

Project cost management

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PMG 227

Lecture 10



Project Cost Management

Lean Six Sigma

Lecture 10

What is Six Sigma?

What is Six Sigma?

- Is the application of the scientific method to the design and operation of management systems and business processes which enable employees to deliver the greatest value to customers and the organization
- Six Sigma is a statistical concept that measures a process in term of defects 3.4 DPMO
- A philosophy and a goal
- A methodology
- A symbol of quality

Six Sigma & organizations

- To help organizations make more Money is the most important reason for using Six Sigma.
- Consider cost of poor quality: Cost of scrap, rework, excessive cycle time, delay, lost business, lost customers, etc.



- Customer wants **zero** defect



What do Companies Want

- Reduce lead times
- Decrease cycle time
- Cut service errors
- Increase rate of transactions
- Develop new products
- Redesign systems
- Understand customer needs

Key Concepts of Six Sigma

- Defects per Million
- Variation Reduction
- Critical to Quality
- Process Capability
- Design for Six Sigma



Core Philosophy of Six Sigma is based on the key concepts (1 of 3)

➤ **Think in terms of**

- key business processes,
- customer requirements,
- and overall strategic objectives.

➤ **Focus on**

- corporate sponsors responsible for championing projects,
- support team activities, help to overcome resistance to change,
- and obtaining resources.

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Core Philosophy of Six Sigma is based on the key concepts (3 of 3)

➤ **Provide**

- Extensive training followed by project team deployment

➤ **Create**

- Highly qualified process improvement experts ("green belts," "black belts," and "master black belts") who can apply improvement tools and lead teams.

➤ **Stretch**

- Objectives for improvement.

Six Sigma Metrics

- Defect – any mistake or error that is passed on to a customer
- Defects per unit (DPU) = number of defects discovered \ number of units produced
- Defects per million opportunities (dpmo) = $DPU \times 1,000,000$

Impact of Six Sigma

- Six sigma is a universal approach for improvement in all aspects of a business. In addition to focusing on defects, other key business metrics include:
 - Cycle time
 - Process variation
 - Throughput

Quality Problem Types

- Efficiency problems
 - When system performance does not achieve organizational goals such as Cost and productivity
- Product design problems
 - Designing new products that better satisfy user needs (Where the expectation of the users matter the most)
- Process design problems
 - Design a new process or revise an existing one. Challenge is to determine process requirements and link processes to customer needs (tool used: benchmarking and reengineering)

Benchmarking

- Process Benchmarking:
 - Specific work processes. Identifies the most effective operating practices from many companies that perform similar work functions.
- Organizational Benchmarking:
 - Comparing the current project, methods or processes with the best practices and using this information to drive improvement of overall company performance.
- Performance Benchmarking:
 - Assess their competitive positions through product and service comparisons.
- Project Benchmarking:
 - New techniques for planning, scheduling, and controlling projects.
- Strategic Benchmarking:
 - How companies compete.

Benchmarking

Motorola's Benchmarking Process:

- Decide what to benchmark
- Select companies to benchmark
- Obtain data and collect information
- Analyze data and form action plans
- Re-calibrate and start over again

Benchmarking

➤ Advantages:

- Helps you to understand your processes
- Enables comparisons of performance measures
- Helps you to incorporate new and different ideas
- Builds relationships
- Continuously improve

➤ Disadvantages:

- Difficult to compare apples to apples (misleading)
- Difficult to get information
- Takes time and money

DMAIC Methodology



DMAIC Methodology

- Principal problem solving methodology used by six sigma
- **DMAIC stands for:**
 - Define
 - Measure
 - Analyze
 - Improve
 - Control



DMAIC

The Six Sigma Project DMAIC Cycle



Define

- ☐ Why must this project be done NOW?
- ☐ What is the business case for the project?
- ☐ Who is the customer?
- ☐ What is the current state?
- ☐ What will be the future state?
- ☐ What is the scope of this project?
- ☐ What are the tangible deliverables?
- ☐ What is the due date?



Control

- ☐ During the project, how will I control risk, quality, cost, schedule, scope, and changes to the plan?
- ☐ What types of progress reports should I send to sponsors?
- ☐ How will I assure that the business goals of the project were accomplished?
- ☐ How will I maintain the gains made?

Measure

- ☐ What are the key metrics for this business process?
- ☐ Are metrics valid and reliable?
- ☐ Do we have adequate data on this process?
- ☐ How will I measure progress?
- ☐ How will I measure ultimate success?



