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MANAGING QUALITY IN INDUSTRIAL COMPANIES: THE EMPIRICAL STUDY OF QUALITY MANAGEMENT SYSTEMS IN THE CZECH REPUBLIC

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Abstract

Since monitoring, managing, sustaining and improving the quality are is so important to the competitiveness of the company, it is advisable to use a variety of Quality Management tools (QMTs) and techniques, in addition to comprehensive Quality Management Systems (QMSs). The main aim of this research study is to explore the connection between Quality Management System (QMS) and selected Quality Management tools (QMTs) in industrial companies in the Czech Republic. This study summarizes the results of the online questionnaire survey between April 2017 and July 2017. The final sample consisted of answers from 200 companies. It has been found that 46% of surveyed companies monitor and evaluate quality of their business processes. Furthermore, it has been found that 59% of surveyed companies are ISO 9001 certified. Larger companies tend to monitor and evaluate quality of their business processes and to have ISO 9001 certification. The relationships between the use of Quality Management tools (QMTs), monitoring and quality assessment of business processes (MQABP) and ISO 9001 certification have been found based on the Pearson's Chi-square Test of Independence, the Fisher's Exact Test of Independence and the Column Proportions Z-Test.

Keywords: Quality Management, Quality Management Tools, Quality Management System, Industrial Companies, Czech Republic

1. INTRODUCTION

The current globalized market is a very competitive and oversaturated business environment with enormous pressure on process efficiency (Nawanir et al., 2016). Therefore, it is very important for every company not only to achieve, but also to improve performance, success and competitiveness, otherwise their future may

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be compromised (Pribeanu & Toader, 2016). To achieve performance, companies need to identify customer requirements, meet these requirements, and achieve customer satisfaction that has the effect of attracting new customers and retaining existing customers (Aguwa et al., 2012). Ercsey (2017) specifies that companies should strive to retain current customers and meet their requirements because retaining a customer can be cheaper than acquiring a new one. Companies need to meet customer requirements by improving their quality, costs, additional services, production lead times and flexibility (Singh & Singh, 2015). This should improve the company's current and future performance, strengthening and competitiveness (Aguwa et al.,2012).

In general, companies are forced to meet customer requirements better and faster than their competitors (Naumann & Jackson Jr., 1999). However, significant process performance cannot be achieved only through management regulations, skilled workers or highly motivated employees, as such improvements are usually the result of other measures and actions at all levels in the enterprise (Hayes et al., 1993).

One of the customers' requirements is the quality of products and services. Because it affects customer satisfaction, it is one of the most important factors for the customer (Dale et al., 2016). However, customers are not the only ones interested in the quality of products; companies themselves are looking for ways to sustain and improve level of quality (Dale, 2003).

Quality is nothing new, it dates back to ancient Egypt and there are many ways to see and pursue quality, as well as a number of systems for managing and improving quality (Fotopoulos & Psomas, 2009). Currently, companies should use Quality Management Systems (QMSs), ISO standards and certifications, vendor ratings, customer training, sales promotion actions, and linking R&D to customers to meet specific requirements, to achieve and enhance customer satisfaction and improve business performance (Kristianto et al., 2012). Companies that use QMSs focus on improving processes, quality, and delivering better value to customers (Kaynak, 2003). Improvement of product quality leads to increased revenues and reduced costs (Tari et al., 2012).

Since monitoring, managing, sustaining and improving the quality are is so important to the competitiveness of the company, it is advisable to use a variety of Quality Management tools (QMTs), in addition to comprehensive QMSs (Dale et al., 2016). Moreover, based on the ISO 9001 standard requirements, companies should measure, analyse, evaluate and improve their business processes, among other things, in terms of quality, using supportive methodologies and QMTs (Psomas et al., 2011). Put simply, companies should perform monitoring and quality assessment of their business processes (MQABP).

Based on the research of scientific publications, it is possible to state that some researchers have explored the relationships between QMTs and QMSs, especially in relation to ISO 9001 (Tari & Sabater, 2004; Fotopoulos & Psomas, 2009; Psomas et al., 2011; Heras et al., 2011; Ismyrlis & Moschidis, 2013; Ismyrlis, 2017). Drew & Healy (2006) confirmed that the level of use of QMTs was greater in companies with implemented QMS. Lagrosen & Lagrosen (2005) identified correlation between the use of QMTs and functioning QMS among ISO 9001 certified companies, especially with the seven basic QMTs.

