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## DIGITAL TRANSFORMATION AND THE CHANGING SHAPE OF QUALITY MANAGEMENT PRACTICES

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**Abstract.** The main purpose of this paper is to explore how digital transformation influences and changes quality management practices adopted by the organisation. The methodology employed in this study is qualitative content analysis with open coding of selected literature followed by an empirical study in three logistic companies. Quality management practices related to leadership and culture, strategy, customer focus, improvement, relationship management, organisation and people, decision-making and processes are likely to transform with the integration of digital technologies. Innovation and digitalisation itself have all prospects to become a new addition to the core quality management concept. This study reviewed the general influence of digital transformation on quality management practices. The impacts of particular digital technology integration, such as blockchain, Internet of Things, robotics, etc. on quality management practices were not considered. The future research can be conducted on aspects of digitalisation of quality management systems and on the role of quality management practitioners in digital transformation. This study could be beneficial for the managers of organisations and quality professionals considering different aspects of digitalisation and adoption of digital technologies in their companies. This paper adds to the general knowledge about the relations between quality management and digital transformation which are not studied widely enough in the existing literature. The findings of the study provide a new insight on quality management in the light of digital transformation.

**Keywords:** *Digitalisation, Digital Transformation, Industry 4.0, Quality 4.0, Quality Management, Quality Management Practices*

**JEL Classification:** L15, O33, Q55

### INTRODUCTION

Digital transformation is a hot topic nowadays. The digitalisation changes our life and business environment. It transforms the way the authors interact with each other, do our daily routines and learn. The organisations are being transformed as due to digitalisation there are not only new ways of how the authors design, produce and sell our products and services, but also new organisational structures, roles, culture, processes, new ways of working and methods of collaboration, new approach to dealing and solving problems, decision making and implementation. This transformation is not only about an adoption and integration of the newest technologies, but it also has several dimensions – Strategy, People, Organisation, Customer, Ecosystem, Technology, and Innovation (Ivančić et al., 2019) and it penetrates right through the whole ecosystem. To be successful there is a need for a new kind of leadership – leadership for

digitalisation, new digital vision and digital strategy. To secure long-term outcomes of digitalisation the top management commitment, customer orientation and technology focus on satisfying customers and business needs are imperative (Elg et al., 2020). Here comes the role of quality management in digitalisation and reshaping of quality management practices in the course of digital transformation.

Quality management embraces the whole organisation and impacts all its activities. The principles of quality management are fundamental beliefs, values, norms and rules that are used as a basis for managing quality. The seven core quality management principles elaborated by international experts of the International Organisation for Standardisation (ISO) are Customer focus, Leadership, Engagement of people, Process approach, Improvement, Evidence-based decision making and Relationship management (International Organization for Standardization, 2015; Quality management principles, 2015). These principles are used as guidelines for organisational development and performance improvement. We have chosen ISO based quality management principles for this study because quality management systems of the companies that participated in the research are built on these principles, although the companies are not formally certified.

Quality management practices can be defined as “the actions and procedures undertaken by a company or organization to ensure the delivery of a high-quality service or product” (Barros et al., 2014). In the context of this paper, by quality management practices the authors understand adoption and practical application of quality management principles within the organisation and its business activities for the purpose of achieving the highest quality of products and services provided. These practices include – but are not limited to – management leadership, human resources, education and training, teamwork, customer focus, supplier management, quality data and reporting, strategic planning, quality systems, quality culture, employee management, process management, product/service design, continuous improvement, quality tools and techniques, project management, change management, service-level management (SLM), content management, information and security management and service reporting (Basu & Bhola, 2016). Both digitalisation and quality management strive for improvements in the organisation in terms of product and service quality, processes, relationships, customer satisfaction, leadership and culture. Can they be the two sides of the same coin? What impact the digital transformation has on quality management practices, what changes there are for quality management and quality management professionals, what concepts of quality management may evolve in the future under this change – all these questions emerge and not all of them have an answer yet. Some propositions exist already that the digitalisation may become in the future one of the quality management keystones along with innovation, adaptability and resilience (Mayakova, 2019).

Digital transformation impacts all processes within the organisation as well as its external environment and vice versa. The integration of digital solutions and approaches into the management system of organisations has not been explored widely enough yet. Quality management may have a direct impact on digital transformation, being at the same time affected by it. Quality management and quality management practices are applied in all organisational levels and processes throughout the whole value chain. As digitalisation impacts and transforms the organisation it also changes quality management practices adopted by it. How and what changes there are for quality management due to digital transformation is to be explored in this paper.

## 1. DIGITAL TRANSFORMATION

Digitalisation has firmly entered our lives. We cannot imagine ourselves living without mobile applications, remote banking, online shopping, digital television and, since quite recently, online schooling, remote working and Zoom conferencing – due to COVID-19. On the business level, digitalisation and digital transformation play an important and, in some cases, vital role in the sustainable development and survival of organisations.

Digitalisation and digital transformation definitions describe the same phenomenon– the process of transformation of an organisation targeted at the creation of unified digital environment by combination of various data management tools and techniques through the whole cycle of product creation (Kovrigin & Vasiliev, 2020). In other words, digitalisation is described as a transformation of data to a new form and exchange of data through digital communication channels, so the data are more concordant with the new technology and digital tools (Ipatov et al., 2020). Digital transformation being by its nature a “fundamental change that completely changes the way the authors operate in all aspects: development and design, production, sales, and after-sales” (Prokhin, 2020) affects all levels and spheres of organisations. It contributes to the nascency of new conceptual and business models. What impact the digital transformation has on organisations is still to be studied.

Several studies have addressed the impact of digital transformation on the organisations. Ivančić (Ivančić et al., 2019) has identified the following digital transformation dimensions: Strategy, People, Organisation, Customer, Ecosystem, Technology, and Innovation. The benefits, disadvantages and risks connected to the integration of digital technologies (Mayakova, 2019; Ralea et al., 2019), challenges of the implementation (Kovrigin & Vasiliev, 2020; Sjödin et al., 2018) and key lessons learned (Tabrizi et al., 2019) are also discussed in the scientific literature. Some studies focus on human aspects of digitalisation (Elg et al., 2020; Dengler & Tisch, 2020) and another research has been done on trends and tendencies of digital transformation (Lola & Bakeev, 2020).

