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Changing role of standard management systems in the Covid-19 crisis

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1 Introduction

Standard management systems, including the ISO 9001 standard, which contains the requirements for quality management systems, are an important part of the everyday life of competitive organizations, whether it is about product production or the quality of service provision. The Covid-19 crisis has had a significant impact on the operation of quality management systems. However, the importance of standard quality management systems in the Covid-19 crisis situation according to the quality management principles and at the level of standard requirements specified in the standard has not yet been examined in this form. Examining the systems from the perspective of the importance of quality management principles and standard requirements, the results contribute to organizations responding more effectively to such and similar crisis situations in the future.

The research topic and its importance

The topic of my research is the change in the role of standard management systems, including quality management systems, in corporate operations during the Covid19 crisis. The Covid19 crisis that began at the end of 2019, as well as the entire society, had a significant impact on the everyday life of companies. The epidemic reached Hungary in March 2020, as a result of which Government Decree 41/2020. (III. 11.) on the ordered emergency measures was published in the Hungarian Gazette on March 11, 2020 (Poór et al., 2021). The Covid-19 crisis has dramatically changed the political and economic environment (Winston, 2020; Verma & Gustafsson, 2020), had a strong impact on the global economy, national economies, large corporations, and small and medium-sized enterprises (Castro & Zermeño, 2020; Gregurec et al., 2021), presenting all sectors with unprecedented challenges (Bacq et al., 2020; Singh, 2020). The Covid-19 crisis has had a strong, negative impact on, for example, production chains, transport and logistics performance, and an unprecedented imbalance in the trade of goods and services (Hammad et al., 2021; Akat & Karataş, 2020; Kuckertz et al., 2020). In this dissertation, I focus on the effects of the Covid-19 crisis at the company level. In the standard, Covid-19 refers to an infectious disease caused by a novel coronavirus, SARS-CoV-2, discovered in 2019. The standard refers to the worldwide spread of the disease during the pandemic. In my research, I examine how the principles and standard requirements of quality management systems have helped companies in the Covid-19 crisis. The

dissertation belongs to the main stream of research on crisis situations that deals with organizational responses applicable in such situations (Doern, 2016; Doern et al., 2019; Castro & Zermeño, 2020), highlighting corporate activities related to rapid response, reorganization, risk management, and, where necessary, process re-thinking and rethinking (Bullough et al., 2014; Korber & McNaughton, 2018; Larsson et al., 2016; Apostolopoulos et al., 2018; Weaven et al., 2021; Pirohov and Tóth, 2022). The main impacts of the Covid-19 crisis on businesses have been: reduced labour supply, labour shortages, limited availability of contractors or temporary workers, reduced or cancelled customer orders, disruption of the supply chain of raw materials or finished products, changes in demand patterns, reduced availability of services such as urgent healthcare or home care services, and even service disruptions (telecommunications, financial-banking) (CCOHS, 2020). According to Sawalha (2020), it is advisable to review the lessons of past events and understand how they can be adapted to new situations so that the organization can benefit from them and mitigate future impacts. Standard management systems contribute to adapting to crisis situations, rethinking processes and operating appropriate risk management mechanisms at the organizational level. As Faragó (2021) puts it, various standard management systems can help in overcoming crisis situations. To support this, the requirements of the standards include, among others, the requirement to prepare for and respond to emergencies, which requires companies to take stock of the risks affecting the organization's operations and manage them. Risk-based thinking appeared as a new requirement in the current ISO 9001 standard, thus helping organizations manage their risks and opportunities in their everyday lives. Additional requirements include the identification of hazards and the management of events (incidents), non-conformities and corrective actions. According to Singh (2020), the use of ISO standard systems can prevent a crisis situation similar to Covid-19 from causing unmanageable conditions in corporate operations. This can be achieved, among other things, by applying the following activities in a regulated manner when operating standard management systems: 1) monitoring, 2) measurement, analysis and performance evaluation, 3) development, 4) change management and 5) regulation of implementation.

According to West (2000), the application of quality management principles contributes to the development of quality management systems, but the author did not examine in detail the relationship between the principles. Although Biå et al. (2020) generally present the main standard chapters of the standard quality management system in relation to Covid-19 crisis management, the examination does not reach the level of standard requirements. In addition to quality

management systems, the use of other standard systems can also help companies respond effectively to a crisis situation. The aim of the occupational health and safety management system standard is to reduce risks, improve employee safety and create better working conditions, supporting organizations in preventing the spread of the new virus (Biã et al., 2020; Faragó, 2021). In connection with this, standard setters have also recognized the importance of occupational health and safety requirements in management systems during the Covid-19 crisis, which is why the ISO/PAS 45005:2020 standard belonging to the standard family was issued, which sets out general guidelines for safe working during the Covid-19 crisis. The international standard for risk management systems provides guidance for identifying and managing risks to an organization (Lucero, 2023). It can therefore be said that standard management systems have played an important role in managing the Covid-19 crisis. Quality management systems prepare organizations for better Covid-19 crisis management (UNIDO, 2020). Beyond these findings and the references, listings and general presentation of the standard on integrated management systems (Biã et al., 2020), the literature hardly provides examples of compliance with individual standard requirements in the Covid-19 crisis. The principles of the quality management system, on which the ISO 9001 quality management system is based, have also not been examined for their relevance in the Covid-19 crisis. At the same time, Luburić (2015) states that failure to comply with any of these principles and requirements endangers the entire management system, and explains that quality management principles also help prevent crisis situations. Based on all of this, in my opinion, it is important to examine the quality management principles and quality management standard requirements in the Covid-19 crisis so that organizations can thoroughly prepare for such and similar crises in the future with the help of their management systems.

Standard management systems are operated in a corporate environment and are designed taking into account corporate characteristics. For example, the operation of quality management systems is closely related to corporate characteristics, such as the size, industry, operational complexity and market environment of the company, as these characteristics are related to quality management processes and control mechanisms. Several studies on the topic establish that quality management is closely related to corporate characteristics (Kaynak, 2003; Parast et al., 2011), including the financial performance of the company. However, Singh (2020) highlights that although quality management systems can be operated in any organization regardless of size and scope of activity,

the priorities and the effects on organizational operations may differ depending on the field in which the organization operates. Therefore, my research questions based on the above are the following:

Research Questions

Q1: How has the importance of quality management principles and their relationship to each other changed for companies during the Covid-19 crisis?

