

# ENHANCING QUALITY IN KNOWLEDGE-BASED ORGANIZATIONS THROUGH THE IMPLEMENTATION OF COLLABORATIVE ROBOTS INTO NONCONVENTIONAL TECHNOLOGIES IN AUTOMOTIVE

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**ABSTRACT:** Quality is crucial for modern organizations and sustainable quality management is key to this. Collaborative robots can help improve the quality of production flows. Currently, mass production flows may involve the use of equipment with nonconventional technologies implemented. The integration of collaborative robots and nonconventional technologies into production processes must be done in a qualitative and knowledge-based way. In this context, knowledge-based management plays an extremely important role in ensuring the success of organizations in the face of competition. It facilitates the learning, transfer, improvement and maintenance of knowledge within the organization, contributing to the provision of high-quality products and services. Collaborative robots have also represented a significant shift in the traditional paradigm of human-robot collaboration, transforming into a nonconventional technology that has helped break down the barrier between these two entities. The scientific paper explores the correlation between the four concepts: quality, collaborative robots, nonconventional technologies and knowledge-based management, to ensure the success of organizations. A parallel can also be found in the scientific work between the knowledge-based organization and the learning organization.

**KEYWORDS:** collaborative robot, knowledge-based organization, automation, quality, automotive

## 1. INTRODUCTION

Currently, the automotive industry is facing increasing challenges. It goes through a continuous transformation, adapting to the difficulties it faces. After the end of the Covid-19 pandemic and the significant growth of electric cars, it had to face the semiconductor crisis entirely.

In addition, massive labour migration from Eastern Europe can be observed. For example, in the case of Romania, it recorded a loss of 3.99 million citizens between 1990 and 2020, who emigrated to different countries. On the other hand, immigration also took place, and in the period 1990-2020, 705,310 international immigrants were registered. [1]

To face these crises, organizations in the automotive industry have had to implement sustainable systems based on quality management and knowledge-based management.

It is evident in the automotive industry that quality is a mandatory requirement, with many customers requesting to obtain various certifications that attest to the quality of the products and services provided. The most common and widespread certifications are ISO 9001:2015 and IATF 16949:2016.

Knowledge is a particularly crucial aspect of organizations. The organization must encourage employees in a continuous learning process by providing various learning tools and resources, as well as allocating the necessary time. Also, the transfer of knowledge from experts to newer employees must be constantly supported by the organization. It must adopt a mindset of continuous learning and also, in case an employee leaves the organization, ensure that with his departure, the accumulated knowledge is not lost. Achieving this aspect can only be achieved by implementing a knowledge-based management system.

Currently, collaborative robots are increasingly common in production flows globally. Given that nonconventional technologies are considered to be those that go beyond traditional frameworks and approaches, collaborative robots can be intrinsically considered an integral part of these nonconventional technologies. To support this assumption, unlike the traditional approach where a robot was locked in an automated cell or surrounded by perimeter fences to prevent human access, collaborative robots work in collaboration with humans, sharing the same work area and cooperating to perform common tasks. It can be said that collaborative robots have demolished the fences that in the past separated man

from the robot, human workspace from robot workspace.

Collaborative robots: robots that work collaboratively with humans, sharing the same work area and cooperating to accomplish common tasks.

## 2. THEORETICAL DEFINITION OF THE CONCEPTS AND THEIR CORRELATION

Quality is a complex concept, being defined in different ways over time. These definitions include the following aspects:

- Compliance with needs and requirements. [2]
- Satisfying the client's needs. [3]
- Fitness for use. [4]
- Correspondence to the requirements of the object. [5]
- Ability to meet specified customer needs. [6]

Also, concerning the knowledge-based organization, it can be described as an entity that adopts a learning-oriented approach, in which employees are engaged in the continuous development of knowledge, exhibiting an attitude and behaviour focused on learning and the accumulation of information. [7]

Alternative technologies, or nonconventional technologies, are terms used to describe technological solutions that are alternatives or replacements for existing conventional or traditional technologies in a certain field. These technologies are considered alternatives due to their innovative, sustainable, efficient or environmentally friendly characteristics compared to conventional technologies. [8]

Nonconventional technologies are in continuous growth and use. If in the past, nonconventional technologies included electroerosion and water cutting processes, nowadays we can observe the appearance of new examples of nonconventional technologies, among which can also be considered:

- 3D printing: using the technique of adding successive layers to create three-dimensional objects.
- Collaborative robots: robots that work collaboratively with humans, sharing the same work area and cooperating to accomplish common tasks.
- Artificial Intelligence: The use of algorithms and computational models to enable systems to learn, solve problems and make autonomous decisions.
- Internet of Things (IoT): Connecting physical objects to the Internet, allowing them to communicate and interact with each other.

