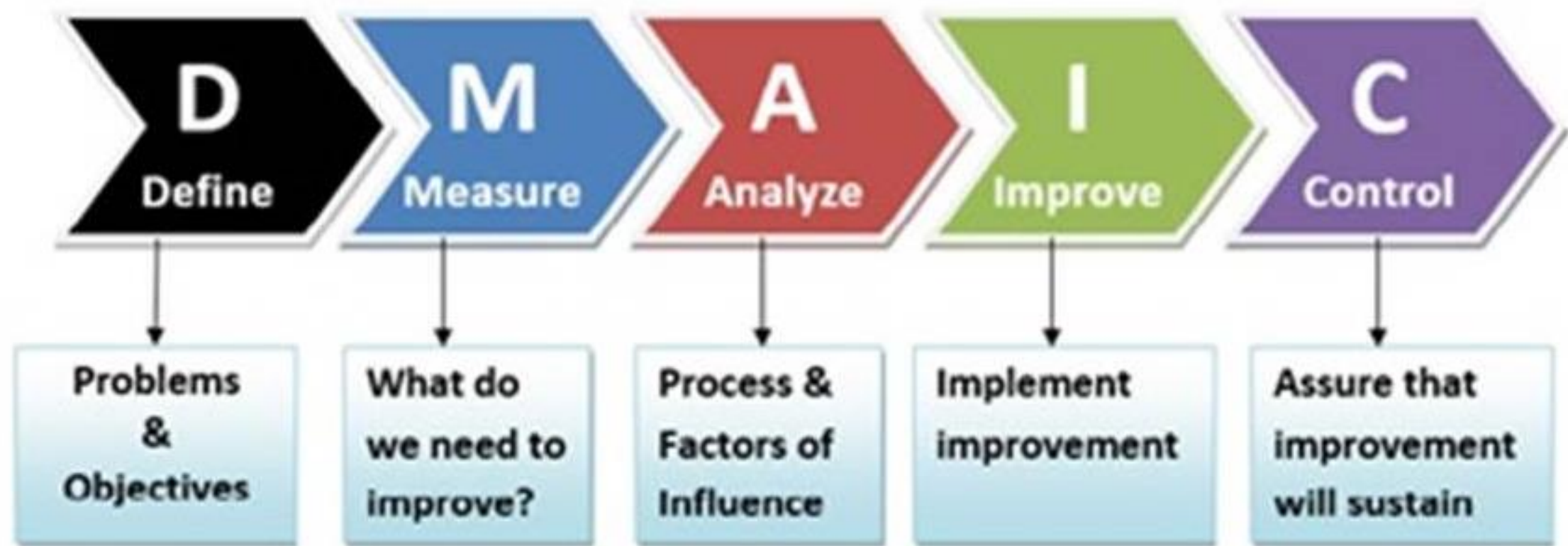


DMAIC



Each group will be allocated a DMAIC phase to research

- Each group to produce a 5 min presentation on their allocated Process Improvement Phase.
- Each group member to contribute to the presentation.
- Presentations should include the following:
 - Brief Introduction to DMAIC
 - A more detailed description and explanation of the groups allocated phase.
 - Where their allocated phase fits into the process (what it offers and why it's important).
 - The typical tools and techniques which are used in that particular phase.
 - Use examples to illustrate your points wherever possible.
 - Be prepared to present your work at **4:00pm in SAIQ 108**. Work should be uploaded to the Turnitin Link on Moodle.

Define

Vision P2

Identify what's important to the customer (VOC).

