Lean Six Sigma
DMAIC Improvement Story

**DMAIC** Project Objective:
TITLE

Last Updated: 04/01/2019

Team:
- M. W. (Team Leader)
- R. F.
- T. D.
- M. G.
- T. L.
- D. J. (Sponsor)

042019
Lean Six Sigma Problem Solving Process

The team utilized the 5-Step DMAIC problem solving process.

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Number</th>
<th>Name</th>
<th>Description of Key Team Activities</th>
</tr>
</thead>
</table>
|              | 1      | DEFINE | • Select Priority Issue / Process  
|              |        |       | • Confirm Stakeholder Requirements  
|              |        |       | • Display Theme Indicator and Performance “Gap”  
|              |        |       | • Develop a SMART Theme Statement  
|              |        |       | • Determine the Cost of Poor Quality  
|              |        |       | • Establish a Method to Monitor Team Progress  
|              |        |       | • Develop a DMAIC Project Schedule |
|              | 2      | MEASURE | • Construct a Process Flow Chart  
|              |        |       | • Perform 8 Wastes Analysis  
|              |        |       | • Develop a Data Collection Plan  
|              |        |       | • Stratify the Problem (i.e. “Gap”) and Select the Significant Problem  
|              |        |       | • Develop a Target and a SMART Problem Statement |
|              | 3      | ANALYZE | • Identify Potential Root Causes(s)  
|              |        |       | • Verify Root Cause(s)  
|              |        |       | • Assess Impact of Root Causes on the Problem in the Measure Step |
|              | 4      | IMPROVE | • Identify and Select Countermeasures  
|              |        |       | • Identify Barriers and Aids  
|              |        |       | • Develop Action Plans  
|              |        |       | • Confirm Pilot Plan Effectiveness and Document Lessons Learned  
|              |        |       | • Determine the Expected Return on Investment |
|              | 5      | CONTROL | • Confirm / Document Improvement Results  
|              |        |       | • Determine the Actual Return on Investment  
|              |        |       | • Standardize Improvements within Operations  
|              |        |       | • Replicate Changes  
|              |        |       | • Document Lessons Learned  
|              |        |       | • Identify Future Plans for Continued Process Improvement |

Note: Keep sponsor informed and engaged.
The team and management used a Checklist to monitor team progress.

<table>
<thead>
<tr>
<th>Step 1: Define</th>
<th>DMAIC Steps – Objectives and Checkpoints</th>
<th>Key Tools / Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The stakeholders and needs were identified.</td>
<td>• Selection Matrix • Line Graph • Theme Statement • Cost of Poor Quality Matrix • Action Plan • Project Charter • Project Planning Worksheet</td>
<td></td>
</tr>
<tr>
<td>2. An indicator measuring performance in meeting the need was developed.</td>
<td></td>
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<tr>
<td>3. A theme statement consistent with the indicator was developed, and the Cost of Poor Quality (COPQ) were determined.</td>
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<tr>
<td>4. A schedule for completing the five DMAIC steps was developed.</td>
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<td></td>
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<tr>
<td>5. The sponsor signed off on the project’s purpose, scope, and significance.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2: Measure</th>
<th>Identify the significant problem and set a target for improvement.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Measurement and data collection systems were developed.</td>
<td>• Process Flow Chart • 8 Wastes • Checksheet, Spreadsheet, Survey • Histogram • Pareto Chart • Target Setting Worksheet • Problem Statement</td>
</tr>
<tr>
<td>7. The theme was stratified from various viewpoints and a significant problem was chosen.</td>
<td></td>
</tr>
<tr>
<td>8. A target for improvement was established based on the stakeholders’ needs.</td>
<td></td>
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<tr>
<td>9. The impact of the target on the theme indicator and the COPQ were determined.</td>
<td></td>
</tr>
<tr>
<td>10. A problem statement that addressed the gap between the actual and target values was developed.</td>
<td></td>
</tr>
<tr>
<td>11. The sponsor signed off on the project’s focus and target.</td>
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</tbody>
</table>
## Monitor Team Progress

### Six Sigma DMAIC Checklist

<table>
<thead>
<tr>
<th>Step</th>
<th>DMAIC Steps – Objectives and Checkpoints</th>
<th>Key Tools / Techniques</th>
</tr>
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<tbody>
<tr>
<td><strong>Step 3: Analyze</strong></td>
<td>Identify and verify the root causes of the problem.</td>
<td></td>
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<tr>
<td>12.</td>
<td>Cause and effect analysis was taken to the root level.</td>
<td>• Cause and Effect Diagram (Fishbone)</td>
</tr>
<tr>
<td>13.</td>
<td>Potential causes most likely to have the greatest impact on the problem were selected.</td>
<td>• 5 Whys</td>
</tr>
<tr>
<td>14.</td>
<td>A relationship between the root causes and the problem was verified with data.</td>
<td>• Qualitative Analysis</td>
</tr>
<tr>
<td>15.</td>
<td>The impact of each root cause on the gap and the COPQ were determined.</td>
<td>• Single Case Bore Analysis</td>
</tr>
<tr>
<td>16.</td>
<td>The sponsor signed off on the verified root causes and impact on the gap.</td>
<td>• Chi Square Test</td>
</tr>
</tbody>
</table>