- Virtual reality (VR) and augmented reality (AR): technologies that create virtual experiences or add virtual elements to the real environment.
- Blockchain technology: a distributed ledger technology that ensures transparency and security of online transactions.
- Renewable energy: clean and sustainable energy sources such as solar, wind and hydroelectric power.

Collaborative robots are a 21st-century innovation. These are mechanical devices modelled as robotic arms with human-like joints. Collaborative robots can be easily integrated into the operator's work environment. [9]

These concepts can be integrated into the production environment. To improve quality, collaborative robots, which represent a nonconventional technology, are implemented. For their quality implementation, specialized knowledge in the field is required, which can be ensured through knowledge-based management.

Implementing these concepts in the production environment brings numerous advantages and opportunities. Integrating collaborative robots into workflows enables efficient collaboration between employees and robots, increasing productivity and operational flexibility. These robots can perform complex and repetitive tasks, freeing up human resources for more valuable and creative activities.

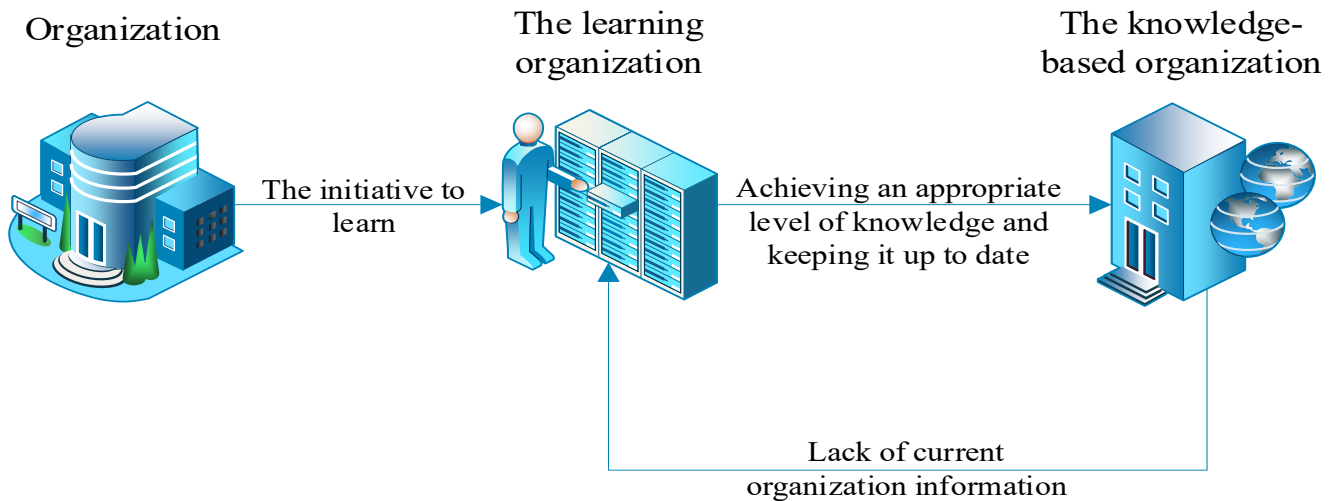
To achieve a successful implementation of collaborative robots, the accumulation of specialized knowledge and skills in the field of advanced technologies is crucial. The specialist team must be familiar with the principles and functional characteristics of collaborative robots, as well as how to integrate them into the existing production environment. Through knowledge-based management, the organization can promote continuous learning and the development of skills necessary for the optimal management and use of collaborative robots.

Also, the successful implementation of collaborative bots requires rigorous planning and an assessment of the organization's specific needs. Depending on the characteristics and requirements of production processes, the areas and tasks that can benefit most from the use of collaborative robots should be identified. The right choice and configuration of robots, along with effective integration into existing workflows, contributes to achieving optimal results in terms of improving quality, increasing efficiency and reducing human error.

### 3. THE KNOWLEDGE-BASED ORGANIZATION VERSUS THE LEARNING ORGANIZATION

Before discussing the learning organization or knowledge-based organization, it is necessary to clarify the terms used. To define these types of organizations, it is important to understand the meaning of the words that accompany these definitions. The terms have the following meanings:

- "Learning" implies the transmission of knowledge and skills in a specific field, to



**Figure 1.** The organization's path to the knowledge-based organization

- "Based on" refers to the foundation or foundation on which something rests. A knowledge-based concept or organization develops and operates on a solid foundation of knowledge and information.
- "Knowledge" refers to the act of becoming aware or informed about a particular subject or situation. To be knowledgeable about something is to be familiar with and possess relevant information in that field. [10]

Therefore, the learning organization or knowledge-based organization can be defined as an entity that develops its skills and knowledge by:

- Practice: The organization must engage in an active process of practising and applying the knowledge gained. Through practice and repetition, the organization strengthens its competencies and improves its skills.
- Retrieving information from proximity: The organization must be open to obtaining information and experiences from its surroundings. By interacting with other organizations, and business partners, or analyzing market data and trends, the

develop the individual's competencies in a specific trade, science or art. The process of learning can be called initiation or training.

losses as learning opportunities. Both success and failure can provide the organization with valuable lessons and stimulate continuous learning and improvement. [11]

An organization's level of knowledge is closely related to its level of accumulated experience.

organization can gather new and updated information to enrich its knowledge.