Q2: How has the importance of quality management standard requirements and their relationship to each other changed for companies during the Covid-19 crisis?

Q3: Is there a difference between the change in the importance of quality management standard requirements and the change in the financial performance of companies during the Covid-19 crisis?

Q4: Is there a difference in the company characteristics of organizations that operate a standard management system compared to those that do not?

The objective of the research is to examine quality management systems from the perspective of which quality management principles and which quality management standard requirements have changed in the significance of organizations operating quality management systems during the Covid19 crisis. The Covid19 crisis is the global pandemic caused by the SARS-CoV-2 coronavirus discovered in 2019, which was an extreme, unexpected, unforeseen event to which organizations had to respond. The research covers the period from March 2020 to December 2021 during Covid19, and I examined the change in the significance of quality management principles and quality management standard requirements in relation to this period.

The quality management principles provide a framework for organizations, summarizing the basic rules for the management and operation of organizations, focusing on the operation of an effective quality management system. A standard requirement is a stated, usually self-evident or mandatory need or expectation. In the case of standard requirements, I examine not only the main chapters of the standard as requirements, but also the second-level standard requirements. Thus, a total of forty standard requirements are examined, thus helping the practical use of the results on a wider scale. In my research, I also examine how closely these quality management principles and quality management standard requirements are related to each other in relation to the Covid19 crisis. My aim is also to study whether there is a relationship between the change in the importance of quality

management standard requirements and the change in the financial performance of companies during the period under review. By financial performance I mean the value of all products, materials, goods and services sold, together with the purchase value of goods purchased and sold in unchanged form and the value of services provided. My research goals also include exploring the relationship between the operation of the quality management system and the corporate characteristics of organizations. Corporate characteristics are important factors (organizational form, financial performance, economic sector, ownership form and number of employees) that determine the basic operation of the company.

The relevance of the research topic is that, in domestic and international terms, the change in the significance of certain quality management principles and quality management standard requirements in the Covid-19 crisis has not yet been examined from this approach. In my opinion, the everyday life of organizations operating a standard management system is still affected by the changed circumstances due to the Covid-19 crisis. By reviewing and rethinking the processes, and knowing the significance of certain standard requirements for a standard management system, organizations will be able to respond more easily to similar crisis situations in the future.

1.1 Expected results of the research

The theoretical significance of the research is that it provides an approach for standard-setting organizations that demonstrates the change in the significance of certain quality management principles and certain quality management standard requirements in the Covid-19 crisis, and on which standard-setting organizations can rely in the future when issuing new standards. Its practical importance is due to the fact that, based on the results of the research, a useful guide is being prepared for the profession (certifiers, consultants, quality management specialists) and companies regarding the changed significance of quality management principles and standard requirements in the Covid-19 crisis, which will help various stakeholders in the future in managing similar crisis situations, for example, which quality management principles and standard requirements organizations should focus on in particular when operating their systems. Furthermore, I set the goal of implementing dissemination activities and preparing educational materials on the research topic, thus contributing to professional, educationally focused development. The results of the research will be incorporated into the subjects of Quality Management, Quality Assurance,

Conformity Assessment and Certification, Corporate Internal Auditor, ESG Consultant and Occupational Health and Safety at the University of Pannonia.

2 Literature summary

According to West (2000), knowledge of quality management principles contributes to the development of quality management systems. According to Luburić (2015), failure to comply with any of these principles and requirements puts the entire management system at risk. However, none of the available studies examines whether the importance of the principles and their relationship to each other has changed during the Covid-19 crisis. Businesses have had to face unforeseen challenges and severe crises caused by the Covid-19 crisis. The structure and management of organizations have been transformed (Grint, 2020; Kordestani et al., 2021), and this paradigm shift has influenced quality management processes and standards (Singh & Arora, 2022). Biå et al. (2020) present some requirements of the main chapters of the ISO 9001 quality management system, such as the organization's environment, leadership, planning, support, operation, performance evaluation and development, which were also applicable in the Covid-19 crisis, but at the level of standard requirements, they do not examine which standard requirements became significant for organizations and which standard requirements decreased in importance during the Covid-19 crisis. According to a McKinsey survey, expectations for 2019 deteriorated significantly as a result of the Covid-19 crisis, as the proportion of companies expecting a decrease in revenue quadrupled, while those expecting an increase in revenue decreased by almost a tenth (Albonico et al., 2020). Respondents to a questionnaire survey conducted in three phases of the Covid-19 pandemic in Hungary estimated that their organization's annual revenue fell by more than ten percent on average in 2020 (Poór et al., 2021). Several studies have linked the impact of quality management operations to company characteristics. Most of them conclude that there is a positive relationship between the implementation of quality management operations and company characteristics, such as improved financial performance (Tari & Sabater, 2004; Ouazi & Jacobs, 2004). However, there is no study available on how operating according to a standard management system was related to the company characteristics (organizational form, financial performance, economic sector classification, domestic or foreign ownership, number of employees) of organizations operating a management system and those not operating one during the Covid-19 crisis, and on which company characteristics have a higher or lower proportion of those operating a management system compared to the full sample. Based on all of this, I formulated my hypotheses related to my research questions, which I present in the next chapter.

3 Methodology

In this chapter, I present the formulation of hypotheses based on the research questions, and I also provide a detailed account of the data collection process of the research and the method used during the analysis.

