[1.] Alexandru Constantin NECHIFOR, [2.] Raul–Bogdan MIRCEA, [3.] Dan Ovidiu GLĂVAN, [4.] Theoharis BABANATSAS

INTEGRATED OPERATIONAL STRUCTURE FOR MONITORING TRACEABILITY AND QUALITY STATISTICAL CONTROL IN SME'S

[1-4.] "Aurel Vlaicu" University of Arad, ROMANIA

Abstract: The general trend in contemporary management is to give greater autonomy to the departments in the structure of companies, but also to the entire staff. Referring to the quality policy, this is a set of rules that show the behavior of the company in this direction. Until the ISO 9000 standards required the definition of a quality policy, companies were relatively indifferent to the formulation of the general policy. Because the quality policy must be developed and made known inside and outside the company, it requires the definition of the general policy of the company. The trend towards WCM is accompanied by a vision in quality assurance towards World Class Quality (W.C.Q.). This is reflected in the way needs are perceived, the attitude towards quality, the expression of concepts about quality. WCQ's vision results from the way in which the possibilities that the company has in the field of quality assurance are selected, from the way in which it opts for some of them.
Keywords: Quality Monitoring, Quality continuous improvements, Process flow

1. INTRODUCTION

The theme focuses on the development and implementation of an integrated operational structure for traceability monitoring and statistical quality control in small and medium–sized enterprises (SMEs). This structure aims to improve the efficiency and transparency of production processes, ensuring compliance with quality standards and market requirements. Main objectives is:

— Development of an integrated framework: Creating a structure that combines traceability monitoring and statistical quality control in a coherent and efficient system.
— Improving traceability: Implementation of a robust traceability system that allows the tracking of products from raw materials to the finished product.
— Statistical quality control: Use of statistical methods for quality monitoring and control at all stages of the production process.

The main aim of the research is to improve the competitiveness and operational efficiency of SMEs by developing an integrated structure for traceability monitoring and statistical quality control. This will help reduce errors, optimize production processes and increase customer satisfaction through high quality. Initial research identified a pressing need for integrated solutions in SMEs to meet quality and traceability requirements. Case studies and surveys were conducted among SMEs to assess the degree of implementation of existing traceability and quality control systems.

2. MATHERIALS AND METHODS

These factors are influenced by the natural conditions, favorable or unfavorable, which create from the beginning a gap between enterprises. A study by the "International Development Institute" in Lausanne, in order to determine economic vitality Figure 1, took into account as favored elements: infrastructure, foreign policy, political and social stability, the education system, seriousness at work, honesty, a total of 330 elements.[1]
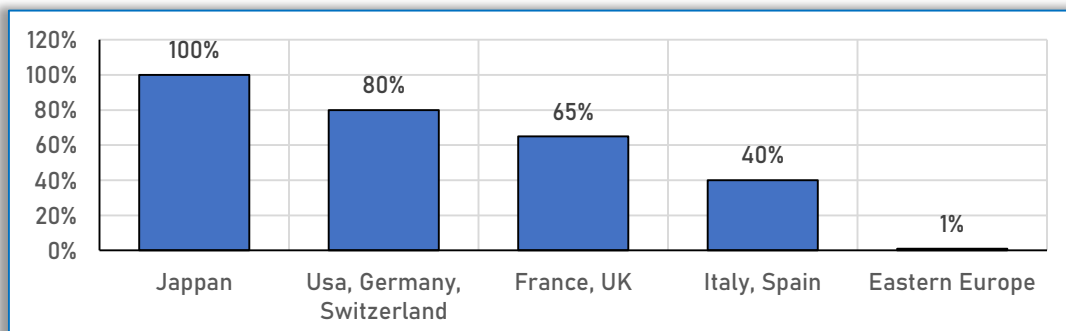

Figure 1. Economic Vitality

According to J. Juran, there are four theories on which the company's policy can be formulated:
— the theory of capability, in which the policy considers the production system, its good functioning;
— the theory of competitiveness, which emphasizes the attraction of customers;
— the theory of use, which emphasizes the diversification of the offer;
— the theory of performance, in which the attention is directed towards the realization of products that must surpass those of the competitors.[2]