Improve

- ☐ What is the work breakdown structure for this project?
- ☐ What specific activities are necessary to meet the project's goals?
- ☐ How will I re-integrate the various subprojects?
- ☐ Do the changes produce the desired effects?
- ☐ Any unanticipated consequences?



Analyze

- ☐ Current state analysis
- ☐ Is the current state as good as the process can do?
- ☐ Who will help make the changes?
- ☐ What resources will we need?
- ☐ What could cause this change effort to fail?
- ☐ What major obstacles do I face in completing this project?

Define Phase

- Describe the problem in operational terms
- Drill down to a specific problem statement (project scoping)
- Identify customers and CTQ's (critical to quality) that has the most impact on performance,
- Describe the current level of performance or the nature of errors or customer complaints,



Define Phase

- **Identify** the relevant performance metrics, cost / revenue implications,
- **Benchmark** best performance standard
- **Address** project management issues such as what's to be done, by whom, and when.

Define - Project Charter

- Charter is to define at a high level:
 - What the Project Team will deliver,
 - What resources are needed, and
 - Why it is justified

- The Charter represents a **commitment** to dedicate the necessary time and resources to the project. For this reason, the Charter should be **shared with all major stakeholders**, securing sign-off when appropriate

Define - Project Goals & Objectives

- Scope Critical Success
- Factors Assumptions
- Deliverable Scope Inputs
- Project Deliverables
- Logical Scope
- Organizational Scope
- Project Timing

Define the Customer

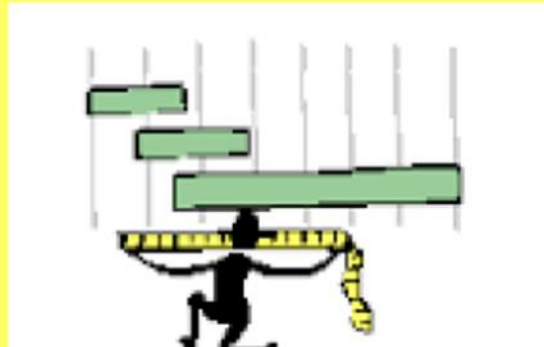
- Quality is measured by Satisfying and exceeding customer needs and expectations in product and service quality.
- Quality is defined by the customer
- Quality is achieved through prevention of problems, not detection of them.

Define: The customer

- **Customer:**
 - Critical to define customer expectations, data driven approach
 - Can be internal and external
 - Need to define gap between customer expectations and satisfaction - gap analysis
- **Cost of an unhappy customer:**
 - 96% of unhappy customer never complain
 - 90% of those who are dissatisfied will not buy again
 - Each unhappy customer will tell his or her story to at least nine other people

Measure Phase

- Focus is on how to measure the internal processes that impact CTQ's
- Key data collection questions
 - What questions are we trying to answer?
 - What type of data will we need to answer the question?
 - Where can we find the data?
 - Who can provide the data?
 - How can we collect the data with minimum effort and with minimum chance of error?



Key Six Sigma Metrics in services

- Accuracy
- Cycle time
- Cost
- Customer satisfaction

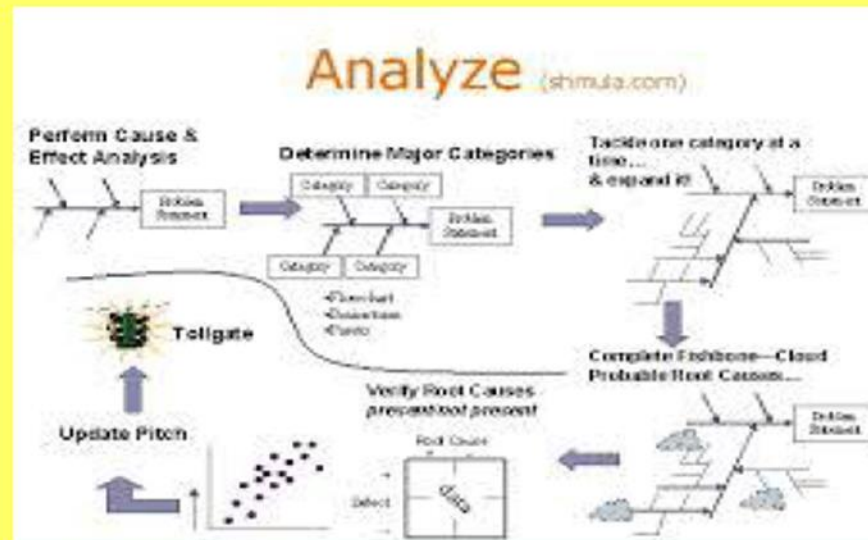
Analyze Phase

- Focus on why defects, errors, or excessive variation occur
- Seek the root cause
- 5-Why technique
- Experimentation and verification



Analyze Phase

- Current state analysis
- Is the current state as good as the process can do?
- Who will help make the changes?
- What resources will we need?
- What could cause this change effort to fail?
- What major obstacles do I face in completing this project?



