



QUALITY IMPROVEMENT THROUGH SIX SIGMA DMAIC PHASES

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Abstract: - An organisation has several objectives. These are not only in form of products to be manufactured and marketed but also include goals of capacity utilisation, achieving profitability as well as intangible objectives of customer satisfaction and societal goals. Resources are utilized as inputs to achieve these objectives. If an organisation wants to improve its capacity, it will have to improve its plans, identify the action which is desirable to improve its working, will have to fix the responsibility and lay down the time schedule. Operational management includes all facts related to the art and practice of capacity and for its successful implementation; it is desirable for an organization to have a well-planned audit system and proper monitoring plan.

Keywords: Six sigma, DMAIC, DOE, Quality management, TQM.

I. INTRODUCTION

Quality in business, engineering and manufacturing has a practical interpretation as the non-inferiority or superiority of something, it can be defined as fitness for purpose. Quality is a perceptual, conditional and somewhat subjective characteristic and may be understood differently by different people. It is supposed that consumers focus on the specification/quality of a product /service, or how it compares to competitors in the market environment. Producers must measure the conformance quality, or degree to which the product /service was produced correctly.

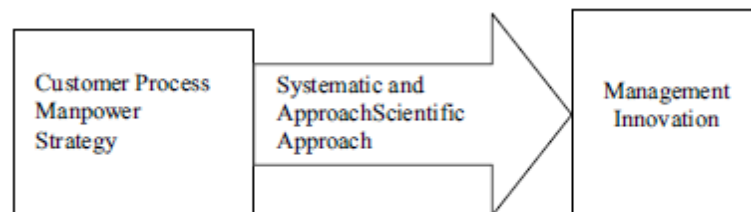


Fig. 1 Systematic and Essence of Six-Sigma

Numerous definitions and methodologies have been developed to improve product or service quality. There are two common quality related functions within a business. One is quality assurance which means the prevention of defects, such as by the implementation of quality management system and preventative activities like Failure Mode and Effect Analysis (FMEA). The other is quality control which is the detection of defects, most commonly associated with testing which takes place within a quality management system typically termed as verification and validation.

II. QUALITY MANAGEMENT AND TOOLS

The term quality management has a specific meaning within many business sectors. This specific definition, which doesn't aim to assure 'good quality' by the more general definition, but rather to ensure that an organization or product is consistent, can be considered to have four main components: quality planning, quality control, quality assurance and quality improvement. Quality management is focused not only on product /service quality, but also the means to achieve it. Quality management therefore uses quality assurance and control of processes as well as

products to achieve more consistent quality. Quality management adopts a number of management principles that can be used by top management to guide their organizations towards improved performance. The principle includes:

- **Customer focus:** Since the organization depends on their customers, therefore they should understand current and future customer needs, should meet customer requirements and try to exceed the expectations of customers. An organization attains customer focus when all people in organization know both the internal and external customers and also what customer requirements must be met to ensure that both the internal and external customers are satisfied.
- **Leadership:** Leaders of an organization establish unity of purpose and direction of it. They should go for creation and maintenance of such an internal environment, in which people can become fully involved in achieving the organizations quality objective.
- **Involvement of people:** People at all levels of an organization are the essence of it. Their complete involvement enables their abilities to be used for the benefit of the organization.
- **Process approach:** The desired result can be achieved when activities and related resources are managed in an organization as process.
- **System Approach to management:** An organization's effectiveness and efficiency in achieving its quality objectives are contributed by identifying, understanding and managing all interrelated processes as a system.
- **Continual improvement:** One of the permanent quality objectives of an organization should be the continual improvement of its overall performance.
- **Factual approach to decision making:** Effective decisions are always based on the data analysis and information.
- **Mutually beneficial supplier relationship:** Since an organization and its suppliers are interdependent, therefore a mutually beneficial relationship between them increases the ability of both to add value. The above mentioned eight principles form the basis for the quality management system standard ISO 9001:2008. Various tools and techniques are applied for achieving quality management. Few of them are Quality Management Systems QMS, Total Quality Management Tom, Continuous Improvement, Six Sigma, Statistical Process Control SPC, Quality Circles, and Business Process Re-engineering and so on.