Strategy is a concept that describes how to act to achieve the goal. The formulation of the quality strategy must respond to some aspects that resulted from the analysis of the concepts of quality assurance and quality control:
— which sequence of activities contributes to the achievement of product quality, for example marketing, planning, financing, scientific research, design, supply, manufacturing, sales, service;
— what elements of the quality system can be displayed for each activity: procedures, specialists, information, equipment;
— what functions of quality assurance must be developed: construction, verification, improvement, guarantee, training;
— which managerial functions must be developed in particular: forecasting, organizing, directing, coordinating, controlling;
— what degree of severity is required.[3]

3. RESULTS AND DISCUTIONS

The results of a 2024 study show that over 60% of Romanian companies use strategic planning tools, and more precisely: 37.22% of companies develop annual plans and policies, 16.25% substantiate, develop and implement strategies for 3–5 years and 9.86% among the companies consider strategic activities for 2–3 years.[4]
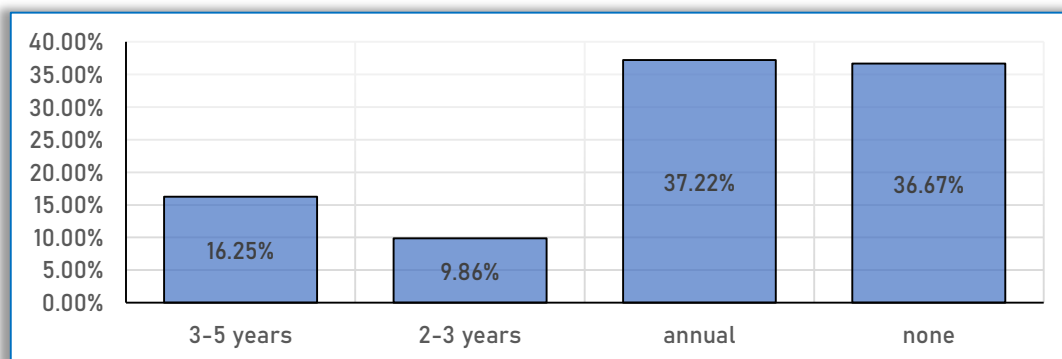

Figure 2. Focus on Forecasting in Romanian SMEs

Based on analyzes performed and the national and international contextual evolutions, a set of priorities at the microeconomic level was scored. Forecasting in Romanian SMEs focuses on the use of forecasting methods in small and medium–sized enterprises (SMEs) in Romania to improve operational planning, inventory management and strategic decision–making. Forecasting involves the use of statistical and analytical techniques to anticipate developments future market conditions, customer demand and other relevant variables.

Identification of Forecasting Methods: Determining the most effective and applicable forecasting methods in the context of Romanian SMEs, such as time series analysis, ARIMA models, linear regression, and machine learning techniques.

Assessing the Impact of Forecasts: Analyzing how accurate forecasting influences the operational and financial performance of SMEs

This paper aims to address point no. 3, respectively the development of high–performance information systems in SMEs. In the age of technology, the expansion of computerization in companies and in management is a necessary step. Increasing the degree of flexibility of the company, the ability to react to complex changes in the economy and streamlining the activity is possible by using modern means of data transfer.
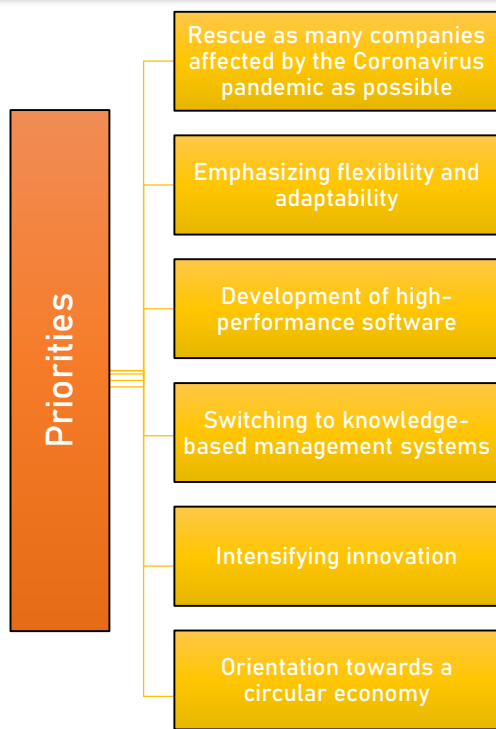
Satisfaction of the managerial requirements specific to the different fields of activity is achieved by extending the computerization to all the company's activities and by building software adapted to the requirements.

Building and managing databases with information about the activities that take place in the company is a benefit for the company's activity. This facilitates very fast access to essential data and leads to work efficiency and the creation of competitive advantages.

