

MANAGERIAL AND ORGANIZATIONAL DETERMINANTS OF QUALITY 4.0 IMPLEMENTATION: EVIDENCE FROM ISO 9001:2015 CERTIFIED COMPANIES

DOI: 10.5937/JEMC2600009T

UDC:
Original Scientific Paper

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Paper received: 17.07.2026.; Paper accepted: 10.09.2026.

Successful implementation of Quality 4.0 requires managerial and organizational conditions that extend beyond the mere adoption of digital technologies. This study examines the key determinants of Quality 4.0 implementation in companies certified to the ISO 9001:2015 standard. The research was conducted in the Republic of Serbia using a structured questionnaire survey. Correlation and multiple regression analyses were employed to examine the effects of top management support, leadership, vision and strategy, organizational culture, managerial competencies, and employee training on the implementation of Quality 4.0. The results indicate that all examined determinants are significantly associated with successful Quality 4.0 implementation, while vision and strategy and employee training remain statistically significant independent predictors in the full regression model. The findings confirm that successful Quality 4.0 implementation depends on the alignment of managerial and organizational capabilities rather than solely on technological factors. This study contributes to the existing literature by shifting the focus from assessing organizational readiness to identifying the determinants that support successful Quality 4.0 implementation, while also providing practical guidance for managers planning digital transformation initiatives.)

Key words: Quality 4.0; Managerial and organizational determinants; Implementation; ISO 9001:2015.

INTRODUCTION

Digital transformation of business systems is significantly changing the way companies manage quality and improve their business processes. The application of advanced technologies, such as artificial intelligence, the Internet of Things, big data analytics, and advanced information systems, enables the development of new approaches to quality management that go beyond traditional continuous improvement models. In this context, the concept of Quality 4.0 is the application and integration of advanced digital technologies into established quality management principles, processes, and practices to enhance quality performance and decision-making.

Although modern technologies represent an important foundation of Quality 4.0, their availability alone does not guarantee the successful implementation of this concept. Companies differ in their ability to integrate technological solutions into existing quality management systems and business processes. Successful Quality 4.0 implementation depends not only on technological readiness but also on the existence of appropriate managerial and organizational conditions. Among companies with similar levels of digital maturity, organizational factors may represent the key difference between successful and unsuccessful implementation.

Previous research on Quality 4.0 has mainly focused on identifying key technologies, digital capabilities, and the potential benefits of their application. However, the managerial and organizational aspects

of implementation remain insufficiently explored, particularly regarding the relative importance of individual determinants when considered simultaneously. Although the literature recognizes the importance of top management support, leadership, strategic orientation, organizational culture, employee competencies, and training, it remains an open question which of these determinants make an independent contribution to successful Quality 4.0 implementation.

Considering the identified research gap, the aim of this study is to examine the influence of selected managerial and organizational determinants on successful Quality 4.0 implementation. The study analyzes the following determinants: top management support, leadership, vision and strategy, organizational culture, managerial knowledge and competencies, and employee training. A particular focus of the research is to determine their relative contribution, i.e., to identify the factors that retain a statistically significant independent contribution when all analyzed factors are considered simultaneously.

The research was conducted using a structured questionnaire survey among companies certified according to the ISO 9001:2015 standard in the Republic of Serbia. ISO 9001:2015-certified companies were selected as the research context because of their formalized quality management systems, rather than as evidence that they already implement Quality 4.0. The focus on certified companies stems from their orientation toward systematic quality management, continuous improvement of business processes, and the application of modern quality management principles. Therefore, these companies represent an appropriate context for examining organizational conditions that may support Quality 4.0 implementation. The respondents included quality professionals, i.e., company representatives who have direct insight into the functioning of quality management systems.

The contribution of this study can be viewed from several perspectives. From a theoretical standpoint, the research contributes to a better understanding of the organizational prerequisites for successful Quality 4.0 implementation by moving beyond approaches that primarily focus on the technological aspects of quality digital transformation. Unlike studies that seek to identify or rank a large number of potential determinants, this study examines which of the analyzed managerial and organizational

determinants make a statistically significant independent contribution to successful Quality 4.0 implementation. From a practical perspective, the findings can help managers identify priority areas for development and direct activities toward creating the organizational conditions necessary for the successful digital transformation of quality management systems.

THEORETICAL FRAMEWORK OF THE STUDY

Quality 4.0 as the research context

The development of Industry 4.0 and the intensive adoption of digital technologies have led to significant changes in the way organizations are managed, with these changes particularly affecting the field of quality management. Traditional approaches, primarily focused on controlling and improving product and process quality, are gradually evolving towards the concept of Quality 4.0, which combines quality management principles with advanced digital technologies. This creates opportunities for the development of intelligent quality management systems based on data analytics, process automation, and real-time decision-making.

Although there is no universally accepted definition of Quality 4.0 in the literature, most authors view this concept as the integration of traditional quality management principles with Industry 4.0 technologies to improve organizational performance. Küpper et al. (2019) define Quality 4.0 as a new approach to quality management that enables the development of high-performance products through the application of innovative digital tools. Dias et al. (2022) emphasize that the concept is based on technological capabilities that enhance human capabilities and existing quality management methods, while Mittal et al. (2023) highlight its role in connecting quality management principles with digital technologies to achieve continuous improvement and innovation. Some authors also define Quality 4.0 as an organization's ability to manage quality in the context of Industry 4.0 (Condé et al., 2022), or as a comprehensive concept for developing modern quality management methods based on information and communication technologies and automation (Vlastaridou et al., 2022).

By integrating traditional methods with advanced digital solutions, organizations improve

effectiveness, flexibility, and the ability to continuously improve business processes (Sader et al., 2022; Thekkootte, 2022). Modern tools and technologies within Quality 4.0 enhance traditional quality management approaches by providing timely information, more accurate planning, simulations, and more efficient prototyping (Glogovac et al., 2022). Intelligent quality management systems enable automated data collection and processing, continuous monitoring of process performance, and decision-making based on reliable information, with knowledge becoming one of the most important organizational resources (Oztemel, 2020).

Numerous studies confirm that the implementation of Quality 4.0 contributes to improved organizational performance through real-time process monitoring, data-driven decision-making (Mittal et al., 2022), reduced duration of production activities (Liu et al., 2023), decreased nonconformities, and increased supply chain flexibility (Antony et al., 2023). In addition, it enables greater operational efficiency and productivity, while contributing to higher organizational competitiveness and innovativeness, as well as improved customer satisfaction (Milward et al., 2019; Sony et al., 2021). The development of cyber-physical systems, artificial intelligence, machine learning, and big data analytics further strengthens the ability to predict deviations, optimize processes, and support timely business decision-making (Arsovski, 2019; Christou et al., 2022). Therefore, Quality 4.0 is considered one of the key drivers of improving organizational performance (Liu et al., 2023).