The general impact of digital transformation on the organisation can be characterised as positive. It provides a competitive advantage for companies by reducing mistakes and errors, improving quality and increasing production speed (Sjödin et al., 2018), raising productivity (Prokhin, 2020; Dewhurst et al., 1999), increasing efficiency and improving quality of management decisions and their execution (Mayakova, 2019), value-chain integration and exploitation of new markets and territories (Ebert & Duarte, 2018), value creation (Sjödin et al., 2018), decreasing production lead time, improving usage of data and data quality (Armengaud et al., 2017), accelerating speed to market (Tabrizi et al., 2019; Sjödin et al., 2018), improving customer service (Mazzuto & Ciarapica, 2019; Prokhin, 2020), rising employees' flexibility and initiative (Dewhurst et al., 1999) and, as the result, ensuring the growth of sales and increased profitability (Sjödin et al., 2018). The usage of Artificial Intelligence (AI) applications ensures regulatory compliance and improve work safety (IBM, 2017). The digital transformation is an enabler for the development of new business models based on digital platforms (Prokhin, 2020; Elg et al., 2020). Also, the participation of customers in product design and development directly expressing their needs and expectations adds to the competitive advantages of the companies ensured by digital technologies (Mazzuto & Ciarapica, 2019; Carvalho et al., 2020). However, in certain cases the implementation of new technologies may lead

to reduction of organisational productivity due to lack of internal knowledge or wrong application (Tabrizi et al., 2019).

The role of digital transformation in creation of better customer experience and value is tremendous. With the introduction of 3D technologies customers can take an active part in product development, have access to data via usage of applications and devices, can monitor processes in a real time and change settings (Prokhin, 2020; Elg et al., 2020). Mazzuto and Ciarapica (Mazzuto & Ciarapica, 2019) add that digitalisation allows to include customers more and more in pre-sales and post-sales activities with the usage of Internet platforms, including the potential and prospective customers. Integration with suppliers and formation of united ecosystem, value chain integration can be considered as direct beneficiaries of digital transformation. Digital technologies allow building digital infrastructures, include customers and suppliers in company processes via digital platforms, share data thus opening doors to cross-industry collaboration (Ebert & Duarte, 2018). Some authors believe that digitalisation impacts also external environment providing connection via applications, augmented and/or virtual reality and other technologies (Ralea et al., 2019; Mayakova, 2019).

Digital transformation is directly connected with innovation – an innovation is being pre-requisite and enabler of digital transformation (Armengaud et al., 2017), which in turn boosts innovation further and contributes to the emergence of culture of innovation (Tabrizi et al., 2019; Mayakova, 2019; Manita et al., 2020).

Digital transformation calls for changes within the organisation, in corporate relations, strategy, culture, leadership, decision-making and internal processes. In order for digital transformation to be successful it requires development of digital culture, culture of knowledge-sharing and improvement. There is also a need for a strategic approach to digitalisation. Digitalisation should be incorporated in the vision of the organisation and in its organisational structure (Ralea et al., 2019; Prokhin, 2020). Although it has been shown by previous research that digital transformation improves collaboration between departments and leads to creation of new cross-functional teams (Ponsignon et al., 2019; Mazzuto & Ciarapica, 2019; Armengaud et al., 2017; Prokhin, 2020), it is also worth mentioning that the interdependency of other functions, such as IT, increases (Elg et al., 2020) and there can be a risk of digitalisation transformation failure due to unwillingness to cooperate between departments (Kovrigin & Vasiliev, 2020).

Dealing with constant changes due to digitalisation may cause stress and fatigue for the whole organisation. At the same time, it makes the organisations employ the newest management methods, such as Scrum, Agile, Business Process Management (Ivančić et al., 2019), thus increasing adaptability and resilience (Ebert & Duarte, 2018). Digitalisation contributes to the formation of autonomous and cross-functional teams. The new ways of working, such as hybrid and completely remote, also has become possible due to technology (Tabrizi et al., 2019; Prokhin, 2020; Mayakova, 2019). Leading such teams requires a new set of skills and abilities from management and leaders (Ebert & Duarte, 2018). The decision-making process is taking new forms under the influence of digital transformation. The availability of Big Data, the usage of predictive and prescriptive analytics allows managers taking decisions faster and improves the quality of the decisions (Menshikova et al., 2019; Mandrakov et al., 2020). Cognitive technologies based on Artificial Intelligence and machine-learning allow to analyse data and propose better solutions based on learning from previous experience (Manita et al., 2020).

The downside of such state of affairs is increased dependency on the quality of data, cyber security, security and privacy concerns (Diong, 2017; Ralea et al., 2019; Ebert & Duarte, 2018; Armengaud et al., 2017; Kovrigin & Vasiliev, 2020; Carvalho et al., 2020). At the same time digitalisation is able to improve and enhance cybersecurity (IBM, 2017).

“Digital transformation is not about technology” (Tabrizi et al., 2019). It asks for a change in the mindset of people as well organisational structure. There are new roles and positions being created to deal with digital tools and techniques (Dewhurst et al., 1999; Armengaud et al., 2017; Ponsignon et al., 2019), e.g. Chief Data Officer (CDO), Data producer, Data consumer, Data broker. In this respect it needs to be analysed if these new roles require re-designing of the organisational structure. With the introduction and implementation of new digital technologies repetitive, monotonous and routine tasks can be automated and human involvement substituted (Dewhurst et al., 1999; Sjödin et al., 2018; Mandrakov et al., 2020, Manita et al., 2020; Branca et al., 2020). There is also a great potential for substitution of physical work, however, regarding the substitution of intellectual jobs the opinions vary. Some authors note that psychosocial work exposure is not associated with substitution potential (Dengler & Tisch, 2020). In this perspective the value of human resources which cannot be replaced by machines will certainly increase (Ebert & Duarte, 2018; Branca et al., 2020). Others argue that with AI, neural networks, machine learning and other technologies decisions can be made by robots. (Kovrigin & Vasiliev, 2020; Prokhin, 2020). The implementation and deployment of digital technologies may induce employees’ fear of losing their jobs and they can sabotage the digitalisation efforts in the organisation (Dewhurst et al., 1999; Kovrigin & Vasiliev, 2020). In general, digital transformation is changing the shape of labour market and can increase inequality between genders and occupational groups (Dengler & Tisch, 2020). There is no doubt that digitalisation contributes to the formation and development of new skills, abilities and competences of personnel, not limited only to digital and IT skills, but also abilities to work with Big Data, dealing with complexity and problem solving in a new business environment (Dewhurst et al., 1999; Mayakova, 2019; Lola & Bakeev, 2020; Kovrigin & Vasiliev, 2020). Lack of the required employees’ skills and lack of qualified employees in the market may also hinder the integration of the digital strategy and tools (Ebert & Duarte, 2018). Digitalisation in companies is also associated with large financial investments and this can be one of the reasons it is mostly adopted by larger companies and enterprises (Kovrigin & Vasiliev, 2020).