However, there is not much empirical research about the use of QMTs in relation to QMS and MQABP in industrial companies. Authors usually focus on a particular industry, narrow groups of QMTs or individual case studies from different companies. The main aim of this research study is to explore the connection between Quality Management System (QMS) and selected QMTs in industrial companies in the Czech Republic.

2. LITERATURE REVIEW

Quality is one of the most important factors for the customer because it affects customer satisfaction. American Society for Quality (2019) define quality as the set of characteristics of a product or service that bear on its ability to satisfy customer needs. The essence of Quality Management (QM) is in managing processes to achieve maximum customer satisfaction at the lowest costs to the organization while continuing to improve the processes (American Society for Quality, 2019). According to American Society for Quality (2019), the QMS is a system that includes documenting the structure, responsibilities and processes to achieve effective QM and creating a controlled way to improve and assure the quality. Shaffie & Shahbazi (2012) found that companies with the QMS are more profitable and growing faster than companies without the QMS.

One possible option is the QMS based on ISO 9001, voluntary QMS standard developed by the International Organization for Standardization (American Society for Quality, 2019). This standard was created for unification and clarification of processes to formally manage quality (Hellman & Liu, 2013). Among other things, ISO 9001 requires monitoring, measuring and analysing business processes. Once a company meets the requirements of this standard, the company gets a certificate. Even though the ISO 9001 standard is not performance standard measuring the quality, but rather a formal standard to systematize business processes, companies may be under pressure from their suppliers and customers to obtain this certificate (Hellman & Liu, 2013). As a result, companies only want to obtain a piece of paper at all costs, because of the benefits of additional business orders, and the very concept of implementing the QMS itself is unimportant (Bacoup et al., 2018). Despite this, there are companies interested in obtaining a certificate to design quality assurance processes and meet customer specifications (Iyer et al., 2013). This standard creates a number of benefits in relation to the customer satisfaction, process efficiency, staff management, documentation and clear knowledge of tasks (Casadesus & Karapetrovic, 2005; Renuka & Venkateshwara, 2006; Magd, 2008; Singh, 2008).

Regardless of the type of the QMS or its basics, there are instruments, tools and techniques that help with monitoring, measuring and analysing business processes in terms of quality (Fotopoulos & Psomas, 2009; Christensen et al., 2013). Generally, these QMTs are means for the appropriate implementation of the QMS in the companies, because QMTs enable improvements and positive changes in companies (McQuater et al., 1995). Ahmed & Hassan (2003) stated that QMS could not be ensured without the application of QMTs.

According to Curry & Kadasah (2002), Bamford & Greatbanks (2005) and Naser (2007), QMTs can be divided into simple/basic tools (e.g. Cause & Effect

Diagram, Histogram, Pareto Chart) and more complex, advanced and sophisticated techniques (e.g. Process Capability Analysis, Quality Function Deployment, Statistical Process Control). The basic QMTs primarily include these seven basic QMTs: Cause & Effect diagram, Checksheet, Control chart, Histogram, Pareto chart, Scatter diagram and Stratification (Ishikawa, 1985). These original seven basic QMTs are simple, easy to learn and widely used, and also called as old, quality tools or quality control tools (Kang & Park, 2000; Sokovic et al., 2009). In addition to the seven basic QMTs, there are the new seven QMTs in this group of QMTs: Affinity diagram, Arrow diagram, Matrix data analysis, Matrix diagram, Process decision programme chart, Relations diagram and Tree systematic diagram (Dale & McQuater, 1998; Terziovski & Sohal, 2000; Siva et al., 2016).

Ahmed & Hassan (2003) discovered that the basic QMTs were the most frequently used and the advanced QMTs were not so popular. Sousa et al. (2005) found that the most frequently used QMTs were the easiest to understand and implement. Psomas et al. (2011) agree with this. Often, individual QMTs are used separately on a case-by-case basis, but relationships and links between them are very important for successful and effective application (Kwok & Rao Tummala, 1998). When solving an easy quality problem in companies, it is possible to use individual QMTs to identify, analyse and solve the problem, but in the case of complex problems, it is appropriate to combine individual QMTs with one another or use complex QMTs (Christensen et al., 2013).

