

# QUALITY MANAGEMENT AND REQUIREMENTS OF THE FOURTH TECHNICAL REVOLUTION

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**Abstract:** *Modern industry requires intelligent development of the product throughout its entire life cycle-from concept to recycling. These intelligent products (Smart Products) have information about their production processes, quality management, future application and recycling. They support active manufacturing processes (when will be produced, with what parameters, with what materials should be produced, when, what kind of modifications, etc.). Under these conditions the management of quality have to meet new requirements imposed by the fourth industrial revolution is discussed in this article.*

**KEYWORDS:** INDUSTRY 4.0, CPS, INTERNET OF THINGS, INTERNET SERVICES

## 1. Introduction

The history of industrial revolutions is as follows, the first industrial revolution was characterized by steam-powered machines, the second was characterized by electricity and assembly lines. Innovations in computing and industrial automation defined the third industrial revolution. The fourth industrial revolution is designing smart products through hyper-connected cyber-physical systems in environments where humans and machines cooperate to achieve goals, and use mega data to generate value.

This radically changed the manufacturing and business models by creating the conditions for greater flexibility and efficiency of resources.

For the first time there is an industrial revolution that predicted a priori and not to monitor its effects. It provides various opportunities to companies and research institutes to active participation and impact on production.

It creates the opportunity for the development of entirely new technological models, services and products. Fourth technical revolution represents not only a technical challenge-the technological change that will provide long-lasting organizational impact and creating opportunities for new production models, concepts and corporate, but a new concept of network world.

In the literature, the "Fourth Industrial Revolution" is used as fully equivalent in everything in terms of content and ideology to the term "Industry 4.0".

Quality assurance becomes a central point on the agenda of top management. But the traditional methods of quality management are no longer enough therefore new, innovative quality management approaches are implemented.

In ISO 9001:2015, quality is the "degree to which a set of inherent characteristics of an object fulfils requirements." (3.6.2) [1].

The purpose of this paper is systematization of problems of quality management regarding the requirements of the fourth industrial revolution.

## 2. Formulation and classification of the quality problems

The fourth technical revolution represents not only a technical challenge-the technological change that will provide long-lasting organizational impact and creating opportunities for new production models, concepts and corporate, but a new concept of network world. In "an

intelligent world" Internet is at the service of all needs, and this leads to a change in the consumption of intelligent energy networks (Smart Grids), sustainable concepts to mobile (Smart Mobility, Smart Logistics), social welfare (Health Smart) and new technological solutions. [2,3].

A study in 2017 of the Bulgarian Chamber of Commerce and Industry (BCCI) about 500 companies expects to increase their export revenues but only 37% actually did it[7].

The most common questions for quality managers:

- are the certifications based on ISO, CMMI etc. going to be sought?
- does the quality take on a new meaning in Industry 4.0 organizations?
- what kind of trainings should a quality practitioner get so that they can prepare for rapid changes in their organizations (or at their customers)?

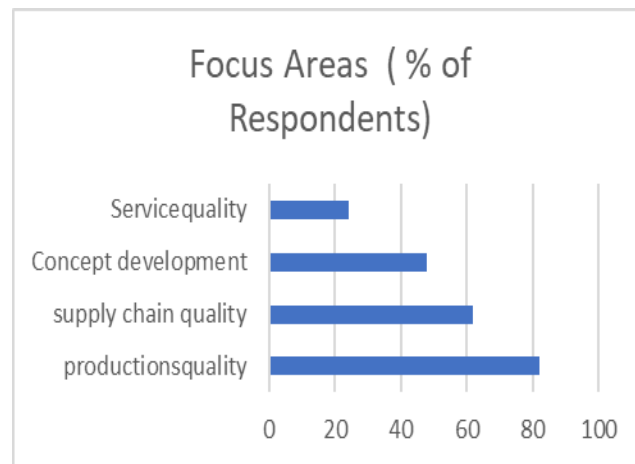


Fig. 1. Focus Areas of quality problems

Quality is not limited to the manufacturing process. To achieve the highest quality, it must already be created in the design process. 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.

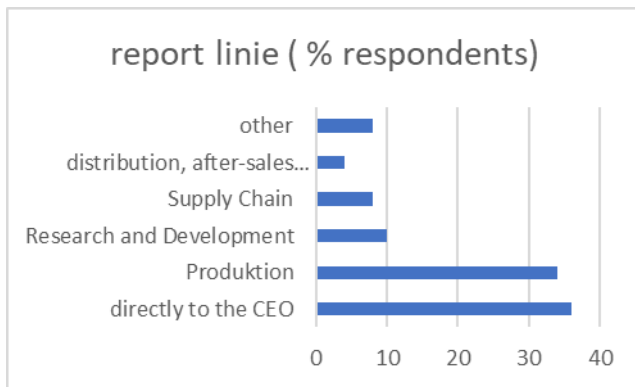


Fig. 2 QM Report Direction

Today, companies need to rethink that the quality is an important issue for the entire company. In about one-third of the companies surveyed, the quality manager now reports directly to the CEO.

The results show that companies are primarily concerned with two issues:

Quality foundations in the face of new challenges and innovative

Apply quality test management methods. It is particularly alarming that companies fail to secure a solid foundation of quality so far. The companies involved with traditional quality management approaches, quality gate processes and performance characteristics pay (KPI) have developed powerful quality management, are suddenly confronted with new realities. Four of 10 executives think that standard quality methods lose their effectiveness and almost half (48 percent) have quality problems observed in the past 10 years. 50 percent expect in the next 10 years another increase in quality problems.

