

A Modern Quality Assurance System - Condition and Support to an Efficient Management

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Abstract – The development and diversification of the business environment needs better and better quality assurance for provided services and products for all execution stages. The organizational management, researchers and specialists in the quality management field are studying, analyzing, comparing and proposing modern solutions for organizing and monitoring a quality assurance system within organizations. In this context, this paper analyzes the interactions between development and quality as well as the way to perform and implement a procedure for regulating the way to prepare and update the documents needed for quality management at the knowledge-based organizations level, using IT&C.

Keywords – Quality Management, Development, Knowledge Management, Digital Economy.

1. Introduction

Quality management can be considered the "cornerstone" of the knowledge-based management. The knowledge-based economy and the digital economy are based on the quality and reliability of smart products. A quality assurance system is

complex, in direct relationship with all elements of an integrated IT system of the organization, and the development of a related software product is a continuous challenge for IT specialists. Quality management, in the sense of SR EN ISO 9000/2006 (definition also present in ISO 9000/2015), refers to those "coordinated activities to direct and control an organization with regard to quality". According to the same standard, quality management may include: establishing the quality policy and quality objectives and also setting processes to achieve these goals through quality planning, quality control, quality assurance and quality improvement. By means of quality management, an organization aims to obtain products that: [1]

- satisfy a certain need or correspond to a well-defined objective;
- meet the actual expectations of the customer;
- comply with the applicable standards and specifications;
- comply with the requirements of the company;
- take account of environmental protection;
- are provided at competitive prices.

In general, in most management branches, there are seven main quality management functions, as follows: [2],[3].

- **quality planning** is the set of processes that contribute to the determination of the company's main objectives in terms of quality, as well as the resources and means to achieve them. Quality planning includes activities setting out quality objectives and quality requirements as well as requirements related to the quality system elements implementation. The objectives and undertaken actions can be set: at Strategic level, by formulating the basic principles and general guidelines of the enterprise in the quality field; at

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Operative Level, by implementing these principles and guidelines;

- **activities organization** is the effect of all the activities carried out at the organizational level in order to achieve the objectives set by the quality management;
- **activities coordination** represents all the processes that ensure the harmonization of the decisions and actions of the enterprise and its subsystems in order to achieve the organizational objectives. Ensuring an effective coordination is largely influenced by the existence of adequate communication;
- **staff training** refers to all the processes by which the organization staff is attracted to participate in the achievement of the planned quality objectives, taking into account the motivational factors.
- **quality controlling** represents all the activities of process performance supervising and quality outcomes assessing in each of the product trajectory stages in relation to pre-established objectives and standards in order to eliminate deficiencies and prevent their emergence in subsequent processes.
- **quality assurance** is made up of all preventive activities, which systematically seek to ensure the correctness and effectiveness of planning, organization, coordination, training and control activities in order to guarantee the achievement of the desired qualitative level. Another definition is that "quality assurance is the set of pre-established and systematic activities carried out within the quality system and demonstrated as much as necessary in order to give proper confidence that an entity will meet the quality requirements."
- **continuous quality improvement** consists of the activities carried out in each of the stages of the product trajectory in order to improve the performance of all processes and their results, in order to better meet the needs of the customers, with maximum efficiency. The outcome of improvement activities is therefore to achieve a higher level of quality than the one planned by standards or specifications. Achieving such a desideratum is conditioned by the proper performance of the other functions. In terms of quality, the word "action" is an attempt to stop the causes of nonconformities, and can be considered synonymous with "improvement." [4].

2. Development and Quality

Development is a progressive, stadial and global (unitary) way of achieving the material and spiritual requirements and the fullest human satisfaction [5].

Quality can be defined as the (value) appreciation given to a product (and its creation processes) to meet (or not) the system of needs and (individual, group, social or global) human necessities.