3.1 Formulation of research questions and hypotheses

Following the literature review, I present my hypotheses in this chapter in relation to the research questions. The first research question concerns the change in the importance of quality management principles and their relationship to each other during the period under study. My first research question is as follows:

- **Q1: How has the importance of quality management principles and their relationship to each other changed for companies during the Covid-19 crisis?**

The quality management standard defines principles that help organizations operate quality management systems in a standardized manner (Csizmadia, 2022). The principles cover, among other things, leadership, customer focus, employee engagement, evidence-based decision-making, and relationship management; their application helps organizations operate quality-focused management systems. According to Luburić (2015), quality management principles also provide great help in preventing and managing crisis situations. However, none of the studies on quality management principles examine the significance of quality management principles in the daily operations of organizations during the Covid-19 crisis, and it is not known how the individual principles were related to each other during the period under study. During the Covid-19 crisis, organizations were unable to focus much on their developments, so this quality management principle was not a priority for them during the period under review – as mentioned above, due to the restrictive measures due to the epidemic (danger), strategic investments were frozen by nearly a third of companies and innovation projects by a quarter (Poór et al., 2021). When examining the relationship between quality management principles, the importance of those quality management principles that helped organizations effectively manage the Covid-19 crisis was similar, such as

customer focus and relationship management. Based on these, I formulate the following hypotheses:

H1a: Apart from the Improvement quality management principle, the importance of all quality management principles has increased during the Covid-19 crisis.

H1b: The relationship between the importance of quality management principles in the Covid-19 crisis was similar.

The second research question concerns the change in the importance of quality management standard requirements and their relationship to each other during the period under study. My research question is as follows:

- **Q2: How has the importance of quality management standard requirements and their relationship to each other changed for companies during the Covid-19 crisis?**

The quality management standard defines requirements, and organizations demonstrate their standard operation by complying with them. The standard requirements are found in the following chapters of the quality management system: Organizational Environment, Leadership, Planning, Support, Operation, Performance Evaluation and Development. I examined the changes in the significance of the forty standard requirements listed in these seven standard chapters in the Covid-19 crisis and their relationship with each other in my doctoral research. As the past period has shown, businesses had to face unforeseen challenges in the Covid-19 crisis, which affected their daily operations and also had an impact on the organization's standard processes (Singh & Arora, 2022). The Covid-19 crisis has also affected the significance of standard requirements in relation to the operation of quality management processes and systems. Biã et al. (2020) confirm that the chapters of the ISO 9001 quality management system were applicable to organizations in the Covid-19 crisis, but they do not cover their specific use at the standard requirement level, so they did not examine in detail, at the level of standard requirements, the change in the significance of standard requirements, nor the relationship between standard requirements in the Covid-19 crisis.

As with the quality management principles, it can be said that the standard requirement related to Development has lost its significance in the everyday life of most organizations, since significant developments could not be implemented in the Covid-19 crisis. In the case of the relationship between standard requirements, for example, the relationship between the needs and expectations of stakeholders and the needs and expectations of employees and other stakeholders shows similar importance in the opinion of the organizations. Based on these, I formulate the following hypotheses:

H2a: Apart from the standard requirements for Improvement, the importance of all standard requirements has increased during the Covid-19 crisis.

H2b: The importance of quality management standard requirements is related to each other in the Covid-19 crisis, i.e. their perceived importance is similar.

The third research question concerns the change in the importance of quality management standard requirements during the Covid-19 crisis and the difference in the change in the financial performance of companies.

- **Q3: Is there a difference between the change in the importance of quality management standard requirements during the Covid-19 crisis and the change in the financial performance of companies?**

The link between operating a quality management system according to ISO 9001 and financial performance is also confirmed by a study listing the benefits of using the ISO 9001 standard (Bernardo et al., 2015). Organizations operating a quality management system have experienced efficiency improvements, which have been accompanied by cost savings, shorter lead times and resource optimization, as well as increased performance. However, Heras et al. (2001) found no evidence overall that ISO 9001 has a real impact on the financial performance of companies with ISO 9001 certification.

In this regard, however, no study has examined how the importance of standard requirements for quality management systems has changed during the Covid-19 crisis and whether the change in financial performance of organizations during the Covid-19 crisis is related to this. A significant part of the examined Hungarian organizations viewed the Covid-19 crisis not only as a problem, but also as an opportunity (Hörcher, 2021), so the correlations between the change in the importance of standard requirements and the change in the financial performance of companies can help organizations, among other things, exploit these opportunities. Based on this, I formulate the following hypothesis:

H3: During the Covid-19 crisis, the importance of quality management standard requirements changed in a similar way to changes in financial performance.

The fourth research question concerns the relationship between the operation of quality management systems and the corporate characteristics of organizations.

- **Q4: Are there differences in the corporate characteristics of organizations that operate a standard management system compared to those that do not?**

As has been confirmed by numerous studies, quality management has a positive impact on the organizational characteristics of the company (Huarng & Chen, 2002; Kaynak, 2003; Parast et al., 2011): it is associated with increased sales due to a larger market share, improved relations with stakeholders and owners, and increased performance and, consequently, an increase in the number of employees. According to Michelberger et al. (2015), the majority of medium-sized enterprises use some kind of management system; they do so primarily for the benefits of reducing costs and improving processes. Several studies attempt to relate the impact of quality management operations to the organizational characteristics of the organization. Most of them conclude that there is a positive relationship between the implementation of quality management operations and the corporate characteristics of the organization (Tari & Sabater, 2004; Ouazi & Jacobs, 2004; Sampaio et al., 2009). Thus, examining this in the Covid19 crisis situation can also yield significant results. Based on these, the following hypothesis is formulated:

H4: The following corporate characteristics of the examined organizations operating standard management systems are significantly different from those of the organizations that do not operate such standard management systems:

- **organizational form**
- **financial performance**
- **economic sector classification**
- **domestic or foreign ownership**
- **number of employees**

3.2 Operationalizing variables

The operationalization of the most important elements of the research topic is presented in this chapter.

The operationalization of the variables used in the research is presented in Table 1.

Table 1. Operationalization of the variables used in the research
(source: own compilation)

Variable name	Operationalizing a variable
Importance of quality management principles	Respondent's rating of quality management principles on a scale of 1–5
Importance of quality management standard requirements	Respondent's rating of quality management standard requirements on a scale of 1–5
Company characteristics: - organizational form - financial performance - economic sector classification - ownership form - number of employees	Based on the respondents' answers: - organizational form (KSH, 2023) - annual net sales (million HUF) - economic sector classification (KSH, 2023) - domestic or foreign ownership (KSH, 2023) - change in number of employees (persons) before and during Covid19

Period	<ul style="list-style-type: none"> - Before Covid19 crisis - During Covid19 crisis
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3.3 Applied research methods

The research questions were answered and the hypotheses were tested using the research methods described in this chapter. I used both quantitative and qualitative methods during the research. When applying the research methods, I aimed for triangulation, which allowed me to exploit the advantages of different methods and to check the consistency of the results obtained based on each method (Balaton & Dobák, 1991).