Analyze Phase

- Develop Cause & Effect Hypotheses
- Talk to the right people, knowledgeable about the processes
- Don't look at just symptoms, get to the root cause.
- Focus on the critical to quality characteristics defined in the Measure phase
- Other tools to apply:
 - DOE, FMEA, control charts (if applicable)

Causes of Flaws in The Analysis

- Lack of knowledge on how the process works which causes inconsistency and increased variation in outputs
 - Lack of knowledge on how the process should work
 - Lack of control of materials/equipment used in the process
 - Careless errors in performing work
-
- Waste & complexity
 - Hasty and poor design specs
 - Failure to understand the capability of a process to meet specs.
 - Lack of training, Poor instrument calibration, and inadequate environmental characteristics

Improve

- Idea generation
 - No silly ideas, defer judgment
- Brainstorming
 - No criticism, all types of ideas allowed
- Evaluation and selection
 - Criteria (cost, time, resources, barriers, potential improvement)
- Implementation planning
 - Responsibility, when, where, how, who, what

Control

- Maintain improvements
- Standard operating procedures
- Training
- Checklist or reviews
- Statistical process control charts

Design for Six Sigma

Focus on optimizing product development and process performance

Features

- A high-level architectural view of the design
- Use of CTQs with well-defined technical requirements
- Application of statistical modeling and simulation approaches
- Predicting defects, avoiding defects, and performance prediction using analysis methods
- Examining the full range of product performance using variation analysis of subsystems and components

Key Idea

- All Six Sigma projects have three key characteristics:
 1. A problem to be solved,
 2. A process in which the problem exists, and
 3. One or more measures that quantify the gap to be closed and can be used to monitor progress.

Lean Production and Six Sigma

Getting more done with less

- Focuses on elimination of waste in all forms
- such as:
 - Defects requiring rework
 - Unnecessary processing steps
 - Unnecessary movement of materials or people
 - Waiting time
 - Excess inventory
 - Overproduction

Lean Production and Six Sigma

Getting more done with less

Identify and eliminate non-added value activity throughout the entire value chain to **achieve**:

- Faster customer response
- Reduced inventory
- Higher quality
- Better human resources

Six Sigma Improvement - MAIC

Measure

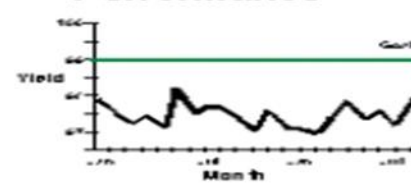
(1) Determine CTQ Characteristics



(2) Establish Measures and Goals



(3) Identify Gaps in Performance



Analyze

(4) Separate into Mistake Proofing and Variation Reduction



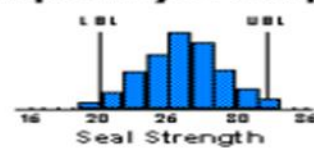
(5) Develop Measureable Outputs



(6) Validate Measurement System

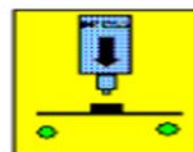


(7) Evaluate Stability and Capability of Outputs

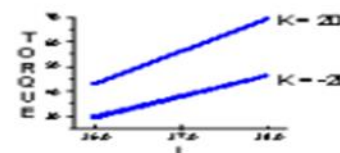


Improve

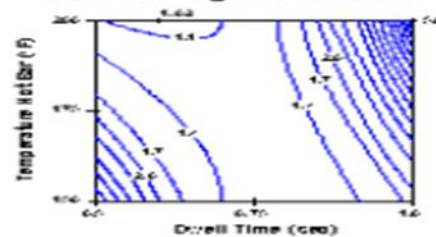
(8) Reduce Errors Using Mistake Proofing



