (2021). The so-called House of Quality, which is based on several tabular expressions for analysis, communication and planning of the creation of a product, expressed in a visual form, is used as a tool for target application of customer desires and requirements into the technical specification. According to Lager (2017), the matrix called the "House of Quality" emerged in an era when the QFD methodology foremost was regarded as a quality tool, but in the light of the findings, one could suggest that this matrix today could more properly be renamed as the "House of Knowledge."

The FMEA method is a basic preventive quality management method. According to Teplická et al. (2021), FMEA is an effective tool for improving all processes in the company. It is based on a team analysis of the occurrence of

failures on the assessed proposal, risk assessment of the proposal and the implementation of preventive measures that will lead to quality improvement. Failure mode and effects analysis (FMEA) is an effective method that is widely used to manage failures and prevent risks, and, thanks to its simplicity and its versatility, the most important and renowned quality norm request it uses (Mzougui & Felsoufi, 2021). The basic goal of the FMEA method is to prevent failures on the monitored object. It is a preventive method that enables early identification of possible malfunctions, errors or non-conformities that may affect system functions or the resulting quality or safety. FMEA method is considered as an important element in the decision-making process.

**2. Research methodology**

The questionnaire was addressed to small and medium-sized Slovak manufacturing enterprises of different industries divided according to NACE Classification (European Industry-standard classification system, section C – Manufacturing). The survey was conducted in the last two years 2020 and 2021 through the platform docs.google.form. The current questionnaire link is as follows: [https://docs.google.com/forms/d/e/1FAIpQLSfp0H8V5dE1f1UTZIF2YjK\\_wDjLTH9IZ8U0qgd-pZd4H6HCIQ/viewform](https://docs.google.com/forms/d/e/1FAIpQLSfp0H8V5dE1f1UTZIF2YjK_wDjLTH9IZ8U0qgd-pZd4H6HCIQ/viewform). The minimum sample size was derived based on the data from the Statistical Office of the Slovak Republic, which registered at that time 2,208 small and medium-sized Slovak manufacturing enterprises.

The minimum sample size was determined following the formula according to Yamane Taro [Richterová et al. (2007)]:

$$n = \frac{N}{1 + N \cdot E^2} \tag{1}$$

With a population size of 2,208 and maximum allowed error 0.05, minimum sample size was quantified to 304 statistical units.

$$n = \frac{2,208}{1 + 2,208 \cdot 0.05^2} = 304 \tag{2}$$

The questionnaire was distributed by individual e-mail contacts to 2,504 Slovak manufacturing enterprises. The representativeness of the sample according to the representation of individual industries in the population was

ensured through stratified sampling (Tab. 1). The return rate of the questionnaires achieved 14.54%. After elimination incorrectly filled out questionnaires, questionnaires from 313 enterprises could be used for the purposes of the research.

Due to categorical level of measurement in the research, all applied tools of descriptive and inferential statistics were concerned with proportions. At the beginning of data processing, the chi-squared goodness-of-fit test was applied to check representativeness of research sample according to the size of enterprises. The Pearson chi-squared test was also used in contingency table analysis to test the relationship between two categorical variables. The chi-squared statistic is based on difference between the observed and expected frequencies – frequencies that would be expected if there was no relationship between the variables (Kohler, 1988). The formula for computing chi-squared with  $k - 1$  degree of freedom, where  $k$  is the number of categories was followed.

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \tag{3}$$

In the case of significant dependence, the strength of the observed relationship was quantified by coefficient of contingency – an index that takes values from the range 0 to 1.

The 95% confidence intervals for a population proportion were constructed by where  $p$  is the sample proportion,  $z$  is the critical value for the selected 95% confidence level, and  $n$  is the sample size (Kohler, 1988).

$$p - z_{\frac{\alpha}{2}} \cdot \sqrt{\frac{p(1-p)}{n}} < \pi < p + z_{\frac{\alpha}{2}} \cdot \sqrt{\frac{p(1-p)}{n}} \tag{4}$$

Statistical analyses were performed using statistical software STATISTICA 12. In hypotheses testing, the 0.05 level of significance as decision rule was applied. In the interval estimates, the 95% confidence was applied. For better readability, the output tables were edited in the MS Excel Office 365 spreadsheet editor.

