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SOCIAL ORIENTED QUALITY: FROM QUALITY 4.0 TOWARDS QUALITY 5.0

Abstract: *A quality concept followed industrial and social development. For first aspect of development is distinguished as a four stages in industrial revolution. Now we are in mixed state with 2nd industrial revolution (using electrical energy in production processes with division of labor), 3rd industrial revolution (using IT and ICT systems for flexible automatization of whole production systems), and 4th industrial revolution (using cyber-physical systems). Social development was very slower but with recognizing the knowledge and spirituality as key factors for succecc these two aspects are more close and in some cases are coupled.*

In the paper are analyzed different elements of Quality 4.0 concept and gave some comments about wholeness of this concept. In second part of the paper are presented achievements in area of consciousness and spirituality. Theory of everything which can be used for improving Quality 4.0 concept.

In third part of the paper are presented some building elements of Social Oriented Quality (SOQ) or Quality 5.0 as next generation of Quality 4.0 concept.

Keywords: *Quality 4.0, Social Oriented Quality (SOQ), Quality 5.0, spirituality*

1. Introduction

A Quality 4.0 concept followed stages of industry development in last 250 years. According Dan Jacob (2017) the Quality 4.0 support the digitalization of quality management, based on digitalization of quality technology, processes, and people. His model consists from 11 axes, i.e. : (1) data, (2) analytics, (3) connectivity, (4) collaboration, (5) App-development, (6) Scalability, (7) management system, (8) compliance, (9) culture, (10) leadership, and (11) competency.

Nicole Radziwill (2018) based her research on contribution of Machine Learning (ML) and Artificial Intelligence (AI) in working of Quality Systems. Through analyzing quality she emphasized discovery aspects and analyzed Gartner Analytic Continuum with four stages: (1) descriptive analytics, (2) diagnostic analytics, (3) predictive analytics, and (4) prescriptive analytics. For all of them she advices Data Science approaches and techniques, especially Big Data for searching and make optimal decisions about different quality. In this approach Quality 4.0 is composed from: (1) connectedness, (2) intelligence, and (3) automation. In this work

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is emphasized six categories of value proposition using Quality 4.0 concept, i.e. : (1) augment/improve human intelligence, (2) increase the speed and quality of decision-making, (3) improve transparency, tracebility and auditability, (4) anticipate changes, removal biases and adapt to new circumstances and knowledge, (5) evolve relationships, organizational boundaries and concept of trust to revel opportunistic for continuous improvement and new business models, and (6) learn how to learn by cultivating self-awareness and other-awareness as skills.

The second group of approaches is related to leadership and competence for Quality 4.0. *Hacker S.* (2017) distinguished IQ (Intelligence Quotient), EQ (Emotional Quotient), and SQ (Spiritual Quotients). Among them are relations because SQ grounded EQ and EQ is related to IQ. Wider references about spiritual leadership emphasized personal traits in digital to Quality of Life (QoL) with interaction of Quality 4.0 with Life Satisfaction (LS), Happiness (HP), Quality of Working Life (QWL), Well-Being (WB), Hope (HO), Spirituality (SP) and Emotions (EM). This aspect is also related to concepts of C.G. Jung (1928), Jaspers (1962).

All previous concepts push a quality paradigm to find answers for the new and probable, complex and disruptive business and social situation (Romero et al., 2016; Jacob & Shah, 2018; Knowles, 2011; Sicari, et al., 2016; Jacob, 2017; Hessing, 2018; Duarte & Cruz-Machado, 2017; Radziwill, 2018; Hacker, 2017).

In the paper is presented evaluation of quality paradigm, with emphasizing Quality 4.0 and Human Oriented Quality (SOQ).

In the paper are analyzed different elements of Quality 4.0 concept and gave some comments about wholeness of this concept. In second part of the paper are presented achievements in area of consciousness and spirituality. Theory of everything which can be used for improving Quality 4.0 concept.

In third part of the paper are presented some building elements of Social Oriented Quality (SOQ) or Quality 5.0 as next generation of Quality 4.0 concept.

