Romanian Aeronautical Industry Productivity Measurement Research Study

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Abstract

Quality improvement is a concept which began several centuries ago. Traceable to the interwar development of aircraft factories, the first aircraft factory began operation in the year 1916. Four of the companies produced more than 2,000 aircraft for military operations for Romania's use in the Second World War. During this period, the concept of quality management was still a strange idea. This research, however, presents important lessons about quality management exhibited in the Romanian aeronautical industry. Blended with the Six Sigma DMAIC model, the research paper will offer insights for conducting a quality improvement process in organizations.

Introduction

The rapid globalization witnessed, particularly in the 21st century, has resulted in stiff competition in almost every financial industry. Organizations and companies are now under immense pressure to remain competitive and achieve business success. In an attempt to become excellent, companies have to conduct various quality improvement measures for their goods and services. However, modern quality improvement procedures are undergoing a paradigm shift. The growing consumer awareness of the quality and safety of products and the changing consumer demand patterns have made organizations align their products with consumer needs and preferences alongside producing quality and safe products. Quality is thus defined and built on the basis of customer needs. Continuous improvement approaches have been initiated in the manufacturing sector to ensure the end product satisfies the end consumer.

The foundation of quality improvement in manufacturing companies revolves around sound process methodologies blended with suitable performance measures. Over the last two decades, quality progress has made available a wide range of continuous improvement mechanisms with the aim of hastening quality improvement processes and productivity measures that aid business growth. Six Sigma is one such continuous improvement tool applied in most competitive global companies. The Romanian Old Kingdom interwar aeronautical factories have long been used to study quality improvement principles that other organizations can use to evaluate their quality and productivity performance. This research paper aims to incorporate the Romanian interwar quality improvement

principles and the Six Sigma model to conduct and analyze quality and productivity measures in industries.

DMAIC will be used as the principal tool for conducting a Six Sigma analysis. The methodology is highly dependent on data for analyzing the causes of falling quality and productivity levels in any organization. In this research paper, the Six Sigma model will be represented using a research diagram. DMAIC focuses on expanding the present process capabilities and identifying new opportunities for improving both current and future quality and productivity processes. The Six Sigma model is thus included in this research paper because it enables companies to become customer-driven. The DMAIC model incorporates multiple techniques and tools to manage variation and reduce defects in operations. The essence of conducting quality and productivity improvement measures is to attain customer satisfaction, decrease defect levels, achieve real-time delivery, and improve productivity with a marginal increase in the cost of quality.

The Quality Principles The Romanian Aeronautical Companies Operated

The first aeronautical industrial plant is now over a century old since its launch in 1916. The old Romanian kingdom was among the few nations in the world that had the know-how to develop flying machines that were heavier than air. The organizational structure of these companies played a key role in making the factories successful. However, in 1946, there was a ban on the production of military aircraft in Romania as a result of the Paris Peace Treaty [1]. This came with significant consequences for the companies, including losses in revenue. Since then, the Romanian aeronautical companies have continued to strive for excellence through the use of their seven quality principles in all of their units. The quality principles sprang from the companies' technical committee on quality management and assurance, which was endowed with considerable competence and experience. These principles are as follows: client orientation, leadership, personal commitment, customer orientation, systemic approach to management, improvement, evidence-based decision-making, and, lastly, relations and connections.

Client orientation, as the first principle, focuses on the fact that companies depend on clients and stakeholders; thus, the company must understand its clients' present and future needs and use that understanding to enhance the quality of aircraft so that it can exceed its clients' expectations [2]. The client approach was made possible in the Romanian aeronautical factories through personalizing orders for their clients, who at the time were the Romanian Army.

The companies also put in place strong leadership as the second quality principle. The personnel working for the organization had to be fully involved in accomplishing the objectives and mission of the company. Managers had to use their skills and charisma to communicate, train, and make proactive decisions that ensured quality. Continuous communication between top management and employees, as well as other stakeholders in the companies, provided transparency and well-informed

decisions [3]. Moreover, the third quality principle emphasizes personal commitment and dedication. This principle is aimed at developing employees with high capabilities at all levels of the company with the aim of delivering value to the organization. The Romanian factories had designers and builders who were highly qualified, well paid, and highly esteemed.

The process approach regarding systemic approaches to management formed the fourth quality principle that the Romanian aeronautical companies implemented. This approach stipulated that there is a need for total commitment that ensures the efficient use of skills and resources for the best benefit of the organization [2]. Process management and system control involved the planning, doing, controlling, and acting cycle, often referred to as the Deming cycle. The Romanian companies implemented this principle by separating design and production into different departments, which ensured efficiency.