**Select and plan effective and feasible countermeasures and determine the expected Return on Investment.**

<table>
<thead>
<tr>
<th>Step 4: Improve</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>17.</td>
<td>Countermeasures were selected to address verified root causes.</td>
<td>• Countermeasures Matrix</td>
</tr>
<tr>
<td>18.</td>
<td>The method for selecting the appropriate practical methods was clear and considered effectiveness and feasibility.</td>
<td>• Work Breakdown Structure</td>
</tr>
<tr>
<td>19.</td>
<td>Barriers and Aids were determined for countermeasures worth implementing.</td>
<td>• Barriers and Aids Analysis</td>
</tr>
<tr>
<td>20.</td>
<td>The action plan reflected accountability, schedule, and cost.</td>
<td>• Cost Benefit Analysis</td>
</tr>
<tr>
<td>21.</td>
<td>A test pilot plan was implemented and evaluated to determine the capability to achieve the target established in the Problem Statement.</td>
<td>• Action Plan</td>
</tr>
<tr>
<td>22.</td>
<td>Lessons learned from the pilot were incorporated into the full-scale action plan, and the project’s <strong>expected</strong> Return on Investment (ROI) was calculated.</td>
<td>• Pilot/Simulated Pilot</td>
</tr>
<tr>
<td>23.</td>
<td>The sponsor signed off on the action plan and expected results.</td>
<td>• Lessons Learned</td>
</tr>
</tbody>
</table>

**Define** → **Measure** → **Analyze** → **Improve** → **Control**
# Monitor Team Progress

## ets Six Sigma DMAIC Checklist

<table>
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<th>Step</th>
<th>DMAIC Steps – Objectives and Checkpoints</th>
<th>Key Tools / Techniques</th>
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</table>
| **Step 5: Control** | Confirm the results including the actual Return on Investment, standardize the changes, and develop future plans. | • Before and After Results Graphs  
• Process Control System  
• Radar chart  
• Action Plan (for Future Plans / Next Steps)  
• Management Presentation |

### Results Phase

- **Evaluate the results by confirming that the countermeasures implemented impacted the root causes, the problem, and the Theme Indicator, and determine the actual Return on Investment.**
- **24.** The effects of countermeasures on the root causes were demonstrated.
- **25.** The effects of countermeasures on the problem were demonstrated.
- **26.** The improvement target was achieved and causes of significant variation were addressed.
- **27.** The effects of countermeasures on the theme indicator representing the stakeholders’ needs were demonstrated, and the project’s actual ROI was calculated.

### Standardization Phase

- **Ensure process revisions are incorporated into standard work, including replication in all applicable areas.**
- **28.** A method was established to document, permanently change, and communicate the revised process or standard.
- **29.** Responsibility was assigned and periodic checks scheduled to ensure compliance with the revised process or standard.
- **30.** Specific areas for replication were identified.

### Future Plans Phase

- **Document lessons learned and develop plans for the next process improvement cycle.**
- **31.** Any remaining problems of the theme were addressed.
- **32.** Lessons learned, P-D-C-A of the ets DMAIC Method, and team growth were assessed and documented.
- **33.** The sponsor signed off on the results and next steps.
The team …

- Identified Stakeholders and their Needs.
- Confirmed alignment to organization’s KPIs. (Scorecard and/or Strategic Plan).
- Created a Theme Indicator (Line Graph) for performance.
- Developed a SMART Theme Statement consistent with the Theme Indicator (Line Graph).
- Determined the Cost of Poor Quality of the “gap”.
- Developed a Project Charter and DMAIC Schedule.
- Achieved Sponsor Sign-off.
# Define Step Roadmap

## Background
- KPI Linkage
- Strategic Plan Linkage
- Selection Matrix
- Bar Chart
- Situation Appraisal
- Consultant Process Tree
- Lean vs. Six Sigma
- 7 Tracks
- Value-added Matrix
- Benefit vs. Effort Analysis

## Stakeholders Needs

<table>
<thead>
<tr>
<th>Stakeholder and Needs Analysis</th>
</tr>
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<tbody>
<tr>
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</tbody>
</table>

## Data Collection Tool

<table>
<thead>
<tr>
<th>Checksheets</th>
<th>Spreadsheets</th>
<th>Surveys</th>
</tr>
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<tbody>
<tr>
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</tbody>
</table>

## Line Graph

- Project Indicator Selection
- 3 Types of Spreadsheets (Spreadsheet design is included in this section and is part of checkpoints 2, 6 and 14)

## Theme Statement

<table>
<thead>
<tr>
<th>Represents Line Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMART Criteria Applied</td>
</tr>
</tbody>
</table>

## Cost of Poor Quality Matrix

<table>
<thead>
<tr>
<th>COPQ Analysis of the “gap”</th>
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## Project Planning Worksheet

- Project Planning Worksheet & DMAIC Schedule
- Project Charter

## Sponsor Sign-off

- Sponsor Review

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A Theme Statement tells specifically what your DMAIC project is attempting to do. In practice, theme statements serve as the “title” of a DMAIC project, and should be clear and concise.