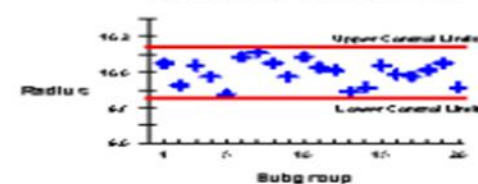
(10) Improve Average by Adjusting Key Inputs



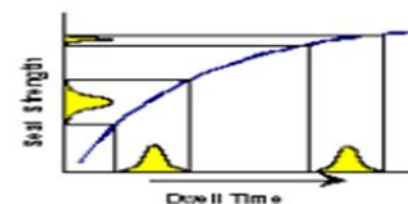
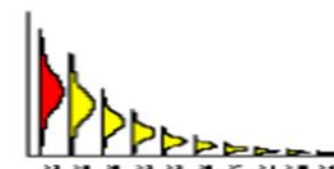
Seal Strength Std. Dev.



(9) Improve Stability by Identifying Causes of Shifts

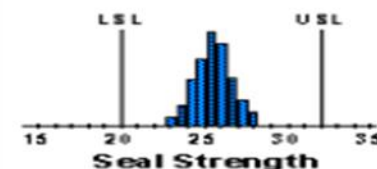


(11) Reduce Variation by Identifying VIP and Robust Design

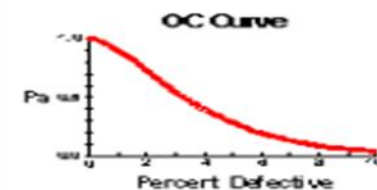


Control

(12) Verify Capability of Outputs



(13) Perform Other Testing



(14) Implement Controls

Control Plan				
Ver	Symbol	Take Action	Control	Control
1.0	1.0	1.0	1.0	1.0
2.0	2.0	2.0	2.0	2.0
3.0	3.0	3.0	3.0	3.0
4.0	4.0	4.0	4.0	4.0
5.0	5.0	5.0	5.0	5.0
6.0	6.0	6.0	6.0	6.0
7.0	7.0	7.0	7.0	7.0
8.0	8.0	8.0	8.0	8.0
9.0	9.0	9.0	9.0	9.0
10.0	10.0	10.0	10.0	10.0

Summary:

Six sigma is defined as a business process that allows companies to improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction .

Six sigma could also be described as an improvement program for reducing variation, which focuses on continuous improvements. Improvement projects are driven in a wide range of areas and at different levels of complexity, in order to reduce variation. The main purpose of reducing variation on a product or a service is to satisfy customers. The goal of six sigma is that only 3.4 of a million customers should be unsatisfied. The major components for a successful six sigma implementation are management involvement , organization, infrastructure, training and statistical tools. There are improvement methodologies in six sigma for already existing processes and for new processes.

The methodology used to improve an existing process can be divided into **five phases**

(1) Define:

Define which process or product that needs improvement. Define the most suitable team members to work with the improvement. Define the customers of the process, their needs and requirements, and create a map of the process that should be improved.

(2) Measure:

Identify the key factors that have the most influence on the process, and decide upon how to measure them.

(3) Analyze:

Analyze the factors that need improvements.

(4) Improve:

Design and implement the most effective solution. Cost-benefit analyses should be used to identify the best solution.

(5) Control:

Verify if the implementation was successful and ensure that the improvement sustains over time.

Some similarities and differences between TQM, six sigma and lean

Concepts	TQM	Six sigma	Lean
Origin	The quality evolution in Japan	The quality evolution in Japan and Motorola	The quality evolution in Japan and Toyota
Theory	Focus on customers	No defects	Remove waste
Process view	Improve and uniform processes	Reduce variation and improve processes	Improve flow in processes
Approach	Let everybody be committed	Project management	Project management
Methodologies	Plan, do, study, act	Define, measure, analyse, improve (or design), control (or verify)	Understanding customer value, value stream, analysis, flow, pull, perfection
Tools	Analytical and statistical tools	Advanced statistical and analytical tools	Analytical tools
Primary effects	Increase customer satisfaction	Save money	Reduce lead time
Secondary effects	Achieves customer loyalty and improves performance	Achieves business goals and improves financial performance	Reduces inventory, increases productivity and customer satisfaction

Now we will show each applicable lean tool in six sigma project phase:

1. Define phase:

- Introduce lean, Value Stream Map, Financial analysis : identify waste & quantify it financially. Understand the **Voice Of Customer** & prepare for the **Value Stream Map**.
- Introduce process baseline performance including VSM metrics, inventory :lead times, cycle time.
- Value added & non value added activities & downtime.
- Identify the LSS suitable tools approach to the selected project; determine if the focus is on the product flow or variability.

