

# DMAIC Approach-Quality Improvement through Six Sigma Methodology

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## Abstract

DMAIC is a data-driven quality strategy used to improve processes. It is an integral part of a Six Sigma initiative, but in general can be implemented as a standalone quality improvement procedure or as part of other process improvement initiatives such as lean. DMAIC is an acronym for five interconnected phases: Define, Measure, Analyze, Improve, and Control. DMAIC is not exclusive to Six Sigma and can be used as the framework for other improvement applications. This classic or traditional Six Sigma methodology was designed to solve a problematic process or product and/or service offering to regain control. It addresses improvements in productivity (how many), financial (how much money), quality (how well) and time (how fast)—PFQT. DMAIC is the tool through which we can improve the Quality and profitability by removing the cause of defects and variability in manufacturing and business processes. DMAIC means Define, Measure, Analyses, Improve and Control. These all works together to create the DMAIC process. This process is incredibly important in six sigma process because it is what helps bring a diverse team together. This is what helps them complete a process or model so that they can share their work and get the job done. It is used to improve an existing business process.

## Keywords

Six Sigma, DMAIC, Quality Techniques, Sustainable Improvement, Process Performance, Wiper Motor.

## I. Introduction

In the decades since W. Edwards Deming (1986) began consulting with Japanese industries in the 1950s on how to improve quality controls for production systems, the world has witnessed an evolution of organizational developmental philosophies that have moved sequentially from quality control to total quality management to lean management (lean). Although the roots of lean spring from Japanese manufacturing, Womack, Jones, and Roos (1990) revealed a more generic set of elements, rules, and tools that can be applied to any organization including manufacturing, merchandising, service-oriented, non-profit, governmental, and educational organizations.

In the late 1980s, Xerox Corporation adopted Deming's Define, Measure, Analyze, Improve, Control (DMAIC) methodology to resolve inefficiencies in its business processes. Gradually, Xerox also used DMAIC as a tool to improve information flow into, through, and out of its educational clients (Kurt, 2004). George (2003) also demonstrated how continuous process improvement (CPI) methods have been adapted to service organizations.

In the globalisation of markets and operations, focus on quality and productivity is of utmost importance. Quality improvement in operations and production has been one of the most significant influences for organisation to be successful. Meeting customer requirement at minimum possible cost and time is the main mantra of success for any sort of business. The main objective of any business is to make profit. For increasing the profit, the

selling price should increase and/or the manufacturing cost should come down. Since the price is decided by the competition in the market, hence the only the way to increase the profit is to cut down the manufacturing cost which can be achieved only through continuous improvement in the company's operation. Six sigma is one such technique available to bring the breakthrough improvements almost in every sector through overall operational excellence. The central idea of the Six Sigma approach is to design processes, or improve existing processes, to obtain very high process capability and hence defect rates that are close to zero. Six sigma is a systematic, highly disciplined, customer-centric and profit-driven organization-wide strategic business improvement initiative that is based on a rigorous process focused and data-driven methodology. Six sigma is defined a customer oriented, structured, systematic, proactive and quantitative companywide approach for continuous improvement of manufacturing, services, engineering, suppliers and other business process.

It is a statistical measure of the performance of a process or a product. Six Sigma is the methodology having statistical base focusing on removing causes of variations or defects in the product or core business processes. The improvement focus is on business outputs which are of critical importance to the customers. It drives customer satisfaction and bottom-line results by systematically reducing variation in processes and thereby promoting a competitive advantage. Six sigma is considered a strategic corporate initiative to boost profitability, increase market share and improve customer satisfaction through statistical tools and techniques that can lead to breakthrough quantum gains in quality. In simple words Six Sigma as a program aimed at the near elimination of defects from every products, process and transactions. Six sigma blends management, financial and methodological elements to make improvement to process and products concurrently. Six Sigma provides business leaders and executives with the strategy, methods, tools and techniques to change their organizations. There are four aspects of the Six Sigma strategy that are not emphasized in other business improvement methodologies and Total Quality Management (TQM). First of all, Six Sigma places a clear focus on bottomline savings. Second, Six Sigma has been very successful in integrating both human aspects (culture change, training, customer focus etc.) and process aspects (process stability, variation reduction, capability etc.) of continuous improvement. Third, Six Sigma methodology (DMAIC) links the tools and techniques in a sequential manner. Finally, Six Sigma creates a powerful infrastructure for training of champions, master black belts, black belts, green belts, and yellow belts.

On the basis of SIX SIGMA, different problems in different departments are identified. Present study was done on application of DMAIC methodology and selection of its tools and techniques for raw material, production conditions, operator's behavior and other factors can result in a cumulative variation (defects) in the quality of the finished product. But the main problem found is intermittent speed of Front wiper motor.

