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Digital transformation of modern quality management

Abstract. *Introduction.* The need to transform modern management systems under the influence of total digitalization is an important and serious social goal of science and business. One of the key areas of management today is quality management. In this regard, *the purpose of the paper* is defining the specifics and main trends and risks of digital quality management transformation on the whole, as well as evaluating the development of modern quality management in the context of digitalization.
Results. Based on the process, complex and systematic approaches and in the context of total digitalization, an enlarged model of quality management has been formed which can be applied for the purpose of evaluating a quality management system at a particular enterprise, since it integrates quality management and risk management, which allows people in charge to monitor and evaluate the entire cycle of creating a service/product, as well as the results of the system development, costs, the need for timely elimination of shortcomings and improvement.
Conclusions. According to the results of this study, there have been formulated a set of key trends and risks of digital transformation of quality management. A positive assessment of the modern quality management development in terms of digitization has been reasoned; an enlarged model of quality management has also been formed in the context of digital expansion.
Keywords: Quality Management; Quality; Risk Management; Digitalization; Digital Expansion.
JEL Classification: M10
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Цифрова трансформація сучасного менеджменту якості
Анотація. Необхідність трансформації сучасних систем менеджменту під впливом тотальної цифровізації є важливим і гострим соціальним завданням науки й бізнесу. Однією з ключових областей менеджменту на сьогоднішній день виступає управління якістю. Відповідно, визначення специфіки й основних трендів і ризиків цифрової трансформації управління якістю в цілому, а також оцінка розвитку сучасного менеджменту якості в умовах цифровізації, є завданням, яке вирішується в даному дослідженні.
Аналіз останніх досліджень і публікацій показав, що існує цілий ряд проблем, не освітлених публікаціями як із тематики цифровізації, так і менеджменту якості, а саме:: методичні аспекти визначення специфіки управління якістю й систем менеджменту якості в умовах цифрової експансії в економіці, освіті, соціальному управлінні; визначення значення та архітектоніки управління якістю в новому кластері цифрової економіки, формування нових методик оцінки розвитку систем менеджменту якості й управління якістю в цілому.

Мета статті – визначення специфіки та основних трендів і ризиків цифрової трансформації управління якістю в цілому, а також оцінка розвитку сучасного менеджменту якості в умовах цифровізації.
Основні результати дослідження: на підставі процесного, комплексного й системного підходів сформовано укрупнену модель менеджменту якості в умовах тотальної цифровізації, яка може бути застосована для цілей оцінки системи менеджменту якості на конкретному підприємстві, оскільки інтегрує в собі менеджмент якості та менеджмент ризику, що дозволяє здійснювати контроль й оцінку керівником всього циклу створення послуги/продукту, а також підсумків розвитку системи, витрат, необхідності своєчасного усунення недоліків і вдосконалення.
За підсумками даного дослідження сформульовано комплекс основних трендів і ризиків цифрової трансформації управління якістю, аргументовано позитивну оцінку розвитку сучасного менеджменту якості в умовах цифровізації; сформовано укрупнену модель менеджменту якості в умовах цифрової експансії.
Ключові слова: менеджмент якості; якість; цифровізація; цифрова експансія; менеджмент ризику.

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Цифровая трансформация современного менеджмента качества
Аннотация. Необходимость трансформации современных систем менеджмента под влиянием тотальной цифровизации является важной и острой социальной задачей науки и бизнеса. Одной из ключевых областей менеджмента на сегодняшний день выступает управление качеством. Соответственно, определение специфики и основных трендов и рисков цифровой трансформации управления качеством в целом, а также оценка развития современного менеджмента качества в условиях цифровизации, является задачей, которая решается в данном исследовании.
Анализ последних исследований и публикаций показал, что существует целый ряд проблем, не освещенных публикациями как по тематике цифровизации, так и управления качеством, а именно: методические аспекты определения специфики управления качеством и систем менеджмента качества в условиях цифровой экспансии в экономике, образовании, социальном управлении; определение значения и архитектоники управления качеством в новом кластере цифровой экономики, формирование новых методик оценки развития систем менеджмента качества и управления качеством в целом.
Цель статьи – определение специфики и основных трендов и рисков цифровой трансформации управления качеством в целом, а также оценка развития современного менеджмента качества в условиях цифровизации.
Основные результаты исследования: на основании процессного, комплексного и системного подходов сформирована укрупненная модель менеджмента качества в условиях тотальной цифровизации, которая может быть применима для целей оценки системы менеджмента качества на конкретном предприятии, поскольку интегрирует в себе менеджмент качества и менеджмент риска, что позволяет осуществлять контроль и оценку руководителем всего цикла создания услуги/продукта, а также итогов развития системы, издержек, необходимости своевременного устранения недостатков и совершенствования.
По итогам данного исследования сформулирован комплекс основных трендов и рисков цифровой трансформации управления качеством, аргументирована положительная оценка развития современного менеджмента качества в условиях цифровизации; сформирована укрупненная модель менеджмента качества в условиях цифровой экспансии.
Ключевые слова: менеджмент качества; качество; цифровизация; цифровая экспансия; менеджмент риска.

