SHAININ'S DOE- SIX SIGMA METHODOLOGY

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ABSTRACT

Customer satisfaction is the main issue to any organization in today's world. If you want to sold your product in the market then you have only single option i.e. the product should be of low cost & high quality. Now a days mostly all SMEs are facing this problem because of high rejection rate. If the process is running with high variation of required parameter then definitely rejection will occur. Taguchi & Shainin has given their statistical techniques to control the variation. In manufacturing industry, Shainin six sigma methodology is highly adopted because of lesser data collection to achieve the target.

In this research article, the methodology for Shainin six sigma implementation in the organization and its utilization to reduce the process variation is detailed.

***Keywords**: Six sigma, DMAIC, Cpk, DOE, R&R, Calibration.*

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1. INTRODUCTION

Sigma (σ) represents variation in the process w.r.t. mean (average line). Six Sigma is a data-driven approach to process improvement .Objective of this methodology is to achieve zero defect by reducing variation. Six Sigma was first time developed & introduced by Sir Bill Smith in Motorola in1987. Organizations world over has implemented Six Sigma successfully for more than 20 years with the aim of continuously improving the process. Six Sigma continues to be the best-known approach to process improvement (Taghizadegan, 2006). Six Sigma was introduced in manufacturing processes; today, however, marketing, purchasing, billing, invoicing, etc., functions are also implementing Six Sigma methodology. Implementation of Six Sigma methodology is having a significant impact on profitability and customer satisfaction of the organization, if successfully deployed (Breyfogle, 1999). It takes users away from 'intuition-based decisions' to 'fact-based decisions' (Breyfogle, 1999). A number of papers and books have been published addressing the fundamentals of Six Sigma. Topics include: What is Six Sigma? (Harry and Schroeder, 1999); Why do we need Six Sigma? (Pande et al., 2000); What makes Six Sigma different from other quality initiatives? Six Sigma deployment (Keller, 2001); critical success factors of Six Sigma implementation (Treichler, 2005); hurdles in Six Sigma implementation (Gijo and Rao, 2005); and Six Sigma project selection (Pande et al., 2003).

1.1 What is Six Sigma methodology?

1. The methodology which are going to discuss is specially focused on eliminating wastes in the manufacturing processes
2. Six sigma helps in eliminating the waste in manufacturing process by two methods
   a. **Problem solving**: this helps in reducing scrap ,rework and customer complaints.
   b. **Existing process optimization:** this helps in increasing the productivity and also helps in fixing the correct tolerance for the design.

1.2 Six sigma level:

First of all check the sigma level of the process as per following:

CP (process capability) = (USL-LSL)/6 σ

Where USL is upper specific limit & LSL is lower specific limit

CPu = (USL-X)/3 σ; and CPl = (X-LSL)/3 σ

Where CPu is process capability of upper side and CPl is process capability of lower side

X is mean value

CPk = least in between CPu and CPl

For six sigma level: Cp > 2 and Cpk > 1.5

2. CULPRIT AREAS

Every organization faces, lot of critical problems related to quality , cost and customer satisfaction. As per market survey and requirement , it is decided that which one problem should be killed first so that maximum benefit can be achieved . if the production is running without any failure or loss then go to process optimization to control "Muda" i.e. any type of waste.

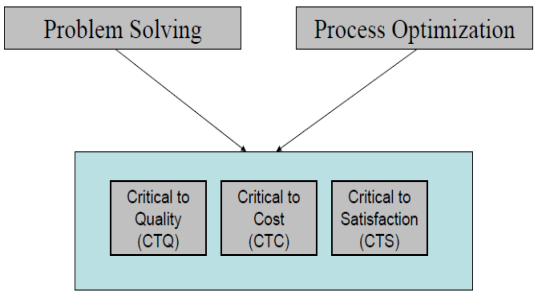

Fig.1: Critical Problem Areas

2.1 Types of problems:

After selecting the culprit area, now it is decided that which problem is to be killed as per cause and solution of the problem. Some problem becomes chronic because of management issues, lack of technology, lack of awareness or lack of facilities. So Problems in any organization are found basically in four categories as shown in fig. Priority is to be given to each category as shown in figure to kill the problem.