*H1: Small and medium-sized manufacturing enterprises that apply a wider range of quality management techniques and approaches (QMTA) achieve also a higher level of performance measured by the Return on Costs indicator.*

H2: It is assumed that the theoretical assumptions will be verified in the practice of SMEs, that the main reasons for the implementation of selected approaches in small and medium-sized manufacturing enterprises are the improvement of product quality and the increase of customer satisfaction.

### 3. Research results

Chi-squared goodness of fit test was used to evaluate whether sample data is representative for the entire population concerning the representation of small and medium-sized enterprises. The results of testing are presented in Tab. 1. No evidence about significant difference ( $p = 0.470$ ) was observed.

**Tab. 1: Sample representativeness test according to the size of the enterprises**

Enterprise size	$\chi^2 = 0.52; sv = 1; p = 0.470$			
	Observed (O)	Expected (E)	E - O	$(E - O)^2 / Q$
Small	180	173.65	6.34	0.23
Medium	133	139.34	-6.34	0.28
Total	313	313.00	0.00	0.52

Source: own

**Tab. 2: Interval estimate of quality management techniques and approaches application within manufacturing enterprises for the target population**

Quality management techniques and approaches	Absolute frequency	Sample proportion (%)	95% interval estimate population proportion (%)	
			Lower limit	Upper limit
Are not applied	180	57.51	52	63
Are applied	133	42.49	37	48

Source: own

Within the surveyed enterprises, 42.49% were in favor of use quality management practices. The remaining 57.51% stated that the practices are not used. Based on the given sample proportions, the proportions in the target population were estimated at intervals with 95% confidence (Tab. 2). Less than half of small and medium-sized enterprises in Slovakia – from 37% to 48% apply QMTA.

In the first part of the Tab. 3, observed frequencies of using quality management techniques and approaches TQM, Six Sigma, ISO 9000, and preventive methods are presented. The most used were ISO standards 9000 with observed frequency 92.48%. It was followed by TQM with 39.85% and Six Sigma 21.05%. Frequency in preventive methods was 7.52%. Interval estimates of using given practices in the environment of small and medium-sized Slovak manufacturing enterprises are presented

at the end of the Tab. 3. With 95% confidence, the use of ISO standards 9000 was estimated at interval from 88% to 97%, TQM 32% to 48%, and Six Sigma 14% to 28%. Preventive methods of quality control are used by the population of Slovak small and medium-sized enterprises at the interval from 3% to 12%.

In the context of the first hypothesis, where the dependence between using QMTA and level of ROC was assumed, the observed data were cross-divided into contingency table in the first step (Tab. 4).

At all levels of return on costs proportions for companies applying and not applying QMTA are quite different (Fig. 1). It was subsequently tested whether the observed differences are big enough for significant dependence between two variables.

Based on the testing (Tab. 5), there is sufficient evidence to conclude that the observed

**Tab. 3:** Use of individual quality management techniques and approaches in the population of small and medium-sized Slovak manufacturing enterprises (95% interval estimate)

Quality management techniques and approaches	Point estimate of proportion (%)	Sample size	95% confidence interval (%)	
			Lower limit	Upper limit
Total Quality Management	39.85	133	32	48
Six Sigma method	21.05	133	14	28
ISO standards 9000	92.48	133	88	97
Preventive methods of quality control	7.52	133	3	12