3.3.1 Data collection

I collected data for the research using a questionnaire (on the one hand at a professional conference, on the other hand by national survey) and semi-structured interviews with company managers.

Semi-structured interview with company managers

To finalize the questions for the questionnaire, I conducted semi-structured interviews with senior managers before sending out the national questionnaire. I considered it important to conduct semi-structured interviews because my goal was to finalize the questionnaire with questions asked to company managers and quality management managers in the research topic of the changing role of standard management systems. I asked managers of companies that had won the Industry 4.0 Model Factory title, and thus those that I had already visited, to be my interviewees. One of them is a three-time quality award-winning organization, which was previously known as the National Quality Award and was renamed the National Excellence Award when it was relaunched after ten years, in 2020. Another organization interviewed was also chosen as an Industry 4.0 model factory

and is also committed to quality. Finally, I conducted interviews with company managers at the corporate partner of the cooperative doctoral program, Medikai Innováció Kft. (Medical Innovation Ltd.). I incorporated the results of the interviews as examples in some chapters of the dissertation and also used them in the practical application of the research.

Questionnaire survey

During the research, I conducted a questionnaire survey twice before starting the national questionnaire survey. On one occasion, I conducted an online questionnaire survey for data collection at the largest professional forum, the XXVII. National Quality Conference of the ISO 9000 Forum in 2020. During the conference, I assessed the relevance of the research topic with the help of forty experts. I structured the questionnaire around four groups of questions, asked the respondents to decide on the one hand, and asked them to provide additional textual comments/opinions on the other. In the stage before filling out the questionnaire, I briefly introduced the purpose and background of the study. I asked them to answer the questions online, using the Mentimeter real-time application, which ensured quick completion, and after completing the questionnaire, the respondents were able to express their opinions in our section. On the other occasion, I tested version 0 of the completed questionnaire with the participation of eight organizations, which are leaders in the operation of standard management systems in terms of being organizations that have won the National Quality Award multiple times or are Industry 4.0 model factories. After the trial completions, the final questionnaire was developed, followed by a national questionnaire survey related to my research.

The questionnaire survey took place in June and July 2023. The questionnaire survey covered the period before the Covid19 crisis and during Covid19 (March 2020 - December 2021). In my opinion, this did not affect the reliability of the answers given before Covid and during Covid, since the responding organizations operate standard management systems, which are documented systems, so there must be a trace of the Covid19 crisis period in the organizations in documented form, whether in risk management or in measures or change management. During the interviews with company managers, the documented information of the management systems was also used by the company managers.

The questionnaire survey was conducted online, using the Orbis database. The organizations received the questionnaire by e-mail. The response was voluntary. The study sample included enterprises of all sizes, from micro-enterprises to large corporations. The questionnaire was filled out by the company managers. The central topic of the questionnaire was the change in the role of standard management systems in the crisis situation. The questionnaire is included in Annex 2. The questionnaire was sent out in 317,603 copies.

The questionnaire was filled out by 2,476 organizations,

- 859 completely,

- the remaining 1,617 organizations only partially.

The 859 fully completed questionnaires were analyzed in the paper. Of these, 271 organizations operated a standard management system, so the questions regarding standard systems were completed only by these organizations. The 1617 partial completions could not be used in this form.

Introduction to the questionnaire

The central topic of the questionnaire was the changing role of standard management systems in the Covid-19 crisis. The survey participants answered fifteen questions in two main areas: 1) general questions regarding the organization, and 2) questions about the standards of the management system. On the one hand, the respondents rated on a five-point Likert scale, and on the other hand, I also gave the opportunity to express additional textual comments/opinions.

3.3.1 Analysis

I used the IBM SPSS Statistics 24 software for the analysis. In the following, I will briefly describe the methods used during the analysis.

Descriptive statistics

I got a primary picture of the sample using descriptive statistical methods (Jánosa, 2011).

Depending on the measurement scale on which the results can be measured:

- in the case of questions that can be measured on a nominal scale, the frequency of the answers (in units corresponding to the basic data) and their relative frequency (in %) are illustrated in a figure;
- in the case of an ordinal (ordinal – Likert) scale, when necessary for the analysis, the descriptive statistics of the answers are summarized in a table:

- mean (arithmetic mean),
- standard deviation,
- median,
- mode,
- minimum, maximum.

Descriptive statistics in the analysis are included in Chapter 4.2 as follows:

- Distribution of responding organizations by organizational form
- Distribution of organizations by economic sector
- Distribution of responding organizations by geographical location of their headquarters
- Distribution of organizations by revenue before and during Covid
- Operation of a standard management system – by standards
- Comparison of the use of ISO 9001, ISO 14001 and ISO 45001
- Change in the importance of the principles of a standard management system
- Change in the importance of the requirements of a standard management system

Relationship analysis

Focusing on the relationship between two variables, I used relationship tests (Cramer's V and Kendall's tau) and hypothesis tests (Pearson's chi-square test and t-test).

Association relationship testing (Cramer's V, Pearson's chi-square and paired sample t-test)

The association relationship is used to test the relationship between two categorical variables (measured on a nominal scale). I used hypothesis testing (Pearson's chi-square test) and relationship test (Cramer's V) to explore the relationship between the two variables. I used Pearson's chi-square test to explore the relationships between organizations operating quality management standards and company characteristics.

Pearson's chi-square test (χ^2) is one of the most commonly used analytical methods for testing hypotheses related to association. Based on this hypothesis test, it can be decided whether the relationship between two categorical variables is significant or not (Sajtos & Mitev, 2007). The chi-square statistic tests the following hypotheses (H0: null hypothesis, H1: alternative hypothesis):
H0: The two variables under study are independent of each other, i.e. there is no relationship between them.