The quality concept has an interdisciplinary character, given the technical, economic, aesthetic and ergonomic conditions that a product has to meet. Studies on the activities carried out within the interdisciplinary teams lead to the establishment of new competencies necessary for quality improvement. [6],[7]

The relationship between development and quality can be approached and studied depending on the analyzed object (field) category and the area of development (local, regional, national or international) subject to analysis.

The most important result of the interactions between development and quality is the quality of life. It results that, from this perspective, the quality of life refers not only to a simple description of some neutral "facts" without any value, but expresses an evaluation of the entire society, its development model (of satisfying human, social, nature self-regulation requirement), and in this situation it may also be useful in products and services quality assessing processes. [8]

Identifying and evaluating the development and quality interactions (DQI) involves the existence of certain mathematical relationships / models that will enable future strategies to be made to streamline or reduce the effects of DQI: the economic development and environmental quality (Kuznets Environment Curve); the quality of the interface and the degree of IoT use (Heuristic Evaluation and 3E method); development and quality of software products (SQIMF, necessary to identify interactions between the quality requirements specific to software projects); assessing the effects of local and regional development programs (the REMI input-output model, based on new economic geography theory, explicitly accounting for agglomeration economies in labour, input, and consumption markets) [9],[10],[11].

In the case of digital economy, there are considered as priorities the relationships between the quality of life and the following fields / applications: social marketing; the Internet of Things / Industrial Internet (IoT); software design quality; software certification; regional economic development; development and diversification of communication infrastructure; e-Government.

In order to increase the role of the factors leading to the implementation of a sustainable economy, it is necessary to analyze the relationships between the quality of life and the development of areas such as: education (with emphasis on higher education); health; transport infrastructure (type, quantity and quality); social assistance; ecology (focusing on managers' environmental education).

In the case of knowledge-based economy, development is generated by integrating knowledge in various fields (such as quality management) and through interactions between the life quality and the following factors:

- individual and social knowledge;
- self-evaluation motivation;
- interactions quality;
- interactions between online and offline (knowledge transfer).

Quantification of the development concept is as follows: Development = high living standard + increased free time + individual freedom + progressive satisfaction of human needs.

Quality is not a closed concept; it evolves with the increasing number of interactions between needs and necessities; intellectual capital and learning organizations; creativity and innovation; continuity and change; quality and competitiveness, individuals, products and markets, etc. In practice, it has been identified that the higher the quality, the higher the Human Development Index (HDI). In 2016, the HDI top three countries were Norway, Australia and Switzerland [12],[13].

3. Quality Assurance System (Q.A.S.)

The QAS has a broad scope representing the association of some active preventive systems, integrated management of the prospecting-designing-production-exploitation process and performing a systemic approach to both the technical and economic aspects of quality as well as organizational, leadership and even psychosocial aspects.

By means of the QAS there is a qualitative leap in the sense that the future customers benefit from products that have not only a controlled quality but also an assured quality. The activities involved in the QAS are: production planning; conception and design; technical, material and organizational preparation of the production; production execution; internal transport, handling, storage; maintenance and repair of the equipment; activities organization at work; quality technical control; contracting and selling activity; staff, education, remuneration.

Increasing the quality of the products requires that within the company a QA department should be established. Its main activity consists in: [14]

- QAS design and implementation;
- coordination and control of the whole activity within the QAS;
- identifying malfunctions and eliminating them from the system operation;
- ensuring effective and timely actions within the compartments involved in the QAS and harmonizing the relationships between them.

In general, the concept of QAS is reflected in the quality assurance and quality improvement program. When implementing an IT system, the structure of the collected data will be as shown in Figure 1.

#	Nume	Tip	Interclasare	Proprietăți	Nul	Implicit	Extra
1	ID	int(11)			Nu	None	AUTO_INCREMENT
2	OBJECTIVES	text	utf8_general_ci		Nu	None	
3	ACTIVITIES	text	utf8_general_ci		Nu	None	
4	INDICATORS	varchar(50)	utf8_general_ci		Nu	None	
5	DEADLINE	varchar(50)	utf8_general_ci		Nu	None	
6	PROJECT_MANAGER	varchar(50)	utf8_general_ci		Nu	None	
7	OBSERVATIONS	text	utf8_general_ci		Nu	None	

Figure 1. Data structure of a quality assurance program

This program should define and establish the necessary management system for quality assurance as well as how to act in all activities involved, from determining the market requirements to assisting the customer after the products delivery.

