

Tools and Methods for the Enhancement of the Quality Management System in Multiapartment Building Management and Maintenance Companies

Kristīne VINOKUROVA

Faculty of Engineering Economics and Management, Riga Technical University
Riga, 6 Kalnciema iela, LV-1048, Latvia

Arta PĪLĒNA-DĀLBERGA

Faculty of Engineering Economics and Management, Riga Technical University
Riga, 6 Kalnciema iela, LV-1048, Latvia
Latvian Standard, Ltd., Riga, 157 Krisjana Valdemara iela, LV-1013, Latvia

ABSTRACT

Quality management is an integral part of companies that strive to ensure customer satisfaction and process efficiency. Nowadays, many companies apply different tools and methods in the operation of their management systems to identify and analyse problems, as well as to find solutions for their prevention and improvement of the efficiency of the quality management system. For multiapartment building management and maintenance companies, it is particularly important to manage the internal processes and their interaction with the services provided to meet customer requirements and ensure their satisfaction, therefore, tools and methods can be applied to the quality management system to facilitate the management of processes and to promote its efficiency.

The aim of this paper is to analyse the contribution of various tools and methods on the enhancement of the quality management system. Research methods such as literature review method and qualitative content analysis are applied. Based on the theoretical research and practical application of the identified tools and methods, the authors identify the contribution of these tools and methods on the enhancement of the quality management system in multiapartment building management and maintenance companies.

Keywords: FMEA, Internal Audit, Ishikawa Diagram, Multiapartment Building Management and Maintenance, Process Efficiency, QFD, Quality Management System, VSM.

1. INTRODUCTION

The processes, customers and operations of companies are closely interlinked and interact continuously, therefore, to ensure continuous improvement of the services and products of the company, quality management systems (QMS) are implemented and maintained in various industries [1;2]. To enhance the efficiency of the QMS, it is possible to apply various tools and methods that facilitate the identification of problems and their causes, define improvement opportunities while promoting employee cooperation in these activities [3;4;5]. Although the authors observe that the application of various tools and methods for the analysis of risks and processes in different industries has been analysed by many authors, a holistic view or research gap can be identified on how a set of different tools and methods are applicable for the improvement of quality management systems of companies in the multiapartment building management and maintenance industry.

The scientific aim of the research activities is to analyse the contribution of various tools and methods on the enhancement of the QMS in multiapartment building management and maintenance companies. The methodology is based on the analysis of literature published by various authors about the concept of the QMS, as well as the benefits and necessary inputs for the application of different process analysis tools and methods. Research methods such as the literature review method and qualitative content analysis are applied. The literature review method, applying different keywords and searching different databases, enables the selection of relevant publications that are appropriate to explore the research question. Also, practical application of the identified tools and methods – internal audit, Ishikawa diagram, value stream mapping (VSM), failure mode and effects analysis (FMEA) and quality function deployment (QFD) – is performed for the analysis and improvement of the QMS in a multiapartment building management and maintenance company.

The results of the literature review method and qualitative content analysis are described in Section 2. In Section 3, an analysis of the previously listed tools and methods is performed to determine their benefits, challenges of application, as well as the potential impact on the QMS of a company. The application of the tools and methods for the analysis of the QMS of a multiapartment building management and maintenance company is discussed in Section 4. In Section 5, the authors summarize the conclusions of the study.

2. THE CONCEPT OF THE QUALITY MANAGEMENT SYSTEM

Traditionally, a QMS is associated with the implementation of the requirements of a standard in a company. Based on one of the most widely used QMS standards worldwide – ISO 9001:2015 – the implementation of a QMS is aimed at ensuring the quality of products and services in accordance with applicable requirements, increasing customer satisfaction, as well as promoting continuous process improvement [6].

In order to understand how the concept of QMS is described in literature, the authors applied the literature review method. Publications were selected to answer the research question "what is a QMS?". The flow of literature selection is presented in the PRISMA diagram (Figure 1). 11 literature sources were selected for the literature review by using scientific databases such as EBSCOhost, SCOPUS and SpringerLink. The following keywords were used to select the most relevant literature sources: quality management system, quality system, total quality management system, QMS.