- Learning through success or failure: The organization must be open to accepting wins and

Similar to an organization that must implement a quality management system before adopting total quality management, organizations cannot become knowledge-based without first going through a learning process. An organization engaged in a continuous learning process is called a "learning organization".

Learning organizations are founded by learning individuals. [12]

Starting from the assumption made by the authors and applying similarly the principle of knowledge-based organizations, it can be deduced that knowledge-based organizations are made up of individuals who possess knowledge.

However, the essential difference between the two entities is experience. Individuals who possess knowledge evolved from individuals who learned and this aspect can also be transferred to organizations, considering that knowledge-based organizations were in the past learning organizations.

Starting from the definition according to which the organization is a collective of human resources that collaborate to achieve a common goal, it can be stated that the experience and quality of the human resources that form the collection of the organization can determine whether an organization is knowledge-based or still in the process of training and learning.

In today's knowledge-based organization, access to learning and knowledge must be fast and available regardless of location or time zone, at optimal costs. Moreover, it is necessary to immediately evaluate the knowledge acquired after the training. This aspect can be achieved by using various digital resources known as electronic learning or e-learning.

A didactic approach based on the use of information and communication technology, known as e-learning, has become increasingly popular in organizations for imparting the necessary knowledge, skills and attitudes. To ensure the effectiveness and positive impact of e-learning on the organization, the entire process must be carefully planned, implemented and evaluated. The viability and benefits that e-learning can provide within the organization are closely related to these key aspects. [13]

The implementation of an e-learning strategy involves the creation of an accessible virtual learning environment, which facilitates the understanding and assimilation of the educational content.

Evaluation in e-learning is an essential aspect, having the role of measuring the effectiveness and impact of the training on the participants and the organization.

#### **4. ASSURANCE OF THE OPERATIONAL QUALITY OF ROBOTS IN THE AUTOMOTIVE INDUSTRY**

In the specialized literature, there are multiple definitions regarding quality assurance. The anatomy of quality assurance and quality control can be similar in terms of quality assessment and comparison, as well as the stimulation of corrective actions. However, the main difference lies in the fundamental purpose of these two approaches. In quality control, the focus is on supporting people directly responsible for operations to regulate current processes. In contrast, in quality assurance, the main objective is to serve those who are not directly responsible for operations, but who need to be informed of their status and ensure that everything is working properly. [14]

According to specialized literature, quality assurance can be defined in the following ways:

- Quality assurance can be understood as the totality of planned and systematic actions, implemented within the quality management system and demonstrated through records, which are necessary to provide adequate confidence that an entity will meet quality requirements.
- Embedded in quality management, quality assurance has as its primary purpose the provision of appropriate confidence in the fulfilment of quality requirements. [5]

To maintain market competitiveness and gain customer trust, quality assurance is an essential component in a high-quality system. This concept involves a series of planned and systematic activities, intending to guarantee the quality of the products or services provided by the enterprise. [9]

Loss of quality over time can lead to non-compliance and customer complaints. For this reason, the use of collaborative robots in manufacturing processes has become increasingly common today. These robots are considered valuable tools in quality assurance and have had a significant impact in production on manufacturing flows. They can be successfully implemented in a wide range of production processes, including the dispensing of paste or materials to products, welding, screwing, pressing, grinding, packaging and palletizing, plastic injection, as well as picking and placing parts in the process flow.

Implementing collaborative robots eliminates quality loss during manufacturing or production on manufacturing flows. They follow programmed steps and technical operating parameters, including speeds, movements, reference points and communication systems.

Reliability is the probability that a robot, a piece of equipment or a system will successfully perform its intended function, within specified technical parameters, over a specified period. [15]

Collaborative robots are integrated into the automotive field so that they can share the workspace with humans. The main requirements that a collaborative robot must meet are the following:

- Fulfilling the functions that make a robot collaborative;
- Sales;
- Easy programming.