Given that they have a very high degree of complexity, these issues are very difficult or even impossible to solve manually, but with the help of modern software they can be solved very quickly and easily, resulting in information that can be used by managers to outline and substantiate strategies more easily, to be able to understand the effects of various options, but also to better understand future issues.[5]

This is a subject of a large interest of most companies. Customers become more and more exigent with their needs and leads to companies to continuously improve their activities, to search for optimal solutions to maximize production with minimal costs and loses.

The quality IT subsystem is part of the Management Information System. Software development involves a purpose–oriented, specialized activity. To date, only certain types of modules have been developed.

The development of a managerial strategy, including the philosophy of quality, requires outlining a vision

Priorities
- Rescue as many companies affected by the Coronavirus pandemic as possible
- Emphasizing flexibility and adaptability
- Development of high–performance software
- Switching to knowledge–based management systems
- Intensifying innovation
- Orientation towards a circular economy

Figure 3. Priorities

of the future state of the system. To run a business, you need both an overview and a vision of quality. The use of accurate forecasts offers significant advantages to Romanian SMEs, such as more efficient management of resources, reduction of operational costs and better adaptation to market demands. To successfully implement forecasting techniques, SMEs need to invest in staff training and appropriate software solutions. These investments are essential to maximize the benefits of forecasting and ensure long–term competitiveness.

Nowadays there are a lot of good software that monitor the whole activity of the company, including the quality management.

Solutions Review's listing of the best data quality tools is an annual mashup of products that best represent current market conditions, according to the crowd. Our editors selected the best data quality tools and software based on each solution's Authority Score; a meta–analysis of real user sentiment through the web's most

Computer Aided Design (CAD)
↓
Extraction of components
↓
Component Analysis
↓
Choice of probes
↓
Route scheduling
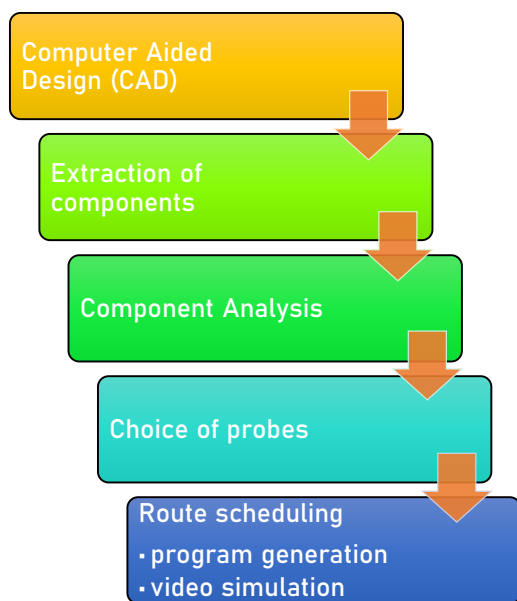· program generation
· video simulation

Figure 4. Computer Aided Inspection Planning (CAIP) Source: O. Nicolescu, I.Popa, C.Nicolescu, S.C.Stefan, C.P.Simion, "Starea de sanatate a managementului din Romania in 2019, Ed. A XI–A", Ed. "Prouniversitaria" 2020, pag.452

trusted business software review sites and our own proprietary five–point inclusion criteria.

Process monitoring is performed using process indicators, records, and statistics generated from records. In SMEs, recordings are made manually, on paper. This has some drawbacks due to human errors, like:
— risk of losing documents,
— long completion time;

— errors of completion;
— transcription errors;
— difficulties in generating statistics and trends;
— difficulties in managing quality alerts
— unproper information (incomplete, irrelevant, tardive)
— management system
— capabilities and attitude of operators
— hardware or software troubles.

The main problem of statistics is not to know how to do calculations, but to gather all the data necessary for a deduction. If certain essential data are missing, we must abandon the idea of reasoning with available information and contenting ourselves with intuition. Some unknown information, practically inaccessible from a "rational" approach, intervenes very effectively in the intuitive process. A first stage in the statistical study consists in distinguishing the cases where it is advisable to use numbers to make a decision compared to those that reveal more intuition. When we decide to use the numbers, each study must be conducted on time taking into account the possible shortage of information, and without forgetting that obtaining information is a long and expensive process.[6]

In practical activity there must be a wide range of instruments to allow detecting the source of errors and elaborating suggestions to solve them. Every SME must know such methods and use them in the proper way.