H1: The two variables under study are not independent of each other, i.e. there is a relationship between them.

If the p-value of the chi-square test is less than 0.05, then the null hypothesis is rejected with a 95% probability (at a 5% significance level), so it can be stated that there is a relationship between the two variables under study.

I used a paired sample t-test to compare the mean of the responses to the quality management principles and quality management standard requirements during the period under review. The paired sample t-test is a hypothesis test used to compare the means of two samples, which examines whether the means (μ) of a random variable in the sample are significantly different from each other:

$$H_0: \mu_i = \mu_j$$

$$H_1: \mu_i \neq \mu_j$$

If the p-value of the test is lower than 0.05, then we reject the null hypothesis with a 95% probability (calculated with a 5% significance level), so it can be stated that there is a significant difference between the means of the two variables under study. This can be further analyzed with Cramer's association coefficient (V), which shows the strength of the relationship. According to several studies, this indicator is one of the "most reliable" indicators for measuring the strength of association relationships (Sajtos & Mitev, 2007).

I used Cramer's V correlation test to explore the strength of the relationships between organizations operating quality management standards and company characteristics. If the p-value for V is less than 0.05, then the relationship between the two variables under study is significant. The value of Cramer's coefficient can be in the interval [0, 1]. The value of the result approaching 0 shows an increasingly weaker relationship between the two variables, and in the opposite case (if the Cramer index value approaches 1) it shows an increasingly stronger relationship. In the practical part, the

results are interpreted according to the following categories: $0 < \tau < 0.2$ weak, $0.2 \leq \tau < 0.7$ medium, $0.7 \leq \tau < 1$ strong relationship (Sajtos & Mitev, 2007).

Examination of rank correlation relationships

I use relationship analysis methods to examine the relationships between the importance of each quality management principle in the examined period, as well as to examine the relationships between the importance of each quality management standard requirement. I also used rank correlation relationship analysis to explore the relationships between standard requirements and changes in the financial performance of organizations. Rank correlation means the relationship between variables that can be measured on an ordinal scale (for example, Likert scale). Such rank correlation relationships are examined with Kendall's tau (τ) indicator: it can examine the relationships according to arbitrary monotonic functions without examining their distribution, it can describe a linear relationship, and it is not disturbed by so-called outlier data. The relationship can be called significant if the p-value corresponding to the tau indicator is less than 0.05. Since the value of tau moves in the interval $[-1, 1]$, its sign and magnitude can also be interpreted. The sign of tau indicates the direction of the relationship: if tau is greater than 0, then we are talking about a positive relationship, if it is less than 0, then we are talking about a negative relationship. The strength of the relationship is determined by the absolute value of tau within the interval $[0, 1]$, which is interpreted based on the classification also used for the Cramer index: $0 < \tau \leq 0.2$ indicates a weak relationship, $0.2 \leq \tau \leq 0.7$ indicates a medium relationship, and $0.7 \leq \tau < 1$ indicates a strong relationship (Sajtos & Mitev, 2007).

4 The results of the research

This chapter evaluates the hypotheses and formulates the theses.

4.1 Evaluates the hypotheses and formulates the theses

The first research question concerns the change in the importance of quality management principles and their relationship to each other during the Covid-19 crisis. My hypotheses related to the research question are as follows:

H1a: Apart from the Improvement quality management principle, the importance of all quality management principles has increased during the Covid-19 crisis.

I examined the significance of the following quality management principles in the dissertation:

1. Customer focus
2. Leadership
3. Engagement of employees
4. Process approach
5. Improvement
6. Evidence-based decision-making
7. Relationship management

I used a paired sample t-test for the analysis. The results show that there is a significant difference between the significance of principles 2, 3, 4 and 7. There is no significant difference in the significance of principles 1, 5 and 6. The greatest change in significance was seen in Leadership during the Covid-19 crisis, followed by an increase in the significance of the Relationship management principle. The significance of all principles increased during the Covid-19 crisis, except for the Improvement principle.

H1b: The relationship between the importance of quality management principles in the Covid-19 crisis was similar.

In the analysis, I examined the relationship between the importance of individual quality management principles before and during Covid. I used Kendall's Tau (τ) index for the analysis. All relationships are significant relationships, the p-value for the Tau indicator is less than 0.05. Examining the relationship of the principles to each other, before Covid, the strongest significant relationship was between Engagement of the employees and the Process approach principles. Its value: 0.532 means a moderate positive relationship. The weakest connection was between the principles of Improvement and Customer Focus. Its value: 0.353 means a moderate positive relationship.

At the time of Covid, the strongest significant relationship was between the principles of Customer Focus and Relationship Management. Value: 0.504 – medium positive relationship The weakest significant relationship is between the principles of Improvement and Customer Focus Value: 0.283 – medium positive relationship.

Based on the results, I confirmed hypotheses H1a and H1b. Based on the results, I formulate the following theses:

T1a: Among the quality management principles, the importance of the following has changed significantly in terms of corporate operations during the Covid-19 crisis: Leadership, Engagement of employees, Process approach, and Relationship management.

T1b: The relationship between the importance of quality management principles did not change during the Covid-19 crisis compared to the previous period, i.e. the relationship between the importance of the principles remained moderately positive and significant.

The second research question concerns the changing importance of quality management standard requirements and their relationship to each other in the Covid-19 crisis. My hypotheses related to the research question are as follows:

H2a: Apart from the standard requirements for Development, the importance of all standard requirements has increased during the Covid-19 crisis.

I used a paired sample t-test for the analysis. The results suggest that there is a significant difference between the standard requirements for the quality management system as follows:

- In the standard chapter entitled Context of organisation, the following standard requirements: Context of organisation, Understanding the needs and expectations of interested parties, Understanding the needs and expectations of employees and other interested parties;
- In the standard chapter Leadership, the following standard requirements: Leadership, Organizational roles, responsibility, Consultation and employee participation;
- In the chapter Planning, all standard requirements;
- In the chapter Support, all standard requirements;
- In the chapter Operation, all standard requirements;
- In the chapter Performance evaluation, the following standard requirements: Performance evaluation, Monitoring, Measurement, Customer satisfaction;
- In the Improvement chapter, the following standard requirements: Nonconformity and corrective action, Event (incident), nonconformity, Improvement.