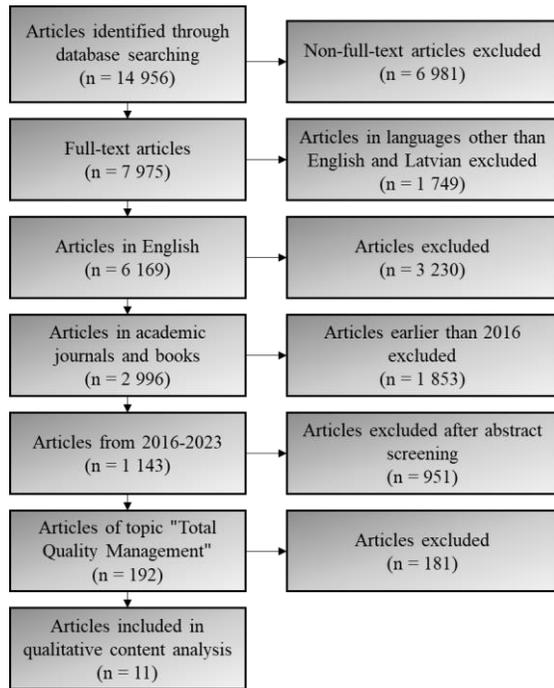


Figure 1. The selection of articles for the analysis of the research question.

Full-text articles of academic journals and books published in English were searched. The authors wanted to explore the most up-to-date information; therefore, the selection period was set to 2016 to 2023, and articles relevant to the topic "total quality management" were selected to reduce the number of publications and to define the direction of the search.

The qualitative content analysis resulted in 5 categories (Figure 2). Codes defined in the initial stages of the qualitative content analysis were combined into categories based on interrelationship. The categories provide the answer to the research question "what is a QMS?".

Category	Explanation	Frequency	% distribution among clusters
Quality improvement	Quality improvement is most often related to the enhancement of performance, criteria and characteristics of products and services, including the development of processes and operations of the company.	16	39%
Ensuring process efficiency	Ensuring process efficiency refers to the reorganising, monitoring and improving the processes of the company to ensure their efficiency.	8	19%
Preventing problems	Problem prevention is related to the processes of identifying and correcting nonconformities and implementing measures for risk prevention.	6	15%
Customer orientation	Customer orientation involves the aligning of the operations of the company to meet the expectations of various stakeholders and to ensure customer satisfaction.	6	15%
Continuous improvement	Continuous improvement implies the reviewing of the performance of the company and developing systemic processes and operations to foster continual growth, as well as ensuring effective management of the company.	5	12%

Figure 2. Categories identified through the qualitative content analysis and their frequency.

The concept of the QMS is mostly associated with quality improvement (39%), which includes various activities and measures, such as quality planning, quality control and quality assurance, to ensure that the products and services of the company meet set requirements, and various activities, processes, and systemic relationships of the company are improved continuously [7]. According to the ISO 9000 standard "quality management can include establishing quality policies and quality objectives, and processes to achieve these quality objectives through quality planning, quality control, quality assurance and quality improvement" [8].

A QMS can be considered as a systematic, integrated set of activities to control the operations and processes of the company to ensure resource management and continuous improvement of performance, thus improving quality [9]. An integral element of the QMS is process management. A process that takes place in a company is a series of continuous activities that relate to work flowing through these activities for a particular purpose and outcome [10]. Processes need to be adapted to the needs of the company, controlled, and monitored to ensure performance according to the defined criteria, thus ensuring process efficiency (19%).

As the organisational lifecycle is surrounded by risks that threaten the quality of products and services, companies should identify the sources of risks, evaluate the frequency of their occurrence, and assess the consequences of these risks within the QMS [11]. The identification and analysis of potential problems and nonconformities often leads to a decision on the need for a QMS to ensure their prevention (15%) [1]. A QMS in accordance with ISO 9000 enables companies to identify problems of processes and propose corrective measures for these problems while ensuring continuous improvement of processes [12]. For example, in construction, the main QMS factor is technical quality control which indicates that quality control is essential and must be performed responsibly to avoid future nonconformities [13]. Quality control is focused on fulfilling quality requirements, i.e., the product or service must meet requirements determined by the company. However, quality assurance is described as a way of eliminating errors and deficiencies as part of quality control to ensure that the requirements of quality standards are met [14].