Thus, in order to streamline the Quality Management system and to make the right decisions, our suggestion was to implement a special software for monitoring, traceability and statistical control.

Information comes from several recording tables. This is why we chose to use a My SQL Database and PHP language as interface between user and software. The database is created on a server that can be accessed by all users connected to the network. PHP programming will allow to customize applications, highlight certain important aspects, easily process data from multiple tables, customize the way statistics are generated in the most relevant way to save time in interpreting results, easily obtain additional information, and saving the resources needed to interpret data and generate reports in order to make corrective action decisions effectively and invest in what solves most issues. In the following we describe the software structure.

The Quality Management System aims to demonstrate the company's ability to permanently meet customer requirements and increase their satisfaction, as well as to keep under control and continuously improve the necessary processes.[7]

According to Armand Feigenbaum, the quality costs are classified based on the difference between 'internal failure' and 'external failure', suggesting four types of costs (Figure 5).

The calculation of non–quality costs is an accounting method that allows to locate in an enterprise the unnecessary expenses caused by product defects. They are sometimes described as "hidden factory". The costs of non–quality include the cost of defects and the cost of detecting them. The cost of quality involves the same elements, to which is added the cost of defect prevention. If we take all the equipment that produces scraps, all the operators that deal with the repairs, all the employees that deal with the controls, all the engineers that do the calculations, we will get a plant whose function is only to produce scraps; this is the hidden factory. It often reaches 30% of the actual plant volume; this is a real waste. this plant is hidden because every employee and every machine participate in the production of defects and because the management has gradually accepted this situation as a normal one. The accounting documents of an enterprise are not made to highlight the hidden factory; accounting does not generally allow the identification of unnecessary expenses. This requires a particular accounting system: it is the calculation of the cost of quality. It must be made monthly by Financial Dep. This information can be found in workshops, laboratories and offices by methods similar to those used in analytical accounting. Quality Dep. Checks their validity several times a year through audits. The results of the calculation of non–quality costs allow management to prioritize quality improvement programs. At the same time, it must be admitted that the information underlying the numbers is not always accurate (in the absence of operational definitions).[8]
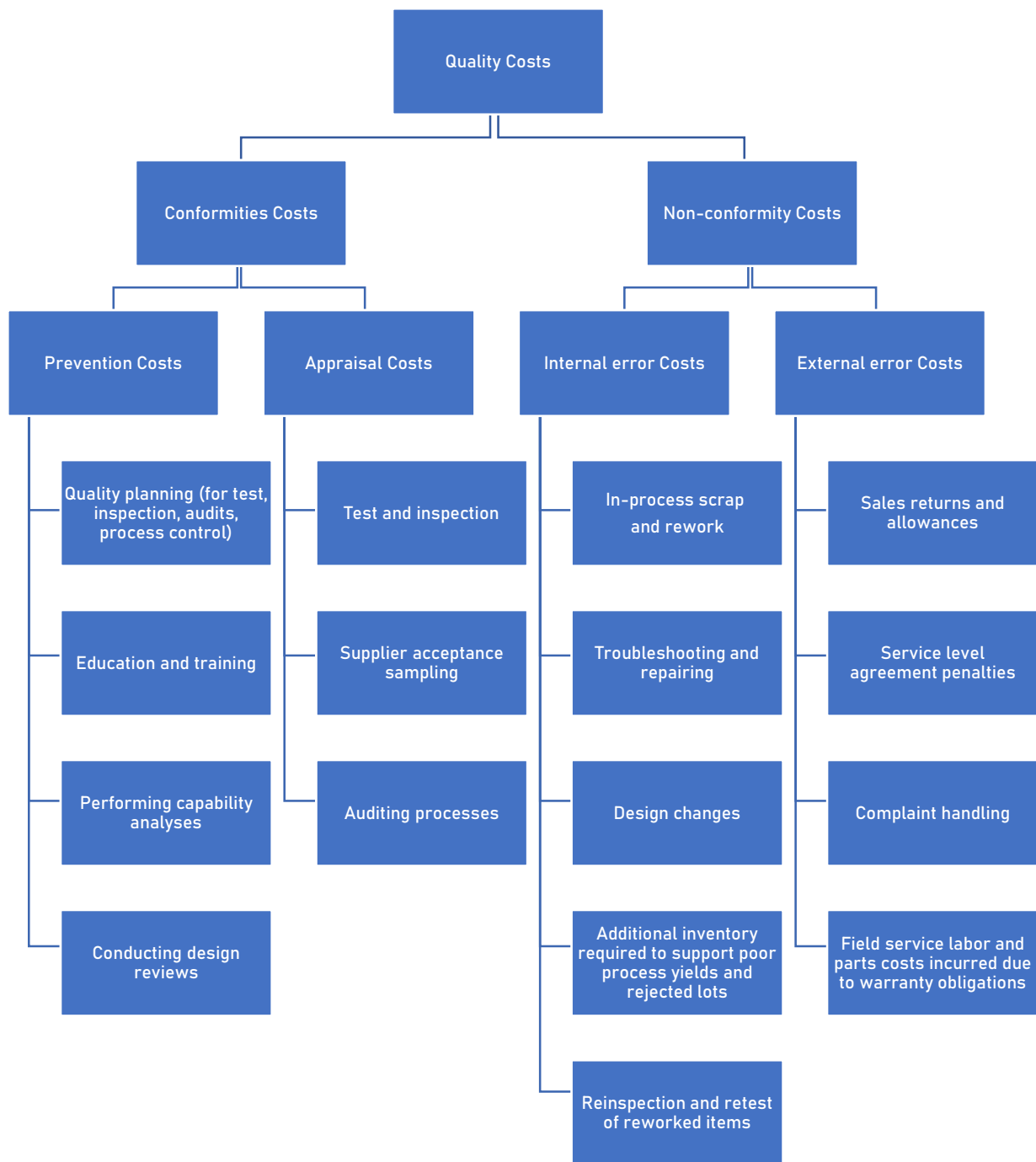
Figure 5. Quality costs diagram. Source: D. Tucu, "Optimizarea costurilor calitatii", Ed Eurostampa, Timisoara 2016, pag.111