All standard requirements have increased in importance during Covid19, except for the Internal audit standard requirement.

H2b: The importance of quality management standard requirements is related to each other in the Covid-19 crisis, i.e. their perceived importance is similar.

The analysis examined the relationship between the importance of each quality management standard requirement before Covid-19 and during Covid-19. I used Kendall's tau (τ) indicator for the analysis. All relationships are significant, the p-value for the tau indicator is less than 0.05. Examining the relationship between the importance of the quality management standard requirements:

4 chapter: Context of organization

Before covid

Strongest (positive) relationship: Between Understanding the needs and expectations of interested parties and the needs of employees and other stakeholders (0.703)

Weakest (medium positive) relationship: Between Understanding the needs and expectations and the management system and its processes (0.495)

During Covid

Strongest (positive) relationship: Between Understanding the needs and expectations of interested parties and the needs of employees and other stakeholders (0.718)

Weakest (medium positive) relationship: Between the management system and its processes and context of organization (0.477)

5 chapter : Leadership

Before covid

Strongest (medium positive) relationship: between Organizational roles, responsibilities and authorities and Consultation and employee participation (0.616)

Weakest (medium positive) relationship: Between Politics and Customer focus (0.365)

During Covid

Strongest (medium positive) relationship: Organizational roles, responsibilities and authorities and Politics (0.590)

Weakest (medium positive) relationship: Between Politics and Customer focus (0.354)

6. chapter: Planning

Before covid

Strongest (positive) relationship: Between Actions to address risks and opportunities and Identification of dangers and assessment of risks and opportunities (0.725)

Weakest (medium positive) relationship: between Planning and Identifying hazards and assessing risks and opportunities (0.556)

During Covid

Strongest (moderately positive) relationship: Between Actions to address risks and opportunities and Identification of dangers and assessment of risks and opportunities (0.675)

Weakest (medium positive) relationship between: Quality objectives and planning to achieve them and Identifying dangers and assessing risks and opportunities standard requirement (0.497)

7 chapter: Support

Before covid

Strongest (positive) relationship: Infrastructure and Resources between standard requirements (0.713)

Weakest (medium positive) relationship: between Documented Information and Support standard requirements (0.421)

During Covid

Strongest (positive) relationship: Competence and Awareness between standard requirements (0.738)

Weakest (medium positive) relationship: between Documented Information and Support standard requirements (0.406)

8 chapter: Operation

Before covid

Strongest (medium positive) relationship: Between the elimination of dangers and the reduction of MEB risks and Control of changes standard requirements (0.584)

Weakest (medium positive) relationship: Customer communication and the Emergency Preparedness and Response standard requirements (0.402)

During Covid

Strongest (medium positive) relationship between: Control of changes and Emergency preparedness and response standard requirements (0.567)

Weakest (medium positive) relationship: Customer communication and the Emergency Preparedness and Response standard requirements (0.395)

9. chapter: Performance evaluation

Before covid

Strongest (positive) relationship: between Monitoring, Measurement, Analysis and Evaluation and Performance Evaluation standard requirements (0.783)

Weakest (medium positive) relationship: Customer satisfaction and Performance evaluation standard requirement (0.430)

During Covid

Strongest (positive) relationship: between Monitoring, Measurement, Analysis and Evaluation and Performance Evaluation standard requirements (0.749)

Weakest (medium positive) relationship: Between internal audit and the standard requirement of Customer satisfaction (0.415)

10 chapter: Improvement

Before covid

Strongest (strong positive) relationship: Event (incident), nonconformity and corrective action and Nonconformity and corrective action between standard requirements (0.764)

Weakest (medium positive) relationship: between Event (incident), nonconformity and corrective action and Development (0.575)

During Covid

Strongest (strong positive) relationship: between Continual improvement and Improvement standard requirements (0.755)

Weakest (medium positive) relationship: between Event (incident), nonconformity and corrective action and Improvement (0.494)

Based on the results, I confirmed hypotheses H2a and H2b. Based on the results, I formulate the following theses:

T2a: The following standard requirements for the quality management system have changed significantly in terms of corporate operations during the Covid-19 crisis:

- In the standard chapter Context of the organization, the following standard requirements: Context of the organization, Understanding the needs and expectations of interested parties, Understanding the needs and expectations of employees and other interested parties

- In the standard chapter Leadership, the following standard requirements: Leadership, Organizational roles, Responsibility, Consultation and employee participation

- In the chapter Planning, all standard requirements

- In the chapter Support, all standard requirements

- In the chapter Operation, all standard requirements

- In the chapter Performance evaluation, the following standard requirements: Performance evaluation, Monitoring, measurement, analysis and evaluation, Customer satisfaction

- In the chapter Improvement, the following standard requirements: Nonconformity and correction, Incident (incident), non-conformity, Continuous improvement

During the Covid-19 crisis, the importance of the above standard requirements has significantly changed from before the Covid-19 crisis.

T2b: The strength of the relationship between the importance of quality management standard requirements did not decrease during the Covid-19 crisis compared to the previous period. The relationship between the importances remained positive, moderately strong, and significant.

The third research question concerns the relationship between the change in the importance of quality management standard requirements and the change in the financial performance of companies during the Covid-19 crisis. My hypothesis related to the research question is the following:

H3: During the Covid-19 crisis, the importance of quality management standard requirements changed in a similar way to changes in financial performance.

In the dissertation, I examined the relationship between the change in the importance of standard requirements and the change in the financial performance of companies before and during Covid-19. I used Kendall's tau (τ) indicator for the analysis. I found a significant relationship in the following standard chapters:

- Understanding the needs and expectations of interested parties (0.074),
- Understanding the needs and expectations of employees and other interested parties (0.081),
- The management system and its processes (0.078) and
- External communication (0.89) between the change in the importance of standard requirements and the change in the financial performance of companies.

Out of the forty examined standard requirements, the change in financial performance (annual net sales) shows a weak positive relationship with the change in the above four standard requirements.

