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6 Sigma and DMAIC Process: Project Development and Implementation

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ABSTRACT: *The 6 Sigma methodology and philosophy are widely used in production and service companies to reduce the variables causing conflicts in processes and products. The objective is to decrease the standard deviation or variation to meet customer requirements. As it is well known, the lesser the variation, the higher the quality of both products and their processes. However, in the implementation of the 6 Sigma methodology, the DMAIC model is used, which stands for Measure, Define, Implement or Improve, and Control. These stages help to solve the variables causing variation in the processes by identifying the root cause of the problem and solving it, so that it does not occur again. The purpose of this manuscript is to facilitate the transition from theory to practice by presenting the basics of 6 Sigma and the DMAIC model. With over forty quality tools available for each stage, it can be overwhelming for anyone wishing to implement 6 Sigma projects. Thus, the tools presented in this manuscript are considered fundamental for beginning the use of this methodology.*

KEYWORDS-*6 Sigma Methodology, DMAIC Method, Quality Tools, Improvement, Control.*

I. INTRODUCTION

Statistics produces 6 Sigma, which is characterized by reduced variability and standard deviation of data relative to the mean [1]. By operating at a 6 sigma level, just 3.4 to 4 errors may or are projected to be produced for every million components produced, resulting in a 99.9997% efficiency level [2]. The DMAIC process—define, measure, analyze, implement, and control—thus serves as the cornerstone of the 6 sigma methodology [3]. The completion of 6 sigma projects is feasible because of these phases, which allow for the analysis of the critics, which are divided into quality critics [4]. There are several quality and identification tools available within each phase utilized in the execution of 6 sigma projects that may be used to identify which variable or variables it is wanted to control first and after a series of analyses [5]. After identifying the main cause of these variables' failures, it is possible to implement an improvement in their behavior or a decrease. The voice of the customer, process mapping diagrams, design of tests, and root cause diagrams, among other tools, may be categorized by each phase of the DMAIC process for a better understanding and successful use [6]. This article covers the phases of the DMAIC process and how it should be implemented using the fundamental quality tools to be starting with the usage of this methodology, employing quality tools that are described in each step of the 6-sigma process. On the other hand, the implementation and types of instruments that may be used in its application are described in a straightforward and understandable manner for the 6 sigma approach to be effectively used in increasing productivity, lowering variability, important variables, and adequate decision-making [7].

II. STAGE OF THE DMAIC CYCLE DEFINITION

The aim of the defining stage is to recognize and record any potential problems or influences that could influence the process or result. Tools like the SIPOC diagram, customer voice, process mapping, and chain mapping are used to do this. among other things, provides [8].

Following the selection of the variables, the goals to be achieved using the DMAIC method and the 6-sigma approach are also developed. These objectives are often defined in light of the projected savings from decreasing the significant challenges they now encounter, along with lowering the variables [9].

III. METHOD MAPPING

Process mapping is the visual depiction of a process' stages. Since these phases are static, they remove information about the process' dynamism (Monika & Jan 2013). Process mapping is also a qualitative technique with a variety of applications. Without having to go into such granular technical specifics, process mapping gives a broad perspective of all processes, allowing for a generalization of the creation of the good or delivery of the service [10].

IV. DEPLOYMENT OF THE QUALITY FUNCTION

Several factors, including cost, processing time, value chain time, and quality, impact a company's productivity. As time goes on, consumers begin to believe that a product's quality is inherent, thus this expectation must be realized (Duque, 2005). In other words, to meet a client's demands, product specs must be converted into those needs in order to create something that could appear difficult, nevertheless, which in fact acts as a tool for the cyclical process. and the implementation of the quality function gives priority to these objectives or requirements [11].

V. SUPPLIERS, INPUTS, PROCESS, OUTPUTS AND COSTUMERS DIAGRAM

SIPOC stands for suppliers, inputs, processes, outputs, and clients. A process that incorporates both internal and external suppliers is shown in this table, along with each supplier's inputs, the process flow diagram, the process outputs, and finally the clients of those outputs. the same on both the inside and outside. This method's goal is to optimize processes based on a schematic depiction of their essential components. The process is extensively examined using the SIPOC approach, which then examines the customers and the outcomes they anticipate because of the process [12].

VI. MEASURE PHASE

In the measure phase, which is when the quality critiques defined in the define stage are applied, the factors that are regarded to be significant in the emergence of process difficulties are utilized (Rahman et al., 2017). Every process has variance, as is well known, and moving forward, the objective is to identify this variation. Understanding what you want to measure and how to measure it is essential at this stage. In order to understand the variation and level of relevance of the variables chosen in the earlier step, several different methodologies are employed to choose and assess the critical variables [7].