Digitalisation opens wide perspectives for advancement of quality management (QM). It can reduce the impact of the “human factor” in detection and prevention of non-conformities and errors (Menshikova et al., 2019; Manita et al., 2020). Various sensors and applications allow registration of performance indicators and control processes in a real time (Prokhin, 2020), thus enabling process and performance management through digitalisation of quality control practices. Better product traceability, which is crucial for some industries, such as food and pharmaceutical, is ensured via RFID and other digital technologies (Ebert & Duarte, 2018; Savina et al., 2020). Digital transformation offers and promotes usage of AI, predictive analytics, big data, image and product-recognition technologies for the benefits of QM. Mobile and interactive applications ensure connection with customers and other stakeholders (Ralea et al., 2019). Digital transformation enhances the revision, optimisation and standardisation of business processes and procedures (Sjödin et al., 2018; Mayakova, 2019; Tabrizi et al., 2019; Menshikova et al., 2019), as well as calls for the revision and

standardisation of business process terminology (Ivančić et al., 2019). Digitalisation may also become one of new quality management principles along with innovation and adaptability (Mayakova, 2019). However, the role of quality management in the process of digital transformation and the resulting changes in the practices of quality management have been studied quite little, therefore, these issues invite for the further research.

Based on the above, the authors can conclude that digital transformation affects the whole organisation and its all stakeholders. It transforms business processes and procedures, organisational structure, changes the shape of labour market as well as the mindset of people, organisational culture and strategy, relationships within teams, companies and the whole ecosystem. Quality management is an imperative part of any business activity, thus digital transformation shall, in no doubt, change the shape of quality practices. Therefore, the following research questions arise:

RQ1: What aspects of organisations are being impacted by digitalisation?

RQ2: What quality management practices are affected?

RQ3: How are these quality management practices changing with digital transformation?

## 2. METHODS AND PROCEDURES

We have chosen a four-phase methodology. First, the authors conducted a brief literature review. Then, to answer RQ1 and RQ2 the authors have performed literature qualitative content analysis with open coding. For the qualitative content analysis, the scientific papers cited in the Web of Science, Scopus and EBSCO databases were selected using the combinations of keywords. To broaden the scope and employing “berry picking” technique (Bates, 1989) some other papers from Google Scholar database were included. The selection criteria were the relevance of the paper to the research questions.

In the third phase, the authors chose to confirm empirically the results – answers to RQ1 and RQ2, acquired in literature content analysis and to answer RQ3 by performing an analysis of digitalisation in three logistics companies belonging to one international group of companies. We conducted nine 45 to 60 minutes semi-structured interviews with the representatives of the companies who were directly involved in the implementation of 2 digital solutions in their companies and/or are the users of these solutions, namely process owners, project managers, chief operations officers and quality specialists. Table 1 contains information about the interviewed persons and their positions in the companies. The records of the interviews were decoded, the results analysed, structured and interpreted.

In the fourth phase the authors validated the results with the same representatives of the companies in order to confirm the authors had interpreted the answers correctly.

**Table 1.** Information about the interviewed persons and their positions

	<b>SIA</b>	<b>OU</b>	<b>UAB</b>
Project manager	X	-	X
Process owner	X	X	-
Chief operations officer	X	X	X
Quality specialist	-	X	X

### 3. LITERATURE ANALYSIS

As a result of qualitative content analysis of the selected literature sources 12 categories and their frequency on the Digitalisation impact on the organisation have been identified (see Fig. 1).



**Fig. 1.** Categories and their frequency: digitalisation impact on the organisation

**Brings improvement category** is related to the improved quality and increased productivity, reduced errors and mistakes, increased efficiency, business adaptability and agility, thus ensuring a competitive advantage.

**Changes the organisation category** is related to substitution of routine and repetitive tasks, changing corporate relations and organisational structure, increase of inequality between occupational groups and genders, improved collaboration between departments.

**Requires digital leadership and strategy category** is related to changes in leadership and execution caused by the digitalisation, implementation of digital culture and incorporation of digital vision in organisation strategy.

**Changes employees' behaviour and abilities category** is related to employees' fear of losing their jobs due to digitalisation, acquisition of new skills, possible sabotage of digitalisation efforts.

**Increases customer satisfaction category** is related to provision of better products and services to customers which is enhanced by digitalisation, customers inclusion in the design and development of new products and services, direct customer interaction, increased product speed to market, new customer experience.

**Improves relationships within the ecosystem category** is related to integration of customers and suppliers in the value chain via digital infrastructure, cross-industry collaboration, digitalisation of external environment.

**Boost innovation category** is related to innovation enhanced by digital transformation and creation of new business models.

**Increases the importance of data quality and security** category is related to the increasing dependence on big data with the digitalisation and data quality. The issues of cybersecurity, data protection and risk management are becoming crucial for organisations.

**Promotes the usage of technology** category is related to application of digital technologies for collection and analysis of big data, process management and performance monitoring, quality control, detection and prevention of errors and mistakes, decision-making.