Despite the significant benefits it provides, successful Quality 4.0 implementation represents a complex organizational process. Although the concept is often associated with the adoption of advanced digital technologies, there is a growing recognition that technology alone is not sufficient to achieve the expected outcomes. Santos et al. (2021) and Tadić Stanić (2023) emphasize that the foundation of Quality 4.0 lies in the integration of people, processes, and technologies, while Chiarini and Kumar (2022) highlight the human factor as one of the key conditions for successful implementation of this concept. Therefore, organizations with adequate technological resources may not necessarily achieve successful implementation unless they simultaneously develop appropriate managerial and organizational conditions that enable effective change implementation.

Assessment of organizational readiness is one approach used to examine the conditions for Quality 4.0 implementation. Such assessment enables the identification of existing organizational strengths and limitations, reduces the risk of unsuccessful implementation, and helps define priorities for further improvement (Zulfiqar et al., 2023). As a relatively new concept, Quality 4.0 is addressed through readiness assessment approaches that are still developing (Chiarini, 2020), compared with the broader range of readiness models available in the Industry 4.0 literature (Hizam-Hanafiah et al., 2020). Such models provide a useful basis for understanding an organization's preparedness and for planning digital transformation initiatives. However, they primarily address whether the conditions for implementation are present, providing less insight into the relative contribution of specific managerial and organizational determinants to successful Quality 4.0 implementation. This highlights the need to examine the relative contribution of specific managerial and organizational determinants to successful Quality 4.0 implementation.

Managerial determinants of Quality 4.0 implementation

Although the adoption of advanced digital technologies represents the foundation of the Quality 4.0 concept, the success of their implementation largely depends on the effectiveness of organizational change management. The introduction of digital technologies into industrial work systems is associated with various sociotechnical challenges that may affect overall system performance and employee well-being, which is why technological transformation requires simultaneous consideration of organizational aspects of change (Kadir & Broberg, 2021). The implementation of new technologies involves redefining business processes, adapting organizational structures, developing new competencies, and aligning strategic objectives with the principles of digital transformation. For this reason, the literature increasingly emphasizes that successful Quality 4.0 implementation is not solely a technological issue, but rather the result of appropriate managerial activities. The most significant managerial determinants include top management support, leadership, vision and strategy, and managerial knowledge and competencies.

Top management support represents one of the most important determinants of successful Quality 4.0 implementation, as the highest level of management defines organizational strategic priorities, makes key decisions, and provides the resources necessary for the transformation process. Mtotywa (2022) emphasizes that active involvement of top management is a fundamental prerequisite for successful implementation of this concept, while Alzahrani et al. (2021) highlight that management support contributes to change acceptance, greater employee engagement, and more effective quality improvement activities. Top management plays a key role in aligning quality objectives with the overall business strategy, overcoming organizational barriers, and ensuring the long-term sustainability of the implementation process (Schneider, 2021). In this regard, top management support represents not only a demonstration of management commitment to quality improvement but also an organizational mechanism for creating the conditions necessary for successful digital transformation.

Leadership involves the ability to guide employees, create a shared vision for development, and encourage the organization to embrace change. In the context of digital transformation, leaders are responsible for developing an organizational environment that promotes collaboration, innovation, and continuous process improvement. According to the Leadership 4.0 framework developed by Oberer and Erkollar (2018), the highest level is represented by the leader of the modern era (digital leader 4.0). Armani et al. (2021) emphasize that a leadership style focused on innovation and change management represents the most suitable approach for Quality 4.0 implementation, as it encourages employees to embrace new ways of working and actively participate in improving organizational processes. Similarly, Sony et al. (2021) highlight that leadership contributes to the development of organizational learning, strengthening employee commitment, and more effective integration of quality management principles with advanced digital technologies. In this way, leadership enables the translation of organizational strategic intentions into concrete implementation activities.

A clearly defined vision and strategy represent the foundation for successful Quality 4.0 implementation, as they provide a common direction for development and align activities across all organizational levels with digital transformation

objectives. Although the availability of appropriate digital technologies represents an important prerequisite for Quality 4.0 implementation, their adoption alone is not sufficient to achieve the expected outcomes. Successful implementation requires a clearly defined development vision and a strategy that connects digital transformation initiatives with the overall business objectives of the organization. A shared vision enables employees to understand the purpose of change, while an appropriate strategy defines priorities, resource allocation, and the approach to implementing transformation activities.

Sony et al. (2021) emphasize that strategic alignment represents one of the key conditions for successful Quality 4.0 implementation, while Radziwill (2018) highlights that the long-term sustainability of digital transformation depends on its integration into the overall business strategy of the organization. This is further supported by the empirical research conducted by Haque et al. (2016), which confirmed the importance of vision in supporting organizational change and growth. Akcay Kasapoglu (2018) argues that successful digital transformation must include relevant strategic decisions that require strong leadership capable of implementing them throughout the organization through systematic employee training at all organizational levels, from top management to operational employees. Accordingly, vision and strategy represent not merely planning documents, but an organizational framework that enables the coordinated implementation of the transformation process.

The effectiveness of managing the implementation process further depends on the knowledge and competencies of managers. Digital transformation of quality management systems requires managers who, in addition to understanding traditional quality management principles, possess appropriate knowledge of digital technologies, data analytics, and organizational change management. For this reason, Salimova et al. (2020) emphasize the need for interdisciplinary training of quality management professionals. Küpper et al. (2019) indicate that Quality 4.0 implementation requires managers capable of integrating advanced technological solutions with existing business processes, while Yadav et al. (2021) highlight that managerial competencies represent one of the important prerequisites for successful implementation of this concept. Similarly, Kannan and Garad (2021) emphasize the need for knowledge, competencies,

and skills development to effectively manage digital transformation. Managers with appropriate professional and organizational competencies are better able to coordinate implementation activities, solve problems more effectively, and ensure alignment between technological capabilities and organizational business objectives.

The obtained findings indicate that top management support, leadership, vision and strategy, and managerial knowledge and competencies are interconnected managerial determinants associated with Quality 4.0 implementation. While top management support provides strategic direction and the necessary resources, leadership encourages change acceptance and employee engagement, vision and strategy define the direction of organizational development, and managerial competencies enable the effective alignment of organizational objectives with technological capabilities. Their combined effect creates a managerial framework that allows organizations to implement the digital transformation of quality management in a systematic and sustainable manner.

Organizational determinants of Quality 4.0 implementation

In addition to managerial determinants, successful Quality 4.0 implementation also depends on the organizational conditions in which the transformation process takes place. Digital transformation of quality management involves changes that include the adaptation of organizational culture and the continuous development of employee competencies. As a complex organizational process, digital transformation requires the development of new organizational capabilities, structures, and resources to enable organizations to effectively respond to changes driven by the adoption of digital technologies (Verhoef et al., 2021).