VII. PROCESS CAPACITY INDEX

Process capability index is intended to determine how frequently the process' standard deviation falls within the parameters that the client has selected. On the other hand, it is predicted that when a process is normal and under statistical control, the quality characteristic of the manufactured goods to be tested would lie between -3 and +3 (99.73%) [13].

VIII. FAILURE MODE EFFECT ANALYSIS (FMEA)

Failure Mode Effect Analysis is a very effective technique for identifying mistakes in goods and processes and objectively evaluating their consequences, causes, and detecting aspects to prevent them from happening in the future and having a strategy of prevention that is recorded. The Failure Mode Effect Analysis is an important resource for information since it is a dynamic document that can hold a ton of data about our operations and goods [14].

IX. DMAIC CYCLE ANALYSIS

The goal of the analysis stage is to identify the fundamental cause of the problem as it is influenced by the key variables picked at the measurement phase. Depending on the type of project being conducted, the instruments used at this stage may vary, but they must all be based on the scientific method, that is, the careful collection and interpretation of data. By using an approach that enables accurate interpretation and root cause identification [15].

X. TOOL FIVE WHYS?

Five Whys is a methodical strategy that makes it possible to find the fundamental cause of an issue by examining why it is occurring. Also, based on the response, the same question is then asked repeatedly until the key variable's source is found. Although the approach is referred to as the "five whys," it shouldn't necessarily be applied just five times. The number of whys utilized will depend on whether the aim is achieved since the objective is to locate the cause of an issue. a rationale for the examination [16].

XI. Ishikawa Diagram

The cause-effect diagram connects an issue or consequence to the elements or causes that might have caused it. The significance of this picture comes in the fact that it compels us to investigate the many factors that contribute to the issue being studied. By doing so, the error of seeking just for remedies without investigating the root causes is avoided. Using the Ishikawa diagram will aid in trying to see the issue from several angles rather than taking the causes for granted [17].

XII. Improve Phase

As the problem's underlying causes have already been determined in the enhance stage, the change must be simple to execute and durable inside the organization. If continuous variables are employed or if factors were identified at this step, an experiment design may be used to find the optimal method to organize the variables in order to minimize the issues that were discovered at the define stage [18].

XIII. Planning of Experiments

To get the greatest desired result—that is, the bigger is better, the lesser is best—changes are made to the independent variables during the test to notice changes in the independent variables. zero is preferable (Fhionnlaoich et al., 2019). To get around restrictions, an experiment design might be used. The design of experiments is simply the strategic planning of experiments and the use of statistics. It provides a strong framework designed to maximize the amount of information obtained from a specific number of tests.

XIV. Control Phase Tools

The maintenance of the implemented improvements makes up the control stage, which may be accomplished by using tools that enable visibility and, as a result, keep control over what has been improved. To make sure that the alterations genuinely reduced the issue that was discovered in earlier stages, the variables that were found to be critiqued are, nonetheless, assessed once more at this level [19].

XV. Process Control Using Statistics

To determine whether a process is under control, it is investigated and controlled using statistical process control (SPC), performance, proactive process control, differentiation between natural and assignable variation, detection, and prevention of the process of causes, and the use of control charts. The best tool for examining process variation is a control chart. A control chart, often known as a time series diagram, is widely used to track a process through time. It is a graph of a process feature that often shows limitations based on statistical analysis over time. It aids the user in choosing the proper course of action to carry out the process when used for process monitoring, depending on based on how much the procedure varies [20].

XVI. Discussion

The 6 sigma technique offers a chance to enhance all aspects of businesses, regardless of the kind of business (e.g., service, government, production, etc.). The advantages of implementing 6 sigma projects are an improvement in productivity and efficiency, as well as an implied financial gain if the variables are identified and important in terms of critical to quality, essential to transport, or crucial to cost [21].

Yet, even if it is feasible to design a process in this level of yield that in accordance with the 6 sigma technique, 6 standard deviation is equivalent to the goal productivity to be reached. Hence, this technique should be viewed as a continual development to increase productivity and efficiency in businesses. in percentage is a 99.9997%, and over time the process will shift 1.5 standard deviations [22]

XVII. Conclusion

The 6 Sigma approach aims to decrease variance through process standard deviation levels; the more deviations there are, the better the quality level. Though theoretically speaking, the methodology's goal is to reduce a manufacturing process's standard deviation to 6; yet, if the 6 sigma level is taken into account as a measure of the process's capabilities, only 3.4 will be created. On the other hand, the 6-sigma approach uses the DMAIC process, which stands for define, measure, analyze, implement, and control, to carry out projects. Each stage of the DMAIC process has top-notch tools that allow the project to effectively finish that stage. In a similar vein, every step of the methodology was described to make it as easy as possible for practitioners of the 6 Sigma method to use it in the execution of projects and the lowering of quality critics from a variety of types of companies, from conventional production companies to service companies or even the government.

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