EIN 5226

Total Quality Management

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EIN 5226 Lecture 1

Six Sigma Overview
Chapter 1

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COPQ

The **Cost of Quality**
1) Appraisal
2) Detection
3) Internal Failure
4) External Failure

Cost of Doing Nothing Different (CODND)

http://www.six-sigma-material.com/Cost-of-Poor-Quality.html

1.1 Background of Six Sigma

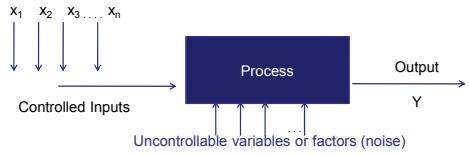
- Motorola (1980s):
  - Bill Smith, Senior Eng. & Scientist
  - Bob Galvin, CEO
  - Jack Germaine, Sr. VP, Quality Director
  - Motorola University
  - Malcolm Baldrige National Quality Award, 1988
- GE (mid-1990s)
  - Jack Welsh, CEO

1.1 Background of Six Sigma

- Project Execution Roadmaps
  - Process Improvement/ Reengineering projects: Sec. A.1
  - Product DFSS: Chapter 49
  - Process DFSS: Chapter 50

DMAIC	S^4/IEE Project Execution Roadmap (High level steps within DMAIC phases)
Define	Define project
Measure	Plan project with metrics Baseline project Consider lean tools Measurement Systems Analysis (MSA) Wisdom of Organization
Analyze	Passive analysis
Improve	Proactive Testing, Implementation
Control	Other evaluation and control phase

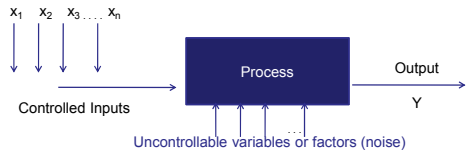
1.4 What is Six Sigma and S^4/IEE?



Controlled inputs – Key Process Input Variables (KPIVs)

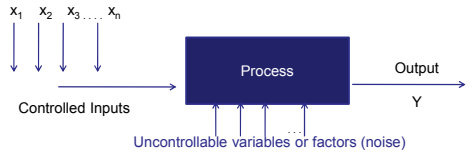
- Inherent process inputs – i.e., raw material
- Process variables – i.e., process temperature
- Resource variables – i.e., personnel/training
- Information variables – i.e., procedures, decisions to take action

1.4 What is Six Sigma and S⁴/IEE?



Uncontrolled variables- noise
- Environmental influences – i.e., weather
- Customer variability – i.e, timing of order placement
- Human resource issues – sickness, accidents
- Competitor actions – i.e, new competing products

1.4 What is Six Sigma and S⁴/IEE?



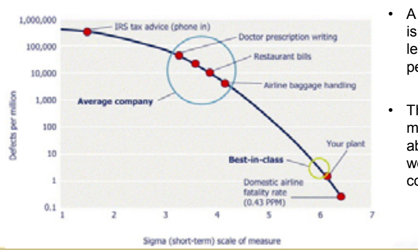
Ys or Key Process Output Variables (KPOVs)/Critical to Quality (CTQ):
- Physical output i.e., completed form, product
- Process Measures i.e., Customer satisfaction, Production cycle time
- Product Measures i.e., Critical dimension on a part

1.5 The Six Sigma Metrics

A "Goodness level" of 99% equates to

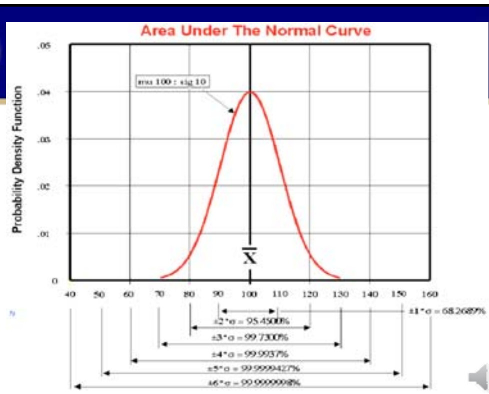
- 20,000 lost articles of mail per hour
- Unsafe drinking water almost 15 minutes per day
- 5,000 incorrect surgical operations per week
- Short or long landing at most major airports each day
- 200,000 wrong drug prescriptions each year
- No electricity for almost 7 hours per month