Digital transformation can be viewed as a process in which digital technologies drive organizational changes and encourage companies to adapt their approaches to value creation, while the success of transformation depends on the organization's ability to manage structural changes and overcome organizational barriers (Vial, 2019). For this reason, contemporary literature increasingly highlights that the sustainability of implementation depends on an organization's ability to create an environment that encourages continuous improvement, learning, and change acceptance. In this context, organizational

readiness for change can be understood as a state in which organizational members are committed to implementing change, while also having confidence in their collective ability to successfully carry it out (Weiner, 2009).

Organizational culture represents an important determinant of successful Quality 4.0 implementation, as it influences the way employees accept changes, collaborate, share knowledge, and participate in continuous improvement activities. The adoption of digital technologies often requires changes in established work patterns; therefore, organizations with a culture that encourages innovation, learning, and openness to change have significantly more favorable conditions for successful implementation. Digital transformation is not a one-time project but a continuous process of integrating digital technologies into the everyday functioning of an organization, where organizational agility is recognized as a key mechanism of strategic renewal that enables business model adaptation, improved collaboration, and the development of a change-oriented organizational culture (Warner & Wäger, 2019).

Illés et al. (2017) emphasize that organizational culture represents one of the key elements enabling the sustainability of Quality 4.0, while Sony et al. (2021) highlight that a culture oriented toward learning and innovation contributes to more successful integration of digital technologies with quality management principles. Standard quality management methods are no longer able to competitively respond to increasingly demanding customer needs (Balouei Jamkhaneh et al., 2022). Accordingly, Fundin et al. (2025) emphasize that nurturing and preserving the elements of the positive core of quality can contribute to the stable transformation of quality management in rapidly changing environments, highlighting the importance of maintaining fundamental quality values during the digital transformation process.

Leaders play a critical role in developing a digital organizational culture by encouraging collaboration, connecting different stakeholders, and fostering an organizational environment oriented toward innovation, learning, and responsible management of the challenges arising from digital transformation (Cortellazzo et al., 2019). Conversely, an organizational culture characterized by resistance to change, insufficient collaboration, and limited knowledge sharing can significantly slow down or constrain the

transformation process. Therefore, organizational culture should not be viewed as a consequence of implementation, but rather as an organizational condition that determines its success.

Successful Quality 4.0 implementation requires continuous organizational investment in employee development through systematically planned training and professional development programs. The adoption of advanced digital technologies, new quality management methods, and innovative business processes requires organizations to provide employees with opportunities to acquire new knowledge and adopt new ways of working. Creating an environment that encourages employee learning contributes to more effective knowledge acquisition (Gil & Mataveli, 2016). Therefore, employee training should not be considered a one-time activity, but rather a continuous organizational process essential for Quality 4.0 implementation and effective adaptation to technological and organizational changes (Zavadska & Zavadski, 2020).

Systematic planning, implementation, and evaluation of training programs contribute to reducing resistance to change, increasing employee involvement in improvement activities, and enabling more effective application of new solutions in daily operations (Schneider, 2021). Resistance to change represents one of the key barriers to successful digital transformation, as it negatively affects organizations' ability to effectively adopt new technologies and business models (Frick et al., 2021). On the other hand, intangible resources represent the foundation of long-term superior business performance (Teece, 2007).

Employee training represents an important organizational determinant of implementation, as it contributes to developing the capabilities required for employees to accept and use new digital solutions. Developing these capabilities is an important factor in successful digital transformation, as it enables more effective integration of technological innovations into everyday business processes (Fonseca et al., 2021). In this way, training contributes not only to the implementation of planned changes but also to their long-term sustainability.

Overall, organizational culture and employee training represent interconnected organizational determinants that enable successful Quality 4.0

implementation. Organizational culture shapes the way employees accept and support change, while employee training ensures the development of competencies required for the application of new technologies and quality management methods. Their interaction creates an organizational environment in which the digital transformation of quality management can be implemented effectively, systematically, and in a sustainable manner over the long term.

Research gap

A review of the available literature shows that previous research in the field of Quality 4.0 has primarily focused on defining the concept itself, identifying its technological characteristics, and developing models for assessing organizational readiness for implementation. Numerous authors have developed readiness models that enable organizations to assess their level of development regarding the adoption of digital technologies, quality management, and organizational capabilities, thereby facilitating the planning of digital transformation processes. However, although readiness models represent an important contribution to understanding Quality 4.0, they are primarily focused on assessing the current state of an organization, while paying considerably less attention to explaining the relative contribution of individual managerial and organizational determinants to successful implementation of this concept.

The number of empirical studies that simultaneously analyze the contribution of multiple managerial and organizational determinants within a single model remains particularly limited. Although top management support, leadership, vision and strategy, organizational culture, managerial knowledge and competencies, and employee training are frequently considered individual success factors, their interrelationships and relative contribution to successful Quality 4.0 implementation have not yet been sufficiently explored. This limitation is particularly evident in research conducted in developing countries, where the number of empirical studies examining organizational determinants of Quality 4.0 implementation remains limited.

Based on the identified research gap, the subject of this study is the examination of the contribution of managerial and organizational determinants to successful Quality 4.0 implementation in compa-

nies certified according to the ISO 9001:2015 standard in the Republic of Serbia. Unlike studies focused exclusively on assessing organizational readiness, this research places emphasis on identifying determinants that represent organizational prerequisites for successful Quality 4.0 implementation and evaluating their relative contribution within a unified empirical model. In this way, the study contributes to expanding existing knowledge on Quality 4.0 by shifting the focus from organizational readiness assessment toward understanding the managerial and organizational conditions that enable successful implementation of this concept. At the same time, the research findings have practical relevance, as they can serve managers as a basis for defining priorities when planning and implementing digital transformation initiatives within quality management systems.

RESEARCH METHODS

Subject of the research

The subject of this study is the examination of the relative contribution of managerial and organizational determinants to successful Quality 4.0 implementation in companies certified according to the ISO 9001:2015 standard. Unlike approaches that focus on identifying or assessing Quality 4.0 readiness factors, this study aims to determine which determinants retain a statistically significant independent contribution when considered simultaneously. In this context, the study analyzes top management support, leadership, vision and strategy, organizational culture, managerial knowledge and competencies, and employee training.

Research objective

The aim of this study is to examine the relative contribution of managerial and organizational determinants to successful Quality 4.0 implementation and to identify the factors that represent significant independent predictors of this process. A specific objective is to move beyond approaches based solely on assessing the importance of individual factors by analyzing their simultaneous effects and identifying the determinants with the greatest explanatory contribution.