1. Introduction

The development of quality management in the context of total digitalization is associated with the widespread use of digital achievements and network activities of stakeholders who are now directly involved in the organization's life and the formation of its status and image in the business space. In addition to that, the role of stakeholders extends to the valuation of business and the assessment of its competitiveness. This is important for quality management, since the changes affect all the basic principles and postulates of quality management theory. The principles of consistency, flexibility, technology, availability and innovation are put at the forefront (Limonova, 2018). In this regard, the digital economy and the new quality management theory generate innovative digital tools, methods and quality management systems: e-government, digital standardization, digital diplomacy, digital rating, e-procurement system, and many others. These examples reflect global changes in the overall management system, in which quality plays a leading role. Accordingly, determining the specifics and main trends and risks of digital transformation of quality management on the whole, as well as evaluating the development of modern quality management in the context of digitalization is an urgent interdisciplinary goal of modern science and practice.

2. Brief Literature Review

Despite the huge amount of educational, scientific and business literature on both digitalization and quality management, there are a number of issues that are not covered by publications: methodological aspects of determining the specifics of quality management and quality management systems in the context of digital expansion in the economy, education, and social management; defining the meaning and architectonics of quality management in a new cluster of digital economy, forming new methods for evaluating the development of quality management systems and quality management in general.

The revealed «white spots» emphasize the importance and relevance of the topic, taking into account the fact that research of digitalization impact on quality management is being conducted by leading scientists around the world: the Russian Academy of Sciences, the Higher School of Economics (Russian Federation), McKinsey Global Institute (USA), Boston Consulting Group (USA), Deloitte Touche Tohmatsu (UK) and many others.

The issues of interrelation and development of quality management systems and digital economy, as well as methodological and instructional validity are presented in the works of Russian researchers (Gugelev & Yegorova, 2009; Vinarik, 2012; Levchenko, 2018; Polyanin et al., 2019; Croft, 2015). Russian and international studies concern the risks of digitalization of the real economy (Plotnikov, Pirogova, & Vertakova, 2019; Chaldaeva & Kilyckov, 2018; Manakhova, 2018; Udalov, 2018; Khodyrevskaya & Mayakova, 2013; Semernik, 2014). Also, a significant contribution to the popularization of the triad concept policy - strategy - tactics in management and planning has been made by the Russian economists O. B. Veretennikova and E. G. Shatkovskaya (2012).

The development and specifics of particular digital methods and tools for quality management are presented in detail in the reports and presentations of foreign scientists and specialists. The key aspects of implementing digital and information technologies, realizing the principles of continuity management, and the impact of human resources on the management of IT-services are discussed in the research of Czech scientists (Ministr & Pitner, 2016, Chren et al., 2018). Tools for quality management and innovation management, strategic management and planning are presented in the works of a group of foreign scientists led by D. Meissner (Scuotto et al., 2017; Bresciani et al., 2018).

Topics of new approaches to measuring economic development, problems and prospects of digitalization, development of automated systems and artificial intelligence are revealed in public research of young American scientists (Liu & Parilla, 2019; Muro, Maxim, & Whiton, 2019). The Internet of things, the smart city, open innovation, Big Data, prospects and opportunities for knowledge management, crisis management, planning and management systems, forecasting models of enterprise development are the targets of research by Italian scientists (Ferraris et al., 2018; Giacosa et al., 2018). Processes of business internationalization, international outsourcing and partner location, synergistic effects and coexistence of networks in clusters are the basics of improving the efficiency of performance measurement systems (Belso-Martinez & Diez-Vial, 2018; Couturier & Sklavounos, 2019).