1.5 The Six Sigma Metrics
(Figure 1.3)



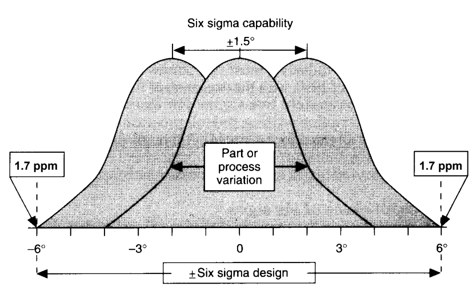
- A "6 sigma process" is defined at the level of 3.4 defects per million parts.
- The sigma level of most services is about 4 sigma, while world class is considered 6.

http://www.sciencedirect.com/science/article/pii/S0015188206707649



http://www.grin.com/en/e-book/115792/six-sigma-in-logistics

1.5 The Six Sigma Metrics
(Figure 1.6)



http://www.google.com/imgres?hl=en&biw=1261&bih=988&tbm=isch&tbnid=90iSNlzoa7pTLM:&imgrefurl=http://www.emeraldinsight.com/journals.htm%3Farticleid%3D840154%26show%3Dhtml&docid=VyurlH69UirQ-M&im

	Normal distribution - Centered		Normal distribution With ±1.5σ	
Spec at	% in spec	PPM	% in spec	PPM
±1σ	68.27%	317300	30.23	697700
±2σ	95.45	45500	69.13	308700
±3σ	99.73	2700	93.32	66810
±4σ	99.9937	63	99.3790	6210
±5σ	99.999943	0.57	99.97670	233
±6σ	99.9999999998	.002	99.999660	3.4

What is the magnitude of improvement you would have to make to improve from a process running at ±4σ to one running at ±6σ?

1.6 Traditional Approach to the Deployment of Statistical Methods

Challenges

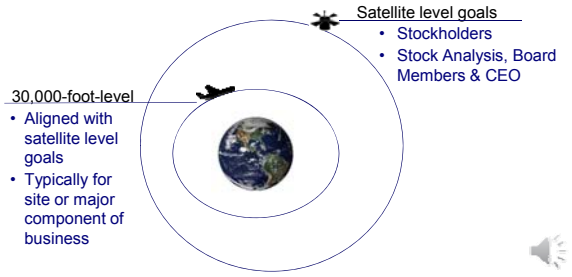
- Complex statistical analysis (software)
- Problem definition and dissemination of statistical techniques
- Benefit ➔$ (Business case)

1.8 S^4/IEE Business Strategy Implementation

Organizational Strategic Plans, Policies, Goals

- Enterprise Business Planning Methodology
  - Goals cascaded through levels of the organization
  - Projects aligned to goals
    - – Results orchestration process
- Goals should have measurable results through defined action plans

1.8 S⁴/IEE Business Strategy Implementation
S⁴/IEE Results Orchestration (RO) Process



1.8 S⁴/IEE Business Strategy Implementation
S⁴/IEE Results Orchestration (RO) Process

Enterprise Business Planning Methodology (EBPM):

- Create satellite-level metrics for the past two to five years.
- Select goals that are in alignment with improvement desires for the satellite-level metrics.
- Select strategies that are in alignment with goals.
- Examine supply chain process map.
- Choose high-potential areas for focusing improvement efforts using goals and supply chain process map to help guide the selection process.