To ensure the operational quality of collaborative robots, they must fulfil their main quality, namely, to

be collaborative. Due to this aspect, it is provided with limited speeds and with the possibility to stop instantly when it encounters a collision on the way. Safety devices have been developed for these types of robots, such as safety radars that check the robot's working perimeter at all times. Also, the movements it performs when the work perimeter is penetrated can be programmed. Collaborative robots can stop instantly when the perimeter is penetrated or can operate at low speeds.

## **5. THE CORRELATION BETWEEN QUALITY, NONCONVENTIONAL TECHNOLOGIES AND COLLABORATIVE ROBOTS IN THE DIGITAL ERA**

In the digital age where technology is rapidly advancing, quality is becoming a crucial component in all aspects of our lives. At the same time, nonconventional technologies and collaborative robots have become increasingly prevalent and represent significant opportunities for improving quality and performance in various fields.

Quality, nonconventional technologies and collaborative robots represent three interconnected and relevant aspects in the context of industrial development and organizational performance improvement. Due to this aspect, we considered it important to explore the correlation between these three areas and how they influence each other.

Quality is an essential concept in any industry and is the extent to which a product or service meets customer requirements and expectations. To achieve the desired quality, organizations use different methods and techniques, and nonconventional technologies and collaborative robots can play a crucial role in this process.

Nonconventional technologies refer to innovative and advanced solutions that go beyond traditional methods and practices. These technologies can include automation, artificial intelligence, virtual reality, 3D printing, and more. They enable organizations to improve production processes, reduce errors and optimize efficiency in the delivery of products and services.

The correlation between quality, nonconventional technologies and collaborative robots becomes apparent when we observe how they can influence each other. The use of nonconventional technologies such as automation and artificial intelligence can enhance quality by eliminating human error and increasing precision and consistency in production processes. Also, these technologies can enable the implementation of advanced quality control and

monitoring methods, such as real-time data analysis or machine learning techniques.

On the other hand, collaborative robots can contribute to increased quality through their ability to perform tasks with high accuracy and consistency. They can ensure uniform production and eliminate the risk of human error or fatigue that can affect product quality. Collaborative robots can also be used in the inspection and quality control process, detecting defects and reducing the number of substandard products.

At the same time, quality is an important factor in the successful adoption of nonconventional technologies and collaborative robots. The use of these technologies and robots requires careful performance monitoring and quality assurance of the final products. The testing and validation processes of these technologies and robots are essential to ensure that they meet the required requirements and quality standards.

Quality, nonconventional technologies and collaborative robots are interconnected fields, where each element can influence and improve the other. The use of nonconventional technologies and collaborative robots can help increase the quality of products and services, while quality assurance is essential for the successful adoption and implementation of these technologies and robots in an industrial environment. By understanding and exploiting this correlation, organizations can gain significant competitive advantages and improve their overall performance.

## **6. CONCLUSIONS**

The relationship between quality, nonconventional technologies and collaborative robots is essential to achieve superior performance and success in the industrial environment. Quality plays a central role in ensuring customer satisfaction, building a solid reputation and gaining a competitive advantage. The use of nonconventional technologies and collaborative robots brings multiple benefits in terms of the efficiency and effectiveness of industrial operations. These technologies can automate repetitive tasks, speed up work and optimize workflows, leading to faster and more efficient production.

The implementation of nonconventional technologies and collaborative robots also brings innovation and development to the industry. These technologies open up new design and manufacturing opportunities, enabling organizations to create innovative products and services. It also helps

increase competitiveness and meet ever-changing market demands.

However, quality assurance is an essential component in the successful implementation of nonconventional technologies and collaborative robots. High-quality products ensure customer satisfaction, and customer loyalty and build a solid image in the market. Eliminating human error and ensuring uniform and consistent production are crucial to achieving the desired quality.

To make the most of the synergy between quality, nonconventional technologies and collaborative robots, organizations must invest in developing integrated strategies. It is important to adopt a robust quality management system that includes clear standards, procedures and monitoring and control processes. Also, proper staff training and education are fundamental to effectively use nonconventional technologies and collaborative robots and to ensure quality at all operational stages.

Implementing nonconventional technologies and collaborative robots within a knowledge-based organization can bring significant benefits. Knowledge-based organizations focus on the effective management and use of internal knowledge and expertise to gain a competitive advantage. Collaborative robots can play an important role in the knowledge management process by automating repetitive and time-consuming tasks. This frees up human resources to focus on value-added activities such as innovation, developing new solutions and sharing knowledge with teammates.

Ultimately, the combination of quality, nonconventional technologies and collaborative robots allows organizations to achieve superior performance, innovate and remain competitive in an ever-evolving industrial environment. By taking an integrated and strategic approach to these issues, organizations can achieve sustainable competitive advantages and bring added value to customers, employees and the entire industry.

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