A number of researches confirm the use of QMTs in different countries, situations, companies and industries, such as Vietnamese banking sector (Ngo & Nguyen, 2016), everyday situations (Bamford & Greatbanks, 2005), global brewing industry (Vrellas & Tsiotras, 2015), Greek industry (Vouzas, 2004), Korean education (Mehra & Rhee, 2009), plastic injection moulding (Adams & Dale, 2001), Polish manufacturing (Starzynska, 2014), Turkish manufacturing (Bayazit, 2003) or water supply infrastructure maintenance (Silombela et al., 2018). Ahmed & Hassan (2003) recommended the use of QMTs to any company because of its benefits.

Singh et al. (2009) have explored relationships between QM and business performance. Sedlacek et al. (2011) studied relationship between quality and performance in tourism sector. Rehor et al. (2014) focused on usage of QM instruments in Czech municipalities. Kovarova (2016) examined measures, problems and competitive advantages of implementing the QMS. Kozel et al. (2017) analysed trends of implementation of the QMS based on the ISO 9001 standard. Ondra et al. (2018) examined the use of selected QMTs in industrial companies and the dependence of QMTs on industrial specialization and type of production.

3. METHODOLOGY

The main aim of this research study is to explore the connection between QMS and selected QMTs in industrial companies in the Czech Republic. Based on the stated main aim, the following research questions (RQs) were defined:

RQ1: How many industrial companies in the Czech Republic monitor and evaluate quality of their processes?

RQ2: How many industrial companies in

the Czech Republic have ISO 9001 certification?

RQ3: Does the extent of use of selected QMTs differ between companies with and without MQABP?

RQ4: Does the extent of use of selected QMTs differ between ISO 9001 certified companies and companies without ISO 9001 certification?

RQ5: Does the extent of MQABP differ between ISO 9001 certified companies and companies without ISO 9001 certification?

In order to answer the above-mentioned research questions and to achieve the main aim, a research project was carried out in the Czech Republic. To obtain the necessary data about industrial companies in the Czech Republic, the research team used a questionnaire survey. Based on the closed questions from the field of quality, a structured questionnaire was created online using Google Forms and distributed by e-mail, between April 2017 and July 2017. The aim was to reach companies from various sectors, from all regions of the Czech Republic, of various sizes and different ages. Within the addressed companies, the researchers focused on interviewing quality managers, industrial engineers and process improvement managers. After few rounds, totally 252 responses were collected, which is approximately 5% of the contacted companies. Obtained data were automatically converted from Google Forms to MS Excel. Exactly 52 companies with a different primarily focus were excluded from the collected data. The final sample dataset consisted of answers from 200 companies with different specializations: mining and processing of materials (33.0%), production of machinery (32.5%), production of chemical products (13.0%), production of electrical components (12.0%) and agricultural and food production (9.5%). Micro (14.0%), small (29.5%), medium (32.0%) and large (24.5%) companies were represented in the research sample. The research sample consisted only of joint stock companies (21%) and limited companies (79%). Sample companies have been on the market for more than 20 years (50.5%), from 11 to 20 years (26.5%) and up to 10 years (23%). These are production companies with primary representation of mass production (20.5%), series production (39.5%) and piece production (40%).

Consequently, adequate statistical techniques were used to analyse the data from the final data set. Basic descriptive statistics were processed in MS Excel. Statistical data analysis was performed through SPSS 23. The Pearson's Chi-square Test of Independence and the Fisher's Exact Test of Independence were conducted to explore the relationships between QMTs and QMS using ISO 9001. For the purpose of completing these tests and pointing out the dependence influencing factors, the cross tables with Column Proportions Z-Tests were conducted. The Fisher's Exact Test of Independence is used primarily in cases where the Pearson's Chi-square Test of Independence could not be used due to low expected counts in two-by-two tables. For the purpose of failing to reject or rejecting the null hypothesis, significance level is set to $\alpha = 0.05$.

The research was focused on the use of selected QMTs. The complete list of all QMTs is quite extensive (Bicheno & Catherwood, 2005; Ismyrlis & Moschidis, 2013). The most frequently used and appropriate QMTs for the QMS were selected. The full list of QMTs that were examined was as follows: Cause & Effect Diagram (C&E Diagram), Affinity Diagram,

Arrow Diagram, Control Chart, EFQM Excellence Model, Histogram, Checksheet, Matrix Diagram, Matrix Data Analysis, Pareto Chart, PDPC Diagram, Process Capability Analysis (PCA), Quality Function Deployment (QFD), Quality Circles, Relations Diagram, Six Sigma, Scatter Diagram, Statistical Process Control (SPC), Stratification, Total Quality Management (TQM) and Tree Diagram.