2-Measure:

- Measure the baseline performance of the current process using the lean metrics
- Present the data graphically.
- Map the current state value stream,
- Measure process capability (defects per million opportunities -& process sigma level)
- Identify waste & quantify it financially.(identify & quantify cost of variation & defects)
- Use value stream metrics which include inventory , lead times, cycle time value added & non value added activities & downtime.
- Use a cause & effect diagram to brainstorm potential variables or inputs that affect process output.
- Use a Kaizen event approach & identify any quick improvement actions that don't need further analysis (just do it items)

3-Analyze:

- Implement the quick hits that don't require further analysis.
- Use graphical tools to investigate the reasons for variation
- Analyze current state VSM :
 .Ex: Analyze unnecessary steps & ways to minimize waste within & between steps
 analyze flow of products & information , lead times, cycle time, rework & downtime .
- Create a lean future VSM to implement the next phase.

4-Improve

- Optimize & standardize the process , eliminate unnecessary steps or at least minimize waste within it, develop standard operating procedures & best practices
- Build an improvement implementation action plan

- Use a Kaizen event to implement improvements:

Ex: improve time & use 5s approach, use mistake-proofing techniques and use visual workplace approach.

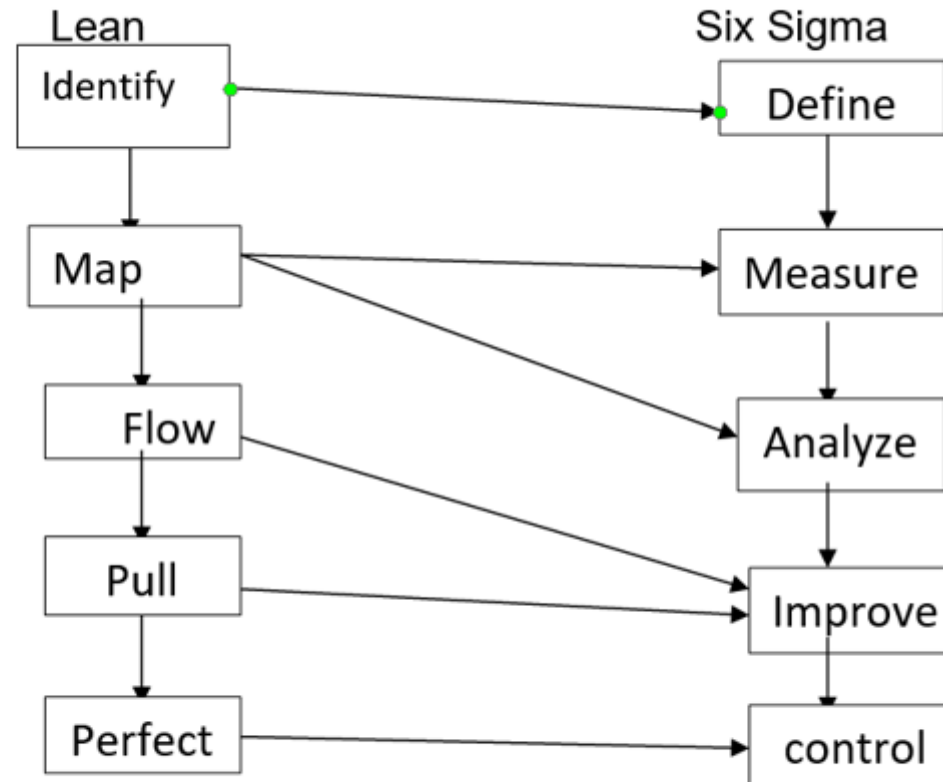
5-Control

- Update sigma level.

- Design a control plan using the mistake –proofing approach; design and implement corrective actions , design an audit plan.

- Reconfirm the financial analysis by conducting cost benefit analysis

- Hand over responsibilities , train process owner on using the control plan and monitor continuously .



Lean & six sigma phases relationship

Critical Success factors of LSS:

- 1-Management support & commitment .
- 2- Company Financial Capability.
- 3- Culture change by using facts to show need for using LSS.
- 4-Clear definition of strategy & goal of the project
- 5- Frequent information sharing, communication & assessment on Lean & Six Sigma results.
- 6-Using six sigma as the infrastructure for applying lean tools.
- 7- Staff involvement , rewards & recognition.
- 8- Effective training & program improvement efforts.



Thank You