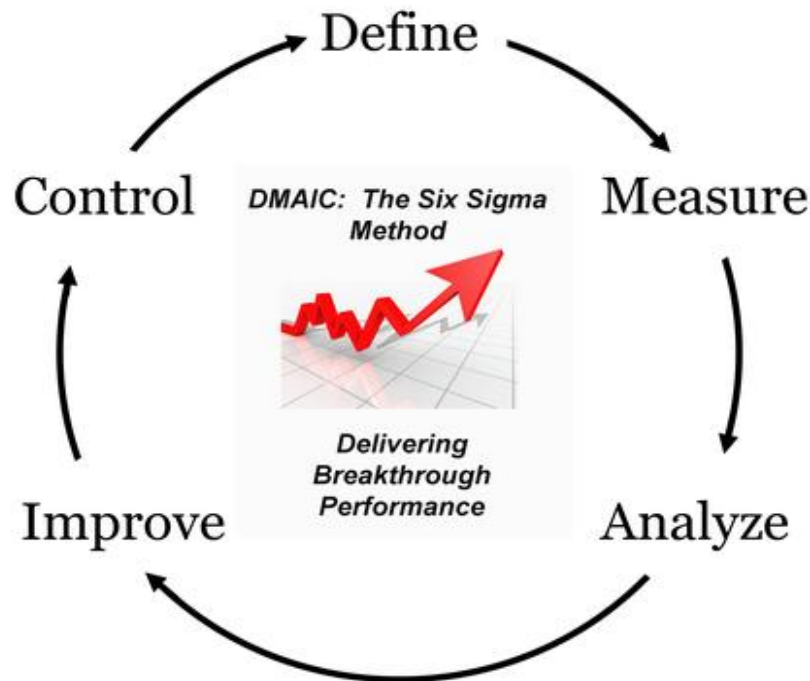


Six Sigma Quality Tools DMAIC

QUALITY TOOLS Check Sheets

Description of DMAIC

The DMAIC, Pronounced (Duh-May-Ick), is an acronym for five interconnected phases, Define, Measure, Analyze, Improve, and Control. This structured model is based on the Plan, Do, Check, Act cycle developed by Dr. W. Edwards Deming. Its sole objective is to eliminate costly variations from manufacturing and business processes. As the backbone of the Six Sigma methodology, DMAIC delivers sustained defect-free performance and highly competitive quality costs over the long run.



When to use the DMAIC

The DMAIC methodology, instead of the DMADV methodology, should be used when a product or process is in existence at your company but is not meeting customer specification or is not performing adequately.

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.

The structure of DMAIC encourages creative thinking within boundaries such as keeping the basic process, product, or service.

How to use the DMAIC

There are two primary options for implementing DMAIC:

Project-team approach

- Black Belts deployed full-time to projects
- Team members work on the project part-time-work on the project is interspersed with regular work
- Full involvement by all team members in all phases of DMAIC
- Duration can be 1 to 4 months depending on scope (some go longer; shorter is better because you can realize gains more quickly)

Kaizen approach

- Rapid (1 week or less), intense progress through all of DMAIC except full-scale implementation
- Preparatory work on Define, and sometimes on Measure, done by a subgroup (team leader and a Black Belt, for instance)
- Rest of the work done by the full group during several days or a week when they work ONLY on the project (participants are pulled off their regular jobs)

Each step in the cyclical DMAIC Process is required to ensure the best possible results. The process steps:

DEFINE

- the Customer, their Critical to Quality (CTQ) issues, and the Core Business Process involved.
- who customers are, what their requirements are for products and services, and what their expectations are
- project boundaries the stop and start of the process
- charter team, define roles and responsibilities
- the process to be improved by mapping the process flow

Tools

- Project Contract
- Gantt Chart
- Financial Savings Review
- Voice of the Customer (VOC)
- Stakeholder Analysis
- Affinity Diagram
- Critical To Quality Linkage (CTQ)
- SIPOC
- Pareto Diagram
- Kano Model
- Spaghetti Diagram and Process Maps
- Surveys, Data Collection and classification.