3. The Purpose of the paper is to determine the specifics and main trends and risks of digital transformation of quality management at large, as well as to assess the development of modern quality management in the context of digitalization.

4. Results

Digitalization has now spread its influence to all spheres of human and social life, hence, digital transformation is both necessary and inevitable. Quality management is trying to adapt itself in the most difficult circumstances of inconsistency of the internal corporate management system at enterprises with the external digital shell. We should note the features of digitalization - multidirection and universality, which imply not only the digitalization of specific tools, technologies, approaches, but also the external environment. Whole paradigms arise under its influence. We observe a «lag» in the implementation of digital technologies in relation to the digitalization of society. According to the Biesot coefficient, the sustainable development of an organization is directly dependent on the speed of response of organization's security system (basic guidelines) and in inverse dependence to the speed of occurrence and development of external risk or threat (in this case, digitalization). The Biesot coefficient (CB) should be greater than 1 (Ilyinsky, 2017):

$$CB = SOR/SDT, \quad (1)$$

where:
SOR - speed of the organization's response,
SDT - speed of external threat development.

At present, the extent to which digitalization is spread and implemented within a particular country is measured by a number of indicators. Considering the fact that digitalization is a trend nowadays, the relevant indicators of it are the Networked Readiness Index (NRI) and Global Innovation Index (GII). We shall give more information about each of them.

NRI is a complex indicator of the level of development and implementation of digital technologies. Its application to assess digitalization as a trend is justified by the fact that digital technologies play a key role in the innovative development, corporate development, increasing the competitiveness and efficiency of organizations, as well as improving the quality of management and execution. Taking into account the fact that the catalyst for generation and dissemination of digital technologies is digitalization, we can say that NRI indirectly characterizes the process and extent of digitalization coverage of a particular state.

At the World Economic Forum, «The Global Information Technology Report» provides annual data on the calculation of this indicator, as well as the rating of countries in terms of NRI. The calculation is based on 53 characteristics (parameters) grouped into 3 generalized systems: availability of conditions for the development of digital technologies; readiness of society to use digital technologies; degree of digital technologies application at various levels (business, society, government) (Khalin & Chernova, 2018). The latest report on this index was submitted in 2016. According to the rating of countries by the value of NRI index at the end of 2016, the leading nations were: Singapore (6.0), Finland (6.0), Sweden (5.8), Norway (5.8), the United States of America (5.8), the Netherlands (5.8), Switzerland (5.8), the United Kingdom (5.7), Luxembourg (5.7), Japan (5.7) (World Economic Forum, 2016).

An indicator that indirectly reflects the country's involvement in the process of total digitalization and its spread is the Global Innovation Index (GII) that was developed in 2007. This indicator reflects the innovation potential, as well as the results of activities in the field of innovation. Given that digital transformation is impossible outside the framework of digitalization and innovation, the Global Innovation Index indirectly assesses digital expansion. According to the report «The Global innovation index 2018» (Cornell University, INSEAD, & WIPO, 2018), the ranking of the leading countries is as follows: Switzerland (68.40), the Netherlands (63.32), Sweden (63.08), the United Kingdom (60.13), Singapore (59.83), the United States of America (59.81), Finland (59.63) (Cornell University, INSEAD, & WIPO, 2018).

Digitalization as a trend of global development can be considered in the case when the degree of its coverage is universal, close to 1. Put that way, digitalization should cover not only business, science, education, social sphere, and the public sector, but also be accessible and acceptable to ordinary citizens. In this regard, the quality of digital technologies and their accessibility to all segments of the population plays an important role. Moreover, at the moment, the availability of digital technologies is one of the indicators for assessing the quality of life.

As to the indicators for evaluating digitalization, the European Commission has proposed Digital Economy and Society Index (DESI EU) (European Commission, 2018, 2019). At the moment, the International Digital Economy and Society Index (I-DESI) is a higher priority. It measures the digital economy of the EU-28 member states and the EU as a whole compared to the 17 non-EU countries, using the methodology similar to the EU DESI Index. I-DESI combines 24 indicators and uses a system of weights to rank each country by its digital characteristics in order to compare digitalization development. It measures effectiveness in five dimensions or policy areas: connectivity, human capital (digital skills), Internet use by citizens, and integration of technology and digital public services (European Commission, 2018, 2019).