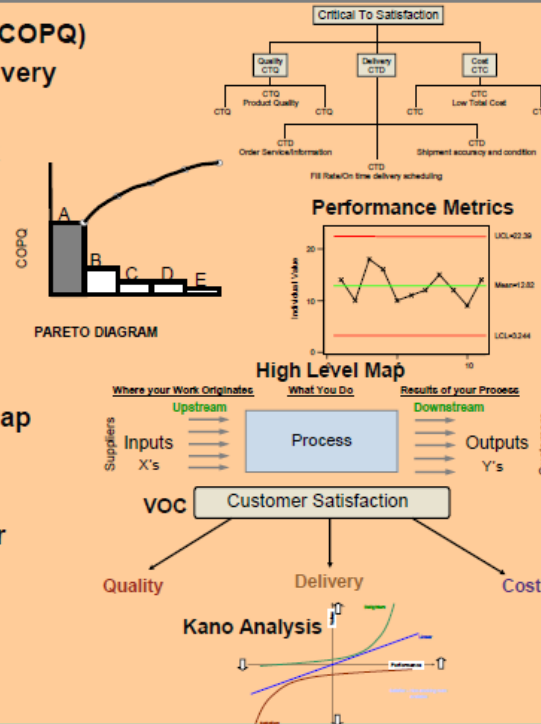
Develop the Project [Charter](#)

Initiate data collection and financial or business benefits

High Level map and scope of project

Tools

- Cost of Poor Quality (COPQ)
– Cost, Quality or Delivery (Cycle Time)
- Critical To (CT) Matrix
- Pareto Chart
- Product, Process Performance Metrics
- High Level Process Map (SIPOC)
- Voice of the Customer
- Kano Analysis
- Survey Design



Sequential Questions

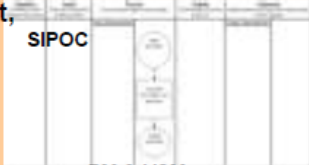
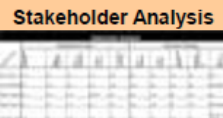
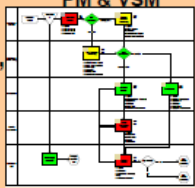
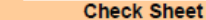
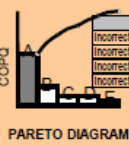
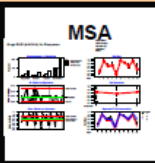
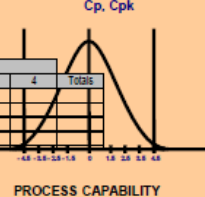
1. What is the product, process, or service to be improved?
How does it align to the business strategy (e.g., core, strategic objectives)?
2. Who are the customers (internal or external)?
Who are the primary groups of people who receive, use, or rely on product/process deliverables?
3. What do the customers care about? What are the critical characteristics (critical to Quality, Cost, Delivery) of the product/ process deliverables that matter most to the customer?
4. Which characteristics should be selected for improvement? Which are we failing to provide as well as the customer would like?
5. What is the cost of poor quality (COPQ)? What are the expected hard and soft cost savings?
Where are the expected benefits to the business (**capacity expansion**, productivity improvement, defect/cycle time/waste reduction, etc.)?
6. What is the project plan (resources, etc.) and what barriers must be overcome? Has the Process Owner been identified and engaged in the project?

Deliverables

- High Priority Project
– product/process to be improved
- Project Definition
– **problem statement**
– **scope and boundaries**
– objective
– CTSS
– supporting data
– team members
– Process Owner
- Project Plan
– time
– resources
– cost
- Show Data/Graphs**
Champion/ Belt Project Review

References

- CT – Page 19-23 BB Memory Jogger
- Pareto Chart – page 29, BB Memory Jogger
- Data Collection – page 69-81, Lean 6 sigma Pocket Toolbook
- High Level maps – page 49-54, BB Memory Jogger
- VOC, Kano & Survey Designs – Chapter 4, page 55 of the Lean 6 Sigma toolbook