4. RESULTS AND DISCUSSION

4.1. Monitoring and Quality Assessment of Processes among Industrial Companies

On the sample of examined companies, it was found that 46% of the industrial companies monitor and evaluate quality of their business processes. This answers the first RQ (*RQ1: How many industrial companies in the Czech Republic monitor and evaluate quality of their processes?*). However, this does not mean that 54% of industrial companies do not perform quality controls of their products. The findings only show that these companies do not monitor and evaluate quality across all their processes. In addition, most companies (54%) that do not monitor and evaluate quality of their business processes are small enterprises of up to 50 employees. In the case of companies that monitor and evaluate quality of their business processes, their share is only 34%. The results show that MQABP is more likely in larger companies.

4.2. ISO 9001 Certification among Industrial Companies

Research shows that 59% of the industrial companies in the Czech Republic are ISO 9001 certified, thus answering the second RQ (*RQ2: How many industrial companies in the Czech Republic have ISO 9001 certification?*). Companies perceive this certification as an advantage for getting orders. Thus, in the absence of a certificate, this may be a disadvantage as customers are interested in ISO 9001 certification. Therefore, the share of ISO 9001 certified companies could be much higher. However, it is obvious that the size of the company plays a role here and larger companies tend to have ISO certification. Small enterprises (up to 50 employees) are only around 30% certified, while non-certified small enterprises are more than double (67%).

4.3. Relationships between Selected QMTs and MQABP

In order to answer the third RQ (*RQ3: Does the extent of use of selected QMTs differ between companies with and without MQABP?*), the statistical tests of independence between used QMTs and MQABP were conducted. Based on the nature of the input data set and the expected values, the Pearson's Chi-square Test of Independence and the Fisher's Exact Test of Independence were used and statistical hypotheses were defined:

H0 hypothesis: There is no statistically significant relationship between used QMTs and MQABP.

H1 hypothesis: There is a statistically significant relationship between used QMTs and MQABP.

Based on the p-value of statistical tests,

the study rejected or failed to reject the null hypothesis, at the significance level $\alpha = 0.05$. The results of statistical tests are shown in Table 1.

Based on the research, it can be concluded that there is a statistically significant relationship between the use of C&E Diagram, Matrix Data Analysis, Matrix Diagram, Pareto Chart, PCA, QFD, SPC, TQM, Tree Diagram, and MQABP. The use of these QMTs is dependent on whether or not the company performs MQABP. In order to determine the cause of dependence between variables, the residual values are calculated in Table 2.

According to calculated residual values in Table 2, all residues are positive in case of all dependent QMTs in companies with MQABP. This means that these QMTs are typically used in this type of company. Such results may be surprising, because all the QMTs would be useful for all types of companies. However, these tools are more likely to be used more in companies that monitor and evaluate quality of processes than in companies that do not.

4.4. Relationships between Selected QMTs and ISO 9001 certification

In order to answer the fourth RQ (*RQ4: Does the extent of use of selected QMTs differ between ISO 9001 certified companies and companies without ISO 9001 certification?*), the statistical tests of independence between used QMTs and ISO 9001 certification were conducted. Based on the nature of the input data file and the expected values, the Pearson's Chi-square Test of Independence and the Fisher's Exact Test of Independence were used and statistical hypotheses were defined:

Table 1. Tests of Independence between QMTs and MQABP

QMTs	Pearson's Chi-square	Pearson's Chi-square p-value	Fisher's Exact Test p-value	Test result
Affinity Diagram	-	-	1.00000	Fail to reject H0
Arrow Diagram	-	-	0.14626	Fail to reject H0
C&E Diagram	10.063	0.00151	-	Reject H0
Check Sheet	0.737	0.39055	-	Fail to reject H0
Control Chart	-	-	0.06188	Fail to reject H0
Histogram	1.811	0.17835	-	Fail to reject H0
Matrix Data Analysis	-	-	0.00599	Reject H0
Matrix Diagram	-	-	0.02445	Reject H0
Pareto Chart	16.671	0.00004	-	Reject H0
PDPC Diagram	-	-	0.09417	Fail to reject H0
PCA	-	-	0.00021	Reject H0
QFD	5.128	0.02354	-	Reject H0
Quality Circles	-	-	0.26054	Fail to reject H0
Relations Diagram	-	-	0.66096	Fail to reject H0
Scatter Diagram	-	-	0.19356	Fail to reject H0
Six Sigma	-	-	0.12708	Fail to reject H0
SPC	10.063	0.00151	-	Reject H0
Stratification	-	-	0.06711	Fail to reject H0
TQM	5.827	0.01578	-	Reject H0
Tree Diagram	4.765	0.02904	-	Reject H0