2. Concept of quality 4.0

Concept of „Industry 4.0“ was introduced at Hannover Fair in year 2011 to describe the fourth industrial revolution. It is based on digital transformation in purpose to find adequate answers on disruptive changes related to customers, organizations, and organizations boundaries. For it were developed new business models *(Arsovski, 2018)* with accentuating the trust, transparency and security through digitalization. The first introduction of term „Quality 4.0“ was in year 2015 in the ASQ Future of Quality Report. Based on this approach we can expect a renaissance in quality tools and methods through themes:

1. quality as inspection,
2. quality as design,
3. quality as empowerment, using i.e. TQM and Six Sigma for holistic approach to quality, higher responsibility and empowerment of all for continuous improvement,
4. quality as discovery, in adaptive and intelligent environment for solving challenges and problems.

Radzwill N. (2018) emphasized six value proposition for Quality 4.0 initiatives with augment (or improve) human intelligence on first place. So *Esko Kilpi* (*Radzwill,* 2018) writed „The real future of work is not in industrial model of pursuit automation but in the post-industrial model of promoting augmentation“. Based on these approaches were developed Quality 4.0 Tools with following tools:

1. *Atificial intelligence*: computer language processing, making complex decisions, etc.,

2. *Big data*: infrastructure for easier access, to data sources, managing and analysing,
3. *Blockchain*: increasing transparency and auditability of transaction, monitoring conditions for achieving quality objectives,
4. *Deep learning*: image classification, complex pattern recognition, time servics forecasting, text generation and recognition, using heuristics, etc.,
5. *Enabling technologies*: sensors, open-source software, 5G networks, etc.,
6. *Machine learning*: text analysis, recommendation Systems, fraud detection, classifying objects into groups, forecasting, and
7. *Data science*: predicting, simulation, performing classifications, inference etc. to generate viable models and solutions.

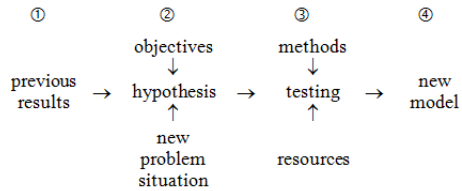
Radzwill N. (2018) argued that quality professionals have to lead the transformation from classical point of view to Quality 4.0, because possession of knowledge and skill related to:

a) system thinking,
b) data-driven decision-making,
c) leadership for organizational learning,
d) establishing processes for continuous improvement,
e) understanding how decision affect people: lives, relationships, communities, well-being, health and society in general.

The last element of knowledge is related to QoL and it is motive for forther improving „Quality 4.0“ into Social Oriented Quality (SOQ).

3. Model of quality 4.0

A concept of Quality 4.0 is now in starting phase. We have not enough information about its functioning and because that is inappropriate classical scientific way:



We have until now small and not systemized information about previous results of research in area of Quality 4.0. Because that we have to avoid second and third phase and construct new model of Quality 4.0 using qualitative methods. For it is possible to use standards, For the research is used Grounded theory.

Based on work of *Glaser B. and Strauss A.* (2017) a generating theory starts with comparative analysis in following steps for:

- accurating data,
- empirical generalization,
- specifying a concept/model,
- verifying theory, and
- generating theory.

Using literature described in chapter 1 and 2 are conducted steps 1 and 2. A concept/ model is partly conducted also in previous literature, but not consequently. For realizing the 3. step are used elements of (Radzwill, et al, 2018), as well as TQM and CIM concepts *(Figure 1).*