Research hypotheses

Successful Quality 4.0 implementation goes beyond the mere adoption of advanced digital technologies and requires companies to develop managerial and organizational conditions that support the transformation process. The introduction of innovative work methods requires adjustments to organizational structures and business processes, while active employee involvement is crucial for change acceptance (Zhao et al., 2023). Among these conditions, top management support represents one of the key organizational determinants (Schneider, 2021), as it influences strategic commitment, resource allocation, cross-functional coordination, and the long-term sustainability of implementation initiatives (Dias, 2021). It also represents an important driver of transformation processes within companies and encourages employee engagement in implementing organizational changes (Sony et al., 2021). Strategic decisions made by top management significantly influence the direction of quality system development and overall organizational performance (Jbeily, 2022). Without active top management support, even companies with adequate technological resources may face significant challenges during implementation. Therefore, top management support should not be viewed solely as a factor related to organizational readiness, but rather as an organizational prerequisite for successful Quality 4.0 implementation (Maganga & Taifa, 2022). Based on the above, the first hypothesis was formulated:

H1: Top management support has a positive impact on Quality 4.0 implementation.

Leadership plays a central role in organizational transformation by shaping employee commitment, facilitating communication, and reducing resistance to change (Arsić et al., 2022). In the context of Quality 4.0, leadership contributes to aligning organizational objectives with digital transformation initiatives and enables the integration of quality management principles with new technologies. Furthermore, its role is reflected in encouraging innovation, organizational learning, and change acceptance (Sony et al., 2021). Particular importance is attributed to leadership focused on developing knowledge and competencies, strengthening collaboration among employees, and building an adaptive organizational culture (Armani et al., 2021). Accordingly, leadership represents an important organizational determinant that enables successful Quality 4.0

implementation (Antony et al., 2020). Based on the above, the following hypothesis was formulated:

H2: Leadership has a positive impact on Quality 4.0 implementation.

The availability of advanced digital technologies represents a necessary, but not sufficient, condition for successful Quality 4.0 implementation. Achieving the expected outcomes depends on the existence of a clearly defined vision and strategy that guide the transformation process, determine development priorities, and ensure the alignment of digital transformation initiatives with the overall business objectives of the organization. The alignment of vision and strategy with Quality 4.0 objectives represents an important prerequisite for successful change implementation and the achievement of expected results (Sony et al., 2021). A clearly defined vision directs employees toward common goals and encourages the acceptance of organizational changes. At the same time, it provides a structured approach to implementation by defining the required resources, activities, responsibilities, and methods for conducting the transformation process. A shared vision and coherent implementation strategy ensure organizational alignment, establish priorities, and facilitate the coordinated execution of transformation activities across different functional areas. Therefore, vision and strategy represent fundamental organizational determinants that support successful Quality 4.0 implementation (Nenadál et al., 2022). Based on the above, the following hypothesis was formulated:

H3: Vision and strategy have a positive impact on Quality 4.0 implementation.

Although Quality 4.0 is primarily viewed through the perspective of technological solutions, the success of its implementation largely depends on the organizational environment in which changes are carried out (Durana et al., 2019; Sader et al., 2022). Organizational culture determines the extent to which employees accept continuous improvement, collaboration, knowledge sharing, and digital transformation initiatives. A culture oriented toward learning and innovation creates organizational conditions for the long-term sustainability of Quality 4.0 implementation. Since this concept involves the adoption of new work methods, digital technologies, and different approaches to process management, employees require an environment that encourages the development of new knowledge and skills. Such conditions are most effectively created within an

adaptive, open, and supportive organizational culture (Sony et al., 2020). Based on the above, the following hypothesis was formulated:

H4: Organizational culture has a positive impact on Quality 4.0 implementation.

Managerial competencies enable organizations to transform strategic intentions into coordinated implementation activities. The role of managers within Quality 4.0 becomes significantly more complex due to the increased integration of processes and greater cross-functional interdependence (Sony et al., 2021). The focus is not only on teamwork, employee motivation, conflict management abilities, and openness to change (Santos et al., 2021), but also on critical thinking, statistical data analysis, data-driven decision-making, and the ability to manage complex information systems (Babatunde, 2021). Managers who possess digital, organizational, and quality management competencies are better able to lead Quality 4.0 initiatives and integrate technological solutions with existing business processes (Jacob, 2017; Küpper et al., 2019). Based on the above, the following hypothesis was formulated:

H5: Managerial knowledge and competencies have a positive impact on Quality 4.0 implementation.

The development of advanced technologies, digitalization of business processes, and the increasing adoption of Industry 4.0 solutions create the need for employees to acquire new knowledge and skills (Santos et al., 2021). Continuous and systematically planned training programs play an important role in preparing employees for the adoption of new technologies, processes, and ways of working (Schneider, 2021). Employee training represents one of the mechanisms through which organizations develop employee capabilities necessary for adopting Quality 4.0 principles. In addition to improving technical competencies, training contributes to a better understanding of transformation objectives, reducing resistance to change, and increasing employee engagement. Conversely, insufficiently developed competencies and inadequate employee preparation represent significant barriers to successful Quality 4.0 implementation (Dias, 2021). Rather than being viewed as an isolated readiness factor, continuous training strengthens an organization's ability to successfully implement technological and organizational changes associated with Quality 4.0 implementation (Ali & Johl, 2022; Küpper et al.,

2019). Based on the above, the following hypothesis was formulated:

H6: Employee training has a positive impact on Quality 4.0 implementation.

Methods, techniques, and research instruments

The research was conducted using a structured closed-ended questionnaire. The respondents were quality professionals employed in companies certified according to the ISO 9001:2015 standard. Respondents' attitudes were measured using a five-point Likert scale, where a value of 1 indicated "strongly disagree" and a value of 5 indicated "strongly agree." The reliability of the measurement instrument was assessed using Cronbach's alpha coefficient, with the obtained values confirming a satisfactory level of internal consistency and reliability of the measurement scales used.

Statistical data analysis was performed using IBM SPSS Statistics, version 26. Descriptive statistics were applied to describe the basic characteristics of the collected data, including the calculation of the mean, standard deviation, variance, skewness coefficient, and kurtosis coefficient.

The relationship between managerial and organizational determinants and successful Quality 4.0 implementation was examined using Pearson's correlation coefficient. This statistical method was applied to determine the direction, strength, and statistical significance of linear relationships between the observed variables, as well as to examine the interrelationships among the analyzed determinants.

To examine the contribution of individual determinants to successful Quality 4.0 implementation, hierarchical and multiple linear regression analyses were applied. Hierarchical regression enabled the assessment of the additional contribution of each determinant in explaining the variance of the dependent variable, while multiple regression analysis was used to identify determinants that make a statistically significant independent contribution within the overall model. The statistical significance of the regression models was tested using analysis of variance (ANOVA).