The activities to be carried out within a quality assurance program can be identified by means of a survey containing questions such as:

- Are there any specialized activities involving specific certifications for the organization employees?
- Are there any activities that justify the development of (specific / additional) qualification programs for contractors or sellers?
- Do the customer specifications (in the quality field) require any specific testing / certifications for materials, equipment or business?
- Is the raw materials inspection / testing justified before use?
- Do the technical / acceptance specifications (provided in the quality manual) require inspections / testing throughout the entire technological flow?
- Is quality management an activity field control process?
- Is it necessary to ensure Photographic Quality Assurance for certain categories of activities (e.g. Underground work, Navy imaging facilities, Quality management stock photos)?

- When is it necessary to use certain testing categories such as functional testing, usability testing, performance testing or security testing?
- Are the warranty terms and conditions in accordance with the legal provisions?
- What sort of connections must exist between responsibility, authority and communication?
- For what purpose is it necessary to develop and distribute a quality plan?
- What are the Quality, Environment, Health and Safety Policy principles / objectives?
- What is the policy on raw materials purchasing and responsible use?

The answers to the above questions, correlated with those used for the purpose of hiring the quality staff, allow for the development and implementation of effective procedures and strategies. [15]

The Quality Assurance Program (systematically updated) includes:

- a) defining the attributions, tasks, competences and responsibilities of the departments involved in achieving the products quality;
- b) procedures used for quality assurance;
- c) procedures for amending and updating the quality assurance program;
- d) procedures for maintaining and raising the personnel qualification;
- e) program distribution system.

The documentation required for the QAS introduction and operation consists of:

- a) The quality assurance manual, which defines the quality policy and the way in which this policy is applied. The use of the manual aims both to develop a unitary concept among all the factors involved in the system design and implementation and to synchronize their efforts, as well as to specify the main work methods, tools and techniques;
- b) The quality control plan, which establishes the technological control program, the operating mode, the control methods used, the necessary resources, the sequence of the quality control activities and their position in the production flow of a product or the service performance.
- c) All the written QAS procedures;
- d) The proper Quality Assurance Inspection Plan which ensures, on the one hand, the internal evaluation of the quality assurance program, the verification of compliance with the procedures provided for the system functioning and, on the other hand, the way suppliers comply with the quality assurance programs.

In practice, the following quality control methods are used:

Integral control (piece by piece) consists in checking each product individually. It applies to small series sole products, to products for special equipment (aviation, navy, etc.), to products and parts that require safe operation and whose failure would result in blockage of the entire system or in the emergence of serious malfunctions.

Quality statistical control is carried out on samples taken from manufacturing or from a batch of finished products, the conclusion drawn from their analysis extending over the entire batch of products.

These control methods apply with greater efficiency to: reception control of raw materials, materials, components or products supplied; control of the semi-finished products on the flow in order to prevent the occurrence of scrap; control of finished products.

Applying the statistical control leads to increased economic efficiency due to the fact that: it reduces the control costs; makes material savings; increases the performers' responsibility.

Quality self-control applies to the verification of those parts that are manually executed or on semi-automatic machines, where the attention and skill of the performer can directly influence the achievement of the quality characteristics within the tolerated limits of the manufacturing documentation. [16],[17] The evaluation (assessment) of the products quality is performed by means of the quality indicators:

- simple indicator → refers only to one of the attributes of the product
- complex indicator → refers to several attributes of the product.