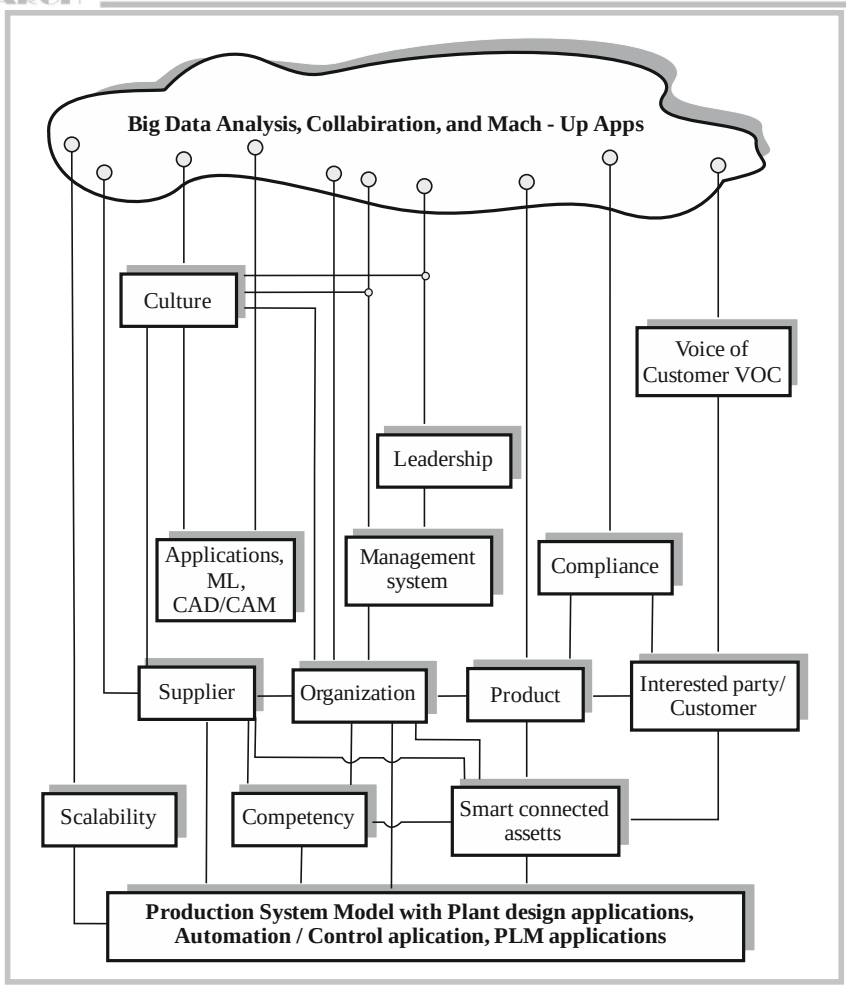


Figure 1. Proposed model of Quality 4.0

Jacob D. & Shah M. (2018) argued that between Operational Technology (OT) and Information Technology (IT) exists integration through six levels:

a) Smart Connected Assets:

– L0: Production Assets and Materials,

– L1: Sensors, Instrumentation, Data Collection,

– L2: Equipment and Process Control,

b) II0T Enobled Next-Gen. Systems:

– L3: Manufacturing Operation Management/Smart connected operations II0T enablled production, Quality, etc.,

– L4: I0T enabled Business Systems, and

– L5: I0T Enabled Governance and Planning Systems.

On level L0 are distinguished:

- people with competences, motivation, etc.,
- plants, building, production lines,

- automation/control equipment (PLC, CNC, etc.),
- machines, equipment, devices,
- transport system (AVG, robotized, drones),
- material, parts,
- tools, etc.

All of these elements were included in previous concept of CIM (Computer Integrated Manufacturing).

Level L1 consists from integration of sensors, instrumentation, and data collection from playot network, using smart technologies.

Level L2 is related to equipment and process control using instruments and test equipment and integrate using plant network. Some of them are detected using CNC or DNC control device.

Level L3 is on enterprise or plant level. It covers functional quality *(Figure 2)*. In previous concept of CIM it was covered by CAQ (Computer Aided Quality) concept.