The concept of QMS is also characterized as a business management system that ensures effective business management, stable market shares and secure customer bases [15]. Meeting the needs and demands of various stakeholders is an essential prerequisite for the operation of the company in the competitive market, thus customer orientation (15%) is also defined as a key element of the concept of the QMS [11]. By implementing a QMS, a company benefits from the trust of its customers, which also increases its competitiveness in the market [16]. Customer orientation ensures the gathering of customer feedback and adapting the services to meet their requirements, thereby increasing customer satisfaction.

The proper implementation of the QMS can improve the quality of products and services provided, the financial performance of the company and increase its competitiveness in the market significantly [17]. QMS can be associated with continuous development (12%) and overall improvement of the performance of the company which contributes to the fact that an increasing number of companies choose to implement the QMS in their operation [2].

Through the analysis of the literature sources, the authors conclude that a QMS is not subject to a single definition and can be described as a set of actions that management should take to ensure quality management in the company, e.g., setting quality

policy, quality objectives and providing resources and processes for their continuous achievement. A QMS is a system of processes, operations, organizational structure, and documentation that contributes to the continuous performance of a company and providing the information necessary for the achievement of defined quality objectives. Most often, the QMS is described in terms of the principles and benefits it entails, which, in the authors' view, gives a more complete understanding of the concept. The QMS is the planning, control, assurance and improvement of product and service quality, the improvement of the efficiency of processes and operations of the company, the orientation towards the increase of customer satisfaction, and the identification and elimination of problems and nonconformities, which contribute to the overall continuous improvement of the performance of the company. The QMS is the interaction of all the activities and require management, control, and constant development. The authors believe that it is important to implement a QMS through timely systemic planning to ensure the success and quality of the business from the outset and prevent problems, risks, and nonconformities from occurring. In order to ensure the effective operation of the QMS, companies must consider these aspects in conjunction with applicable requirements and the expectations of internal and external stakeholders to ensure continuous improvement and the increase of customer satisfaction. For this purpose, it is possible to apply various tools and methods in the implementation of the quality management system.

3. TOOLS AND METHODS FOR THE ENHANCEMENT OF THE QUALITY MANAGEMENT SYSTEM

Companies apply various tools and methods to analyse different aspects of the management system, as well as to identify and prevent possible risks and problems in their operation. These tools and methods facilitate the detection and analysis of nonconformities, as well as the identification and development of solutions for improvement to increase efficiency and customer satisfaction.

Internal audit: Internal audit of the QMS is a requirement of the ISO 9001 standard and is often carried out once a year to get an overview of the functioning of the QMS in accordance with the set requirements. Internal audit is characterised as a tool by which an organization can make substantial enhancements in its systems and performance [18]. That said, internal audit should not be considered as a burden, as an evaluation could provide new opportunities and benefits for the improvement of the system. The main objectives of an internal audit are to identify and monitor the risks of the company, assess the effectiveness of the internal controls, and improve the overall management of the company [19]. Before conducting an internal audit and to ensure a comprehensive analysis, it is recommended for auditors to prepare checklists of requirements to provide the best possible overview of the processes and the overall performance of the QMS [3]. It is recommended to use open-ended questions during the audit to obtain as much information as possible. Also, the internal auditors should have the adequate competence to assess the specific company, as well as the skills and personal traits to ensure an appropriate environment for successful conduction of interviews, as well as to monitor the audited operations adequately.

The authors conclude that an internal audit is necessary to assess the adequacy and performance of the implemented management system. Applying this method to the assessment of the QMS of

the company provides the data necessary for implementing ongoing improvements. As internal audits are often carried out periodically, it is possible for a company to monitor its growth by detecting possible nonconformities and risks in the system and contribute to the elimination or control of these elements. It should be noted that in order to ensure the highest possible reliability of the results, the impartiality and independence of the auditors involved from the audited entities should be ensured, which may introduce challenges in small companies.

Ishikawa diagram: The Ishikawa (also fishbone) diagram, or cause-and-effect diagram, is a visualization tool for analysing the root causes of an identified problem. To create an Ishikawa diagram, it is necessary to identify and describe the problem, create a fishbone structure, brainstorm to determine as many factors influencing the problem as possible, and to set priorities to put forward the root causes of the problem [20]. Successful development of an Ishikawa diagram would require the involvement of employees of the company to combine their views, communicate and discuss the problems identified to explore the main causes of their occurrence. It helps the representatives of the company to take the most appropriate decisions and move in the right direction by proposing solutions to the problem [4]. Teamwork to identify the possible causes and develop solutions may strengthen the company by motivating and encouraging employees to be involved in problem solving and putting forward proposals and solutions for improvement. That said, as the tool may require the participation of a variety of employees in different organisational levels, consideration of the workload and time-consumption that the application of this method requires is needed.