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- Theme Statement
- Project Planning Worksheet
- Sponsor Sign-off
- Define
- Measure
- Analyze
- Improve
- Control
The team …

- Constructed a Process Flow Chart and applied the 8 Wastes.
- Developed a Checksheet / Spreadsheet or Survey to collect data.
- Created a Histogram (if measurable data).
- Developed a Pareto Chart to prioritize problems.
- Selected the significant problem.
- Set a target for the problem (big bar on the Pareto Chart).
- Determined how much achieving the target on the problem (big bar) will impact the Theme Indicator.
- Developed a SMART Problem Statement.
- Achieved Sponsor Sign-off.
During school year 2013/2014 (when), 40.7% of students with disabilities (who) were at Level 3 and above in reading (what). This is 19.3 percentage points below the district’s target (gap) and contributes to 7 schools (where) not achieving AYP and $2.5 million in potential funding restrictions and penalties (pain).
The team …

- Developed a Cause & Effect Diagram (Fishbone) to identify potential causes and applied 5 Whys. 12.
- Selected most likely potential causes. 13.
- Performed Qualitative Analysis for potential “Quick Wins”.
- Assessed the impact of verified root causes on the Problem (big bar on Pareto Chart) target in the MEASURE step. 15.
- Achieved Sponsor Sign-off. 16.
Analyze Step Roadmap

Potential Causes
- Cause & Effect Diagram (Fishbone)
- Brainstorm
- Affinity Process
- 5 Whys

Probable Causes
- Qualitative Analysis
- Multi-voting
- Scatter Diagram
- Single Case Bore Analysis

Root Causes
- Contingency Table
- Chi Square Test
- Verification through Observation
- Root Cause Verification Matrix

Impact on Problem
- Impact of Root Causes Relative to Problem Target in Measure Step Determined

Sponsor Sign-off

Define Measure Analyze Improve Control
The team …

- Developed a Countermeasures Matrix and Selected Countermeasures to Address Root Causes.  
- Evaluated Practical Methods for effectiveness and feasibility.  
- Applied Work Breakdown Structure and Performed Barriers and Aids Analysis.  
- Conducted Cost Benefit Analysis.  
- Reviewed and updated COQP from DEFINE step.  
- Developed Action Plan.  
- Conducted a Pilot Project (An actual pilot or simulation).  
- Documented lessons learned from the Pilot.  
- Documented lessons learned from the Project.  
- Calculated Expected Return on Investment (ROI).  
- Achieved Sponsor Sign-off.
**Improve Step Roadmap**

1. **Countermeasures Matrix**
   - CM1
   - CM2
   - CM3
   - PM 1
   - PM 2
   - PM 3
   - PM 4
   - PM 5
   - PM 6
   - PS
   - VRC

2. **Work Breakdown Structure**
   - Barriers & Aids Analysis
     - Yes
     - Yes

3. **Action Plan**
   - Cost-Benefit Analysis
     - COPQ Matrix in Define Step Reviewed

4. **Pilot Project**
   - Actual or Simulated Pilot

5. **Lessons Learned**
   - Lessons learned from Pilot (if applicable)
   - Lessons Learned from Project
   - Expected “ROI” (Return on Investment) Calculated

6. **Sponsor Sign-off**
   - Yes
   - Yes
   - Yes

**Define > Measure > Analyze > Improve > Control**
The team ...

- Developed Before and After Graphs (using graphs shown in the Analyze, Measure, and Define steps in reverse order).
- Determined Actual Project Return on Investment (ROI).
- Updated the Process Flow Chart and revised procedures.
- Provided training in new procedures.
- Updated and implemented the Process Control System.
- Monitored compliance with new methods.
- Identified Replication Opportunities.
- Developed an Action Plan for Future Plans / Next Steps.
- Documented overall project lessons learned / team growth.
- Achieved Sponsor Sign-off.
- Team made its Management Presentation, received Recognition.
Control Step Roadmap

- Results
  - Before and After Graphs
  - Reverse Order:
    - Root Causes (Analyze)
    - Pareto (Measure)
    - Histogram (Measure)
    - Line Graph (Define)
  - Actual Project ROI Calculated

- Standardization
  - Procedures Revised
  - Training Conducted
  - Process Control System Revised and Monitored for Compliance
  - Replication Planned

- Future Plans
  - Other Opportunities (Pareto in “Results”) Identified
  - Overall Lessons Learned from Project Documented
  - Team Growth Determined

- Sponsor Sign-off

- Team Presentation
  - Celebration
  - Recognition

Define → Measure → Analyze → Improve → Control
Appendix

Use the Appendix for:

- Back up data and analysis documentation.
- Meeting minutes.
- Source documents and reports.
- Organization’s Key Performance Indicators (KPIs), Scorecard, and/or Strategic Plan.

Notes:

- The “Essential Tools” will be used in most DMAIC project stories. Some projects may require additional tools.
- Remember: Fact-based conclusions; consistency in terminology; continuity of data; and logical story flow.