Measure	Tools	Sequential Questions	Deliverables	References
Quantify current performance and estimate improvement target. Data Collection and mapping of inputs, outputs and value stream of process Identify preliminary waste opportunities Validate current measurement systems & methods	• SIPOC - Supplier, input, process, output, customer • Stakeholder analysis • Process Mapping, including Value Streams, VSM • Spaghetti Chart – waste tool • Check Sheet • 5S analysis • Pareto Diagram • Measurement Systems Analysis (MSA) • Process Capability Analysis        	☐ 7. For each critical characteristic selected for improvement, specifically what should be measured (Y)? What are the collateral Ys to be measured? How will you assure that you do not negatively affect other critical outputs? ☐ 8. What are the process boundaries within which we can make changes to improve the Ys? ☐ 9. What existing data is available to assess current performance? ☐ 10. Is the measurement system adequate? If not, how can it be improved? ☐ 11. What are the “opportunities” and defects at each process step? Is there Waste in the process? ☐ 12. What is the current performance (Cpk, PPM or DPMO, Sigma Level)? ☐ 13. Based on this analysis has the scope of the project been narrowed sufficiently to establish a manageable and specific focus? ☐ 14. What is the estimated improvement target?	☐ Problem Statement (narrowed project scope) ☐ Measurement System Analysis ☐ Baseline Process/Product Performance (Cpk, PPM or DPMO, Sigma Level) ☒ Estimated Improvement Target SS ☐ Waste opportunities identified Show Data/Graphs Champion/ Belt Project Review	• Maps – Page 38-52 of the Lean 6 Sigma toolbox • Stakeholder Analysis – Web or sample files • Spaghetti Chart – page 42, Lean 6 sigma Pocket Toolbox • MSA – page 73-94, BB Memory Jogger • Process Capability –, page 135-140 of the Lean 6 Sigma toolbox or page 95-100 of BB Memory Jogger

Analyze

Narrowing the X's

Provide analytical & statistical **evidence that causes are real.**

Commit to improvement target for Y.

Tools

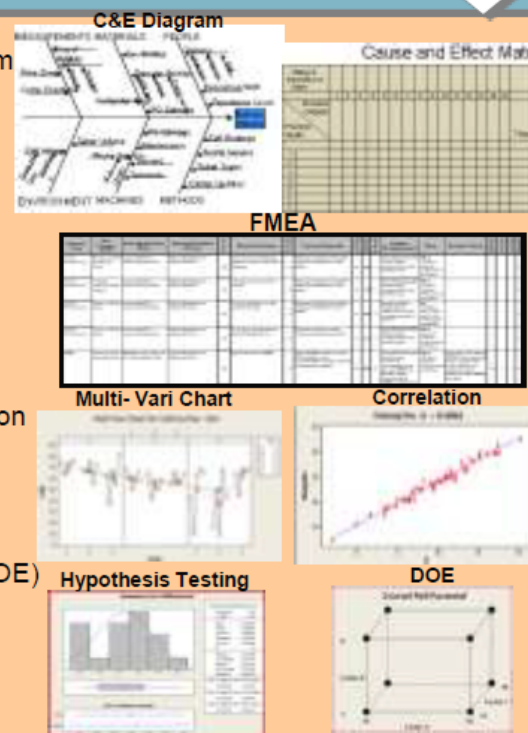


Sequential Questions

Deliverables

References

- Cause and Effect Diagram
- Cause and Effect Matrix
- Failure Mode and Effects Analysis (FMEA)
- Multi-Vari Chart
- Correlation and Regression
- Hypothesis Testing
- Design of Experiment (DOE) Screening



- ☐ 15. What are the possible causes for the undesirable output (variation or defect) that was selected for improvement?
- ☐ 16. Which causes are most likely the biggest contributors? What are the likely key process input variables (Xs)?
- ☐ 17. Which of these causes are within the team's control? Which are outside the project boundaries?
- ☐ 18. How can these suspected "big" causes be verified? What data should be collected and what statistical test performed?
- ☐ 19. Based on the analysis of Xs, what is the improvement target to which the team can commit?
- ☐ 20. Have the value streams been part of the analysis? If so, which processes are or could be effected. Does the FMEA reflect the possibilities