The authors conclude that discovering the root causes of detected problems and nonconformities, especially when the possible causes are considered under different categories, enables the in-depth analysis of reasons for their occurrence which might not have been conceivable at first. The advantage of the Ishikawa diagram is not only the identification of the main causes of a problem, but also the strengthening of teamwork and employee collaboration in the process of applying this tool.

Quality function deployment (QFD): The QFD matrix is a tool aimed at translating customer needs into product and service requirements to pursue superior product and service quality [21]. For companies interested in achieving competitiveness and gaining new market shares, the development of a QFD matrix offers several advantages such as the possibility of collecting and analysing the data on customer requirements that could be reused in new product development or the improvement of existing products, the facilitation of collaboration among the employees of the company, as well as the reduction of costs. [22]. During the creation of the QFD matrix, customer needs are transformed into technical requirements and the interrelation between these elements is analysed. The method can contribute to the prevention of nonconformities and potential risks and may be applied in the beginning of the product or service development cycle to help companies by taking into account the needs and requirements of customers [23]. Also, the characteristics of the products or services of the company can be compared to other competitors in the market. However, it must be noted that the creation of the QFD matrix is a time-consuming process that requires the obtaining of a large amount of data, therefore adequate resource allocation is required.

Focusing on the industry covered in this study, the authors conclude that the QFD matrix may be especially useful for service provider companies, as the customer is a key element in the operation of these companies. Hearing the voice of the

customer would enable to develop new services or improve the quality of existing ones in compliance with customer requirements, thus ensuring their satisfaction.

Failure mode and effects analysis (FMEA): To ensure continuity, companies must analyse risks systematically in order to protect their operation from adverse errors. The goal of FMEA is to eliminate failure modes and reduce risk occurrence. [24]. FMEA contributes to the prevention rather than the detection of risks by identifying the operations that are most likely to lead to errors. This tool is an efficient and effective way for a company to foresee and analyse potential risks and their consequences as the analysis of these risks reveals the amount of their impact and how they can be prevented or reduced [25]. It must, however, be noted that quantification of risks, their probability of occurrence and magnitude of impact may be subjective, and employees need in-depth knowledge to identify and develop scenarios of the consequences of possible risks thoroughly.

The authors conclude that the detection of risks protects the operation of companies and gives an advantage in anticipating the possible effects. Therefore, FMEA can be considered as a useful tool for companies to identify and prevent possible risks while also identifying their mitigation and avoidance measures. The application of the method can make a significant contribution to maintaining the efficiency of the QMS and ensuring the quality of products and services.

Value Stream Mapping (VSM): VSM provides a visual representation of how a process can be adjusted to improve its efficiency. The method presents both the process steps and the required resources, information flow and time, identifying the creation of value and presenting opportunities for possible adjustments. VSM provides the opportunity to plan the state of future processes using the current process flow and the identified losses that can be transformed into improvements [5]. The method is effective in capturing the necessary data about a process in a visual way that is easy for employees to understand and helps to identify and explain the nature of possible problems and opportunities for improvement [26]. It should be considered that the development of the VSM requires potentially time-

consuming in-depth process analysis and accounting of time that may not be feasible at certain stages of specific processes.

The authors conclude that the method can provide easy-to-view information for streamlining processes in the company and allows understanding of value streams for optimization of resources and operations. It is also worth noting that it would be especially useful to apply VSM to processes that do not meet the current needs or planned results of the company.

To summarize, the reviewed tools and methods add complementary elements to the quality management system that study the different types of processes, product and service characteristics and their relation to the needs of customers, the evaluation of risks and causes of nonconformities, as well as opportunities for systemic improvements. Thereby, it is possible to conclude that the tools and methods contribute to the enhancement of all the aspects of the QMS identified through the qualitative content analysis (Figure 3). By applying these tools and methods, companies are able to discover new opportunities and eliminate weaknesses which are important for the development and improvement of the QMS.