III. DMAIC –SIX SIGMA STEPS

Define: Define stage are primarily for data collection which influences the management of the project start and terms of reference. Tools for data collection:-

- D1: IPO Diagram,
- D2: SIPOC Diagram,
- D3: Flow Diagram,
- D4: CTQ Tree&
- D5: Project Charter.

Measure: This stage includes selecting the measurement factors to be improved and providing a structure to evaluate current performance as well as assessing, comparing and monitoring subsequent improvements and their capability. The important tools for measurement should include:

- M1: Check Sheets,
- M2: Histograms,
- M3: Run Charts,
- M4: Scatter Diagrams,
- M5: Cause and Effect Diagrams,
- M6: Pareto Charts,
- M7: Control Charts,
- M8: Flow Process Charts&
- M9: Process Capability Measurement.

Analyze: This stage includes centers in determining the root cause of problems (defects) understanding why defects have taken place as well as comparing and prioritizing opportunities for advance betterment. The important tools for analysis should include:-

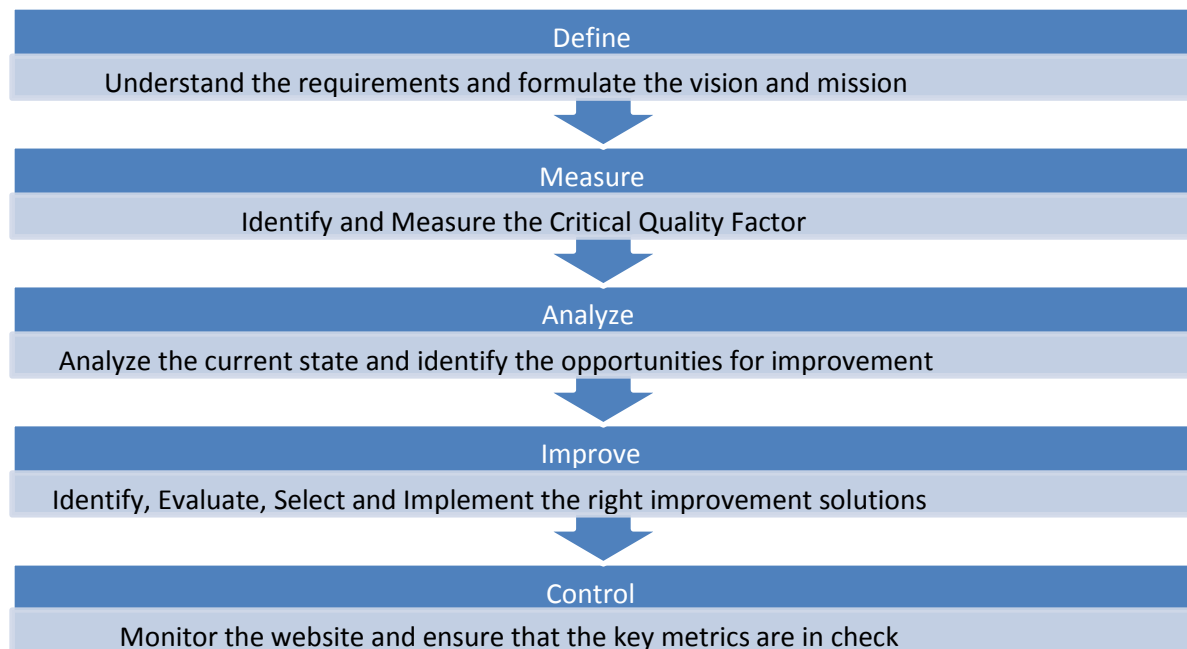
- A1: Process Mapping,
- A2: Regression Analysis,
- A3: RU/CS Analysis (Resource Utilisation and Customer Service),
- A4: SWOT Analysis,
- A5: PESTLE Analysis (Political, Economic, Social, Technical, Legal and Environmental),
- A6: The Five Whys,
- A7: Interrelationship Diagram,
- A8: Overall Equipment Effectiveness&
- A9: TRIZ: Innovative Problem Solving.