Only 23% of them said that during 2018 are planned investments in new capacity and 27% in new products and innovation. The focus of investment firms is placed on the development of human potential. About 25% of them plan to hire new staff, while the share for 2017 was around 30%.

Impact of different trends on the quality management of your company. Time, for 68 percent of respondents, this poses a major challenge. As another important factors are becoming increasingly complex products (58 percent) that continue to be around globalization (54 percent) and an increase in regulatory changes (54 percent) called.

Industrial companies in the country do not know the essence of "Industry 4.0" not currently intend to finance on this direction. However, they participate in European projects of the program Horizon 20/20, which essentially is an initiative of "Industry 4.0".

Unlike in Germany, where in 2015 a study was done in 235 companies of the German Chamber of Commerce, who in five years are going to invest 3.3% of its annual turnover in "Industries 4.0" technical solutions. This represents 50% of investments in new facilities or amounted to 40 billion euros and thus meet the requirements, principles and selection of appropriate scenarios "Industries 4.0."

Interestingly, a vast number of existing quality-centered Industry 4.0 initiatives are not being led by quality, but by IT, operations, engineering, or sales and marketing.

Many conversations with quality leaders make it clear that a large portion of them do not possess a clear understanding of Industry 4.0 technologies, their application, and their importance.

Creation of conditions for effective application of the fourth technical revolution in the industrial companies in Bulgaria requires consideration of the aspects related to the unification and standardization of parts, assemblies, products and activities. The fourth industrial revolution, as an important feature in modern industrial environment leads to significant changes in terms of economic development strategies undertaken by national governments. The transformation of the global economy in the digital world affects all sectors of industry and services and sets new challenges

### 3. Challenges on the way to the fourth industrial revolution

Industry 4.0 certainly includes the digitalization of quality management. Technologies associated with Smart Factory – IoT, Big Data, Machine Learning etc. - can all be utilized to improve quality[4].

More importantly it is the impact of that digitalization on quality technology, processes and people..

Manufacturers should use the framework to interpret their current state and identify what changes are needed to move to the future state.

On the basis of a literature review, the following principles can be defined:

- Interoperability: Machines, devices, sensors and people that connect and communicate with one another.
- Information transparency and Virtualization : The systems create a virtual copy of the physical world through sensor data in order to contextualize information.
- Real Time Capability und Service Orientation: the ability of the systems to support humans in making decisions and solving problems and the ability to assist humans.
- Decentralized decision-making: The ability of cyber-physical systems to make simple decisions on their own and become as autonomous as possible[5,6].

|                      | Cyber-Physical Systems | Internet of Things | Internet of Services | Smart Factory |
|----------------------|------------------------|--------------------|----------------------|---------------|
| Interoperability     | X                      | X                  | X                    | X             |
| Virtualization       | X                      | -                  | -                    | X             |
| Decentralization     | X                      | -                  | -                    | X             |
| Real-Time Capability | -                      | -                  | -                    | X             |
| Service Orientation  | -                      | -                  | X                    | -             |
| Modularity           | -                      | -                  | X                    | -             |

Fig.3. Principles and elements of Industry 4.0

As a result, quality approach emphasize real-time visibility, intelligent decision support, and improved communication — between people, systems and machines. It describes the technological innovations that will help us more quickly assess compliance and customer satisfaction and optimize business processes through systems integration — whether the object we are working with is a process, a product, a person or an intelligent software system.

Companies that have built a solid quality foundation can do so with the help of a variety of new technologies to further increase their level: Data analytics, Industry 4.0 users, such as automation and cloud computing as well as new forms of customer interaction allow to improve the quality.

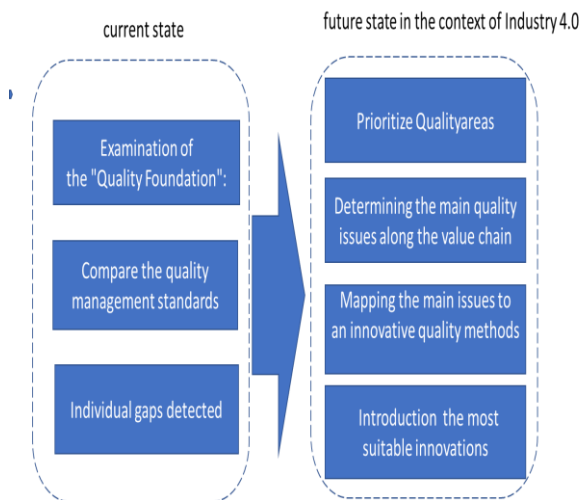


Fig. 4. Approach to the achievement of the next level of quality management

In a first step, a "quality baseline check" is carried out to a possibly to expose existing gaps in your quality foundation. By comparing the Quality management-the standards will be the main areas of improvement clearly visible. In a second step are qualities areas identified and innovative quality methods such as reliability testing, determining the main quality issues along the value chain und new innovative qualitative methods can be developed and implemented.

#### 4. Conclusions

The article examines the characteristics and principles of Industry4.0 and their impact on quality.

On the basis of done research , the state of Bulgarian enterprises revealed and outline quality problems . New innovative qualitative methods have also been analyzed. A comparison has also been made with international companies in Germany. On this basis, an approach is proposed for quality management and meeting the requirements of Industry 4.0.

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