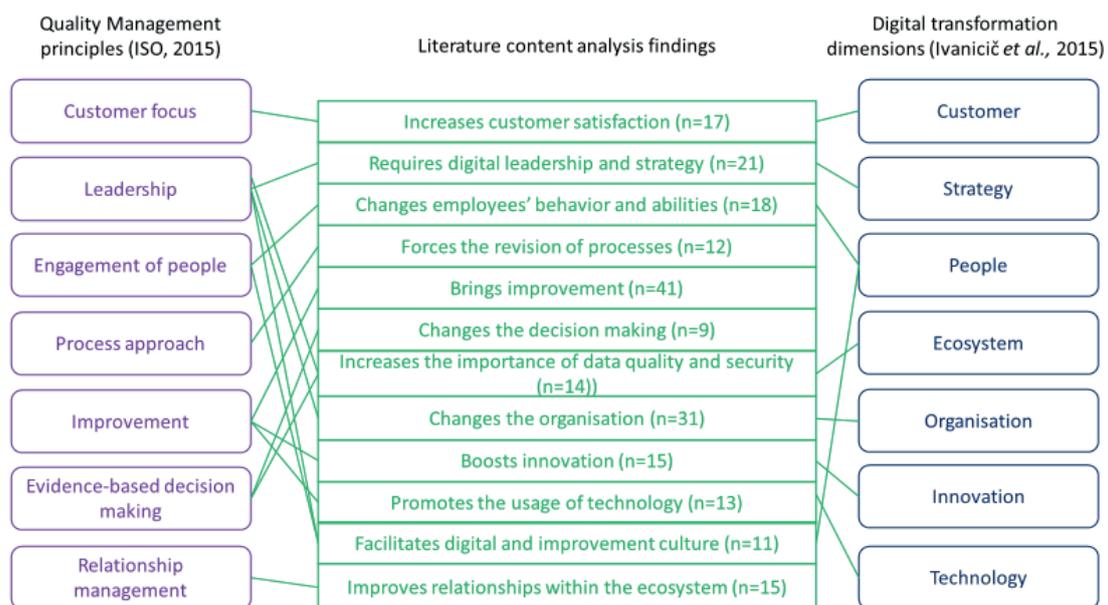
**Forces the revision of processes** category is related to revision, optimisation and standardisation of business processes, procedures and related terminology in the course of digital transformation.

**Facilitates digital and improvement culture** category is related to the promotion of digital culture and culture of continuous improvement based on digital technologies, improved communication and knowledge-sharing.

**Changes the decision-making** category is related to improved quality of the decisions that are made using AI and based on big data, machine-learning and neural networks as well as decisions made by machines and robots.

There was one sub-category with n=1 not fitting into any of the categories mentioned above – failure of digitalisation to improve productivity due to lack of internal knowledge thus not included in the categories, however, worth mentioning.

The qualitative content analysis results show that the impact of digitalisation lays in the same areas as the application of core quality management principles. The findings also generally support the conclusions of a previous study that identified seven dimensions of digital transformation, although the authors have identified several categories not fitting those dimensions. The summary of literature content analysis findings, quality management principles and dimensions of digital transformation identified in the previous research are presented in Figure 2.



**Fig. 2.** Comparison of QM principles, digitalisation dimensions and literature content analysis findings

The figure 2 shows digital transformation and quality management affect the same areas of the organisation such as leadership and strategy, customers, people, relationship, processes improvement and decision-making. Cultural and organisational aspects are not stated as separate core principles of QM; however, leadership and strategy contribute to the formation of culture with certain values and may impose changes in the organisation. Building a strong improvement and, in case of digital transformation, also digital culture, requires engagement of people, thus making all those aspects interconnected and interdependent. Therefore, the authors can say cultural and organisational aspects are incorporated in quality management principles and those are also the aspects of digital transformation.

Innovation and integration of technology are important elements of digital transformation, not being addressed by fundamental quality management principles. Innovation is an important part of continuous improvement, whilst technology is a tool. Most innovations are driven by technology, even concepts or business models, because application and integration of technology stimulate thinking, experimentation, research and development, which in turn accelerate innovation. To satisfy customers and gain competitive advantage which are the main goals and tasks of quality management the innovation and integration of new technologies are imperative, therefore they shall be addressed by quality management.

The increasing with the digitalisation dependence on data and data quality increases the importance of security issues in the organisation, especially cybersecurity and protection of personal data. This affects the decision-making process and requires the management to identify and address them.

#### 4. LOGISTIC COMPANIES PARTICIPATED IN THE EMPIRICAL PART OF THE RESEARCH

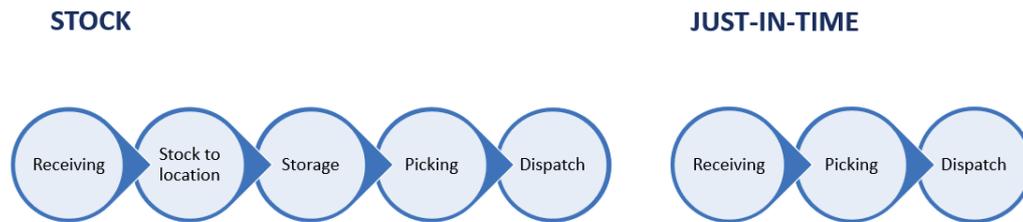
Three logistics companies that participated in this research are part of large international corporation. The companies provide warehouse logistics services in the Baltic states for retail companies. For data protection purposes the authors have named the company in Latvia as SIA, in Estonia – OU and in Lithuania – UAB. The basic data for the companies are represented in Table 2.

**Table 2.** Basic information about the companies participated in the research

	<b>SIA (Latvia)</b>	<b>OU (Estonia)</b>	<b>UAB (Lithuania)</b>
Company foundation year	1995	2006	2002
Number of employees	700	180	175
Number of warehouses	2	2	1

SIA is the biggest among these companies operating 24 hours a day, seven days a week.

The main activities of the warehouse operations consist of goods receiving, storage, picking, dispatch, inventory management, receiving of returns and waste collection. There are two main processes how goods are stored and assembled in a warehouse: JUST IN TIME (JIT) – goods that are assembled immediately after receipt and STOCK – goods that are assembled from defined storage locations (see Fig. 3).



**Fig. 3.** STOCK and JIT warehouse operations

The difference in the processes is that in STOCK operations a picker goes to the specified location to pick up goods for the exact order. In JIT a picker picks goods from pallets and distributes them to several orders, therefore the risk of mistake is very high.