Sample and research context

The research was conducted on a sample of companies certified according to the ISO 9001:2015 standard in the Republic of Serbia. The focus on

Serbia was based on the fact that, in 2022, the country had 3,541 registered certified companies, representing more than one-third of the total number of certified companies in the Western Balkans region (ISO, 2022). Considering the significant share of the Republic of Serbia in the total number of certified companies in the region, Serbia represents an appropriate context for examining the managerial and organizational determinants of Quality 4.0 implementation.

The participating companies represented a broad range of industry sectors. The largest proportion operated in other activities (31.5%), followed by manufacturing (16.3%), construction (13.0%), wholesale and retail trade (10.3%), and electricity, gas, steam and air conditioning supply (6.5%). The remaining companies operated in education (4.3%), transportation and storage (3.8%), water supply, sewerage, waste management and remediation activities (3.3%), agriculture, forestry and fishing (3.3%), accommodation and food service activities (3.3%), information and communication (1.6%), and mining and quarrying (1.6%).

Regarding company size, the sample included micro (9.8%), small (29.3%), medium-sized (33.7%), and large companies (27.2%), indicating that companies of different sizes were represented in the study.

The questionnaire was distributed via e-mail to approximately 1,500 ISO 9001:2015-certified companies in the Republic of Serbia. A total of 184 companies participated in the survey, corresponding to a response rate of 12.3%. The respondents were quality professionals employed. As some respondents did not answer all questionnaire items, the number of valid responses varied across analyses. Missing data were not imputed; only available valid responses were included in each statistical analysis. Consequently, the final multiple regression model was estimated using 145 complete cases.

RESEARCH RESULTS

Descriptive analysis

The internal consistency of the measurement scales was confirmed using Cronbach's alpha values. The lowest values were recorded for the determinants of top management support ($\alpha = 0.883$) and vision and strategy ($\alpha = 0.888$). The remaining values were above 0.9 (employee training – $\alpha = 0.911$, managerial knowledge and competencies – $\alpha =$

0.933, organizational culture – $\alpha = 0.941$, and leadership – $\alpha = 0.958$). The obtained results indicate high to very high reliability of the measurement scales and good consistency among the items within the analyzed determinants.

Descriptive statistics were used to determine the values of the mean, standard deviation, variance, skewness, and kurtosis coefficients. The obtained results are presented in Table 1.

Table 1: Descriptive Statistics

Managerial / Organizational Determinants	Mean	Std. Deviation	Skewness	Kurtosis	Variance
Top management support	4.05	0.93	-1.19	1.09	0.23
Leadership	3.98	1.02	-0.91	0.09	0.26
Vision and strategy	3.79	0.94	-0.91	0.66	0.25
Organizational culture	3.60	1.03	-0.52	-0.31	0.29
Managerial knowledge and competencies	3.83	0.99	-0.86	0.41	0.26
Employee training	3.35	1.11	-0.27	-0.70	0.30

The mean values indicate that all examined determinants were rated above the midpoint, ranging from 3.35 to 4.05. The highest average score was recorded for the determinant of top management support ($M = 4.05$), followed by leadership ($M = 3.98$), managerial knowledge and competencies ($M = 3.83$), and vision and strategy ($M = 3.79$). A lower value was recorded for organizational culture ($M = 3.60$), while employee training received the lowest average score ($M = 3.35$).

The standard deviation values ranged from 0.93 to 1.11, indicating a moderate dispersion of responses and a relatively consistent level of agreement among respondents. The highest variability of responses was recorded for the employee training determinant, while the lowest variability was observed for top management support.

All examined variables were characterized by negative skewness values, ranging from -0.27 to -1.19. This indicates a left-skewed distribution, meaning that respondents more frequently provided higher ratings. The most pronounced skewness was observed for the top management support determinant.

The kurtosis values ranged from -0.70 to 1.09. Positive values for the determinants of top management support, leadership, vision and strategy, and managerial knowledge and competencies indicate a higher concentration of responses around the mean values, while negative values for organizational culture and employee training indicate a more evenly distributed pattern of responses.

The coefficient of variation ranged from 0.23 to 0.30, indicating low to moderate relative variability of respondents' answers. The lowest relative variability was observed for top management support (0.23),

while the highest was recorded for employee training (0.30). These values indicate that respondents' perceptions of top management support were more consistent compared with their perceptions of employee training.

Correlation analysis

The correlations between managerial and organizational determinants and the successful implementation of the Quality 4.0 concept are presented in Table 2. The strongest relationship was identified between successful implementation and organizational culture ($r = 0.54$), followed by vision and strategy ($r = 0.53$) and employee training ($r = 0.53$), which showed identical correlation coefficient values. The weakest relationship was observed with the determinant of top management support ($r = 0.46$). All correlations were positive and statistically significant at the $p < 0.01$ level, with their values indicating a moderate to moderately strong relationship between the examined determinants and successful implementation.

Table 2: Correlations between managerial and organizational determinants and the successful implementation of the Quality 4.0 concept

Managerial / Organizational Determinants	The successful implementation of the Quality 4.0 concept
Top management support	0.46**
Leadership	0.49**
Vision and strategy	0.53**
Organizational culture	0.54**
Managerial knowledge and competencies	0.49**
Employee training	0.53**

Regression Analysis

To determine the contribution of individual managerial and organizational determinants in explaining the successful implementation of the Quality 4.0 concept, hierarchical regression analysis was conducted, with predictors being gradually introduced into the model (Table 3).

In the first step, the determinant of top management support was included, which independently explained 22.0% of the variance in the successful implementation ($R^2 = 0.22$; Adjusted $R^2 = 0.22$). By adding the leadership determinant, the explained variance increased to 24% ($R^2 = 0.24$; Adjusted $R^2 = 0.23$). In the third step, the vision and strategy determinant was included, increasing the explained variance to 30% ($R^2 = 0.30$; Adjusted $R^2 = 0.28$). The addition of organizational culture further

improved the model, which explained 31% of the variance ($R^2 = 0.31$; Adjusted $R^2 = 0.29$).

The inclusion of managerial knowledge and competencies did not result in an increase in the explained variance, as R^2 remained unchanged ($R^2 = 0.31$), while the adjusted coefficient of determination slightly decreased (Adjusted $R^2 = 0.28$), indicating that this predictor did not provide additional explanatory contribution to the model.

By including the employee training determinant, the final model was established, explaining 33% of the variance in the successful implementation of the Quality 4.0 concept ($R^2 = 0.33$; Adjusted $R^2 = 0.30$). The multiple correlation coefficient was $R = 0.58$, while the standard error of the estimate was 0.86, indicating a moderate predictive power of the model.

