

THE INNOVATIVE DEVELOPMENT OF QUALITY MANAGEMENT

Assoc. Prof. Eng. Ina Nikolova-Jahn
Dept. IIIM, TU – Sofia, Bulgaria

Abstract: *Smart Products have information about their manufacturing processes, management of their quality, future application and recycling. They actively support the production processes (when they will be produced, with what parameters, with what materials they should be produced, where their quality control should be located, when, what modifications, etc.). In these conditions, quality management should meet new requirements imposed by the fourth industrial revolution.*

KEYWORDS : *Industry 4.0, Quality 4.0, intelligent products, quality management*

Introduction

Industrial development passed through different stages of development or the so-called. Industrial revolutions. The first industrial revolution is related to the mechanization driven by water and steam. It was followed by the second industrial revolution, mass production (Ford, Taylor, etc.) with the help of assembly lines and the use of electrical energy. The third industrial revolution is the digital revolution characterized by the use of electronics and information technologies to further automate production. However, the increasing complexity of the products, new requirements for production and quality management are set, which are the heart of the fourth Industrial Revolution (Industry 4.0).

I. Requirements of Industry 4.0

The factors that impose these changes are: increasing flexibility requirements, resource efficiency product customization, integration of customers and suppliers in the designing and production process, reorganization of the value chain of production processes in the global market.

The following questions are standing:

- How do you integrate the production data and all the quality data that is attached to it in the new digitized business processes?
- What is the current state of Industry 4.0 development and how will it affect the industry?
- Why should quality management also be reinvented and what safety aspects should be considered?
- How Automated Quality Management Systems (CAQ) will be developed to meet Industry 4.0 requirements in the near future

II. Intelligent Factory (Smart Factory) and Innovative Development of Quality Management

Structure of Smart Factory. An important element of the fourth Industrial Revolution is the Smart Factory. Quality management is an important part of the future intelligent infrastructure function [1] Smart Factory is defined as a factory where there is independent communication between people, machines and resources in integrated network to perform production tasks. These systems perform their tasks based on the information coming from the physical and virtual world through the

Internet of Things (Components) and the Internet of Services [3].

Physical world information is a real position or state, unlike the information of the virtual world, such as electronic documents, drawings, simulation models, etc.[9,11]

Quality 4.0 is a reference to Industry 4.0. The fourth Industrial Revolution is happening around us at the moment. The digital impact of it is expanding and uniting it with the physical and natural world. Several critical technological changes have been allowed, including big data, analysis, connectivity, scalability and collaboration. It connects people, machines and data in new ways, creating an adequate environment, leadership, cooperation.

Historically, the notion of quality assurance through control at the end of the production process today has changed to the concept that the quality is planned, created and provided to the production of the product or the supply of the service. The optimization of quality planning processes, the introduction of preventive actions reduces errors, reduces costs and achieves greater efficiency in value. As a result, new management methods and concepts of production control are developed and implemented, through quality assurance and total management of customized products[5].

According to a number of studies, for example the Stuttgart Quality Management Institute, the highest proportion (70 per cent) of discrepancies occurred at the product planning stage and the highest proportion to remove inconsistencies (80 per cent) was in the production stages and sales shown in Fig. 1 [8].

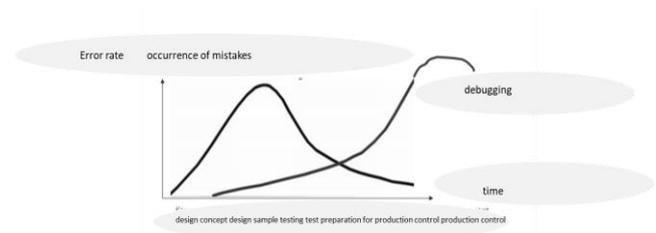


Fig. 1. Creating and removing errors in stages of product development

Each manager should have knowledge to create the quality as well as the social and didactic-methodical knowledge of their distribution in the company. Because of this reason, the interest in quality is constantly increasing in theoretical and practical terms.

Quality management occupies a significant share in various sciences, and it is actively presented as a subject of contemporary empirical interdisciplinary researches and has an important role in the field of economic science and management theory.

In a study in 2017 of the Bulgarian Chamber of Commerce and Industry (BCCI) about 500 companies have expected to increase their export revenue but only 37% actually did it [10].

The most common questions for quality managers:

- Are the certifications based on ISO, CMMI, etc. going to be sought?
- Does the quality take a new meaning in Industry 4.0 organizations?
- What kinds of trainings should quality managers get so that they can prepare for rapid changes in their organizations (or their customers' demands)?

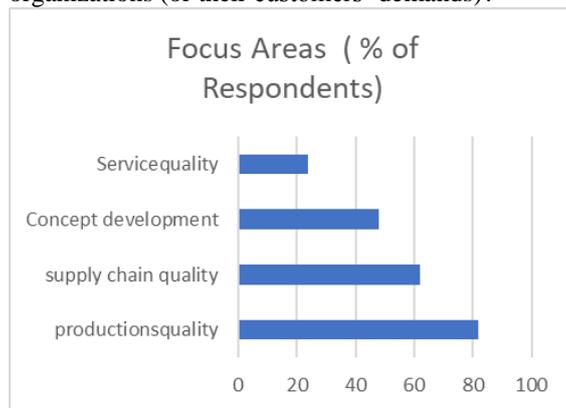


Fig. 2. Focus Areas of quality problems

Quality is not limited to the manufacturing process. To achieve the highest quality, it must already be created in process of designing. 82% of respondents say that production quality plays a big role in their business, but in contrast, only 48% say their quality management also focuses on the concept definition phase.