Based on the results, I was only able to partially confirm the H3 hypothesis. Based on the results, I formulate the following thesis:

T3: A weak positive relationship with changes in financial performance during the Covid-19 crisis can only be demonstrated in the case of changes in the importance of the following quality management standard requirements:

- **Understanding the needs and expectations of interested parties**

- **Understanding the needs and expectations of employees and other interested parties**
- **The management system and its processes**
- **External communication**

In the other cases, no significant relationship was demonstrated between the changes.

The fourth research question concerns whether there are differences in the company characteristics (organizational form, financial performance, economic sector classification, domestic or foreign ownership, and number of employees) of organizations operating a standard management system compared to those that do not operate a standard management system.

My hypothesis related to the research question is the following:

H4: The following corporate characteristics of the examined organizations operating standard management systems are significantly different from those of the organizations that do not operate such standard management systems:

- **organizational form**
- **financial performance**
- **economic sector classification**
- **domestic or foreign ownership**
- **number of employees.**

The H4 hypothesis was aimed at examining whether the company characteristics of the organizations operating standard management systems under study differ significantly from those of the organizations that do not operate standard management systems. I used Pearson's chi-square test (χ^2) for the analysis. If the p-value of the chi-square test is less than 0.05, then we can reject the null hypothesis with a 95% probability (at a 5% significance level), so it can be stated that there is a dependence between the two variables under study. I further analyzed this with Cramer's association coefficient (V), which shows the strength of the relationship. Based on the analyses, it

can be concluded that all differences are significant. Regarding the strength of the relationships, the following results can be shown for the operation of quality management systems and

- organizational form (0.290),
- annual net sales (before Covid19: 0.436; during Covid19: 0.438),
- economic sector classification (0.305),
- domestic or foreign ownership (0.242) and
- number of employees (0.430).

Based on the results, I confirmed hypothesis H4 and formulate the following thesis:

T4: The categorical breakdowns of the examined organizations operating standard management systems and the organizations not operating standard management systems according to the company characteristics differ significantly in

- **organizational form (a higher proportion of joint-stock companies, a lower proportion of cooperatives compared to the entire sample)**
- **financial performance (a higher proportion of organizations with sales revenue of HUF 2.51 and 25 billion, a lower proportion of organizations with sales revenue between HUF 51 and 100 million)**
- **economic sector classification (a higher proportion of vehicle manufacturing, and the production of chemical, pharmaceutical and medical chemical products in the sector, a lower proportion in the accommodation, catering, tourism, and travel sectors)**
- **domestic or foreign ownership (a higher proportion of organizations with foreign/international or mixed ownership, a lower proportion of domestic private organizations)**
- **number of employees (a higher proportion of organizations with 251-500 employees employing organizations, to a lesser extent, organizations without employees)**

in the case of characteristics.

In the next chapter, I will discuss the practical application of the research.

4.1 Practical application of research

My doctoral research was conducted within the framework of the Cooperative Doctoral Program (KDP-2020), so I was able to directly apply the results of the research at the corporate partner, including during the audit of the quality management system according to the ISO 9001 standard. My doctoral research also aimed to develop both a theoretical and a practical approach for users of standard management systems, such as standard setters, certifiers, consultants, quality management specialists and company managers. In my opinion, the significance of the research is that a guide is being prepared for standard-setting organizations that presents the changes in the significance of individual quality management principles and individual quality management standard requirements in the Covid-19 crisis, which standard setters can rely on in the future when issuing new standards. Its practical importance is also given by the fact that the results of the research will be used to create a useful guide for the profession regarding the importance of quality management principles and standard requirements in the Covid-19 crisis.

Furthermore, I set the goal of implementing dissemination activities and preparing educational materials on the research topic, thus contributing to professional, educationally focused development. The results of the research will also be incorporated into the subjects of Quality Management, Quality Assurance, ESG Consulting and Occupational Health and Safety at the Institute of Management of the Faculty of Economics of the University of Pannonia. I also apply the results of the research during the development of the quality management system of the University of Pannonia.

In this chapter, I present a part of the complete guide, the possible audit questions related to the Leadership quality management principle and standard requirement, and the related measures, which can be used by auditors (certification, internal) and managers and specialists of organizations using the standard during the operation of quality management systems. The results of the research show that organizations, among others, attached great importance to the Leadership quality management principle and standard requirement during the Covid-19 crisis. Furthermore, I chose Leadership as a model because no management system can function well without the commitment of the top manager. This has been proven by the Covid-19 crisis.

In preparing the guide, I used five standards for Leadership:

- the ISO 9001 quality management system standard because organizations primarily use this management system standard when operating their quality management systems;
- the ISO/DTS 9002 standard as guidelines for the application of ISO 9001:2015;
- the ISO 45001 occupational health and safety management system standard because its application has intensified during the Covid-19 crisis;
- ISO 45003 Occupational health and safety management – Psychological health and safety at work – Guidelines for managing psychosocial risks, a standard issued by the standard setters during the Covid-19 crisis;
- ISO/PAS 45005, which provides general guidelines for safe working during the Covid-19 crisis.

The guide is new for the industry in that audit questions and related measures have not yet been prepared for the Leadership standard chapter to meet the standard requirements for crisis situations similar to the Covid-19 crisis using five management system standards.

In the guide, I present the possible audit questions for the Leadership requirements for certification bodies.

In this regard, I indicate in italics the possible measures that provide guidance to senior managers and professionals of organizations using the management system.

Standard requirements related to the Leadership chapter

The leadership and commitment of the organization's senior management is critical to the operation of the governance system and the achievement of the desired results, even during the Covid-19 crisis. Senior management therefore has specific responsibilities that they must personally participate in or lead.

- How can you demonstrate that you are taking overall responsibility and accountability for the effectiveness of the governance system, even during the Covid-19 crisis?

During the regular management reviews held during the Covid-19 crisis, the effectiveness of the management system is monitored and continuous performance is monitored, and this is documented, among other things, in Management Review Minutes and Action Plans by defining tasks, responsibilities and deadlines.