Table 3: Hierarchical regression model of managerial and organizational determinants of the successful implementation of the Quality 4.0 concept

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.47 ^a	0.22	0.22	0.91
2	0.49 ^b	0.24	0.23	0.91
3	0.55 ^c	0.30	0.28	0.87
4	0.56 ^d	0.31	0.29	0.87
5	0.56 ^e	0.31	0.28	0.87
6	0.58 ^f	0.33	0.30	0.86

a. Predictors: (Constant), Top Management Support

b. Predictors: (Constant), Top Management Support, Leadership

c. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy

d. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy, Organizational Culture

e. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy, Organizational Culture, Managers' Knowledge and Competencies

f. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy, Organizational Culture, Managers' Knowledge and Competencies, Employee Training

The statistical significance of the hierarchical regression models was tested using analysis of variance (ANOVA). The results indicate that all developed models were statistically significant, as the significance values for all steps were below 0.001 ($p < 0.001$). In the first model, which included only the top management support determinant, statistical significance of the model was confirmed ($F = 40.39$; $p < 0.001$). By adding new predictors, additional models were developed, which also remained statistically significant, with F-statistic values of 22.06 in the second, 19.86 in the third, 15.65 in the fourth, 12.43 in the fifth, and 11.42 in the sixth model.

The final model, which included the determinants of top management support, leadership, vision and strategy, organizational culture, managerial knowledge and competencies, and employee

training, was statistically significant ($F(6, 138) = 11.42$; $p < 0.001$). The obtained results confirm that the examined managerial and organizational determinants jointly make a significant contribution to explaining the successful implementation of the Quality 4.0 concept (Table 4).

The results of the regression analysis presented in Table 5 indicate that, among the examined determinants, vision and strategy ($\beta = 0.28$; $p = 0.046$) and employee training ($\beta = 0.26$; $p = 0.032$) had a statistically significant effect on the successful implementation of the Quality 4.0 concept. The positive values of the standardized regression coefficients indicate that stronger presence and development of these determinants contribute to greater success in implementation.

The dominant influence of the vision and strategy determinant indicates that the implementation of Quality 4.0 is primarily a strategic process of organizational change. This result suggests that organizations with clearly defined development

directions and long-term objectives have more favorable conditions for successful implementation of this concept.

Table 4: Analysis of variance (ANOVA) of hierarchical regression models examining the impact of managerial and organizational determinants on the successful implementation of the Quality 4.0 concept

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.68	1	33.69	40.39	.000 ^a
	Residual	119.27	143	0.83		
	Total	152.95	144			
2	Regression	36.25	2	18.13	22.06	.000 ^b
	Residual	116.70	142	0.82		
	Total	152.95	144			
3	Regression	45.44	3	15.15	19.86	.000 ^c
	Residual	107.52	141	0.76		
	Total	152.95	144			
4	Regression	47.26	4	11.82	15.65	.000 ^d
	Residual	105.69	140	0.76		
	Total	152.95	144			
5	Regression	47.26	5	9.45	12.43	.000 ^e
	Residual	105.69	139	0.76		
	Total	152.95	144			
6	Regression	50.75	6	8.46	11.42	.000 ^f
	Residual	102.21	138	0.74		
	Total	152.95	144			

Dependent Variable: The successful implementation of the Quality 4.0 concept

a. Predictors: (Constant), Top Management Support

b. Predictors: (Constant), Top Management Support, Leadership

c. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy

d. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy, Organizational Culture

e. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy, Organizational Culture, Managers' Knowledge and Competencies

f. Predictors: (Constant), Top Management Support, Leadership, Vision and Strategy, Organizational Culture, Managers' Knowledge and Competencies, Employee Training

Table 5. Regression coefficients of managerial and organizational determinants of the successful implementation of the Quality 4.0 concept

Managerial / Organizational Determinants	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Top management support	0.127	0.180	0.113	0.708	0.480	0.189	5.297
Leadership	-0.049	0.189	-0.049	-0.259	0.796	0.137	7.317
Vision and strategy	0.304	0.151	0.282	2.016	0.046	0.247	4.046
Organizational culture	0.109	0.167	0.109	0.654	0.514	0.174	5.760
Managerial knowledge and competencies	-0.093	0.154	-0.089	-0.603	0.547	0.223	4.480
Employee training	0.244	0.113	0.259	2.168	0.032	0.339	2.946

Dependent Variable: The successful implementation of the Quality 4.0 concept

The statistical significance of the employee training determinant indicates that the development of employee capabilities represents one of the key organizational mechanisms enabling the adoption of new technologies and new quality management principles. This finding suggests that investment in

human resource development is not merely a supporting activity in the implementation process, but rather an integral component of it.

The determinants of top management support ($p = 0.48$), leadership ($p = 0.80$), organizational culture

($p = 0.51$), and managerial knowledge and competencies ($p = 0.55$) did not demonstrate a statistically significant individual contribution to explaining the dependent variable. The absence of statistical significance does not imply that these determinants have no role in Quality 4.0 implementation. Rather, the result suggests that their contribution is achieved through interactions with other organizational determinants, which is why they should be considered as elements of a broader organizational framework rather than as isolated factors.

Multicollinearity diagnostics indicated relatively high intercorrelations among the predictors. Tolerance values ranged from 0.14 to 0.34, while VIF values ranged from 2.95 to 7.32. Although these values did not exceed the commonly accepted critical thresholds (Tolerance < 0.10 ; VIF > 10), they indicate the presence of notable multicollinearity, which may have reduced the stability of the individual regression coefficients. Consequently, the significance of individual predictors should be interpreted with caution.

DISCUSSION OF RESEARCH FINDINGS

The research presented in this paper aims to examine the role of managerial and organizational determinants in the successful implementation of the Quality 4.0 concept. It is based on the assumption that successful implementation does not depend solely on the availability of advanced digital technologies, but also on the organizational conditions that enable their effective application. In this context, the research focuses on determining the contribution of top management support, leadership, vision and strategy, organizational culture, managerial knowledge and competencies, and employee training as key managerial and organizational determinants supporting successful Quality 4.0 implementation.

The research was conducted in the Republic of Serbia, with respondents being quality professionals employed in companies certified according to the ISO 9001:2015 standard. Companies holding this certification represent an appropriate research context because they operate within formalized quality management systems and are oriented toward systematic quality management and continuous improvement, while certification itself does not imply that companies already implement Quality 4.0. This context enables the examination of managerial and organizational conditions that may

support Quality 4.0 implementation. Considering that more than one-third of all companies certified according to the ISO 9001:2015 standard in the Western Balkan countries were located in the Republic of Serbia in 2022, this study may also provide a useful reference point for future comparative research in the broader Western Balkan context. A total of 184 companies participated in the research, and all valid responses were included in the analysis. Data were collected using a five-point Likert scale, with response options ranging from “strongly disagree” to “strongly agree”.