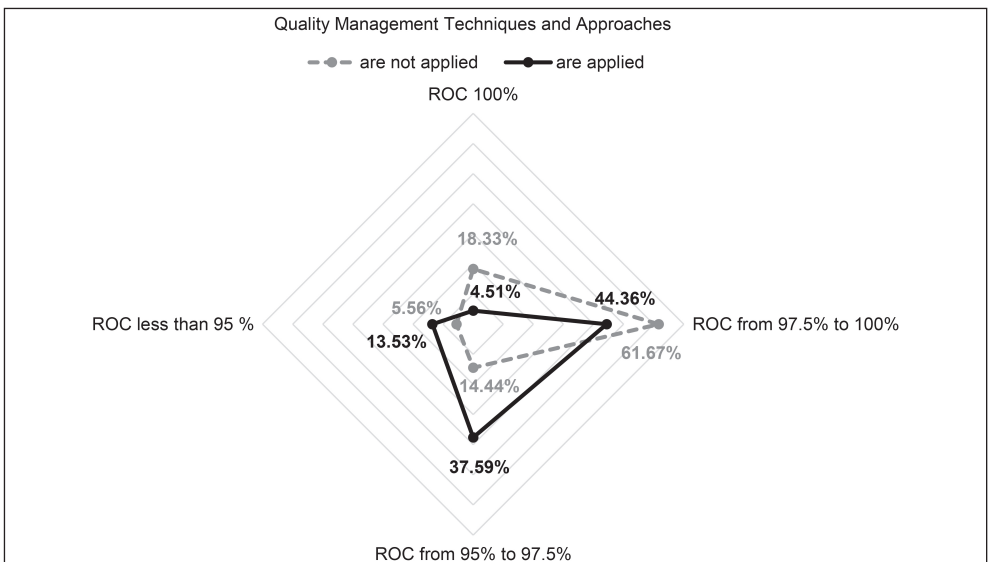
Source: own

**Tab. 4:** Contingency table (combinations of using quality management techniques and approaches and ROC; relative frequencies by rows)

Quality management techniques and approaches	ROC (%)				
	100%	97.5% to 100%	95% to 97.5%	Less than 95%	Total by rows
Is not used	18.33	61.67	14.44	5.56	100
Is used	4.51	44.36	37.59	13.53	100

Source: own

**Fig. 1:** Using of quality management techniques and approaches and the ROC level



Source: own

**Tab. 5: Results of Pearson chi-squared test of contingency**

Using quality management techniques and approaches versus ROC				
Contingency	Chi-squared test	Degree of freedom	p-level	Contingency coefficient
		38.27	3	0.000

Source: own

distribution is not the same as the expected distribution ( $p = 0.000$ ) and significant relationship exists between the categorical variables. The power of dependence between using quality management practices and ROC was determined as moderate based on the contingency coefficient of 0.32.

By looking at the differences between the observed cell counts and the expected cell counts (Tab. 6), it was determined which variable levels have the most impact on dependence.

The largest contribution to the chi-squared statistic was observed in the cell with bold text – enterprises applying QMTA with ROC level 95% to 97.5%.

The second hypothesis focused on the main reasons for applying QMTA. Based on sample proportions, interval estimates of the individual reasons were computed for the target population. The results in Tab. 7 indicate that the decisive reasons for using QMTA in small and medium-sized enterprises are product quality and customer satisfaction. In terms of product quality, 95% interval estimate is from 63% to 78% of Slovak small and medium-sized enterprises. For 46% to 63% of companies, the basis of applying QMTA is customer satisfaction. Noticeable frequencies are also observed in case of competitiveness and customer requirement as a guarantee of quality.

**Tab. 6: Contingency table – residual frequencies**

Quality management techniques and approaches	ROC			
	100%	97.5% to 100%	95% to 97.5%	Less than 95%
Is not used	<b>10.5719</b>	<b>13.2364</b>	-17.7061	-6.10224
Is used	-10.5719	-13.2364	<b>17.7061</b>	6.10224

Source: own

**Tab. 7: Reasons for use quality management techniques and approaches in the population of Slovak manufacturing enterprises (95% interval estimates)**

Reasons for use QMTA	Point estimate of proportion (%)	Sample size	95% confidence interval (%)	
			Lower limit	Upper limit
Improving market position	21.05	133	14	28
Competitiveness	48.87	133	40	57
<b>Product quality</b>	<b>70.68</b>	<b>133</b>	<b>63</b>	<b>78</b>
<b>Customer satisfaction</b>	<b>54.89</b>	<b>133</b>	<b>46</b>	<b>63</b>
Customer requirement as a guarantee of quality	43.61	133	35	52
Participation in tenders	11.28	133	6	17
Positive references	8.27	133	4	13
Getting better orders	16.54	133	10	23

Source: own

## Conclusions

Quality management represents a very dynamic category and in connection with the current development of the society in changing conditions it acquires a new meaning. Modern management of top organizations currently prefers a strategic approach to the quality of all outputs and activities of the organization. The main goal is to achieve maximum customer satisfaction at the optimal cost level, because many enterprises seek to minimize the amount of their costs, however, this procedure reflects in the reduction of the quality level from a certain limit, which would certainly not correspond to the main goal - the customer satisfaction. The strategy of increasing customer satisfaction brings improvement in productivity, efficiency and quality, which brings an increase in competitiveness, that is, the overall success of the organization. To fulfill this goal, the currently built and functioning quality management system is not sufficient and it is necessary to continuously increase quality, efficiency and effectiveness.