The improvement quality principle became the fifth principle implemented by the organization. It is only through a consistent and constant focus on improvement that organizational success is achieved. The Romanian interwar companies constantly diversified their production through the utilization of new technologies to improve their performance. The sixth principle was evidence-based decision-making, which required that all decisions taken be backed by evidence, therefore implying the use of data to make all decisions, which eventually leads to expected outcomes.

The seventh principle is the relations principle, which stresses the importance of management in forming relationships with suppliers and other stakeholders to optimize organizational performance. All these principles yielded what is now the quality improvement concept [4]. Romanian companies maintained stable relationships with their suppliers, such as engine, chemical, fabric, and wood suppliers. Good relations between the factories and other stakeholders and interested parties, such as the Aviation Corps of the Army and the Ministry of the Army, helped the companies optimize their performance as well as develop subsidiaries.

Application Of Six Sigma In Quality And Productivity Measurement And Analysis

The application of Six Sigma is developing and growing from the field of industrialization to incorporate all manufacturing and business operations. These business operations include marketing and advertising services, transactions, and some administrative services. The growth of Six Sigma has been witnessed in areas that directly affect the consumer [5]. Six Sigma is an organized method of strategic procedures that depends on statistical and mathematical tools as well as scientific approaches that enhance the reduction of consumer-defined defect rates. The Six Sigma approach for completed projects includes measuring, analyzing, improving, and controlling procedural improvements. Besides, since the 1980s, Six Sigma's excellence-management approach has appeared as a key framework for implementing value-added enhancement. Six Sigma started in the late 1980s. It was developed by Motorola as a response to demand for its commodities, which had

many components and experienced high defect rates in product functions.

The real benefits of Six Sigma started through the efforts of Jack Welch, who was the chief executive officer of General Electric in 1995. Previously, Welch had observed the success experienced through a method used by Bill Smith. He intensively explored and supported the Six Sigma methodology in General Electric. Moreover, the statistical measure of the rate of defects within a structure is reinforced by statistical techniques and methods. It is a method that represents a systematic way of increasing improvement as well as focusing on reducing defect rates to 3.4 in every million opportunities. Within a system, defect rates provide an example useful in illustrating Six Sigma.

The variation between 99 percent quality and superior rates in the Six Sigma model indicates a different situation, and thus, this is used to indicate the meaning of Six Sigma in a real application. For instance, in a case where a certain post office worked at a ninety-nine percent quality rating for three hundred thousand letters provided, there would be three thousand letters that were not delivered, compared to just one misdelivery when Six Sigma was used in operating the statistics [6]. Besides, when Six Sigma is used in determining the operation of stations and channels on television, 99 percent would result in an estimated one hour and sixty-eight minutes of downtime in a period of one week, compared to 1.8 seconds if the statistics are worked at Six Sigma levels.

Additionally, Six Sigma is highly applied in most manufacturing industries and organizations. General Electric and Motorola are the most prominent organizations where the application of Six Sigma is utilized appropriately. Besides, it has contributed to the success of some construction industries. However, the current focus on the use of Six Sigma principles is mainly aimed at the service sector [7]. Numerous businesses and organizations apply Six Sigma in different ways and processes. It is used in diverse areas, including business and accounting, supply chain management, and human resource management.

Six Sigma is also used in payroll, hazard and safety engineering, and other departments to enhance inventions and innovations in industry. As evidenced by Raytheon Corporation, which uses Six Sigma in the area of human resource management improvement, this model is significant in most business enterprises. Besides, chief executive officers and financial officers in businesses can adequately utilize Six Sigma applications to ensure compliance with the Sarbanes-Oxley Act [6]. The financial sector and financial services have become the most popular fields where Six Sigma is applied. Moreover, as described by (X), Six Sigma is also applied in improving the process of allocating loans to students and showing how creditors benefit. Six Sigma has become useful in various banking-industry and marketing processes.

Six Sigma DMAIC Framework

Six Sigma offers a platform for using quality and productivity measures through the application of DMAIC. DMAIC stands for five stages: Define, Measure, Analyze, Improve, and Control a process.

These phases of a project's life are further subjected to the planning, doing, studying, and acting (PDSA) framework, often referred to as the Deming cycle [8]. The use of PDSA helps to arrive at quick decisions and actions that lead to sustainable improvements. During the process of applying each of the PDSA procedures, a manager uses several process improvement tools to achieve the desired outcome. Figure 1 depicts the DMAIC quality improvement process. The Six Sigma DMAIC methodology is useful in improving, optimizing, and stabilizing a business process. The model relies heavily on data to improve a process.