During the recent years, the companies have implemented many digital solutions in order to optimise their operations, providing better services to the customers, ensuring competitive advantage and sustainability. In this research 2 such solutions and their implications were in focus. Table 3 shows the implementation timeline

**Table 3.** DriveIn and Voicy implementation timeline

	SIA (Latvia)	OU (Estonia)	UAB (Lithuania)
<i>DriveIn</i> implementation period	12/2018	05/2020	12/2018
<i>Voicy</i> implementation period for STOCK	01/2020	01/2020	11/2019
<i>Voicy</i> implementation period for JIT	-	12/2020	04/2021

DriveIn – implementation of warehouse entrance registration programme for suppliers and service providers. The suppliers have the possibility to pre-register delivery using an interface that is connected to the DriveIn application and also warehouse management system (WMS) completing information about purchase order number, date and estimated time of delivery, and truck number. Upon the arrival, the system via license plate reading camera automatically recognizes and lets the truck in. If the pre-registration is not done, on arrival the driver inputs information into the kiosk in the arrival area, then the system checks the conformance of the supplier or service provider data with WMS data and lets the truck or car into the warehouse territory. Simultaneously the driver receives an SMS with the ramp number where he shall unload. The implementation of the solution allowed to fasten the registration process, improved goods traceability and warehouse security, and allowed eliminating several positions of inbound operators.

Voicy – implementation of goods picking solution where the commands what goods to pick and from what warehouse location are given by voice. The placement of goods for storage and registration in the system are also done by voice: the system directs the picker to the location and then he confirms the goods are placed there. Prior to the implementation of Voicy the picking and placement were done using scanners. Voicy allows employees having free hands, therefore the productivity shall increase. With the implementation of Voicy the picking sequence was optimised as well, thus reducing driving distance between the picking locations. Also, the solution positively impacts work safety as the pickers do not have to look at the scanner when driving the warehouse equipment and performing the assembly of goods.

In JIT operations Voicy gives voice commands about the picking not from the exact warehouse location, but directly from the received goods placed on pallets in the JIT

picking zone where they are delivered immediately after receiving. The store orders assembly logic is different, therefore the deployment of the same solution in two types of operations were considered as two separate projects.

Voicy had been tested but was not implemented in SIA for JIT operations because due to big volumes another automated solution was sought after.

## **5. DIGITALISATION IN THE RESEARCH COMPANIES**

The digitalisation of suppliers' check-in process had two objectives – to optimise the time of registration and to reduce costs by elimination of physical operators at inbound. Additional benefits are improved security and visibility, as well as product traceability which is a crucial component of food safety management, as the process is fully automated, and records are kept in the system. DriveIn connection with WMS ensures access to all suppliers' database, ex-works conditions and all purchase orders. Human errors have been minimised, because in case of data discrepancy the system rejects the supplier. It has also improved the communication with the driver, his phone number is in the system and the driver can be contacted directly.

Digitalisation allowed to reduce 6 full time operator positions in SIA which has resulted in total savings of approximately 120 000 EUR annually. In UAB the reduction of 4 full time positions was achieved. However, in OU the situation is different. Although more than two years have passed since the digitalisation of the check-in process, there are still some technical issues which require physical employee presence, thus this objective has not been achieved. All three companies reported significant reduction of registration time and increased transparency of the process. It is important to note though, in case of system technical issues or errors, there still must be available operators to let the drivers in and report an issue to the technical support personnel. Many errors still appear due to incorrect actions by the suppliers' drivers. Hence the importance of correct written guidelines for the users emerges.

The suppliers and service providers check-in process became much faster with the digitalisation. In the beginning it caused dissatisfaction of some customers as the drivers had to adjust and learn the new registration process. Also, pre-registration required certain activities to be done on the customer side which was not initially appreciated. Over time, customers positively assessed the benefits of the solution, which were described above.

Voicy implementation expected to increase employee productivity and improve work safety. In UAB and OU implementation in STOCK operations went relatively smoothly, even taking into consideration the changes in the salary system. The minor issues with employees were solved by additional training (training had to be repeated several times) and explanations provided. Individual approach and investigation of each case when something went wrong, and the employee was involved or unsatisfied also helped. The expected productivity was reached in UAB within two months, and in OU within three months from the beginning of implementation. Most employees accepted the solution and there were minor technical and systemic issues necessary to be solved and improved. The adjustments were made continuously without implementation process interruption. The quality of picking remained on the previous level.

However, in SIA there was huge resistance from employees and many more technical issues. Due to these issues instead of productivity increase it went in the opposite direction.

SIA Chief operations officer: “The person (employee) was being constantly interrupted by the system; we were losing 10% in productivity”.

System improvements took a long-time and caused frustration among pickers as well as between developers and those responsible for the digitalisation internally – project manager, process owner and operations manager. Additional resources were spent for training, adjustment, improvement workshops and the general education of employees. The process was reviewed several times and the supporting documentation underwent significant changes resulting in the creation of many versions. The deployment of the solution increased the importance of data, meaning both master data about goods in WMS and the precision of information received by voice from the pickers in goods placement to stock process. The pickers were constantly complaining about listening to the voice and reported certain problems even after work, like seeing bad dreams. In SIA the expected productivity was achieved only 6 months after the implementation of the solution.

Digitalisation of JIT processes is more complex. The picking is done from the pallets to several orders simultaneously, thus increasing the possibility of human mistakes. In UAB the process was not initially developed in the correct way: the sequence of picking was wrong (heavy goods placed on top of fragile ones), different labelling was required, orders were mixed. Often the system did not recognise what the picker said resulting in the incorrect information in the system. With Voicy employees need more concentration; if some goods remained on the pallet during the picking, it is not possible to check in Voicy, the picker needs to connect to a scanner and see where the goods were missed. There was no such problem when scanning with a scanner. Many human mistakes and errors occurred, especially with new employees, thus affecting negatively the quality and productivity. The quality of picking was stabilised after several improvements of the system and many additional trainings. The productivity is still not on the expected level, but the trend is positive. In OU the technical issues and the process inconsistency led to reduced quality and productivity, frustration and complaints from employees. There was a huge resistance from employees, who could not get used to the new way of working. Even the most experienced and long-term employees made mistakes. Whilst technical issues and process amelioration were solved during three-four months since the digitalisation start, the employee attitude and ability to work in a new digital environment is still an issue despite the fact that many trainings were organized, including individual.