## II. Six Sigma Methodology

Six Sigma has been defined as the statistical unit of measurement, a sigma that measures the capability of the process to achieve a defect free performance. Six is the number of sigma measured in a process, when the variation around the target is such that only 3.4 outputs out of one million are defects under the assumption that the process average may drift over the long term by as much as 1.5 standard deviations. The term —sigma is used to designate the distribution or the spread about the mean of any process. Sigma measures the capability of the process to perform defect-free work. A defect is anything that results in customer dissatisfaction. For a business process, the sigma value is a metric that indicates how well that process is performing. Higher sigma level indicates less likelihood of producing defects and hence better performance. Six sigma has key methodology- DMAIC

## III. DMAIC

DMAIC approach differs from other quality programs in its top down drive in its rigorous methodology that demands detailed analysis fact based decisions. It is a rigorous data driven method for dealing with defects, waste and quality problems, in manufacturing, services and other business activities. This approach is an upcoming quality problem solving, because of high rejection rates. The product is Front wiper motor. In all processes the smallest variation in quality of improvement process and is proving to be a powerful tool for solving complex problems. It would not work well without full commitment from upper management. The DMAIC methodology has a core process: Define Measure-Analyze-Improve-Control (DMAIC) methodology. The five steps to DMAIC approach are shown in fig. 1.

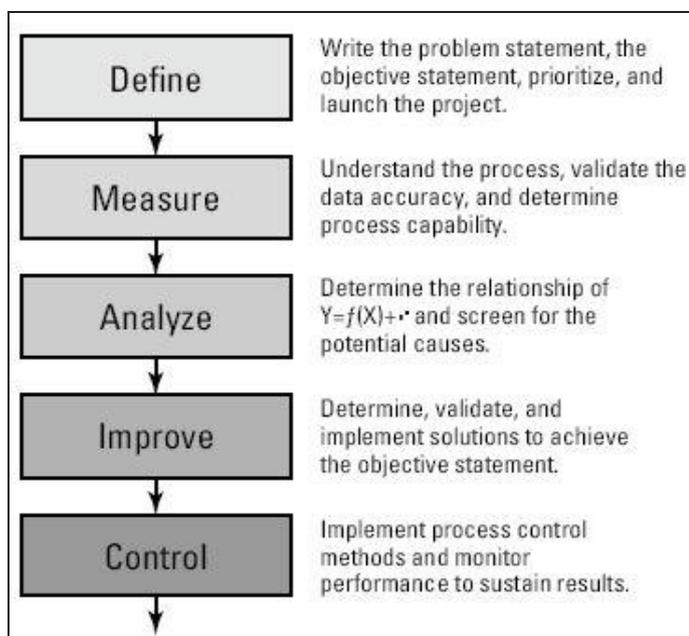


Fig. 1: The Five Steps to DMAIC Approach

### A. Define

The definition of the problem is the first and the most important step of any DMAIC project because a good understanding of the problem makes the job much easier. An average definition may mislead people into trying to achieve goal which are not required or making the problem more complex. Thus the definition of the problem forms the backbone of any DMAIC project. In this phase, define the purpose of work, scope and process background for both internal and external customers. The different tools which

can be used in define phase are:

- Voice of Customer
- Quality Function deployment

### B. Measure

The measure phase identifies the defects in the product, gathers valid baseline information about the process and establishes improvement goals. DMAIC approach is based on measured data

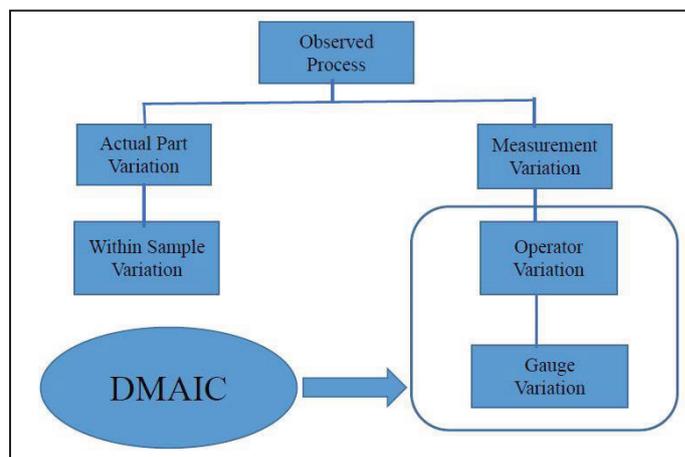


Fig. 2:

There will be unfavorable consequences from analysis using quality tools if there is problem with measuring system.

### C. Analyze

The analyze phase examines the data collected in order to generate a prioritized list of source of variation. It is the key component of any defect reducing program. This is the stage at which new goals are set and route maps created for closing the gap between current and target performance level.