- ☐ Updates to living documents – PM, FMEA, etc
- ☐ Verified Causes of Variation/Defects using data analysis
- ☐ Improvement Target Commitment

Show Data/Graphs

Champion/ Belt Project Review

- C&E Diagram – Page 65-72 of the BB Memory Jogger
- C&E Matrix – Page 148-149 of the Lean 6 sigma Pocket Toolbook
- FMEA – page 211-220, BB Memory Jogger
- Multi-Vari charts – page 127-138, BB Memory Jogger
- Correlation & Regression –, page 167-178 of the BB Memory Jogger
- Hypothesis Testing – page 149-156 of the BB Memory Jogger
- DOE – Page 185-210, BB Memory Jogger

Improve

Determine solutions
(ways to counteract
causes & eliminate
waste).

Install optimized
solutions and
provide analytical &
statistical evidence
solutions work.

Assess Risks for
solutions

Adjust project
benefits based on
applied solution

Tools

- Regression Analysis
- Design of Experiment (DOE)
- Mistake Proofing
- 5S and Visual management
- KANBAN – Pull systems
- **Kaizen events, waste elimination team activities**
- Failure Mode and Effects Analysis (FMEA)
- Hypothesis Testing

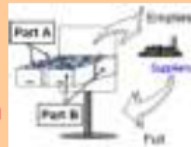
Regression



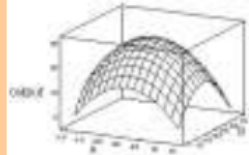
Mistake proofing

1. Identification: Recognize potential errors.
2. Registration: Identify causes and effects. Change process to make errors less likely.
3. Counteraction: Make it easy to avoid errors and find errors.
4. Confirmation: Make it easy to identify errors and correct them.
5. Evaluation: Verify the impact of the solution.

KANBAN



DOE



5S

Step	Goal	Activities	Tools
Step 1: Sort	Eliminate clutter	Sorting	Sorting
Step 2: Set in order	Organize workspace	Labeling	Labeling
Step 3: Shine	Keep workspace clean	Cleaning	Cleaning
Step 4: Standardize	Establish standards	Standardization	Standardization
Step 5: Sustain	Maintain standards	Monitoring	Monitoring

Kaizen



Hypothesis Testing



FMEA

Item	Function	Failure Mode	Effect	Severity	Cause	Occurrence	Control	Detection	Score
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10	10

Sequential Questions

- ☐ 21. For each verified cause (x), what are the possible ways to counteract the cause?
- ☐ 22. Of these possible solutions, which ones are thought to be most effective, easiest to implement and lowest cost?
- ☐ 23. For each key process input variable (x), what is the optimal setting and tolerance?
- ☐ 24. How can each "solution" be verified with data prior to full-scale implementation?
- ☐ 25. Will these solutions allow us to meet our improvement target?
If not, what causes or solutions have we missed? What is the predicted impact on Y?
- ☐ 26. What is the predicted impact on **collateral** Ys?

Document Process/Procedures

Deliverables

- ☐ Solutions to Counteract the Causes & remove waste
- ☐ Optimal Settings and Tolerances for Key Process Input Variables (Xs)
- ☐ Installation & testing Solutions
- ☐ Statistical Evidence that Solutions Work
- ☐ Data Verifying Impact of Solutions on Y
- ☐ Collateral Y Impact Assessment
- ☐ New Process Map; VSM & SOPs
- ☐ Measurement System Analysis Validation

References

- Regression –, page 167-178 of the BB Memory Jogger
- DOE – Page 185-210, BB Memory Jogger
- Mistake proofing – page 232-234, Lean 6 sigma Pocket Toolbook
- 5S – page 206-212, Lean 6 sigma Pocket Toolbook
- KANBAN – page 213-221 of the Lean 6 Sigma toolbook
- Kaizen – page 20-25, Lean 6 sigma Pocket Toolbook
- FMEA – page 211-220, BB Memory Jogger

Control

Put controls in place to **maintain improvement over time** and provide statistical evidence that improvement is sustained.