At the end of 2019, additional indicators were added to the 5 already existing ones. Thus, the system of indicators of the major index for evaluating the digitalization of countries looks like this:

- Communication - development of the broadband communication market in EU;
- Human capital - digital integration and skills;
- Use of Internet services;
- Integration of digital technologies;

- Digital public services;
- EU ICT sector and its R&D results;
- Research and innovation: ICT projects in Horizon 2020 Digital.

According to the report results of «International Digital Economy and Society Index 2019» (European Commission, 2019) over the past year, all EU countries have improved their digital indicators. Finland, Sweden, the Netherlands and Denmark are the leaders of DESI 2019 rating, which is not surprising, since these countries are among the world leaders in the field of digitalization. Also, at the top of the rating are the United Kingdom, Luxembourg, Ireland, Estonia and Belgium. However, some other countries still have a long way to go and the EU as a whole needs to improve to be able to compete on the world stage.

Returning to the issue of quality management, we would like to note that under the influence of digitalization of each individual organization, it is recommended to review the main directions of management, taking into account both the internal adaptation of digital technologies and external digital «pressure», and the level of digitalization of a particular state in which the organization operates, especially for companies that have access to the international market. In this regard, we suggest the following trends in digital transformation of quality management, depending on the nature of the organization's corporate environment: organizational and behavioural.

The structure of the organizational trend of quality management digital transformation can include the following instruments:

- improving quality by building a simplified interaction network for plenty of stakeholders;
- forming a strategy of active interaction with stakeholders in order to create a positive image of an organization;
- continuous monitoring of quality management in order to form a management system, the main task of which is a universal focus on success and promotion of a company in the market;
- adding new ones and transforming existing quality management principles in the context of total digitalization (for example, the principle of adaptability, innovation, digitalization;
- developing quality management programs and tools based on digital technologies;
- modernizing digital and cyber-defence systems against hacker attacks and digital fraud as a result of improving the quality of an organization's security.

The structure of the behavioural trend of digital transformation of quality management can include the following means:

- system upgrading of tools for working with information data, including Big Data, in the corporate environment of the organization;
- real implementation, adaptation and continuous improvement of «individual approach» quality management method;
- focusing on the electronic (digital) market segment: expanding opportunities, attracting new consumers, establishing network interaction with potential customers, improving the quality of activities by simplifying the interaction «buyer-seller»;
- focus of the management system on innovation in all areas of the organization;
- formation and development of digital skills and abilities of personnel;
- stabilization of corporate relations, attracting employees to work remotely on the basis of a developed digital network.

The main approaches within quality management are the following: process, complex, and system ones. In the scientific and technical literature, each approach is described in detail; therefore it is not appropriate to pay attention to the description. At the same time, based on these approaches and trends proposed above, we present a model of quality management in the context of digitalization (Figure 1).

The process approach is one of the most fundamental in quality management, so we took it as the basis of the model. With some refinements, the horizontal «input-output» axis was transformed into a vertical representation, and resources and control actions were disclosed in detail inside the «black box». This task was solved through a systematic approach, in which the directions of digital transformation of quality management were ranked and distributed according to complexity level. The integrated approach allowed combining the key areas of quality management and digitalization, making the model logical and easy to present and understand.

This model has the following advantages:

- the model can be the basis for the formation of a new concept of quality management in the organization, as well as one of the tools for strategic planning and decision-making;