The digitalisation process in these cases included many adjustments and modifications. For DriveIn there were improvements on the system and interface side initiated by internal needs and by customers. New languages were added to the kiosk registration application for the drivers having the possibility to register using their own languages (e.g. Polish).

For Voicy there were several technical issues that had not been foreseen in the development process, therefore during the implementation process many improvements and adjustments were made. There was also a tension between the developers and project managers responsible for the digitalisation; and between project managers and users of the solution – process owners and operations managers, who are their internal customers. Whilst operations managers blamed digitalisation in the decrease in productivity and quality, project managers explained it with human factors.

UAB project manager: “Voicy – it is not about the devices, not about the technology, it is about people’s way of working.”

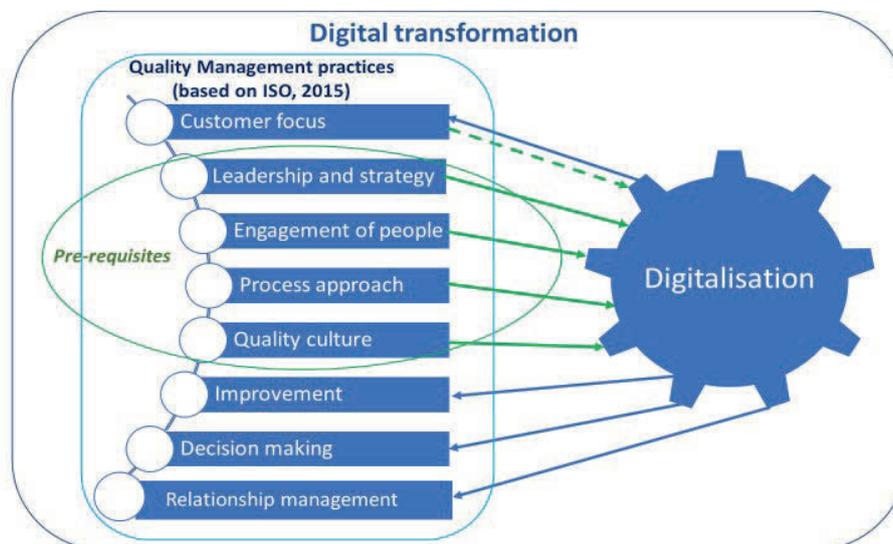
The implementation of these solutions was not run as a separate process, rather as a continuous improvement from the strategic point of view. Digitalisation of these processes required the review of the process, evaluation of risks, calculation of costs, estimation of expected benefits, development of new solutions, implementation, persuasion and education of employees, development of process documentation, followed by adjustment and improvements and continuous work with employees. It is important that many improvement solutions came from the users of the solution – the pickers in case of Voicy, the drivers and customer representatives in case of DriveIn. The future plan for DriveIn is development of an even more user-friendly interface, the possibility to use it on the phone or tablet. For Voicy the future plans are to improve the picking sequence ensuring better quality of orders picked and making the whole process more efficient.

## 6. EMPIRICAL RESEARCH RESULTS

Based on the information received during the interviews the authors have identified that quality management practices related to leadership and strategy, quality culture, engagement of people and process approach are pre-requisites for successful digitalisation.

Customer focus in all three company cases implementation of those 2 digital solutions was neither pre-requisite, nor the driver for the digitalisation. The digitalisation efforts were rather having internal drivers, such as optimisation and cost reduction, keeping, however, customer interests in mind. Nevertheless, customers with no doubt have benefited from the implementation of these digital solutions.

Quality management practices related to improvement, relationship management and evidence-based decision making are being impacted by the digitalisation. Figure 4 represents the Interrelation between digitalization and quality management practices.



**Fig. 4.** Interrelation between digitalisation and quality management practices

**Engagement of people.** Engagement of people, their education and development become the most important quality management practice for digital transformation. Digitalisation without true transformation of people’s mind-set, relationships and culture would not bring the desired improvement. The implementation of DriveIn did

not provoke straight resistance from the employees, as incoming operators were not directly involved in the process. However, there was a certain turbulence in the organisation noted in SIA and UAB caused by the changes in the organisational structures, e.g. reduction of employees. Some operators were transferred to other positions within the organisation, but several employees were made redundant which, understandably, caused a negative reaction among employees. There was a huge resistance from employees during the deployment of Voicy for stock operations in SIA and for JIT operations in UAB and OU. Also, the productivity and quality decreased as employees could not get used to the new way of working. These obstacles were overcome by additional training, education, persuasion of employees, individual approach and investigation of each case separately, where quality specialists played an important role.

**Leadership and strategy.** In all three companies the implementation of these solutions was a strategic decision. Each solution was thoroughly calculated and reviewed as a separate business case. The realisation of the projects was included in two to three years' strategic development plan. It was approved and supported by top management of the company. All respondents in all three companies stressed that the company sees digital transformation as the future of the company. Leadership played an important role in dispute resolution when there was a tension between the developers, implementors and the users of the solutions. The development and implementation of these solutions required significant financial investments, which did not bring immediate returns, thus top management leadership and commitment are extremely important to support digitalisation. Quality management practices related to leadership are one of key pre-requisites for digitalisation.

**Process approach.** Quality management practices related to process approach also become one of the prerequisites for digitalisation as digitalisation requires revision of the existing processes, development of new processes based on big amount of data, creation of new process documentation and working instructions for employees. At the same time digitalisation itself is the process changing the way of working and decision making. This process was, and still remains as it continues, iterative requiring many adjustments and improvements.

**Quality culture.** Having quality culture, culture of continuous improvement with no blaming and “witch hunting” is imperative for digital transformation. In UAB the process of digitalisation went more smoothly than in SIA and OU where the internal culture and communication issues became at some point limiting factors for digitalisation and hindered the process. The planting of quality culture for digitalisation, which can be defined as digital improvement culture, the changing the mindset of people toward improvements via digital tools and solution application are one of key quality management practices in the course of digital transformation.

**Customer focus.** During the interviews the authors got the confirmation that digitalisation in all three companies was not driven by the customers yet taking into the consideration their interest and offering certain benefits to them. Thus, the authors can conclude that customer related quality management practices are being transformed as the customer is not a first priority in the course of digitalisation. The customer benefits in case of DriveIn are the traceability of products and faster registration – therefore their employees spend much less time at the warehouse. In case of Voicy implementation productivity increase allowed offering better service price.