Table 2. Causes of Dependence between QMTs and MQABP

QMTs	Companies monitor and evaluate quality of processes and use QMTs		Companies do not monitor and evaluate quality of processes but use QMTs	
	Residual	Residual (%)	Residual	Residual (%)
C&E Diagram	6.990	69.830	-6.990	-58.299
Matrix Data Analysis	4.450	97.802	-4.450	-81.651
Matrix Diagram	3.360	92.308	-3.360	-77.064
Pareto Chart	11.165	66.320	-11.165	-55.368
PCA	7.265	93.924	-7.265	-78.413
QFD	4.990	49.850	-4.990	-41.618
SPC	6.990	69.830	-6.990	-58.299
TQM	6.800	37.363	-6.800	-31.193
Tree Diagram	5.170	43.702	-5.170	-36.486

H0 hypothesis: There is no statistically significant relationship between used QMTs and ISO 9001 certification.

H1 hypothesis: There is a statistically significant relationship between used QMTs and ISO 9001 certification.

Based on the p-value of statistical tests, the study rejected or failed to reject the null hypothesis, at the significance level $\alpha = 0.05$. The results of statistical tests are shown in Table 3.

According to Table 3, it can be concluded that there is a statistically significant relationship between the use of Arrow Diagram, C&E Diagram, Check Sheet, Matrix Data Analysis, Pareto Chart, Quality Circles, Six Sigma, TQM, and ISO 9001 certification. The use of these QMTs is dependent on whether or not the company has ISO 9001 certification. In order to determine the cause of dependence between variables, the residual values are calculated in Table 4.

Based on the calculated residual values in Table 4, all residues are positive in case of all dependent QMTs in companies with ISO 9001 certification. This means that these QMTs are typically used in this type of company. Such results may be surprising, because all the QMTs would be useful for all types of companies. However, these tools are more likely to be used more in companies with ISO 9001 certification than in companies without this certification.

4.5. Relationship between quality assessment of processes and ISO 9001 certification

In order to answer the fifth RQ (*RQ5: Does the extent of MQABP differ between ISO 9001 certified companies and companies without ISO 9001 certification?*), the statistical test of independence between MQABP and ISO 9001 certification was conducted. Based on the nature of the input data file and the expected values, the Pearson's Chi-square Test of Independence was used and statistical hypotheses were defined:

H0 hypothesis: There is no statistically significant relationship between MQABP and ISO 9001 certification.

H1 hypothesis: There is a statistically significant relationship between MQABP and ISO 9001 certification.

Based on the p-value of the Pearson's Chi-square Test of Independence (p-value = 0.00002), the study rejected the null hypothesis, at the significance level $\alpha = 0.05$. According to the test, it can be stated that there is a statistically significant relationship

Table 3. Tests of Independence between QMTs and ISO 9001 Certification

QMTs	Pearson's Chi-square	Pearson's Chi-square p-value	Fisher's Exact Test p-value	Test result
Affinity Diagram	-	-	0.27344	Fail to reject H0
Arrow Diagram	-	-	0.02964	Reject H0
C&E Diagram	-	-	0.00104	Reject H0
Control Chart	-	-	0.63940	Fail to reject H0
Histogram	-	-	0.12243	Fail to reject H0
Check Sheet	8.050	0.00455	-	Reject H0
Matrix Data Analysis	-	-	0.00621	Reject H0
Matrix Diagram	-	-	0.14603	Fail to reject H0
Pareto Chart	11.110	0.00086	-	Reject H0
PCA	-	-	0.44111	Fail to reject H0
PDPC	-	-	1.00000	Fail to reject H0
QFD	-	-	0.10560	Fail to reject H0
Quality Circles	-	-	0.01647	Reject H0
Relations Diagram	-	-	0.08213	Fail to reject H0
Scatter Diagram	-	-	1.00000	Fail to reject H0
Six Sigma	-	-	0.00159	Reject H0
SPC	-	-	0.49155	Fail to reject H0
Stratification	-	-	0.43734	Fail to reject H0
TQM	22.596	0.00000	-	Reject H0
Tree Diagram	1.174	0.27852	-	Fail to reject H0