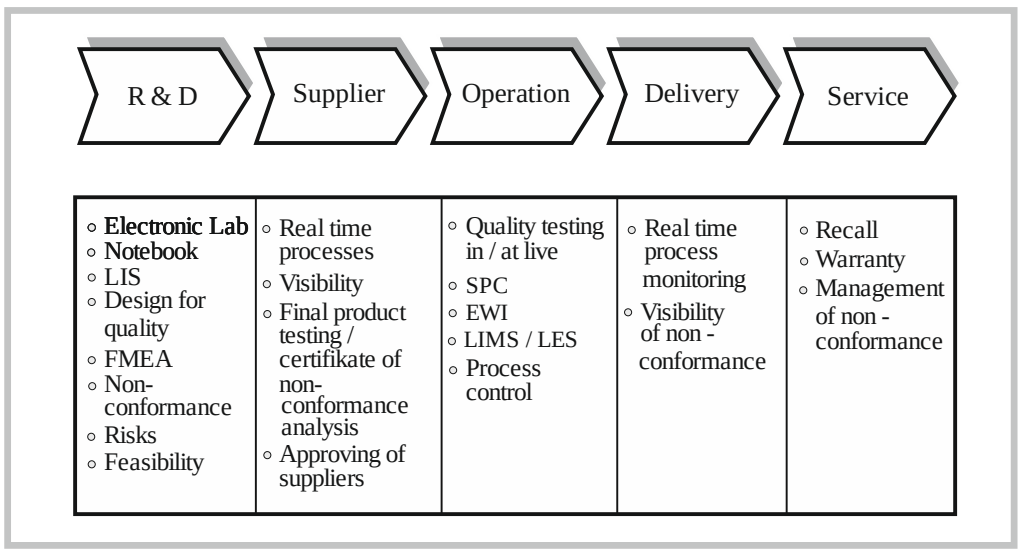


Figure 2. Value chain in area of functional quality

Level L4 covers I0T enabled business systems including: Audit, Supplier Quality, Training and Certification, Inspection Plans, Product Quality and Compliance, SOPs/G ∗ Ps, Customer Complaints, Quality Metrics, as well as Document Management System for control, collaboration, regulatory services etc. In previous concept of CIM it was covered partly by CIQ (Computer Integrate Quality).

Level 5 covers governance and planning systems and decision support systems, including QMS, RMS, Operational excellence, Knowledge Management, Sustainable Growth, Change Management etc. In previous concept of CIM it was cowered by higher levels of CIQ.

4. Evoluation of quality 4.0 in Serbia

Evolution of quality to Quality 4.0 in Serbia was followed by the development of industry as the concept of Industry 4.0.

Industrialization in Serbia was started in the middle of the 19th century in Kragujevac

with the development of the first Topolivnica weapon factory. Already then, the first Quality Ordinance (Arsovski, 2017) was promulgated by the Ministry of Defence. The quality attributes corresponded to the concept of Industry 1.0, and the quality particularly to quality 1.0 and 2.0, especially in the quality control domain. Further development of the industry, especially after the Second World War, was developed in Kragujevac and in the automotive industry in Kragujevac and other parts of Serbia, corresponding to the Industry 2 concept. The concept of automation and mass production demanded the application of statistical methods, process and final controls, which is part of the Quality 2.0 concept. During this period, the curricula for the subjects in the field of quality control and partly quality management have been developed at the faculties, especially in the field of mechanical engineering. Parallel with this, other elements have been developed such as sensors, data acquisition systems, adaptive systems. Thus, for example, in 1973 in Kragujevac was defended the master thesis in the field of sensory development on a radioactive approach, and this research was confirmed in a prestigious international journal.

Industry 3.0 supports IT that was developed in Serbia in the early 70s. The largest center was in Kragujevac in the automotive industry, and Belgrade through the cooperation of the Faculty of Mechanical Engineering and Lola Institute. In addition to classical IT support, the Computer Integrated Systems (CeNT), Kragujevac (CIM Center), Novi Sad and Niš have begun to develop in the mid-80s. During this period, several projects of flexible machining systems (1988) and CIM system were implemented through the Ministry of Science, within which the common databases (1992) were. Also, within the CIM Center of the Faculty of Mechanical Engineering in Kragujevac, a CIM system project for FAD from Gornji Milanovac with 30 modules, including the CAQ module, was realized in 1993-1995. In the same period, strategic management and decision-making systems have been developed in the 90's, including for the CIM / PPC development area.

During this period, the first papers from this area were also presented. These papers are presented through conferences, books, monographs. For example, in the chapter Flexible Automation (1994) and Production Systems (1995), one chapter was devoted to CIM systems and quality within them.