**Improvement.** Digitalisation certainly facilitated improvement in the organisations under this study. Digital transformation starts with the review of the existing processes and becomes a process of continuous improvement itself where quality management practices are in the development of new ways of working, review and improvement of processes and development of supporting documentation.

**Decision-making.** The decision-making practices are affected drastically. On the one hand, the digitalisation allowed completely substituting inbound operators in SIA and UAB, letting the system take the decision. In case of Voicy the decisions about picking sequence and the location are also done by the system. On the other hand, the dependence on data quality and cybersecurity increased enormously. The focus of quality management shifts from evidence-based decision making, based on reports and KPIs towards risk management, data quality and security.

**Relationship management.** The digitalisation in an organization cannot take place without the participation of stakeholders. In case of DriveIn implementation a continuous dialog with the customers and the suppliers was held. Many improvements were initiated by the suppliers and their needs (e.g. improvements of the interface, addition of Polish language). There was also some resistance from customers and the suppliers who needed to do additional work and acquire, like in case of supplier drivers, additional skills. Also, within the organisation establishing connections between different departments is a key task of quality management for digital transformation. In case of Voicy implementation in SIA and OU there were issues and misunderstanding of where the root of the problem was, if it was technical or human related, if it belonged to the developers or operations. Quality management practices in such cases transformed towards being mediating and educating.

## CONCLUSION

Digitalisation of any organisation requires leadership and strategy, structured approach and change in the mindset of people involved. The integration of technology alone is not enough. The beauty of digitalisation is establishing connections and improving relationships with the ecosystem via the digital infrastructure. Digital transformation calls for organisation re-design, the acquisition of new skills and abilities of personnel, revision of processes, development of new strategy and taking care about the customer needs. These are the same tasks and goals for the quality management - ensure customer satisfaction providing better services and products, satisfy stakeholders' needs, establish relationships, enhance collaboration, create environment for excellence within the organisation via improved culture and strategy with the involvement of people and top management commitment. Digital transformation and quality practices go hand in hand and the transformation brought by the integration of digital technologies changes inevitably the way quality management practices are applied for the benefits of the organisation, its customers and the whole ecosystem.

In this study the authors have discovered that certain quality management practices become imperative as pre-requisites for digitalisation and for successful digital transformation, whilst other practices are being impacted and affected by digitalisation.

Leadership and strategy for digitalisation is the first cornerstone, which confirms the literature qualitative content analysis findings where the category "Requires digital leadership and strategy" had a frequency n=21. Quality management practices related

to the engagement of people, changes of way of working and organisation itself are another crucial pre-requisite for digitalisation. "Digital transformation is not about technology" (Tabrizi et al., 2019) was confirmed by UAB project manager saying that digitalisation was not about tools or technology, but it was about way of working adopted by employees. Similar conclusions derived from literature content analysis where digitalisation impact on employee behaviour and abilities (n=18) and changes in the organisation (n=31) are among the categories with the highest frequencies. Digital transformation is a continuous improvement process, the engagement of people hence plays an utmost important role, as they may support this transformation or hinder it. Human resource perspective of quality management (Foster, 2007) can contribute to the solution of employee related digitalisation issues. Similar findings were noted in other research (e.g. Branca et al., 2020).

Literature analysis showed that digitalisation facilitated digital and improvement culture in organisations (n=11), however, in our study the authors conclude that quality management practices related to quality culture shall be adopted by the organisation for the digitalisation being successful and smother. As empirical study and literature analysis showed the digitalisation of the processes brings improvements into the organisation (n=41); however, this path is thorny and difficult. In order to achieve those benefits the continuous improvement process approach shall be employed. Both literature and empirical study showed that digital transformation starts with the review of existing processes (n=12) and becomes a process of continuous improvement itself where quality management practices lay in the area of the development of new ways of working, review and improvement of processes and development of supporting documentation.

Quality management practices shift from being customer-centric towards playing a mediating role for digital transformation. Although digitalisation offers better customer experience (Ralea et al., 2019; Prokhin, 2020), new products and services (Elg et al., 2020), better satisfaction of end customer needs by increasing collaboration between the organisation and its customers (Mazzuto & Ciarapica, 2019), the customer satisfaction category (n=17) is not among the impacts with highest frequencies detected in the literature content analysis. Our empirical study confirms that digitalisation was not driven by the customer needs, although at the end there were certain benefits for the customers. The authors have also shown that digitalisation not only allows the substitution of monotonous and repeating tasks along with physical work as was described by Manita and Dengler and Tisch (Manita et al., 2020; Dengler & Tisch, 2020), but also the decision making can be done by the digital system confirming the findings of previous research by Prokhin (Prokhin, 2020).

The results of this research show that quality management practices related to leadership and culture, strategy, customer focus, improvement, relationship management, organisation and people, decision-making and processes are likely to transform with the integration of digital technologies some of them becoming extremely important being prerequisites for the transformation, whilst others are being transformed under the impact of digitalisation. The focus of quality management practices in the digitalisation process shifts from being customer-centric towards playing mediating role with the increasing importance of human resource perspective of QM.