Effective hand off to process owners and team members responsible for the product/process.

Benefits validated, tracked and recorded continuously

Project storyboard in place and all data and files are located into a central searchable repository

Communicate Success Stories & Celebrate

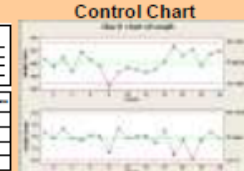
Tools

- Control Plan
- Control Chart
- Audit Plans
- Mistake proofing, established
- Visual Management, established
- Total Preventative Maintenance (TPM)
- Procedures/Work Instructions
- Process Capability (New)
- Standardized Operations
- Final FMEA, Failure Mode & Effects Analysis

Control Plan
Process Control Plan

Process Name	Project	Priority	Page
Customer	Owner	Approval	Revision
Material	Equipment	Approval	Revision
Method	Environment	Approval	Revision

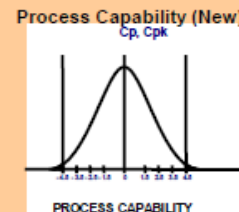
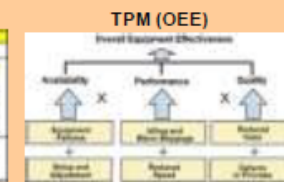
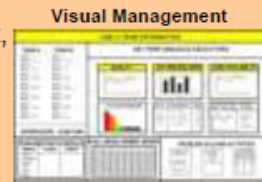
Item	Process	Control	Frequency	Reaction	Owner	Sign-off



Audit Plans

Audit Description	Audit Date	Audit Results	Follow-up

- Mistake proofing**
1. Elimination: Prevent possibility of errors
 2. Replacement: Substitute correct for incorrect actions (Change process or value-added tool, safety)
 3. Facilitation: Make it easy to do correct actions first time
 4. Detection: Make it easy to identify errors that do occur
 5. Mitigation: Reduce the impact of any errors



FMEA

Item	Process	Control	Frequency	Reaction	Owner	Sign-off

Sequential Questions

- 27. Specifically, how can we **control each key process input variable over time**? What are the **new standard operating procedures**, and what is the training plan?
- 28. Are the measurement systems adequate?
- 29. How does the **new performance level compare to our improvement target**?
- 30. Are we able to maintain the new performance level?
- 31. Did we reach our **improvement target and financial goals**?
- 32. What **further improvements** are needed?
- 33. Is waste recognition and elimination part of the control plan?
- 34. How can we apply what we learned to obtain improvements in other areas? Has "project replication statement been completed?"

Close Project in project tracking system

Lookback and \$ validation process RIGOR!

Deliverables

- New Process Capability Data
- Comparison of New Performance Level to Target
- Project Handed-off to Process Owner with Team Member Engagement
- Project Documentation
- System In Place to Monitor X's and Adjust Process According to the Control Plan. Robust to Management Changes
- Three Months (Min) of Data to Audit Results
- Validated Cost Savings and other Benefits
- Opportunities to Translate Improvements to Other Areas;
- Show Data/Graphs
- Champion/ Belt Project Review

References

- Control Plan – Page 241-245, BB Memory Jogger
- Control Charts – Page 221-236, BB Memory Jogger
- Audit Plan – Web or use Sigma Flow software
- Mistake proofing – page 232-234, Lean 6 Sigma toolbox
- Visual Management – page 237-240, Lean 6 Sigma toolbox
- TPM – page 237-240, BB Memory Jogger
- Procedures/WI – See Company Policies for Documentation
- Process Capability –, page 135-140 of the Lean 6 Sigma toolbox or page 95-100 of BB Memory Jogger
- Standard Operations – page 197 Chapter 9, Lean 6 Sigma toolbox or Web
- FMEA – page 211-220, BB Memory Jogger