Table 4. Causes of Dependence between QMTs and ISO 9001 Certification

	ISO 9001 certified companies use QMTs		ISO 9001 uncertified companies use QMTs	
QMTs	Residual	Residual (%)	Residual	Residual (%)
Arrow Diagram	3.860	54.062	-3.860	-79.424
C&E Diagram	6.910	52.788	-6.910	-77.553
Check Sheet	8.225	30.719	-8.225	-45.130
Matrix Data Analysis	4.050	68.067	-4.050	-100.000
Pareto Chart	8.985	40.813	-8.985	-59.960
Quality Circles	4.265	55.139	-4.265	-81.007
Six Sigma	5.885	58.181	-5.885	-85.476
TQM	13.200	55.462	-13.200	-81.481

between MQABP and ISO 9001 certification. The state of MQABP is dependent on whether or not the company has ISO 9001 certification. In order to determine the cause of dependence between variables, the residual values are calculated in Table 5.

Based on the calculated residual values in Table 5, it can be concluded that in ISO 9001 certified companies the quality of processes will be more likely to be monitored and evaluated; as well as that in companies without this certification, the quality of processes will be monitored and evaluated less likely. Therefore, it can be stated that ISO 9001 certified companies tend to monitor and evaluate the quality of processes, whereas companies without this certification do not show this activity. These results are not surprising as it is stated in ISO 9001 that companies should monitor and evaluate the quality of their processes.

Table 5. Causes of Dependence between MQABP and ISO 9001 Certification

	ISO 9001 certified companies		ISO 9001 uncertified companies	
	Residual	**Residual (%)**	**Residual**	**Residual (%)**
Companies monitor and evaluate quality of processes	14.855	27.436	-14.855	-40.307
Companies do not monitor and evaluate quality of processes	-14.855	-22.905	14.855	33.650

5. CONCLUSION

The main aim of this research study is to explore the interconnection between the QMS using ISO 9001 and the use of selected QMTs in industrial companies in the Czech Republic. According to the obtained data and the results, several conclusions can be drawn with regard to research questions.

It has been found that 46% of the industrial companies in the Czech Republic monitor and evaluate quality of their business processes. The results show that MQABP is more likely in larger companies. This is not a big surprise, because in larger companies there is often a greater emphasis on MQABP, both realistically and formally, mainly by supervisors, customers, industry standards or management interests. Similar conclusions were found in the case of ISO 9001 certification. The results show that larger companies tend to have ISO 9001 certification more likely than small enterprises. And even when companies perceive ISO 9001 certification as a business advantage, only 59% of the industrial companies in the Czech Republic have this certification.

Research further revealed the relationships between the use of QMTs, MQABP and ISO 9001 certification based on the Pearson's Chi-square Test of Independence, the Fisher's Exact Test of Independence and the Column Proportions Z-Test. According to statistical tests, it can be concluded that C&E Diagram, Matrix Data Analysis, Matrix Diagram, Pareto Chart, PCA, QFD, SPC, TQM and Tree Diagram are more likely to be used in companies that monitor and evaluate quality of processes than in companies that do not. Based on the conducted research, it can be stated that Arrow Diagram, C&E Diagram, Check Sheet, Matrix Data Analysis, Pareto Chart, Quality Circles, Six Sigma and TQM are more likely to be used in companies with ISO 9001 certification than in companies without this certification. Furthermore, it can be concluded that there is a statistically significant relationship between MQABP and ISO 9001 certification. In other words, the ISO 9001 certified companies tend to perform MQABP more likely, whereas companies without ISO 9001 certification do not show this activity.

The research study recommends to industrial companies in different industries of the Czech Republic, to focus on implementation of QMSs using ISO 9001, especially the real side of it, not just the formal one and to use QMTs in case of monitoring, managing, sustaining and improving the quality of business processes. By using QMTs and implementing QMS, the company can achieve a higher business and process performance, higher quality of products, better customer satisfaction and competitiveness. This research has been

processed with the limitation in research sample of 200 industrial companies. Another way of classification parameters for evaluation will be considered in further research.