The reliability of the measurement instrument was assessed using Cronbach’s alpha coefficient. The lowest value was recorded for the top management support determinant ($\alpha = 0.883$), followed by vision and strategy ($\alpha = 0.888$), while the values for the remaining determinants were above 0.90 (employee training – $\alpha = 0.911$; managerial knowledge and competencies – $\alpha = 0.933$; organizational culture – $\alpha = 0.941$; leadership – $\alpha = 0.958$). The obtained results confirm a high level of measurement instrument reliability and indicate satisfactory internal consistency of all measurement scales.

Descriptive statistical analysis included the calculation of the mean, standard deviation, skewness coefficient, kurtosis coefficient, and coefficient of variation for each analyzed determinant. These indicators were used to assess the average values, dispersion of responses, distribution characteristics, and degree of variability of the observed data, providing the basis for further correlation and regression analyses.

The results of the descriptive analysis show that all analyzed determinants were rated above the midpoint of the scale, indicating that respondents positively assessed the presence of the examined managerial and organizational practices in their companies. At the same time, differences in mean values suggest variations in the level of development among the analyzed determinants, indicating that organizations demonstrate stronger capabilities in certain areas, while others require further attention and improvement.

The highest average score was recorded for the top management support determinant ($M = 4.05$), indicating that respondents, on average, positively assessed top management’s commitment to quality management, support for employees, allocation of resources, and promotion of the importance of

quality within their companies. This result demonstrates that top management activities aimed at quality management are significantly present in the observed organizations. At the same time, the high average score for leadership ($M = 3.98$) indicates that respondents positively evaluated the role of managers in managing change, motivating employees, and directing quality improvement activities. The obtained results suggest that top management support and leadership represent important managerial determinants of successful Quality 4.0 implementation, as they provide strategic direction, coordination of activities, and support for organizational changes.

Relatively high mean values of the vision and strategy ($M = 3.79$) and managerial knowledge and competencies ($M = 3.83$) determinants indicate that respondents positively assessed the existence of clearly defined quality strategies, their alignment with company objectives, as well as managers' knowledge and competencies in the field of quality management. The results show that both determinants are present to a similar extent in the observed organizations, with managerial competencies receiving slightly higher ratings than vision and strategy.

A clearly defined strategic direction enables the alignment of digital transformation initiatives with the organization's long-term business objectives, while competent managers ensure that strategic intentions are translated into coordinated implementation activities. In this way, strategic orientation and competent management create organizational conditions in which the application of digital technologies can lead to sustainable improvements in quality management systems. Therefore, the obtained results suggest that vision and strategy, together with managerial knowledge and competencies, represent important managerial determinants of successful Quality 4.0 implementation.

The organizational culture determinant achieved a mean value of $M = 3.60$. Respondents provided more moderate assessments of aspects related to change management, encouraging active employee involvement in quality improvement, and creating an organizational environment that supports change. Compared with managerial determinants, this result indicates that organizational culture represents an area with greater potential for further development in the observed organizations.

The lowest mean value was recorded for employee training ($M = 3.35$), with this determinant also showing the highest variability of responses. This result indicates more pronounced differences among companies regarding the assessment of activities related to employee training, identification of training needs, evaluation of acquired knowledge, and implementation of incentive systems for quality improvement. The greater dispersion of responses suggests that employee development practices are unevenly implemented across the observed organizations.

The results indicate that organizational culture and employee training systems represent areas with potential for improvement within the preparation of organizations for the implementation of the Quality 4.0 concept. The development of a change-oriented culture and continuous improvement of employee competencies represent important aspects for the application of digital technologies in quality management.

Overall, the results of the descriptive analysis show that managerial determinants achieved slightly higher mean scores compared with organizational determinants. Among the managerial determinants, top management support received the highest rating, while among organizational determinants, lower mean values were recorded for organizational culture and, particularly, employee training. This pattern indicates that activities related to quality management and management involvement were evaluated more positively than organizational practices supporting long-term transformation and employee development. From a management perspective, these findings suggest that successful Quality 4.0 implementation requires the simultaneous development of both managerial and organizational determinants, whereby strategic direction and management support should be accompanied by the development of an organizational culture and continuous improvement of employee competencies through training systems.

Positive and statistically significant correlations were identified between all analyzed managerial and organizational determinants and successful Quality 4.0 implementation. This finding confirms that the implementation of this concept does not depend on individual organizational elements, but rather on their interrelationship. Top management support, leadership, vision and strategy, organizational culture, managerial knowledge and

competencies, and employee training represent complementary determinants that jointly contribute to the digital transformation of quality management. The fact that all determinants demonstrated a positive relationship with the dependent variable indicates that none of them should be neglected when planning the implementation of the Quality 4.0 concept.

The highest correlation coefficient values were recorded for vision and strategy, organizational culture, and employee training. This finding implies that successful Quality 4.0 implementation requires a clearly defined strategic direction, an organizational environment oriented toward change, and continuous development of employee competencies.

The results of the hierarchical regression analysis further confirm that managerial and organizational determinants do not contribute equally to Quality 4.0 implementation. The greatest increase in explained variance was achieved by including the vision and strategy determinant, indicating that strategic orientation represents the key element connecting individual organizational activities into a unified implementation process. Top management support can provide resources and initiate organizational changes, but without clearly defined strategic objectives and a development direction, coordinated and long-term sustainable implementation of the Quality 4.0 concept is difficult to achieve.

Although leadership was positively correlated with successful Quality 4.0 implementation ($r = 0.49$, $p < 0.01$), its standardized regression coefficient became negative and statistically non-significant ($\beta = -0.049$, $p = 0.796$) in the final regression model. This result is likely attributable to the relatively high intercorrelations among the managerial and organizational determinants, as indicated by the multicollinearity diagnostics. Therefore, the regression coefficient for leadership should not be interpreted as evidence of a negative effect, but rather as an indication that its unique contribution could not be distinguished from the effects of the other closely related determinants included in the model.

The inclusion of organizational culture resulted in a relatively small increase in explained variance, while the inclusion of managerial competencies did not provide additional improvement of the model. These results do not indicate that these determinants

are unimportant, but rather that their contribution largely overlaps with the effects of previously included variables. In other words, organizational culture and managerial competencies represent integral elements of a broader organizational environment whose role is realized together with strategic and managerial determinants, rather than as completely independent sources of influence.