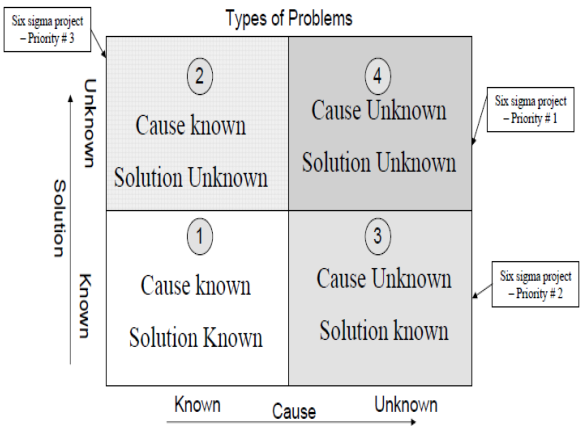

Fig.2: Types of problems

3. KEY POINTS

1. Six sigma is all about reducing and eliminating wastes in all processes.

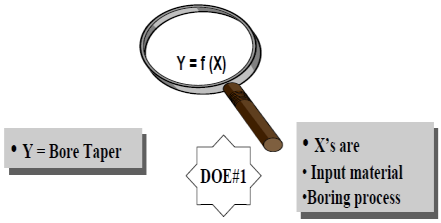

Fig.3: Response vs Suspected source of variable

2. The following are the two objectives
   of six sigma
   a) Problem solving
   b) Process optimization
3. Methodology adopted is "Funneling".
4. The technique used to funnel is **"design of experiment"** DOE

4. DMAIC PROCESS

a) Phase-1 : Define
b) Phase-2 : Measure and Analysis
c) Phase-3 : Improve
d) Phase-4 : Control

4.1 Introduction to DMAIC cycle:

a. Once the project is selected, the first step is we needed to **DEFINE** the Problem in phase -1.
b. The next step is to use **DOE** techniques to pin point the root cause(s) of the problem. This is done in phase-2.
c. When the root cause(s) are pin pointed, we have to plan and implement Process Improvement action . This is done in **IMPROVEMENT** PHASE. Root cause is also validated in phase-3.
d. Once the process improvement actions are implemented, we need to ensure that the actions stay permanent in process. This is done in phase-4.

4.2 Phase vs DOE Tool :

Phase	Tools
Define	Process mapping
	Pareto
	Brainstorming
	Calibration
	R&R study
Measure and Analysis	Paired comparison
	Product process
	Component search
	Modified component search
	Multy –vary analysis
	Process concentration chart
	Variable search
	Full factorial
Improve	B vs C
Control	Variation analysis
	X-bar and range chart
	Pre control chart

Table1: Phase vs Tools

5. APPLICATION OF DOE TOOLS

Paired Comparison :

It Can be used only when the SSVs are measurable on both Good & Bad Products.

(Good & Bad parts are selected based on the response /effect of the problem defined)

Product / Process Search :

SSVs related to the Process Parameters or Input Material which can not be measured on both Good & Bad parts, 'Product / Process Search' DOE Tool Used. Examples: Temperature, Pressure ,Pouring time, Input material wherein dimensions get changed during processing like: Drill dia in the case of Thread Loose or Tight Problem. (Good & Bad parts are selected based on the response / effect of the problem defined)

Concentration Chart :

Concentration Chart is mostly used for the attribute type of defects to identify It's intensity at various location / sector. Is used when defect can generate at multiple streams from the process and streams are too high to apply Multi-Vari Analysis.Example: Dents, Scratches, Burrs, Paint peel off, Dust, Porosity & Blow Holes in casting.

Component Search:

When problem is on an assembled product & the assembly can be dis-assembled and re-assembled without damaging parts. Response can be either attribute or Variable Is used for assembly related problems (HV Failure, Leakage ,Vibration, Pressure Drop, etc.)

Modify Component Search:

When problem is on an assembled product & if some parts get damaged during disassembly. Response can be either attribute or Variable

Multy Vary Analysis:

When input material is not the Cause of the problem and process is the only cause of the problem.

Response has to be Variable

Variable Search:

When the problem is due to design parameters of Product/Process, and parameters are >3.

It can be used for problem solving only when all the variation related SSV's are eliminated and the cause is confirmed as Process design Is also used for existing process optimization to arrive at an optimal setting for cost, productivity and quality

Full Factorial:

When the problem is due to design parameters of Product/Process & parameters are ≤ 3,

Process to be optimized for <=3 Design parameters

B vs C:

When root cause of the problem Or optimal setting for a process is identified and it has to validated

Variation analysis:

When the action on root cause is implemented and type of control to be decided for monitoring. This can be done both for Root X as well as Big Y Is used to identify the type of controls (monitoring method) that are required for the action implemented so that the problem does not reoccur again due to the same root cause.

Is done only when Product dimensions are the root cause for the problem.

6. CONCLUSION

Six Sigma methodology can be implemented to control the variation, to achieve zero defect level and to run the process at six sigma level in all the organizations mostly where **the physical product** is manufactured. As discussed above it is clear that Shainin DOE tools are very effective for **manufacturing industry** for problem solving and process optimization.

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