In the Covid-19 crisis, the definition of a culture supporting the organization's management system by senior management, such as the definition of individual and group values in the changed situation. Good examples, management practices, attitudes, patterns that determine the commitment of stakeholders to the organization's management system. In the Covid-19 crisis, the daily pattern of behavior, conduct and example set by the manager.

- How do you ensure continuous communication in the Covid19 crisis?

Developing communication within the organization based on cooperation and trust is receiving even greater attention in the Covid19 crisis. Continuously communicate, among other things, the importance of operating according to the given requirements of the quality management system and the systems and processes belonging to the changed circumstances. e.g. through internal information meetings, e-mail, personal meetings, the organization's intranet, internal communication channel.

Regulation of communication in the Covid19 crisis in a communication procedure, policy. When, who, with whom and how to communicate, e.g. with stakeholders inside and outside the organization. Definition of communication channels and levels. If necessary, application of local, regional or national guidelines in the processes and the communication related to them.

- How can you demonstrate that you take overall responsibility and accountability for preventing work-related injuries and health impairments, and for ensuring safe and healthy workplaces and activities, even in the Covid-19 crisis?

You make a documented commitment to encourage employees to actively participate in identifying quality management and occupational health and safety management risks and opportunities during the Covid-19 crisis, and demonstrate confidence in the effectiveness of preventive and protective measures, for which you have a continuous monitoring system in place within the organization. To achieve this, you ensure cooperation between departments/departments/and functions. You provide high-level management support to resolve problems arising during the Covid-19 crisis.

You specify in documented information how employees and other stakeholders should report incidents or concerns, how they should be handled in the organization's processes, and through which communication channels responses should be communicated.

Assigns responsibilities and authorities to relevant staff or groups related to preventive and protective measures, and monitors the effectiveness of the measures.

Makes a documented commitment to encourage employees to report incidents, hazards, risks and opportunities, including during the Covid-19 crisis, and protects employees from sanctions such as threats of dismissal or disciplinary action if they report. Requires continuous monitoring of the risk management system and emergency planning as documented information. Ensures coordination between all parts of the organization in the implementation of measures to manage risks related to the Covid-19 crisis.

- How do you ensure consultation and employee participation in the Covid-19 crisis in terms of the success of the management system and processes and the adaptation to the changed circumstances?

Encourage participation and engagement, for example in safety committees or Covid-19 crisis support networks, adapted to the size and context of the organisation. In smaller organisations, the consultation process is carried out directly with employees, taking into account and seeking the experience and expertise of employees in the changed circumstances. In the Covid-19 crisis, the management of psychosocial risks to stakeholders is given priority. Documented information is provided on the roles and responsibilities of both management, the organisation and employees. In larger organisations, safety committees, works councils or other representative bodies have an important role in managing the Covid-19 crisis.

4.2 Future research

I set myself the goal of continuing future research on this topic, as it still holds many possibilities, including the examination of the relationship between quality management standard requirements. These results will, among other things, help those operating standard management systems in terms of which standard requirements can be shown to have a strong relationship, and which standard requirements it is advisable for organizations to manage together at the regulatory level in similar crisis situations. In the future, these results can also be used in the development of quality

management systems, including by incorporating them into the development of the quality management system of the University of Pannonia.

5 Summary

My research topic was aimed at examining the role of standard management systems in the Covid-19 crisis. Among the standard management systems, I examined the change in the role of quality management systems in the Covid-19 crisis.

In connection with this, I analyzed which quality management principles and standard requirements had changed in importance during the period under review. Quality management principles, as their name suggests, form the basis of quality management systems, so their change in importance could have affected the operation of quality management systems in the Covid-19 crisis. Quality management standard requirements are the requirements specified in the ISO 9001 standard for the operation of quality management systems, based on which the systems can be operated. In connection with this, the aim of the dissertation was to examine the standards relating to the quality management system at the level of requirements: which were considered significant and which had decreased in importance during the Covid-19 crisis. The research also examined the closeness of the relationship between quality management principles and quality management standard requirements, thereby helping organizations in the future in operating their quality management systems in a crisis situation similar to Covid19.

The PhD research aimed at a quantitative analysis of the use of standard management systems among Hungarian organizations before and during Covid19: it was based on the analysis of data obtained from a questionnaire survey developed and conducted by the author. Descriptive statistics and relationship tests (examination of association relationships and examination of rank correlation relationships) were used during the analysis.

The results of the research can be summarized as follows: the importance of four of the seven quality management principles – Leadership, Engagement of people, Process approach and Relationship management principles – changed significantly during the crisis. The largest change was observed in the case of Leadership in terms of the importance of the principles during Covid19, followed by the change in the importance of the Relationship management principle. No significant change was detected in the relationship between the principles during Covid19 compared to the

pre-Covid19 period. Regarding the change in the importance of quality management standard requirements, the results show that, with the exception of six of the forty standard requirements – Management system processes, Customer focus, Policy, Internal audit, Management review and Improvement standard requirements – the importance of thirty-four quality management standard requirements significantly changed during the period under review.

The biggest change was in the importance of the standard requirements Understanding the needs and expectations of employees and other stakeholders, Leadership, Identifying hazards and assessing risks and opportunities, Internal communication, Emergency preparedness and response, Monitoring, measurement, and Incident, non-conformity and corrective action during Covid-19 compared to the pre-Covid-19 period. The relationship between the standard requirements during Covid-19 did not change significantly compared to the pre-Covid-19 period. Examining the change in the importance of quality management standard requirements together with the change in the financial performance of the organizations, the results show that in the case of four out of the forty standard requirements, Understanding the needs and expectations of interested parties, Understanding the needs and expectations of employees and other interested parties, Management system and processes, and External communication, the change in financial performance (annual net sales) shows a weak positive relationship with the change in the standard requirements. Finally, based on the analysis of the relationships between the operation of the quality management system and the corporate characteristics of the organizations, it can be said that there is a significant, moderately strong relationship between the organizational form, financial performance, economic sector classification, domestic or foreign ownership, number of employees and the operation of quality management systems. Therefore, the operation of quality management systems is affected by these characteristics of the organization.

Overall, it can be said that the change in the role of quality management systems in the Covid-19 crisis can be justified both at the level of quality management principles and standard requirements.

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