## REFERENCES

- Armengaud, E., Sams, C., von Falck, G., List, G., Kreiner, C., & Riel, A. (2017). Industry 4.0 as Digitalization over the Entire Product Lifecycle: Opportunities in the Automotive Domain. *Communications in Computer and Information Science*, 334–351. <https://doi.org/10.1007/978-3-319-64218-528>
- Barros, S., Sampaio, P., & Saraiva, P. (2014). Quality management principles and practices impact on the companies' quality performance. *Proceedings of the 1st International Conference on Quality Engineering and Management*, 237–247.
- Basu, R., & Bhola, P. (2016). Impact of quality management practices on performance stimulating growth. *International Journal of Quality & Reliability Management*, 33(8), 1179–1201. <https://doi.org/10.1108/ijqrm-10-2015-0153>
- Bates, M. J. (1989). *The Design of Browsing and Berrypicking Techniques*. Pages.gseis.ucla.edu. Retrieved from <https://pages.gseis.ucla.edu/faculty/bates/berrypicking.html>
- Branca, T. A., Fornai, B., Colla, V., Murri, M. M., Streppa, E., & Schröder, A. J. (2020). The Challenge of Digitalization in the Steel Sector. *Metals*, 10(2), 288. <https://doi.org/10.3390/met10020288>
- Carvalho, A., Sampaio, P., Rebentisch, E., & Oehmen, J. (2020). *Title: Technology and quality management: a review of concepts and opportunities in the digital transformation*, 698–714. Retrieved from <http://hdl.handle.net/1822/70713>
- Dengler, K., & Tisch, A. (2020). Examining the Relationship Between Digital Transformation and Work Quality: Substitution Potential and Work Exposure in Gender-Specific Occupations. *KZfSS Kölner Zeitschrift Für Soziologie Und Sozialpsychologie*, 72(S1), 427–453. <https://doi.org/10.1007/s11577-020-00674-3>
- Dewhurst, F., Martínez Lorente, A. R., & Dale, B. G. (1999). Total quality management and information technologies: an exploration of the issues. *International Journal of Quality & Reliability Management*, 16(4), 392–406. <https://doi.org/10.1108/02656719910249333>
- Diong, T. (2017). The Future of Management Systems. *Quality Magazine*. <https://www.qualitymag.com/articles/94207-the-future-of-management-systems>
- Ebert, C., & Duarte, C. H. C. (2018). Digital Transformation. *IEEE Software*, 35(4), 16–21. <https://doi.org/10.1109/ms.2018.2801537>
- Elg, M., Birch-Jensen, A., Gremyr, I., Martin, J., & Melin, U. (2020). Digitalisation and quality management: problems and prospects. *Production Planning & Control*, 1–14. <https://doi.org/10.1080/09537287.2020.1780509>
- Foster, S. T. (2007). *Managing quality : integrating the supply chain*. Pearson Prentice Hall.
- IBM. (2017, March 13). *7 keys to digitize manufacturing*. 7 Keys to Digitize Manufacturing. Retrieved from <https://www.ibm.com/industries/industrial/resources/7-keys-business-transformation/#section-4>
- International Organization for Standardization. (2015). *ISO 9000 Quality management systems - Fundamentals and Vocabulary* (Fourth revision).
- Ipatov, O., Barinova, D., Odinokaya, M., Rubtsova, A., & Pyatnitsky, A. (2020). The Impact of Digital Transformation Process of the Russian University. *DAAAM Proceedings*, 0271–0275. <https://doi.org/10.2507/31st.daaam.proceedings.037>
- Ivančić, L., Vukšić, V., & Spremić, M. (2019). Mastering the Digital Transformation Process: Business Practices and Lessons Learned. *Technology Innovation Management Review*, 9(2), 36–50. <https://doi.org/10.22215/timreview/1217>
- Kovrigin, E. A., & Vasiliev, V. A. (2020). Barriers in the Integration of Modern Digital Technologies in the System of Quality Management of Enterprises of the Aerospace Industry. *2020 International Conference Quality Management, Transport and Information Security, Information Technologies (IT&QM&IS)*. <https://doi.org/10.1109/itqmis51053.2020.9322960>
- Lola, I. S., & Bakeev, M. (2020). Pilot study of Industry 4.0 and digital technology prevalence in Russian manufacturing companies. *Management and Production Engineering Review*, 11(3), 26–37. <https://doi.org/10.24425/mper.2020.134929>
- Mandrakov, E. S., Vasiliev, V. A., & Dudina, D. A. (2020). Non-conforming Products Management in a Digital Quality Management System. *2020 International Conference Quality Management, Transport and Information Security, Information Technologies (IT&QM&IS)*. <https://doi.org/10.1109/itqmis51053.2020.9322931>
- Manita, R., Elommal, N., Baudier, P., & Hikkerova, L. (2020). The digital transformation of external audit and its impact on corporate governance. *Technological Forecasting and Social Change*, 150, 119751. <https://doi.org/10.1016/j.techfore.2019.119751>

- Mayakova, A. (2019). Digital transformation of modern quality management. *Economic Annals-XXI*, 180(11-12), 138–145. <https://doi.org/10.21003/ea.v180-15>
- Mazzuto, G., & Ciarapica, F. E. (2019). A big data analytics approach to quality, reliability and risk management. *International Journal of Quality & Reliability Management*, 36(1), 2–6. <https://doi.org/10.1108/ijqrm-01-2019-294>
- Menshikova, M. A., Piunova, Y. V., & Makhova, M. N. (2019). Digital Transformation in the Quality Management System. *2019 International Conference "Quality Management, Transport and Information Security, Information Technologies" (IT&QM&IS)*. <https://doi.org/10.1109/itqmis.2019.8928438>
- Ponsignon, F., Kleinhans, S., & Bressolles, G. (2019). The contribution of quality management to an organisation's digital transformation: a qualitative study. *Total Quality Management & Business Excellence*, 30(sup1), S17–S34. <https://doi.org/10.1080/14783363.2019.1665770>
- Prokhin, E. (2020). *Digital Transformation of Industrial Companies: What is Management 4.0?* The 11th International Conference on E-business, Management and Economics, Beijing China.
- Quality management principles*. (2015). International Organization for Standardization. Retrieved from <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100080.pdf>
- Ralea, C., Barbu, C., Tanase, C., & Dobrin, O.-C. (2019). Looking to the Future: Digital Transformation of Quality Management. *Proceedings of the International Management Conference*, 13(1), 121–132.
- Savina, A., Malyavkina, L., Baturina, N., Bolshakfova, L., Zimina, L., & Vlasova, M. (2020). Information and technological support of the system of food quality and safety management in the digital economical environment. *Proceedings of the International Scientific Conference - Digital Transformation on Manufacturing, Infrastructure and Service*. <https://doi.org/10.1145/3446434.3446443>
- Sjödin, D. R., Parida, V., Leksell, M., & Petrovic, A. (2018). Smart Factory Implementation and Process Innovation. *Research-Technology Management*, 61(5), 22–31. <https://doi.org/10.1080/08956308.2018.1471277>
- Tabrizi, B., Lam, E., Girard, K., & Irvin, V. (2019, March 13). *Digital Transformation Is Not About Technology*. Harvard Business Review. Retrieved from <https://hbr.org/2019/03/digital-transformation-is-not-about-technology>

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