The main types of indicators are:

- a) *Partial indicators of the products quality*, which are included in the standards, for example: for fabrics → weight / square meter, thickness in number of yarns / square centimetre etc.; for food → content in fats, salts, water, proteins; for insulating materials → weight / mc, heat transfer coefficient, etc.
- b) *Indicators expressing the share of high quality products* in total products of the same kind:

1. the average quality coefficient
- $$c = \frac{\sum cq}{\sum q}$$

where:

c = quality coefficient, having value 1 for quality I, 2 for quality II, etc.

q = quantity of products of different quality classes

2. the average cost of the product
- $$p = \frac{\sum pq}{\sum q}$$

where:

p = production cost differentiated by quality classes

q = quantity of products of different quality classes

4. The non-quality coefficient of the products in manufacture is given as follows:

$$K = \sum (dp) / n$$

where:

d = number of flaws in a particular class

p = score for the class of flows

n = number of products in the batch that were analyzed

The lower the k value, the lesser or the less important the defects are.

In case of quality indicators for software products, the measurements for the development period are performed over 20 months more or less, and those specific to the implementation period for 1.5 months. These are added to the measurements performed during the maintenance and market withdrawal periods [18].

5. Case Study. Developing QA Data Flow Diagrams

The practical study of this paper, using the theoretical support presented in the previous sections, aims to develop a procedure for regulating the way the documents are prepared and updated to ensure the quality system functions (system procedures, working procedures, forms etc.).

The procedure is applied for documenting the activities within the quality system in a company, involving all its departments. Terminology and abbreviations used:

MR - Management Representative

QAS - Quality Assurance Specialist;

PQAD - Production and Quality Assurance Department;

The terminology and definitions in SR EN ISO 9000/2006 apply to this procedure.

In order to understand this procedure, please refer to the Quality Manual.

The responsibilities for the performed activities are those defined in the logical flow diagram (logical scheme - Figure 2.).

In this procedure, the decision-making authority is the person having the highest position of the designated ones, responsible for carrying out the respective activity. For the other procedures, the decision-making authority, in case there are more people responsible for carrying out an activity, will be clearly defined in the respective procedure.

The need to clarify and improve some quality system documents should be expressed on the "Modification Form" form by defining the problem and proposing a potential solution. The "Modification Form" form is completed in two copies: one is submitted to the PQAD and the other one remains with the applicant. Solving the identified need and problem can be carried out by:

- developing a new system procedure;
- developing a new working procedure
- changing a system / work procedure;
- developing a new form;
- changing the existing form;

and / or modifications thereof. The procedure structure is the one detailed above. The structure of a form should be appropriate to the registration purpose, but must contain at least the form identification and registration fields. The internal validation is the process by which the staff who will use the document (procedure or form) has the possibility to understand it and to agree on it. The external validation is the process by which the staff of the departments involved in the application of a procedure / form on which this document has an impact can clarify the ways to use the procedure / form in accordance within the limits of the SR EN ISO 9001 standard and the company's objectives. The moderation of the consensus talks shall be conducted by the management representative or the General Manager. The distribution list is filled in by the QAS on the "Distribution List" form, which each recipient of the distributed document signs on receipt of the copy. To distribute the changes to a procedure and / or form, the QAS draws up a new distribution list. The modification request and distribution list forms will be registered and archived (each having assigned an ID).