The aim of the paper was to analyze the use of quality management approaches and techniques in Slovak small and medium-sized manufacturing enterprises. Through the use of statistical tools, the established hypothesis was confirmed, which assumed that small and medium-sized manufacturing enterprises that use a wider range of quality management techniques and approaches (QMTA) also achieve a higher level of performance measured by the Return on Costs indicator. At the same time, the results show that small and medium-sized manufacturing enterprises most often use ISO 9000 standards and the TQM philosophy, to a lesser extent the Six Sigma methodology, or preventive quality management methods, such as the QFD method, or FMEA. It was confirmed that enterprises that do not apply QMTA achieved lower performance, measured by the ROC indicator.

The results of the research also confirmed the results of research conducted by other authors on the impact of TQM on business performance (Gorondutse, 2021; Olaleye, et al. 2021; Potjanajaruwit, 2021). Similarly, Kriemadis and Sainis (2021) examined the impact of QMS implementation in SMEs, which confirmed their positive impact on the financial performance of enterprises.

The findings show a clear link between sustainability and TQM, which results in the need

for continuous improvement of the organizations and respect for all stakeholders and also highlights TQM and sustainability practices as key factors for organizations to successfully overcome a crisis (Sainis et al., 2022).

In the second part of the paper, the reasons why small and medium-sized enterprises decide to implement quality management approaches and techniques were examined. The establishment of the hypothesis was based on theoretical assumptions that should be verified in the conditions of SMEs. The hypothesis assumed that the main reasons for the implementation of selected approaches in small and medium-sized manufacturing enterprises are the improvement of product quality and the increase of customer satisfaction. The results indicated that the established hypothesis was again confirmed, where the key reasons why enterprises decided to implement quality management were product quality, customer satisfaction, and the third reason was the competitiveness of companies. The authors (Bravi & Murmura 2021; Nenadál et al., 2018) confirm the presented results of this research.

In terms of answers to the research questions, the following can be stated: *RQ1* addressed whether it was possible to measure the impact of using quality management approaches and techniques through ROC. Based on the research, it can be concluded that the use of this indicator is suitable for monitoring the benefits of using QMTA, where the presented results confirm these assumptions. *RQ2* addressed whether the use of QMTA had an impact on business performance. Based on the presented results, it can be concluded that by using management approaches and techniques, manufacturing enterprises achieved a higher level of performance, which confirms the assumption defined in *H1* that the orientation and use of a more comprehensive range of quality management systems have an impact on the performance of enterprises. The future possible implementation of all the above-mentioned QMTAs analysed in this paper would be able to reduce the cost of nonconformity products, increase the quality of production and process performance, and thus contribute to increasing customer satisfaction and better indicators of cost-effectiveness and efficiency of enterprises. By extending the implementation of the existing QMTA range, it is possible to strengthen the level of business management



also concerning their readiness for crisis situations, which are part of the current business environment due to the effects of the energy crisis, high inflation and pandemic risks persisting to a certain extent. Quality itself will not solve the problems that enterprises face with high energy prices, rising inflation, uncertainty and much more difficult predictability in the markets. However, by its very nature, it can contribute to a higher level of adaptation and agility of enterprises with respect to competitiveness and a higher level of management flexibility in times of crisis, as QMTAs offer the potential for cost-saving effects and reduction of losses from non-conformity products. This concept is based on the continual improvement of quality, which results in a higher level of customer satisfaction leading to an increased level of competitiveness. The research contributed to the identification of differences in the use of QMTAs within the individual examined industries, where there is still a group of enterprises within different sectors that rejects the implementation of quality management systems. Therefore, there is still a relatively wide space and potential for more intensive use and implementation of quality management systems. Another contribution was that quality management approaches and techniques were not investigated individually but comprehensively and the results presented can serve as an information base for comparing other research projects within individual countries. The future direction of research could be oriented towards identifying the reasons for the relatively low level of QMTA implementation, especially in small enterprises, but also towards identifying the real benefits that enterprises achieve from their implementation. Future research should also include the extension of the overall research objective to other countries, whether in the restricted context of Europe or worldwide. At the same time, certain research barriers have been identified, which include data collection and especially the reluctance of many manufacturing enterprises to provide information and data necessary for research assessment. There may also be risks in expanding the sample to other countries, where it will certainly be much more difficult to obtain the necessary input data and cooperation with foreign scientific bodies will need to be intensified. On the other hand, by cooperating and extending the research to other countries, it is possible to gain valuable knowledge and

information that can help the development of the Slovak business environment and also raise awareness of the essence and effects of QMTA implementation.

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