After the employee training determinant was included in the final step, the explained variance of the model increased once again. This indicates that employee competency development represents an organizational determinant that provides an additional contribution even after strategic, managerial, and cultural aspects of implementation have been included in the model. Successful Quality 4.0 implementation does not depend solely on decisions made at the management level, but also on employees' ability to apply acquired knowledge in everyday work processes.

The results of the multiple regression analysis further confirm this interpretation. Among all analyzed determinants, only vision and strategy and employee training retained a statistically significant independent contribution, indicating their role in explaining successful Quality 4.0 implementation. Organizations that integrate digital transformation into their long-term development objectives create more favorable conditions for coordinating activities, allocating resources more effectively, and aligning technological changes with the quality management system.

The independent contribution of employee training demonstrates that the development of employee knowledge and skills represents an organizational determinant whose effect cannot be replaced by other factors. Without continuous employee development, even organizations with an appropriate strategy and management support may face difficulties in the practical application of Quality 4.0 principles. This result indicates that investment in human capital development represents one of the key conditions for successful implementation.

It is important to emphasize that all analyzed managerial and organizational determinants showed statistically significant positive associations with successful Quality 4.0 implementation at the level of correlation analysis. However, the results of the multiple regression analysis indicate that only vision and strategy and employee training make an

independent statistically significant contribution to explaining the variance in successful implementation when all predictors are considered simultaneously. This difference between the correlation and regression results suggests that top management support, leadership, organizational culture, and managerial competencies are significantly associated with implementation, but their individual contributions cannot be clearly distinguished after controlling for interrelated organizational factors.

The fact that top management support, leadership, organizational culture, and managerial competencies did not retain statistical significance in the final model does not imply that these determinants are unimportant. On the contrary, their statistical insignificance may be explained by the overlap of their effects with other organizational determinants, which is also supported by the identified multicollinearity values. This finding indicates that these determinants interact as elements of a unified organizational system, in which management support, leadership, organizational culture, and managerial competencies create an environment where strategic orientation and continuous employee training can achieve their full effect.

From a practical perspective, the research findings indicate that organizations planning to implement the Quality 4.0 concept should not focus exclusively on the adoption of new digital technologies. Successful implementation requires a clearly defined strategy, continuous investment in employee development, and the simultaneous strengthening of managerial and organizational determinants that support the implementation of changes. Such an approach enables the digital transformation of quality management to be viewed as a long-term organizational change rather than as an isolated technological project.

CONCLUSION

The results of this study indicate that the successful implementation of the Quality 4.0 concept does not depend exclusively on the availability of advanced digital technologies, but rather on the organization's ability to develop appropriate managerial and organizational conditions for their effective application. The obtained results partially confirmed the proposed research hypotheses. The correlation analysis showed that all analyzed managerial and organizational determinants were statistically significantly associated with successful

Quality 4.0 implementation. However, the results of the multiple regression analysis demonstrated that only vision and strategy and employee training retained a statistically significant independent contribution to explaining successful Quality 4.0 implementation.

These findings indicate that a clearly defined strategic direction, together with the continuous development of employees' knowledge and skills, represents one of the most important managerial and organizational prerequisites for successful Quality 4.0 implementation. At the same time, top management support, leadership, organizational culture, and managerial competencies should not be considered less important, as their contribution depends on their interaction with other managerial and organizational determinants.

The obtained results also have significant practical implications for management. Organizations planning to implement the Quality 4.0 concept should not focus exclusively on investments in digital technologies. Particular attention should be devoted to developing a clear vision and strategy, as well as to continuous investment in employee training, since these determinants demonstrated an independent contribution to successful Quality 4.0 implementation. At the same time, top management support, leadership, organizational culture, and managerial competencies remain important organizational conditions whose characteristics can facilitate the implementation process. Therefore, successful implementation of the Quality 4.0 concept should be viewed as a comprehensive managerial and organizational transformation supported by advanced digital technologies, rather than merely as a technological transformation.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

One limitation of this study relates to its cross-sectional design and the fact that the research was conducted on a sample of companies from a single country. Although this approach enables an assessment of the relationships between the analyzed determinants and successful Quality 4.0 implementation within a specific context, future research should include longitudinal designs and samples from different countries to enable a more comprehensive assessment of the generalizability of the findings.

An additional limitation concerns the fact that both independent and dependent variables were measured using the same self-report questionnaire completed by a single respondent from each company. Therefore, the possibility of common method bias cannot be completely excluded. Future studies could collect data from multiple respondents within the same company and apply additional measurement model validation procedures, including confirmatory factor analysis (CFA) within a structural equation modeling (SEM) framework.

Another limitation is related to the observed interrelationships among certain managerial and organizational determinants, which indicated the presence of multicollinearity among the predictors. Although the VIF and tolerance values did not indicate a critical level of this issue, such intercorrelations may affect the stability of individual regression coefficients and make it more difficult to isolate the unique contribution of individual determinants. Future research could further examine the complex relationships among these factors by applying more advanced statistical approaches, such as PLS-SEM models and models incorporating moderating or mediating effects.

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UPRAVLJAČKE I ORGANIZACIONE DETERMINANTE IMPLEMENTACIJE KVALITETA 4.0: DOKAZI IZ PREDUZEĆA SERTIFIKOVANIH PREMA STANDARDU ISO 9001:2015

Uspešna implementacija Kvaliteta 4.0 zahteva upravljačke i organizacione uslove koji prevazilaze samu primenu digitalnih tehnologija. Ovo istraživanje ispituje ključne determinante implementacije Kvaliteta 4.0 u preduzećima sertifikovanim prema standardu ISO 9001:2015. Istraživanje je sprovedeno u Republici Srbiji primenom strukturisanog upitnika. Korelaciona i višestruka regresiona analiza primenjene su radi ispitivanja uticaja podrške top menadžmenta, liderstva, vizije i strategije, organizacione kulture, menadžerskih kompetencija i obuke zaposlenih na implementaciju Kvaliteta 4.0. Rezultati pokazuju da su sve analizirane determinante statistički značajno povezane sa uspešnom implementacijom Kvaliteta 4.0, dok vizija i strategija i obuka zaposlenih ostaju statistički značajni nezavisni prediktori u punom regresionom modelu. Nalazi potvrđuju da uspešna implementacija Kvaliteta 4.0 zavisi od usklađenosti upravljačkih i organizacionih sposobnosti, a ne isključivo od tehnoloških faktora. Ovo istraživanje doprinosi postojećoj literaturi pomeranjem fokusa sa procene organizacione spremnosti na identifikovanje determinanti koje podržavaju uspešnu implementaciju Kvaliteta 4.0, uz istovremeno pružanje praktičnih smernica menadžerima koji planiraju inicijative digitalne transformacije.

Ključne reči: Kvalitet 4.0; Upravljačke i organizacione determinante; Implementacija; ISO 9001:2015.