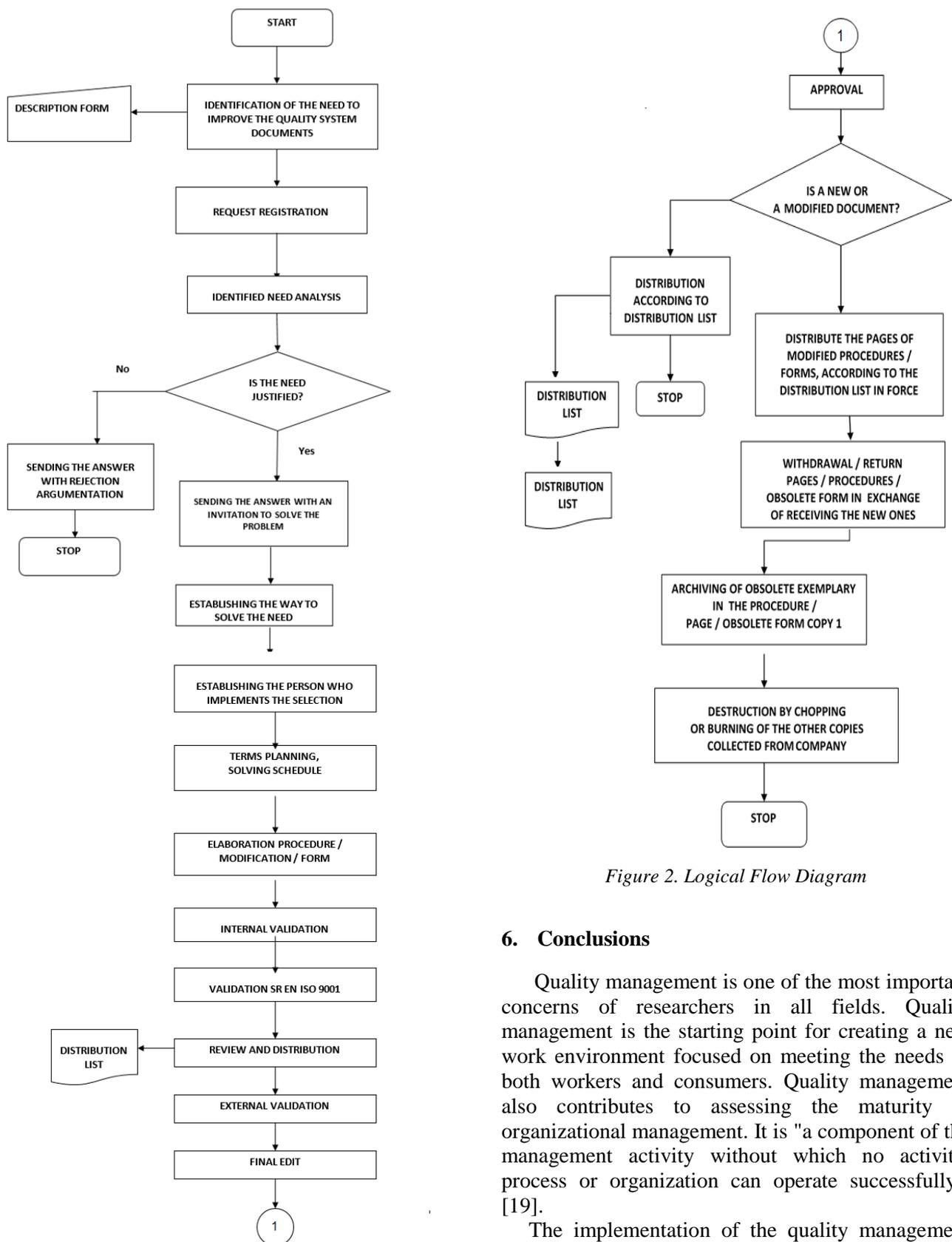


Figure 2. Logical Flow Diagram

6. Conclusions

Quality management is one of the most important concerns of researchers in all fields. Quality management is the starting point for creating a new work environment focused on meeting the needs of both workers and consumers. Quality management also contributes to assessing the maturity of organizational management. It is "a component of the management activity without which no activity, process or organization can operate successfully." [19].

The implementation of the quality management facilitates the knowledge transfer specific processes. The knowledge-based economy justifies the need for a considerable increase in quality in all areas of activity, but also provides the support and information resources needed to effectively achieve this goal. The information society has a positive impact on the quality, with respect to the job number

increase, the emergence of new forms of work organization (work on projects, homework, virtual office, telework, etc.), e-inclusion, a more efficient management of the work-life balance, etc. Exploring various ways to approach the quality management through the IT Project Management Process efforts, we can generate procedures, guides to good practice, interchangeable models / relationships between departments / divisions / subsidiaries that will continually improve the quality of products / services and, implicitly of the organization management.

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