In the research study, there are some limitations, but they give impulses and create the ground for future research. The study is based on data obtained from the online questionnaire survey and therefore the subjectivity of data from managers or representatives of the companies (because of perception) cannot be excluded. Thus, there is a risk of obtaining biased answers. In the case of further research and research studies, it would be appropriate to obtain objective data directly from the information systems and internal documentation of selected companies. Another limitation is the research sample itself, which is limited to industrial companies of different sizes and specializations. The question is then the significance of latent factors such as company's size, age, geographical location and industry specialization. It would be appropriate to extend the variables into more latent factors and take them into consideration in order to detect any statistically significant differences. Another suitable option for a future study would be to focus on manufacturing or business performance with respect to QMS and QMTs and how each tool affects that performance.

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УПРАВЉАЊЕ КВАЛИТЕТОМ У ИНДУСТРИЈСКИМ ПРЕДУЗЕЋИМА: ЕМПИРИЈСКА СТУДИЈА СИСТЕМА УПРАВЉАЊА КВАЛИТЕТОМ У ЧЕШКОЈ

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Извод

Будући да су контрола, управљање, одржавање и побољшање квалитета толико важни за конкурентност компаније, препоручљиво је користити низ алата и техника управљања квалитетом (QMTs), поред свеобухватних система управљања квалитетом (QMSs). Главни циљ ове истраживачке студије је да истражи везу између система управљања квалитетом (QMS) и одабраних алата за управљање квалитетом (QMTs) у индустријским компанијама у Чешкој. Ова студија сумира резултате анкете путем онлајн упитника између априла 2017. и јула 2017. Коначни узорак састојао се од одговора 200 компанија. Утврђено је да 46% анкетираних компанија прати и процењује квалитет својих пословних процеса. Поред тога, утврђено је да 59% анкетираних компанија има сертификат ISO 9001. Веће компаније имају тенденцију да прате и процењују квалитет својих пословних процеса и да имају ISO 9001 сертификат. Односи између употребе алата за управљање квалитетом (QMTs), праћења и процене квалитета пословних процеса (MQABP) и ISO 9001 сертификата пронађени су на основу Пеарсоновог теста хи-квадрат независности, Фишеровог теста независности и колоне Пропорције Z-тест.

Кључне речи: управљање квалитетом, алати за управљање квалитетом, систем управљања квалитетом, индустријске компаније, Чешка

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QUESTIONNAIRE

1. In which industry does your company operate?
    a. Mining and processing of materials
    b. Production of machinery
    c. Production of chemical products
    d. Production of electrical components
    e. Agricultural and food production
2. What is the legal form of your business?
    a. Joint-stock company
    b. Limited company
3. How long (in years) does your company operate on the market?
    a. Up to 10 years
    b. 11 - 20 years
    c. Over 20 years
4. What is the approximate number of employees in your company?
    a. Less than 10
    b. 11 to 50
    c. 51 to 250
    d. 251 to 500
    e. More than 500
5. What type of production predominates in your company?
    a. Mass production
    b. Piece production
    c. Serial production
6. What is the approximate annual turnover of your company?
    a. Up to € 2 million
    b. € 2 to 10 million
    c. € 10 to 50 million
    d. Over € 50 million
7. Does your company monitor and evaluate quality of processes?
    a. Our company monitor and evaluate quality of processes
    b. Our company do not monitor and evaluate quality of processes
8. Does your company have ISO 9001 certification?
    a. Our company has ISO 9001 certification
    b. Our company does not have ISO 9001 certification
9. Which of the Quality Management Tools do you use in your company?
    a. Cause & Effect Diagram (C&E Diagram)
    b. Affinity Diagram
    c. Arrow Diagram
    d. Control Chart
    e. EFQM Excellence Model
    f. Histogram, Checksheet
    g. Matrix Diagram
    h. Matrix Data Analysis
    i. Pareto Chart
    j. PDPC Diagram
    k. Process Capability Analysis (PCA)
    l. Quality Function Deployment (QFD)
    m. Quality Circles
    n. Relations Diagram
    o. Six Sigma, Scatter Diagram
    p. Statistical Process Control (SPC)
    q. Stratification
    r. Total Quality Management (TQM)
    s. Tree Diagram