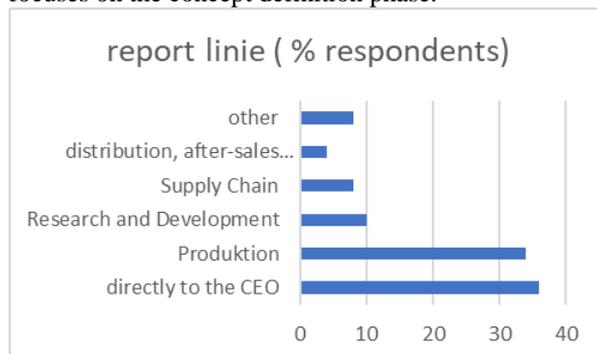


Fig. 3 QM Report Direction.

The prospects for the companies surveyed are good. They can easier move to information services and software systems. This opens new opportunities for regional firms, which also will be able to integrate internationalization processes. In every case, these companies will benefit from the interdisciplinary transfer of knowledge and technologies. Currently, many companies use CTI-typical technologies such as cloud services, etc. In addition 90% of the interviewed

companies have reliable WLANs. Discussions made it clear that currently that clouds are very important part of the modern companies.

Technology related to Intelligent Factory - IoT, big data advanced machine learning reality, and so on - can be used to improve quality.

III. Challenges to Quality 4.0.

On the basis of the conducted studies, the requirements of Quality 4.0 can be outlined in the different stages of the product life cycle:

- / design / design stage

In the past, "quality" is usually associated with production processes - used raw materials, assembly, finishing and packaging - but quality must be an integral part of the concept / design / design phases.

- At the control and service stage

By collecting and getting the sense of user data from the field, future failures can be prevented with minimal loss of material. The time it takes to identify inconsistencies can be extremely short, thus ensures customer satisfaction.

IV. The Role of Human Factor and Company Culture in Quality 4.0

Quality 4.0 has broad scope of business, and companies should strive to inspire a quality approach as part of the overall corporate culture[1,2,7].

The use of sensors to collect data for root cause analysis, diagnostic techniques can be performed remotely. By collecting feedback from a number of devices, it can also be used as a method for further analysis of machine behavior or product performance.

Conclusions

The following conclusions can be made:

- Ensuring Quality 4.0 is one of the most important key factors for successful implementation of Industry 4.
- Unified frameworks and standards need to be set up at an early stage to make industry ready to invest. This is necessary to examine the individual quality issues in more detail and to further explore through detailed technology impact assessments.

Quality management must be in constant optimal relation to the functions of the production cyber-physical system. • Quality management is radically altered and qualitatively different from the existing one, with the information component (stream) being entirely virtual in cloud boundaries, allowing free real-time communication with Smart-Cyber system

References

- [1] Андреев, О. (2016), Мениджмънт на проекти, Софтрейд, ISBN9543340374
- [2] Ангелова, Й. (2017) Управление на качеството на обслужване на клиентите в енергийните центрове, XV Международна научна конференция "Мениджмънт и инженеринг", 17" Созопол, България, ISSN 1310-3946

- [3] Chukalov K. (2017) Horizontal and vertical integration, as a requirement for cyber-physical systems in the context of industry 4.0, International Scientific Journal, Industry 4.0, ISSN 2543-8582, YEAR II, ISSUE 4/2017, pp 151-157
- [4] Damianov, D., K.Chukalov (2016) Structural reorganization in the informational - technical system of a production machine (hybrid) for operating in the Industry 4.0, International Scientific Conference, "INDUSTRY 4.0", Proceeding XXIV, Volume 27/213, ISSN 1310-3946
- [5] Galabova, L. (2018) Strategic Value of Design: an Intellectual Capital Perspective" Proceedings of 13th International Forum on Knowledge Assets Dynamics "Societal Impact of Knowledge and Design, Delft, Netherlands, July 4-6. ISSN 2280-787X. ISBN 978-88-96687-11-6, pp. 1306-1317
- [6] Kagermann, et al, (2011) Mit dem Internet der Dinge auf dem Weg zur 4. Industriellen Revolution, VDI-Nachrichten
- [7] Koleva, N. (2019) Conceptual Framework to Study the Role of Human Factor in digital manufacturing environment, International Scientific Journal Industry 4.0, Year IV, Issue 2/2019, pp82-88
- [8] Tomov, P., (2015) Innovative Solutions for the Automatisation of Discrete Production Engineering, 12th International Conference on Standardization, Prototypes and Quality: A Means of Balkan Countries' Collaboration, Kocaeli
- [9] Roth, A. (2016) Einführung und Umsetzung von Industrie 4.0, Springer
- [10] Statement of Bulgarian Chamber of Commerce and Industry (BCCI), 2017.
- [11] VDMA Industrie 4.0 Forum (2016) Industrie 4.0 in Practice: Solutions for Industrial Applications, Frankfurt am Main