

15 June 2005

Quality Improvement Methodologies

Most commonly used quality improvements methodologies - A brief description.

Quality improvement is the periodic examination of organizational activities, policies, procedures and performance to identify areas requiring improvement. This includes implementation of corrective actions or policy changes.

Only a few statistical methods flourished and are still in use though many have been developed. These methods depend on two factors.

- Identification of the quality features and those that have a significant impact on process improvement.
- Evaluating these quality features using quantitative methods prior to authentication.

Some of the most famous statistical methods are Statistical Process Control (SPC), Taguchi Methods, Response Surface Methodology (RSM), Improvement by Experimentation, Total Quality Management (TQM), Quality Function Deployment (QFD), Automatic Process Control (APC) Shainin Strategies and Six-Sigma program.

We will briefly review each methodology.

Statistical Process Control (SPC) – SPC is a technique that uses sampling and control charts to identify process variation and its causes, for corrective action. It focuses on quality control, helps identify the deviations from the desired output, the cause of deviation and factors that contribute to the deviation.

Response Surface Methodology (RSM) – RSM is an iterative process that involves experimental design, experimental model building, and an evaluation of the developed model.

Typically, RSM consists of a four-step process, decide, design, experiment, and analyze. The first step helps one decide the location of experimentation and the appropriate representation of the system. In the design stage, the model is evaluated and the probable outcome assessed. In the next two stages, the experiment is carried out and the outcomes analyzed.

RSM is applied either to map a response surface over a particular process to be evaluated, to optimize the response or to maintain appropriate operating conditions to achieve desired specifications.

Total Quality Management (TQM) – TQM is a business wide customer driven strategy of change, which steers a company progressively to an environment where a steady and continuous improvement of every task attempted is a way of life.

Quality Function Deployment (QFD) – QFD is a technique for optimizing the process of developing and producing new products on the basis of customer need. It is a team-



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based methodology used to identify and translate customer requirements into technical specifications for product planning, its design, process, and production. QFD primarily focuses on a schematic approach of the available resources rather than trying to find the root cause of the issue.

Automatic Process Control (APC) – APC is a process where the input variables of a process are adjusted so that the output of the process is close to the desired output value. It is called the feedback control process. This process also does not focus on identifying the cause that leads to the confronting issue.

The most popular are the Taguchi Methods, Shainin Strategies and Six-Sigma. We will now discuss briefly these three approaches to quality improvement and their basic work principles.

Taguchi Methods

Dr. Genichi Taguchi of Japan pioneered Taguchi Methods, also called the Robust Design methods. Though Taguchi was working continuously on quality improvement methods from 1950's, the methods were largely confined to Japan. Only after the 1980's did they become popular through out the world.

Taguchi methods stressed not merely on inspection but on quality right from the design stage. The methods identify the variations if any at different stages of manufacturing a product, or during its use. Its main aim is to enhance the basic operability of a product by varying the design. It makes the variation in three stages of design namely at the

- System level design
- Parameterization
- Tolerating capacity

This method calls attention to controlling the variation in the quality of the product. Depending on the results and the deviations observed in the process, the controllable input variables could be altered. The control variables are set to such values that the process is resistant to undesirable and unavoidable variables that occur in the process.

As a next step, that is parameterization, the control variables are changed in such a manner that the desired process mean is obtained without actually varying the other parameters that would affect the quality of the process.

The process is further enhanced if needed by initially designing it in such a way that it increases the tolerance of the process. This reduces the variation of the process.

All these steps are accomplished offline.

The Shainin Strategies

Consider the case of a company that draws glass for making fluorescent tubes. It observed that the glass tubes took a weird shape during the setting time. Investigation revealed that the track that is used to draw the glass was not straight. The reason for the bent shape of the tube was attributed to the track. However, the number of items that



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were not in shape varied everyday. The company realized that though a prime factor the track was not the only reason for the alteration in the shape of the tubes.