4. APPLICATION OF THE IDENTIFIED TOOLS AND METHODS IN MULTIAPARTMENT BUILDING MANAGEMENT AND MAINTENANCE COMPANIES

In order to assess the suitability of the analysed tools and methods for companies operating in the multiapartment building management and maintenance industry, the authors applied the tools and methods to the QMS of one of the largest companies in this field in Latvia. The company in question provides management and maintenance services to multiapartment buildings such as maintenance of common areas and associated territory, maintenance, and improvement of the technical condition of buildings, e.g., by conducting visual inspections, as well as renovation of buildings which includes the inviting of apartment building residents to apply for renovation loan programmes which provide funding for renovation of common areas and landscaping of the buildings. The company is in the process of implementing a QMS, therefore the current status of

	Quality improvement	Ensuring process efficiency	Problem prevention	Customer orientation	Continuous improvement	References	
Internal audit	Provides an overview of the processes and the overall performance of the QMS.		Identifies and monitors the risks of the company, assesses the effectiveness of the internal controls.	Provides an overview of the functioning of the QMS in accordance with the set requirements.		3; 18; 19	
Ishikawa diagram	Identifies and describes problems, the factors influencing the problem, puts forward the main possible root causes of the problem. Involves employees in problem solving and putting forward proposals of solutions for improvement.						4; 20
QFD	Translates customer needs into product and service requirements to pursue superior product and service quality.	Introduces facilitation of collaboration among the employees of the company, as well as the reduction of costs.	Contributes to the prevention of nonconformities and potential risks in product and service development.	Ensures the hearing of the voice of the customer to develop and improve products and services that ensure compliance with customer requirements.		21; 22; 23	
FMEA	Ensures systematic analysis of risks, helps to identify risk mitigation and avoidance measures, thus ensuring the overall effectiveness of the quality management system and the quality of products and services.						24; 25
VSM	Provides the opportunity to plan the state of future processes through the use of the current process flow and the identified losses and created value that can be transformed into improvements of the QMS. Helps to determine the amount of resources and information required and how it should be flowing through the value streams in a more user-friendly and comprehensible way, thus supporting the overall functioning of the QMS.						5; 26

Figure 3. The contribution of different tools and methods to the identified aspects of the QMS.

the management system was assessed against the requirements of ISO 9001:2015, taking into account the desire of the company to implement the requirements of this standard in the near future.

Internal audit was applied to identify the necessary actions that the company should consider in order to establish a QMS and to ensure that its business is operating in accordance with the requirements of the ISO 9001 standard. The assessment revealed a number of nonconformities, including the lack of revision of the stakeholders of the company and their requirements in relation to the QMS, the lack of definition of the scope of the QMS and process interactions and measurements to monitor process performance, the lack of defining the quality policy and quality goals, difficulties with knowledge retention, as well as problems with timely review of electronically documented information. Also, the internal audit helped to discover the incomplete identification of customer expectations and criteria for the re-evaluation of external suppliers. As sustainable construction consists of four pillars – environmental, economic, social, and technological –, the activities of sustainability cover the whole life cycle of a building starting with the mining of raw materials until the end of life of the building [27]. Therefore, it is important to re-evaluate the selected outsourced service providers in order to also contribute to the sustainability of the apartment buildings. The authors concluded that for companies operating in the multiapartment building management and maintenance industry, internal audit can provide a comprehensive overview of the effectiveness and compliance of the QMS with the applicable requirements, thereby creating an opportunity to identify opportunities for improvement in all elements of the QMS.

Since the ISO 9001 standard requires the provision and timely updating of documented information, and the internal audit revealed a problem with document management in the company, the authors developed an **Ishikawa diagram** to identify the causes of the problem. Failure to update the documentation of the company risks incorrect actions that compromises customer satisfaction with the services provided, safety of employees, and consequently also the image of the company. The reasons identified suggest that the internal regulations of the company are not updated in a timely manner, for example due to its large size and the volume of information contained in the documentation. The Ishikawa diagram, through the conduction of brainstorm and involvement of employees of the company, also helped to identify that the responsibilities and tasks of the employees for document management are defined incompletely.

The authors conclude that the Ishikawa diagram facilitated the identification of causes of the problem significantly and the in-depth analysis revealed problems that were not previously detected in the operation of the QMS. The authors conclude that this tool may be applied not only to internal processes of multiapartment building management and maintenance companies, but also to solving the issues related to customer satisfaction and the serviced buildings.