A company's goal is to fully satisfy its customers through its products. The quality control system is the main instrument to pursue this goal.[9]

A targeted software guarantees the conformity of the batches according to the quality norms that they must fulfill. With a special system, quality tests can be set and production processes can be managed, along with parameters that influence quality in production.

Using data is collected and monitored in real time and the system ensures quality compliance at all stages of production. Through its modern functionalities blockages are eliminated, waste of time is avoided, materials and money are saved, and, finally, it strengthens the business partnerships and the company's position in the market.
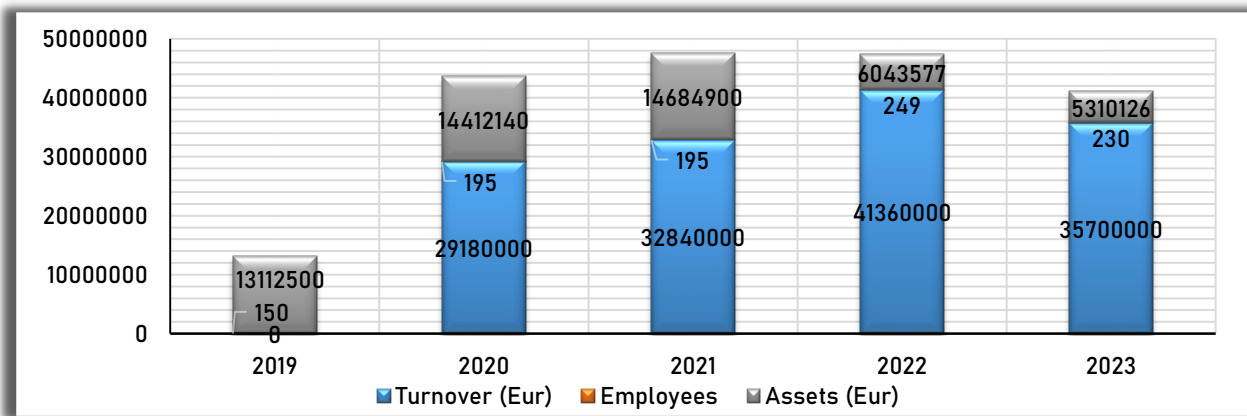
Figure 6. Economical facts

The system described below is targeted on all quality processes which are analyzed in detail. After having implemented it, first as a pilot, a lot of improvements could be noticed, among which a huge cost saving (as can be seen forward).