During this period, especially since the year 2000, research has been carried out through PhD dissertations, most of which were realized at the Faculty of Mechanical Engineering in Belgrade, Novi Sad, Kragujevac and Niš.

Concept Quality 4.0 in Serbia includes the elements of the previous three concepts and with the development of I_0T and other concepts in the AI and others domains, allowing them to further integrate in industrial processes and beyond, according to the social environment. This was recognized within the Center for Quality and the CIM Center of the Faculty of Engineering Sciences in Kragujevac, where the focus of activity shifted to man, ie the quality of life as the main goal. These were also highlighted by quality gurus, but the "classic" view of the world was dominant. That's why the new Quality 4.0 Plus model will need to include quality of life (Q0L), in particular Quality of Working Life, positive psychology, and virtual quality (Virtual Quality) because the virtual environment in the future will be dominant. This is a practically a Quality 5.0 concept whose initial model is presented in Figure 3.

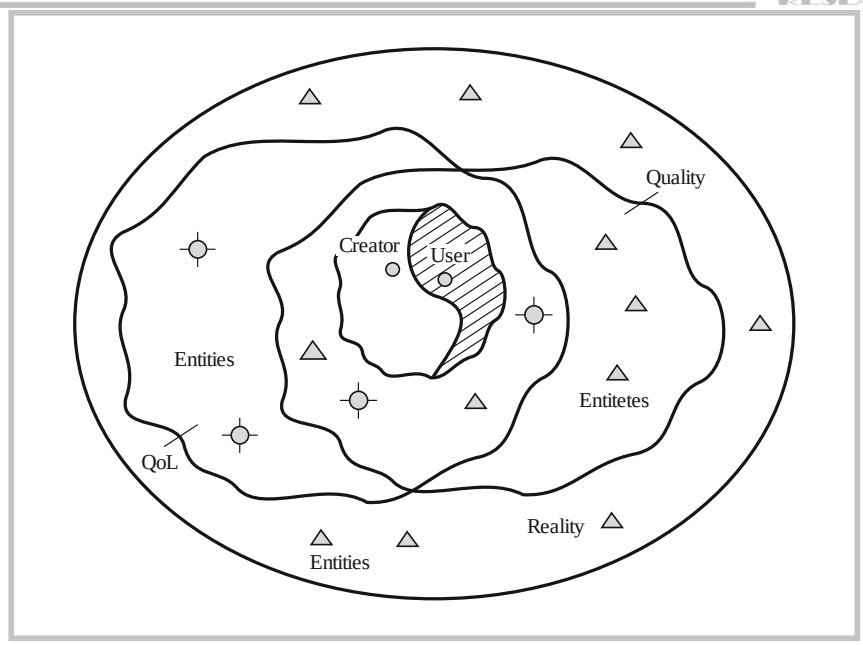


Figure 3. Human being as creator/user in space of integrated QoL/Quality and real environment (physical, political, economic, virtual, etc.)

In this model, human being has two sides, both creations and uses of created goods. In addition to it, QoL and Quality include other entities, such as culture, spirituality, leadership, knowledge, technology, products, etc. They are all housed in reality (physical through machines, sensors, earth, computers, etc.) and virtual reality (software / hardware devices and environments).

Developing this initial Quality 5.0 model will be carried out in different directions, such as technology, based on new paradigms (smart cities, knowledge economics, etc.), spirituality, virtual reality, etc.

5. Conclusion

A quality concept evolved from Quality 1.0 across Quality 2.0 and Quality 3.0 in era of Information and Communication Technologies. For supporting Industry 4.0 concept is developed Quality 4.0 but it is time for development of Quality 5.0 for supporting Society 5.0 developed in Japan. The paper analyzed needs and expectations for Social Oriented Quality (SOQ) especially needed knowledge and spirituality, as well as leadership for success in future.

Now we are in Serbia mixed Quality concept of Quality 2.0, 3.0 and in some cares 4.0. Using existed knowledge and government policy we can expect to make more than quant steps and in some communities and organizations to go forward and be beyond Quality 4.0.

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