Adhering to the identified document management issue of the QMS, the authors developed **VSM** for the process of developing and updating internal regulations. The method helped to define the process steps and identify time losses, thus revealing the weaknesses in the process. The creation of VSM also identified whether the process steps create value for the customers or the company. The development of the VSM enabled the authors to identify the main reasons of why the internal documentation is not updated in a timely manner. By addressing the problem causes identified in the VSM through process improvements, it will be easier to maintain the QMS of the company, as the documented information required by the ISO 9001 standard, as

well as the documented information necessary for the operations of the company will be developed, used, and updated regularly.

The authors conclude that, although applying the method is time-consuming, it provides transparent and easy-to-understand information about the process steps, helps to identify time losses, as well as reasons for process deficiencies, and gives the opportunity to follow changes in process efficiency in the long term. It is possible to conclude that the method has a high potential in the development and review of processes of companies operating in the multiapartment building management and maintenance industry as the services of these companies are formed by the interaction of complex and interrelated processes which create value for both the company and its customers.

Using the **FMEA** method, potential risks in the operations of the company were identified and assessed. The FMEA revealed a number of risks that could have a negative impact on the performance of the company and therefore measures to mitigate the occurrence of the risks were determined. For example, focusing on the problems of document management, it is important for the company to update the internal regulations by defining the regularity of reviewing the documents to reduce the risk that the processes described in the documentation are outdated. There is a risk of employees following internal regulations that describe outdated processes, thus making mistakes and providing inadequate services to the customers resulting in losses and customer dissatisfaction with the services provided. The FMEA analysis enabled the determination of measures for risk mitigation to allow the company to prevent, minimize or eliminate possible errors and nonconformities.

The authors evaluate the FMEA as an easy-to-use method the results of which can be regularly updated, thus ensuring constant monitoring of risks. The authors also conclude that it could be a challenge for companies to develop scenarios for risks that have not yet occurred, therefore the involvement of employees participating in the relevant processes is necessary. Since risks can be identified in all areas of the QMS of the company, including process efficiency, customer satisfaction, management of external suppliers, etc., the method can be evaluated as adjustable to the needs of different companies operating in the multiapartment building management and maintenance industry. According to the results of a customer survey conducted in 2021, almost 50% of the customers surveyed are not satisfied with the services provided by the reviewed company. This means that it is necessary to implement measures that would contribute to the increase of service compliance to the needs of customers. For this purpose, the authors created a **QFD matrix** to transform the needs and requirements of customers in terms of multiapartment building management and maintenance services. In developing the QFD matrix, customer requirements were identified based on customer satisfaction surveys conducted by the company, while service characteristics were identified in collaboration with the employees of the company through the conduction of a brainstorm and by filling in a targeted survey. The authors used the assessments of employees to determine the importance of the customer requirements in correlation with service characteristics. It was concluded that for the multiapartment building management and maintenance company in question, the service characteristics that are most likely to meet the needs of the customers are timely responses to customers enquiries, promptly delivered services, quality assurance of services, and inspections. It can be concluded that the application of the QFD matrix allows multiapartment building management and maintenance companies to identify which service characteristics are most relevant to customer needs, thus providing an overview of

services that have the potential to be improved to increase customer satisfaction.

By applying the discussed methods to the selected company, the authors conclude that these tools and methods are suitable for the analysis and improvement of the quality management systems of companies operating in the multiapartment building management and maintenance industry as they provide evidence-based data on the effectiveness of the QMS, help to discover problems and their causes within the system, facilitate the defining of measures for their prevention and elimination, as well as facilitate the development of solutions for the improvement of QMS not only in internal processes, but also in relation to the provided products and services, thus contributing to the increase of customer satisfaction.

5. CONCLUSIONS

The qualitative content analysis revealed that the concept of the QMS is most often described in the literature in the context of quality improvement. QMS is associated with the activities and benefits that the implementation of the system brings to the company, such as process efficiency, problem prevention, customer orientation and continuous development. Tools and methods for analysis of different elements of the QMS enables companies to identify new opportunities and eliminate weaknesses to contribute to their overall development and improvement of the QMS.

The tools and methods applied enabled an extensive analysis of the current state of the QMS of the multiapartment building management and maintenance company and identified new opportunities for filling the gaps within the system in order to foster its development and improvement.