They tried to find other reasons for the recurrent inconsistencies in the shape of the tubes. Varying surrounding temperatures proved to be another cause. Based on the temperature variations the glass tube would transit from molten state to the setting stage. The weird shapes of the tube showed that the tubes reached the setting stage at the wrong time.

With the help of established principles and designs of experiment most engineers cannot find reasons for variations. Solving chronic technical problems that arise due to more than a single reason is the main aim of Shainin Strategies.

Shainin Strategies mainly focuses on two issues:

- Influence of more than one cause on the effect
- The inability to recognize all the probable sources of causes.

While the other methodologies typically proceed by first finding the causes, the investigation of Shainin Strategies starts from the results, gradually centering onto the causes.

The working of Shainin Strategies...

All possible causes for the issue are identified and categorized as Red X, Pink X, Pale Pink X and so on, based on the influence of the cause on the issue. These are named according to the order of their influence on the issue, major one being Red X.

A systematic elimination process followed and the major cause the Red X, is identified. In case Red X cannot be eliminated, steps will be taken to make the process more tolerant to it.

Once the Red X is identified and resolved, the remaining causes are reconsidered and a Red X is identified among them. This process is repeated until all possible reasons identified are eliminated.

As Shainin Strategies do not deal much with statistics they are easy to implement. This makes it easy for technically qualified individuals with little or no statistical knowledge to solve persistent technical problems without delving into the statistical jargon.

Shainin Strategies could use any of the seven tools in its approach. The seven tools include

- Multi Vari charts
- Component search
- Paired comparison
- Variable search
- Full factorial
- Better vs. current

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- Scatter diagram.

Six-Sigma

Six-Sigma is a statistical concept, used to describe the state of zero defects or as close to it as possible. A letter in the Greek alphabet, Sigma denotes the standard deviation of a process. Standard deviation measures the variation of a result from the process average.

The higher the Sigma number, the lesser the number of defects. A defect could be anything that causes customer dissatisfaction.

The Six-Sigma approach...

The primary objective of Six-Sigma is the implementation of a measurement-based strategy. It focuses on process improvement and reduction in variation through the implementation of various improvement projects. It adopts a five-stage methodology for process improvement discussed below.

1. Define: During this stage a company needs to identify the processes in the project that could be affected. They also set targets for the completion of the project and analyze the potential financial gains. The common tools used at this stage include a process scope contract, process mapping and a CT matrix.

2. Measure: In this stage process measures called “Y”’s are developed and used to evaluate the performance of the process. The evaluation includes an analysis of:

- The process
- The inputs and outputs affecting the process
- The performance of the process
- The best level of performance the process can produce

This would determine the current performance of the process and assess it against the desired performance level.

Tools generally used in this stage are process mapping, cause-and-effect diagrams, failure mode effects analysis and graphical techniques.

3. Analyze: During the analysis stage it is necessary to:

- Identify the process inputs and the extent to which these inputs affect their customers.
- Collect and analyze data to identify the root cause of the problems and the scope for improving quality.
- Observe the affect of different inputs on the same process function at different locations.
- Analyze the effect of various combinations of process variables on the process.
- Determine the number of observations and the confidence level required to make valid assumptions.



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Tools that can be used in this stage include process mapping, graphical techniques, multivariate studies, hypothesis testing and correlation and regression analysis.

4. Improve: At this stage, they develop different solutions to quality problems and select the best alternative. Difficulties might be encountered while:

- Analyzing the selected cost-benefit solution
- Evaluating of the solution
- Designing the implementation plan
- Communicating the plan

Tools required in this stage include process mapping, design of experiments, simulation and optimization.

5. Control: During this final stage of DMAIC cycle it would be critical to design a control plan, document the project, transfer the opportunities identified to other parts of the organization, develop a structured approach for improvements and draft an audit plan. The aim is to sustain the gains achieved during the entire DMAIC cycle.