Improve: This step focuses on the use of experimentation and statistical techniques to generate possible improvements to reduce the amount of quality problems and/or defects. The important tools for improvement should include:-

- I1: Affinity Diagram,
- I2: Nominal Group Technique,
- I3: SMED, I4: Five-S,
- I5: Mistake Proofing,
- I6: Value Stream Mapping,
- I7: Brainstorming,
- I8: Mind Mapping&
- I9: Force Field Diagram.

Control: This last stage within the DMAIC process ensures that the improvements are sustained and that ongoing performance is monitored. Process improvements are also documented and institutionalized. The key tools for Control should include:-

- C1: Gantt Chart,
- C2: Activity Network Diagram,
- C3: Radar Chart,
- C4: PDCA Cycle,
- C5: Milestone Tracker Diagram&
- C6: Earned Value Management.



Challenges and Advantages on Six Sigma Implementation

Challenges	Advantages
• Failing or lack of resources and time for the implementation of the program. • Unawareness about the strategic advantages of Six Sigma as one of the most efficient methodologies. • Mistaken belief that Six Sigma include lots of mathematics (statistics) which is beyond the domain of normal enterprises and it is a type of luxury, which is being sold by the Management Counsellors at very high fees. • Cozy with the culture of resorting to an easy way out solutions and healing the situation and problem as and when encounter. i.e., generally indifferent about investing capital and valuable time, eternal and strategic cure.	• Full involvement of Administration and management in the implementation program. • Comfort of arriving and locating at the consensus for the highly problematic vast area for the trial of Six Sigma improvement program. • Ease of keeping a close eyes on the current processes and experimenting with variables for quality improvement. • Simpler and quick reaction to alter program in the context of Six Sigma implementation drive. This advantages flexibility and leanness in responding to small variations. • Comfort of keeping close to the users and finding the vital few Critical to Quality (CTQs), which concerns most or can comfortably be improved.

IV. SIX SIGMA AND QUALITY MANAGEMENT

Six sigma is very popular in Korean Industry. There are several reasons for this popularity. First it is regarded as a fresh quality management strategy which can replace TQC, TQM and others. In sense, we can view the development process of six sigma as shown in the figure below. Many companies which were not quite successful in implementing the previous management strategies such as TQC and TQM are eager to introduce six sigma.

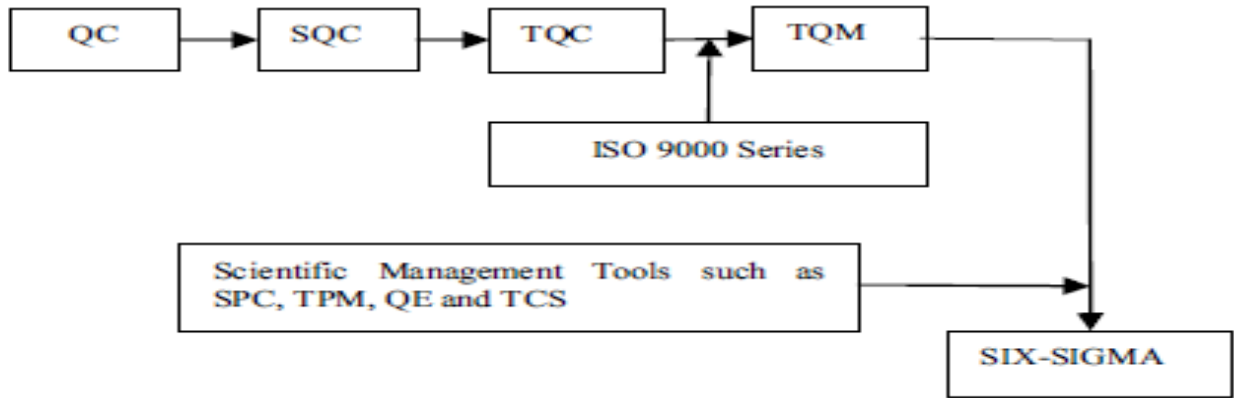


Fig 3 Development process of Six-Sigma in quality management

Statistical Quality Control (SQC), Statistical Process Control (SPC), Total Productive Maintenance (TPM)

Quality Circles (QC), Total Customer Satisfaction (TCS)