Definition Phase

The define phase focuses on identifying the product or process that requires improvement. Notably, the definition stage involves several procedures, such as selecting the best project from among alternatives [4]. This mainly involves choosing areas of business that need the most improvement. Additionally, during this phase, the organization has to benchmark its key products and processes against those of its competitors. Moreover, at the end of this stage, full project approval is signed and formalized.

Key details such as important metrics and scope of operation form part of the plan. The project plan then obtains sponsor approval before it is commenced. The team to spearhead the implementation of the project is then selected, and the project begins. Business actions such as mapping the overall business process or product, including key value-chain actors and stakeholders, are carried out [7]. Further, the product team identifies customer needs, which revolve around the cost of the product, quality, and speed of delivery. In this sense, a credible baseline is formulated in which clear and realistic goals and targets are defined and set, with their financial implications well documented.

Measurement Phase

The phase is based on the ability of an organization to assess the performance of all the areas that need improvement. The stage is characterized by a selection of product characteristics. These product attributes include dependent variables, product mapping, constant measurement, recording of results, and approximating both short-run and long-term proficiencies. On some occasions, one needs only to improve measurement ability to achieve improvements [5]. The measurement mechanisms must ensure minimal variation in the process and compliance with specification restrictions. Firstly, the area that needs to be measured is identified as the business activities continue.

This is followed by comprehensive data collection to ensure that a quantifiable evaluation is possible. Hence, performance will be based on observable data. Some of the data collected include time, sales made based on gender or type of customers, and the number of defects encountered in the products [7]. Also, key responses and product-output metrics are specified. Baseline data are included to

measure baseline product or process performance and to determine the level of improvement, if any. Opportunities that can provide quick wins for the organization are identified, as well as quick decisions to take advantage of such opportunities.

However, a risk assessment of these opportunities has to be made. Low-risk, attractive opportunities hence save time and energy besides saving the costs of the analysis and control stages. For instance, opportunities such as step elimination, changes in procedures, and application of simple communication improvements can provide large gains for the company. These improvements add momentum to the product improvement process besides adding value and confidence to the organization at the initial stages of the project. [8]. Two kinds of measurement variation are distinguished. Reproducibility means that different people can obtain dissimilar measurements arising from one similar activity. Repeatability or equipment variability, on the other hand, means that an individual obtains contrasting measurements for an identical process between successive measurements.

Analysis Phase

The analysis phase involves analyzing and reviewing the critical performance aspects of the product or process. Gap analysis is done to identify the common factors that determine successful performance. Besides, cause evaluations become necessary, encompassing an iterative process revolving around hypotheses, observations, and statistical tests. This forms the basis on which current performance hypotheses are made [2]. It then follows that the best hypothesis is chosen, and those that are termed unrealistic or impossible are neglected. These hypotheses are validated via statistical methods as well as by approximating their effects on the performance metric. The manager thus has to determine whether there is a quantifiable relationship between the causes and/or the critical factors. In this sense, the causes are quantified, and identifying causes for improvement is vital in this phase.

Improvement Phase

The improvement phase relates to the selection of process or product performance attributes that need improvement. Two types of improvement include incremental and transformational. Transformational or exponential improvements test the initial process hypothesis and design the product or process with higher possibilities collectively [5]. Incremental improvement, on the other hand, is usually small and successively increases from one step to another, which ultimately leads to higher improvements.

The generation of many potential solutions for the causes discussed in the analysis stage helps to narrow down specific solutions or combine them to form an overall solution that leads to improvement. Companies usually develop process maps and implementation plans to carry out

quality and productivity activities [4]. The most straightforward and easiest solutions among the alternatives are chosen and executed first. Further, the PDSA cycles come in at this stage to test the performance viability of the solutions.

Control Phase

The control phase is commenced by establishing control mechanisms as well as monitoring the anticipated improvements. This stage aims at ensuring sustainable outcomes and is facilitated by the use of statistical process-control tools. Many organizations create control plans to document any upgrades and failure areas [6]. Additionally, financial outcomes are recorded for further review. The results of the review generate follow-on analysis or may necessitate a revisit to some of the preceding stages.

Conclusion

Quality and productivity improvement measurement is an essential business operation that can lead to business excellence. The research paper has captured the seven quality principles that the Romanian interwar factories implemented to improve their performance and productivity. Additionally, the paper has captured the Six Sigma DMAIC model to explain the process and measurement of quality and productivity for a given project to implement.

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