The internal audit is a suitable method for companies to monitor the compliance of their activities in accordance with established requirements such as the requirements of a standard, and the internal audit exercise allows the identification of areas for improvement of the QMS. During an internal audit, the employees of the company should cooperate with the auditor to obtain the most comprehensive data on the current state of the QMS. Also, the competence and skills of the auditor is a prerequisite for a successful audit and the reliability of results. The authors would like to add that it should be taken into consideration that companies operating in the multiapartment building management and maintenance industry are usually subject to the regulatory requirements of the specific territory of operation which determine the principles and activities of managing residential buildings. Therefore, these requirements must be integrated into the quality management systems of the companies and, consequently, their fulfilment must be audited.

The auditors conclude that the Ishikawa diagram is an effective tool for discovering the causes of a defined problem. The tool is useful to apply for multiapartment building management and maintenance companies not only to conduct an in-depth analysis of the root causes of problems but also to encourage teamwork and the involvement of employees in conducting brainstorming and problem solving.

VSM is a practical method for the visualisation of processes of companies to identify their strengths and weaknesses in terms of value creation and time loss. This method can allow further monitoring of the results of the business processes, for example by tracking changes in the consumption of time and resources, thus contributing to the increasing of the efficiency of the QMS. To prevent errors and risk occurrence in the operation of multiapartment building management and maintenance

companies, it may be useful to apply the FMEA method. This analysis contributes to the continuous improvement of the QMS as it also includes the development of risk reduction measures and facilitates the monitoring of risk occurrence. The development of risk scenarios may be found challenging; however, the identification of potential risks may be facilitated through the cooperation of employees involved in the related processes. The application of the method is appropriate to prevent and protect the operation of companies from adverse process outcomes and their consequences.

The QFD matrix requires extensive gathering of information due to the need of defining customer requirements and service characteristics to be measured, however, the development of the QFD matrix provides companies with the necessary guidance on which of the service characteristics need to be improved in order to meet customer requirements and to ensure customer satisfaction. The development of the matrix can contribute to competitiveness of multiapartment building management and maintenance companies as the analysis of competitors can also be included in the QFD matrix, which may lead the companies to identify their strengths and weaknesses, and opportunities to improve their performance.

Improving the QMS and the quality of services of multiapartment building management and maintenance companies is important to ensure successful operation, conformance to applicable requirements, and to promote the increase of customer satisfaction. Also, as such companies usually operate in a competitive market, continuously improving the services offered may improve their competitiveness. The study revealed that the application of the various tools and methods can contribute to the enhancement of the QMS through all of the identified aspects of the QMS – by improving the quality of products and services, ensuring process efficiency, preventing problems and nonconformities, promoting customer orientation, as well as ensuring the continuous improvement of the QMS.

6. REFERENCES

- [1] G. Kutnjak, D. Miljenovic, A. Mirkovic, "Improving Competitiveness of Small and Medium-Sized Enterprises with the Application of Quality Management System", **Scientific Journal of Maritime Research**, Vol. 33, No. 1, 2019, pp. 11-21.
- [2] A. Rozentale, I. Kotane, "Assessment of the quality management system in woodworking companies", **Journal of Regional Economic & Social Development**, Vol. 13, 2021, pp. 97-110.
- [3] A. Nichols, "ISO 9001: Internal Quality System Audits", **Quality**, Vol. 51, No. 10, 2012, pp. 39-41.
- [4] S.S. Li, L.C. Lee, "Using fishbone analysis to improve the quality of proposals for science and technology programs", **Research Evaluation**, Vol. 20, No. 4, 2011, pp. 275-282.
- [5] M. Kavosa, I. Lapiņa, "Value Stream Mapping: Effective Process Improvement Tool in the Certification Process", **The 24th World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI 2020): Proceedings**, United States of America, Orlando, 13-16 September, 2020. Winter Garden, Florida: International Institute of Informatics and Systemics (IIS), 2020, Vol. 3, 2020, pp. 59-64.
- [6] ISO 9001:2015 Quality management systems - Requirements (2015) [online]. **International Organization for Standardization** [accessed 21 May 2023]. Available at: <https://www.iso.org/standard/62085.html>