MEASURE

- the performance of the Core Business Process involved.
- assess current measurements, measurement capability
- develop a data collection plan for the process
- collect data from many sources to determine types of defects and metrics
- compare to customer survey results to determine shortfall

Tools

- QFD
- Fishbone
- Process Map
- Pareto Chart
- FMEA

ANALYZE

- The data collected and process map determine root causes of defects and opportunities for improvement.
- Identify gaps between current performance and goal performance
- Prioritize opportunities to improve
- Identify sources of variation
- Do detailed process mapping
- Create future value stream map

Tools

- Box plot to get an overview of the data
- Run Chart to display data trends over time
- Multi-Vari Chart
- Histogram to display variation in a process
- Dot Plot to display variation in a process
- cause and effect (fishbone diagram)
- Pareto
- process mapping
- FMEA

IMPROVE

- the target process by designing creative solutions to fix and prevent problems.
- create innovate solutions using technology and discipline
- improve or re-design the process
- eliminate or reduce root causes of input/output process variables.
- implement workplace organization (5S)
- improve material replenishment system (e.g., Kanban)
- implement Visual Controls
- pilot and verify changes, then implement
- develop and deploy implementation plan

Tools

Depends on the problem sophistication (complexity, business impact, risk, data availability)

- **Basic**
 - fishbone
 - box plot
 - linear regression
 - hypothesis testing (z-test, t-test, ANOVA, chi-square, HOV)
 - process map
 - time order plots
 - mistake proofing
 - multi-vari plot
 - force fields
 - action work-out
- **Intermediate**
 - DOE (full, fractional)
 - multi-variate regression
- **Advanced**
 - Response surface
 - Taguchi (inner/outer array)

CONTROL

- the improvements to keep the process on the new course.
prevent reverting back to the “old way”
- require the development, documentation and implementation of an ongoing monitoring plan
- institutionalize the improvements through the modification of systems and structures (staffing, training)
- error proof the improved process study measures to confirm effectiveness, or make changes
- implement Statistical process control
- final report

Tools

- SPC Charts
- Assessing Final Process Capability
- Total Productive Maintenance ((TPM)
- Revised FMEA
- Mistake Proofing
- Control Plan
- Verify Financial Savings
- and finallyclose out the Project Contract.

Tips on use of DMAIC

- Develop a plan to accurately set and meet customer expectations
- Focus adequate attention on project selection and scoping
- Establish a clear understanding of current operations and direction
- Determine and focus on key metrics and success indicators
- Do not underestimate the importance of the Control phase

Applications of DMAIC

- To solve a problematic process or product and/or service offering to regain control.
- To address improvements in productivity (how many), financial (how much money), quality (how well) and time (how fast), costs dominated the financial aspects.
- To reduces process variance (in total, across the activities and within-step) to bring it back on target—the customer specification or requirement.
- To reduce the cycle time.

Examples of DMAIC

To implement 5S

Define

- Plan a course of action.
- Select and educate team.

Measure and analyze

- Evaluate the work area.

Improve

- Initiate the 5S's.
- Measure the results.

Control

- Maintain 5S activities.
- Deploy to other areas.

Single Minute Exchange of Die

Define

- Reduce setup time.

Measure

- Gather data on current approach to changing setups and time required.

Analyze

- Identify the source of operator setup activities and time requirements.

Improve

- Change work methods and implement.
- Measure effect of new procedures.
- Deploy approach to other processes.

Control

- Make physical changes to the machines for operators to work on setups only in the new way and not the old ways.

References

- Nancy R. Tague, *The Quality Toolbox*, second edition, ASQ Quality Press, 2004.
- *DMAIC Screenshot: Heidi Wiesenfelder*
- *Pareto Chart Screenshot: Michele McDonough*
- GE's DMAIC approach