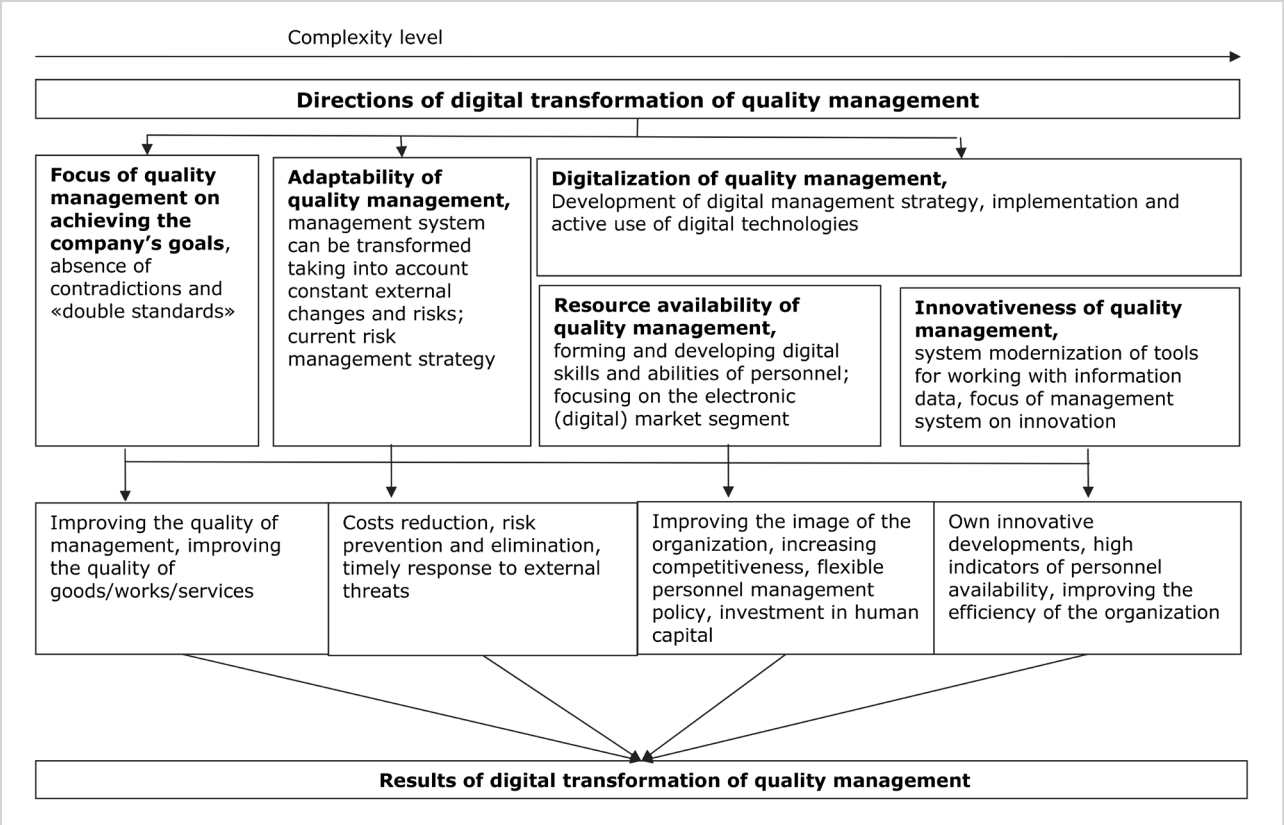

Figure 1:
Quality management model in the context of total digitalization
Source: Developed by the author

- the model will allow you to more effectively regulate expense portion necessary for the implementation of innovative activities of the organization under the conditions of digitalization, as well as reduce costs;
- the model allows for making changes, as well as the introduction of new directions of transformation taking into account changing environmental conditions, their ranking and structuring, as well as setting new goals and objectives;
- the model can become one of the effective tools for additional monitoring when evaluating the effectiveness of the organization's activities, as well as its effectiveness and competitiveness, which will allow for total control over compliance with the organization's strategic guidelines and goals.

Thus, on the basis of process, complex and system approaches, an enlarged model of quality management in the context of total digitalization has been formed. The model not only systematizes modern ideas about the levels and directions of quality management development, but also reflects the «development - effectiveness» relationship of both quality management and total quality management. The model can be applied for the purpose of evaluating the quality management system at a particular enterprise, since it integrates quality management and risk management, which makes it possible for managers to monitor and assess the entire cycle of creating a service/product, as well as the results of the system development, costs, the need for timely elimination of flaws and improvement.

5. Conclusions

On the basis of digital quality management transformation study there have been formulated a set of key trends with the consideration of risks and the latest achievements of total digitalization. There has been reasoned a positive assessment of modern quality management development in terms of digitization on the basis of recent measurements and calculations of indices, reflecting the spread of digitalization, the introduction of digital technologies across countries; there has also been formed an integrated model of quality management in the context of digital expansion with the presentation of advantages and limits of the model's applicability.

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