- [7] K. Ali, S. Mubin, E. Gavrishyk, "Evaluating Quality Management System of Construction Projects", **International Journal of Performability Engineering**, Vol. 18, No. 7, 2022, pp. 492-501.
- [8] ISO 9000:2015 Quality management systems – Fundamentals and vocabulary (2015) [online]. **International Organization for Standardization** [accessed 21 May 2023]. Available at: <https://www.iso.org/standard/45481.html>
- [9] J.P. Christopher, "The importance of implementing a quality management system in the laboratory", **MLO: Medical Laboratory Observer**, Vol. 51, No. 1, 2019, pp. 26-27.
- [10] I. Lapiņa, I. Briede, D. Aramina, "Interrelation of Process Management and Employee Stressors in Organization", **The 25th World Multi-Conference on Systemics, Cybernetics and Informatics (WMSCI 2021): Proceedings**, Vol.3, United States of America, Orlando, 18-21 July, 2021. Winter Garden, Florida: International Institute of Informatics and Systemics (IIS), 2021, pp. 140-145.
- [11] M.A. Samani, N. Ismail, Z. Leman, N. Zulkifli, "Development of a conceptual model for risk-based quality management system", **Total Quality Management & Business Excellence**, Vol. 30, No. 5/6, 2019, pp. 483-498.
- [12] N.G. Bagaoutdinova, M.E. Camargo, A.V. Gumerov, A.N. Ibraghimova, "Strategy of Sustainable Development by the example of Department of Business Economics and Marketing: Introduction of Quality Management System", **Business Management Dynamics**, Vol. 12, No. 1, 2022, pp. 1-9.
- [13] D.S. Emelyanova, S.L. Kolesnichenko-Ianushev, M.A. Tokarev, "Organizational and economic problems of applying quality management system at engineering companies", **St. Petersburg State Polytechnic University Journal. Economics**, Vol. 12, No. 2, 2019, pp. 92-102.
- [14] C.S. Patel, J.R. Pitroda, "Quality management system in construction: a review", **Reliability: Theory & Applications**, Vol. 60, 2021, pp. 121-131.
- [15] A. Jarvis, L. Morales, U. Ranadive, **Achieving Customer Experience Excellence Through a Quality Management System**, Milwaukee: ASQ Quality Press, 2016.
- [16] M. Mihailovic, J. Todoc, J. Jotic, "Implementation of quality management system and the level of maturity of the company in the dairy industry of Serbia", **Ekonomika**, Vol. 67, No. 3, 2021, pp. 63-74.
- [17] A. Gargasas, M. Samuolaitis, I. Mugiene, "Quality management systems in logistics", **Management Theory & Studies for Rural Business & Infrastructure Development**, Vol. 41, No. 2, 2019, pp. 290-304.
- [18] R. Wolniak, "Internal audit and management review in ISO 9001:2015", **Scientific Papers of Silesian University of Technology. Organization & Management**, No. 151, 2021, pp. 711-723.
- [19] R. Staciokas, R. Rupsys, "Internal Audit and its Role in Organization Government", **Management of Organizations: Systematic Research**, Iss. 33, 2005, pp. 169-180.
- [20] N. Radziwill, "Creating Ishikawa (Fishbone) Diagrams With R.", **Software Quality Professional**, Vol. 20, No. 1, 2017, pp. 47-48.
- [21] P. Sivasankaran, "Literature Review on Quality Concepts in Industrial Systems using QFD (Quality Function Deployment) – Survey and Extensions", **Productivity**, Vol. 61, No. 4, 2021, pp. 463-469.
- [22] C.N. Madu, **The House of Quality in a Minute: A Guide to Quality Function Deployment**. 3rd edition, Charlotte: Information Age Publishing, 2020.
- [23] A. Huang, J. Cao, H. Zhang, "Construction of patient service system based on QFD in internet of things", **Journal of Supercomputing**, Vol. 77, No. 3, 2021, pp. 2155-2171.
- [24] D.H. Stamatis, **Risk Management Using Failure Mode and Effect Analysis (FMEA)**. 2nd edition, Milwaukee: ASQ Quality Press, 2019.
- [25] M.M. Weeden, **Failure Mode and Effects Analysis (FMEA) for Small Business Owners and Non-Engineers**, Milwaukee: ASQ Quality Press, 2015.
- [26] G.G. Ramos, M.A. Coelho, "Value stream mapping in healthcare and sustainable development: a systematic review", **Revista Producao Online**, Vol. 21, No. 4, 2021, pp. 1116-1142.
- [27] S. Mjakuškina, M. Kavosa, I. Lapiņa, "Achieving Sustainability in the Construction Supervision Process", **Journal of Open Innovation: Technology, Market, and Complexity**, Vol. 5, No. 3, 2019, pp. 1-11.