The measurement and data must be analyzed to see if they are consistent with the problem definition and also to see if they identify the root cause. A problem solution is then identified. Sometimes, based on the analysis, it is necessary to go back and restate the problem definition and start the process over. The objective of Analyze phase in a Six Sigma project is to identify the root causes that are responsible for high variation in the selected CTQs. The aim of the analyze phase in a Six Sigma project is to identify the potential causes for the process problem being studied and then select the root causes with the help of data and their analysis. Once a list of potential causes has been generated, the next step is to plan for validation of these causes based on the data collected from the process. Lot of innovative thinking and discussions are required to identify the potential causes for a problem. A brainstorming session was planned and conducted by the team with the involvement of all the concerned personnel of the process, and a list of potential causes for variation in CTQ was generated.

The conventional quality technique like brainstorming, root cause analysis, Cause and effect diagram etc. may be used for carrying out the analysis.

### D. Improve

After identification of root causes, next step is to improve the process to remove cause of defects. Specific problem identified

during analysis and develop the solution of problems in the process by changing the parameters used in the process.

1. Use of brain storming and action workouts
2. Extracting the vital few factors through screening
3. Understanding the correlation of the vital few factor
4. Process optimization and confirmation experiment.

The purpose of this step is to identify, test and implement a solution to the problem; in part or in whole. Identify creative solutions to eliminate the key root causes in order to fix and prevent process problems.

#### E. Control

Control the process to make sure that defects do not recur i.e. remove the root cause of the problem. The control phase is preventive in nature. All the specific identified problems from the analysis phase were tackled in the control phase. It defines control plans specifying process monitoring and corrective action. This phase provides systematic re-allocation of resources to ensure the process continues in a new path of optimization. It also ensures that new process conditions are documented and monitored. The purpose of this step is to sustain the gains. Monitor the improvements to ensure continued and sustainable success. Create a control plan. Update documents, business process and training records as required

#### IV. What is the Main Objective of DMAIC Approach?

The DMAIC (Define-Measure-Analyze-Improve-Control) is the classic Six Sigma problem-solving process. Traditionally, the approach is to be applied to a problem with an existing, steady-state process or product and/or service offering. Variation is the enemy—variation from customer specifications in either a product or process is the primary problem. Variation can take on many forms. DMAIC resolves issues of defects or failures, deviation from a target, excess cost or time, and deterioration. Six Sigma reduces variation within and across the value-adding steps in a process. DMAIC identifies key requirements, deliverables, tasks, and standard tools for a project team to utilize when tackling a problem.

The main objectives of this case study are:-

1. To identify the root factors causing intermittent speed of Front wiper motor.
2. To improve the quality by reducing the line rejection of intermittent speed of Front wiper motor.
3. To reduce customer claim By Mock up rejection.

#### V. Key Requirements Define DMAIC Approach

Requirements come from the customer and the business, depending on the problem scenario. The (internal and external) customer requirements get translated into what is critical-to-quality (CTQ). These CTQs define the criteria to evaluate what good looks like—how well the project scope and deliverables meet requirements. Hence, the project team must meet the requirements of a phase before declaring completion and closing it out.

The DMAIC method was designed and structured to answer the following overall business questions:

1. What does the customer define as the problem? (Secondarily, is the problem sustained over time, is it chronic, or is it a one-time occurrence?)

2. What characterizes the current problem (e.g., process and performance metrics), and how has it changed over time? (Secondarily, is the process in control, and does it have a good measurement system? Is the process capable of producing the customer requirements?)
3. What are the root causes, and what improvement actions correct them to meet customer requirements again? (Secondarily, is the process capable of producing the customer requirements?)
4. What controls should be implemented to sustain this improvement, including a warning system, action plan, and communication plan needed in case requirements fail to be met? (Secondarily, can the improvements be sustained over time?)

#### VI. Conclusion and Future Scope

This paper was an attempt to review the product (front wiper motor) due to high rejection rate using six sigma methodology studied by various researchers. And it is in a way of learning six sigma concept and DMAIC in more detail. Firstly all problems and their root causes (due to which the problems can occur in the process) are identified. Also at the same time preventive action for these problems are found.

The Six Sigma Approach is customer-driven. The approach aims at continuous improvement in all the process within the organisation. This works on the belief that quality is free, in that the more we work towards zero-defect production, the more return on investment we will have. The advantages of six sigma approaches are reduction in defects/rejections, cycle time, work in progress etc. and increase in product Quality & Reliability, customer satisfaction, productivity etc. leading ultimately to excellent business results. The core principles of statistical thinking and the role of management in statistical thinking for improving business performance will continue to grow in importance in the forthcoming years.

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