Total Quality Management (TQM), Quality Engineering (QE) & Total Quality Control (TQC)

V. A CASE STUDY

About the company

The company Precicheck India selected for the study is a small scale general engineering firm who are engaged in manufacturing a variety of products falling under a broad product range of gauges, cutting tools and automobile components such as plain ring gauge, plain snap gauge, plain plug gauge, measuring pin, drilling jig bushes, drilling jigs, liner bushes, diameter gauges, taper mandrels, base circle disc, chamfer checking instruments, new facing & centring machine, T-max cutters, face mill arbour, Sleeve (for automobile gears) etc. The company was established in the year 1980 with a vision to deliver quality gauges, cutting tools and automobile components to fulfil the requirements of the customer. It owns the most sophisticated manufacturing unit and is equipped with the latest technology and tools to fabricate quality products which render long term service.

Define Phase

In the Define step, Six-sigma refines the problem statement & identifies the factors which are critical to quality. This also ensures the business goal, priorities & expectations. Three major outputs from the define stage are:

- Process Map
- High Level Process Map – SIPOC (Supplier, Input, Process, Output, and Customer) diagram

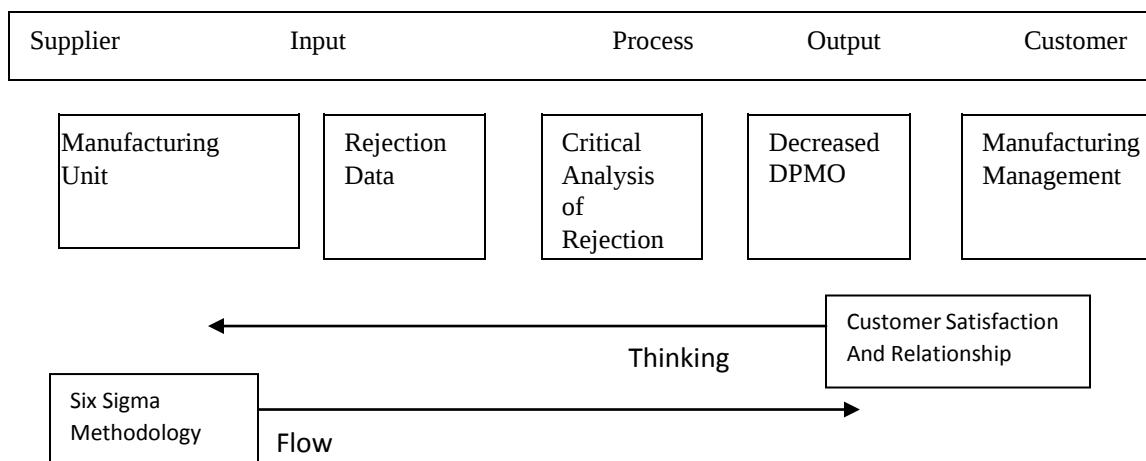


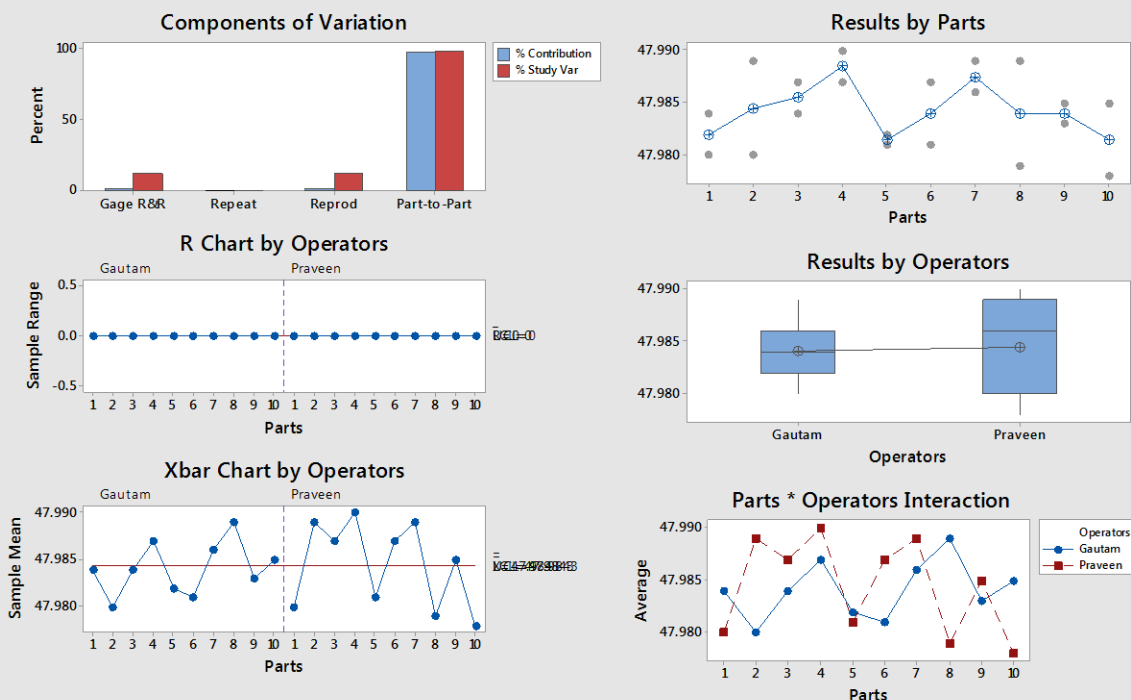
Fig. 4 SIPOC Diagram

Gauge R&R study: To ensure measurement system is statistically sound Gauge R&R study is performed. Gauge reproducibility & repeatability studies shows that how much of the observed process variation is due to measurement system variation. The sample size was 20 and two readings were taken on each sample, thereby making a total of forty readings. The gauge used for measurement circumferential confining gauge—a shaft is confined in a ring gauge and rotated against a set indicator probe.

Gage R&R (Xbar/R) Report for Results

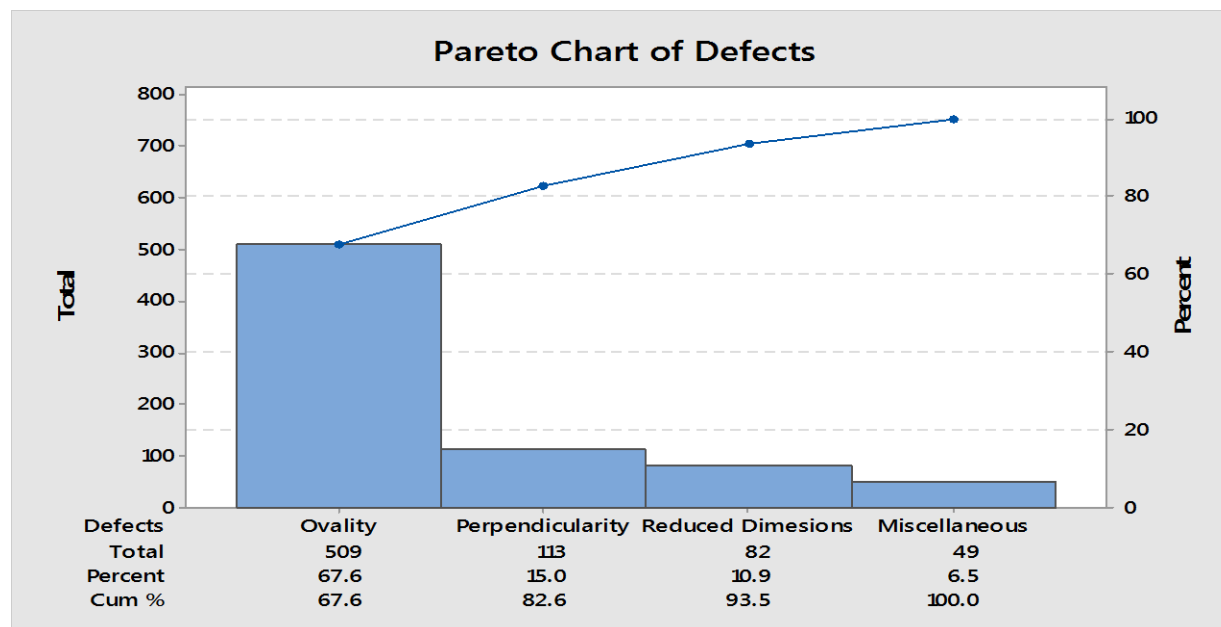
Gage name:
Date of study:

Reported by:
Tolerance:
Misc:

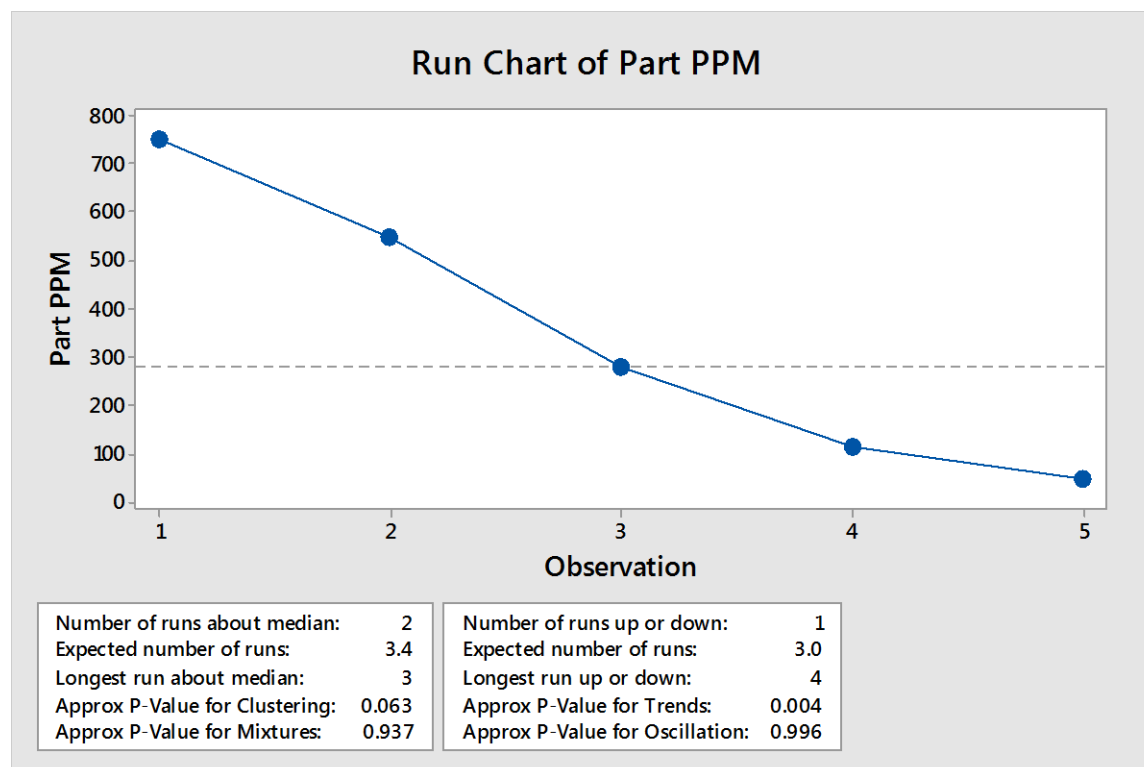


Pareto Analysis:

A Pareto diagram is a type of bar chart in which the various factors that contribute to an overall effect are arranged in order according to the magnitude of their effect.



Graph shows the decrease in PPM in five months after the improvement done. Initially, PPM was about 753 in the starting of January which has been reduced month by month to nearly 100 PPM in a short period of five months.



VI. CONCLUSION

Six Sigma is not only a strategic tool, but it can be used as a process improvement tool as well. It can also lead us to intangible savings such as reduction in consumer complaints and inspection is avoided during assembly.

Six sigma is a powerful tool to achieve customer satisfaction by improving the processes in any system, which may be production or service sector.

Six Sigma implications can be studied and explored over different service organizations like healthcare, safety care, transportation, traffic management etc.

ACKNOWLEDGEMENT

I would like to express my deep gratitude to Dr. Rajendra M Belokar, my research supervisor, for their patient guidance, enthusiastic encouragement and useful critiques of this research work.

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