Statistical Process Control (SPC) is an important tool in continuous production processes. The search for high reliability at the lowest price, in order to face the competition, requires a significant control of the production processes. The aim is the power to guarantee a defect coefficient close to zero (eg. less than one piece per 1,000,000 pieces produced).[10]

4. CONCLUSIONS

The Importance of Forecasting: The use of accurate forecasting can bring significant benefits to Romanian SMEs, including better resource management, cost reduction and improved responsiveness to market demands.

Efficient Methods: Forecasting methods such as ARIMA models, time series analysis and machine learning techniques have demonstrated high efficiency in the context of SMEs, allowing more accurate and adaptable predictions to market changes.

Need for Investment: Successful implementation of forecasting techniques requires investment in staff training and appropriate software solutions.

Implementation Mode is:
— Initial Audit: Conduct an audit to assess the specific needs of SMEs and the current level of use of forecasting techniques.
— Selection of Methods: Choosing the appropriate forecasting methods according to the specifics of each SME and the available data.
— Systems Development and Testing: Implementation of forecasting systems, followed by a period of testing and fine–tuning to ensure their accuracy and effectiveness.
— Staff Training: Organizing training sessions for key staff in the use of forecasting techniques and interpretation of results.
— Continuous Monitoring and Improvement: Constantly monitoring the performance of forecasting systems and adjusting them based on feedback and market changes.

Recommendation is:
— Gradual Adoption: SMEs should adopt forecasting techniques gradually, starting with critical processes to minimize risks and enable incremental adaptation.
— Collaboration with Experts: Collaboration with experts in the field, universities and research centers can facilitate the effective implementation and use of forecasting techniques.
— Use of Modern Technologies: Investing in modern technologies such as IoT and AI to collect and analyze real–time data, improving the accuracy of forecasts.

This research emphasizes the importance of using forecasting techniques in Romanian SMEs to improve planning and decision making. Implementing accurate forecasts helps optimize resources, reduce risks and increase competitiveness, thus ensuring the sustainability and long–term success of SMEs in the global economy.

References

[1]   Xenakis, Xenakis, DM Dunn, DS "Quality improvement via quality costs".(2023) – ASQC's 51st annual quality congress proceedings.

[2]   Adrian, D. (2001). Managementul Proiectelor. Brasov: Disz Tipo.

[3]   Dale E. Hall, Y. K. (1993). Proceedings of the Simposium on Quality Management.

[4]   De Barrie, G. D. (2017). "Quality Costing", page 138. Taylor & Frances Group.

[5]   Gogue, J. (1997). "Management de la Qualité". Paris : Ed. Economica.

[6]   Harrington, H. J. (1987). Poor–Quality Cost,. American Society for Quality, OCLC 14965331.

[7]   Hoyle, D. (2017). "Quality Management Essentials", page 25–26. Elsevier .

[8]   Hoyle, D. (2017). "Quality Management Essentials", page 49, 145. Elsevier .

[9]   Ionescu, C. (1997). Ëxcelenta industriala, practica si teoria calitatii. Bucuresti: Ed. Economica.

[10]   Jens J. Dahlgaard, G. K. (n.d.). Fundamentals of Total Quality Management.

[11]   Kevin Tatroe, P. M. (2013). "Programming PHP: Creating Dynamic Web Pages",Chapter 1. O'Reilly Media Inc.

[12]   Mike Bourne, P. B. (2011). "Handbook of Corporate Management", page 167. John Wiley and Sons Ltd.

[13]   Mike Bourne, P. B. (2011). "Handbook of Corporate Performance Management",page 81. Johnh Willey and Sons Ltd.

[14]   Misiurek, B. (Taylor & Francis Group). "Standardized Work with Training Within Industry: Eliminating Human Errors in Production and Service Processes", page 4 . 2016.

[15]   Montgomery, D. C. (2020). "Introduction to Statistical Quality Control", page 8. Wiley.

[16]   O. Nicolescu, I. C. (2020). Starea de sanatate a managementului din Romania in 2019, Ed. A XI–A. Bucuresti: Ed. Prouniversitaria.

[17]   Odeh, R. (n.d.). "Parts per Million Values for Estimating Quality Values", page v. CRC Press.

[18]   Practices, T. K. (2021). https://solutionsreview.com/data–management/the–best–data–quality–tools–and–software/

[19]   R. Chevalier, E. D. (1996.). "Le management de la qualite. Grenoble: Presses Universitaires de Grenoble.

[20]   Tucu, D. (2016). Optimizarea Costurilor Calitatii in Sistemele Industriale. Timisoara: Eurostampa.