Cascading Metrics

Satellite-level Metrics

Stockholders

• Dividend Payment • Stock Price Increase • Return on Equity

Stock Analysts, Board Members, & CEO

• Sales Growth • Earning per Share • Price/Earning Ratio

30,000 foot-level Metrics - Operational

Corporate Executive

• Profit & Loss Optimization Metrics • Asset Management Metrics
• Supply Chain Metrics

Site metrics

• Factory Metrics (Percent Yield, Run Time, Productivity, etc.)
• People Development • Safety • Patents
• Salesperson Productivity • Supplier Metrics (Cost, Quality, Service)

1.8 S⁴/IEE Business Strategy Implementation S⁴/IEE Results Orchestration (RO) Process

Enterprise Business Planning Methodology (EBPM):

- Select and create 30,000-foot-level operational metrics that are in alignment with the high potential areas for improvements.
- Select S⁴/IEE project areas that are in alignment with operational metrics.
- Drill down project areas to well-scoped projects (project scope) that are not too large or too small.
- Create 30,000-foot-level project metrics for base-lining projects and tracking impact from S⁴/IEE project work.

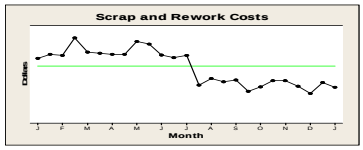
1 2

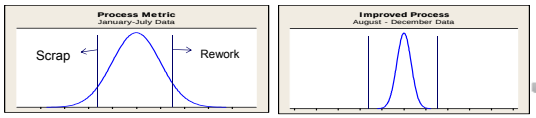
Cascading metrics

Corporate Metric – Cost of Sales

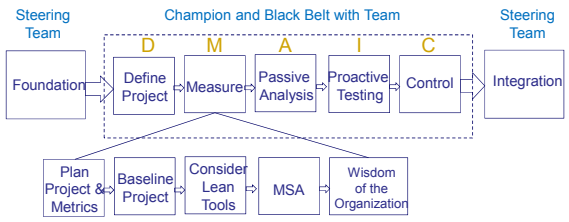
Operational Metric

Process Metric





1.9 Six Sigma as an S⁴/IEE Business Strategy: DMAIC Project Execution Roadmap



1.10 Creating An S⁴/IEE Business Strategy with Roles and Responsibilities

- Executive Sponsors/Steering Team/Champions – Upper Management, responsible for overall program and satellite/operational metrics
- Process Owners/Sponsors - Owner of functional process being improved, responsible for process metrics
- Black Belt – Leads teams in improvement activity across functional areas
- Green Belt – leads an improvement effort within own functional area
- Master Black Belt – Full time process improvement professional and instructor

Black Belt Program Roles and Responsibility

Executive:
- Motivate others toward a common vision.
- Set the standard, demonstrate the behaviors.

Steering Team: Same as executive roles and responsibilities, plus
- Develop project selection criteria.
- Set policies for program implementation..

Champions: Works with Steering team, plus
- Remove barriers to success.
- Identify and prioritize projects.
- Question methodology and improvement recommendations.
- Verify completion of deliverables. Approve completed projects

1.10 Creating An S⁴/IEE Business Strategy with Roles and Responsibilities

Process Owner/Sponsor:
- Function as change agents.
- Remove barriers to success.
- Ensure process improvements are implemented and sustained.
- Obtain necessary approval for any process changes.
- Communicate the S⁴/IEE vision.
- Aid in selecting team members.
- Maintain team motivation and accountability.

1.10 Creating An S⁴/IEE Business Strategy with Roles and Responsibilities

Black Belt:

- Develop a detailed project plan.
- Schedule and lead team meetings.
- Oversee data collection and analysis.
- Sustain team motivation and stability.
- Deliver project results.
- Track and report milestones and tasks.
- Calculate project savings.
- Interface between finance and information management (IM)
- Monitor critical success factors and prepare risk-abatement plans.
- Prepare and present executive-level presentations.
- Complete 4 to 6 projects per year.

Black Belt Program Roles and Responsibility

Green Belt: Similar to black belt except they typically:

- Address projects that are confined to their functional area.
- Have less training than black belts.
- Are involved with improvements in a part-time role.

Master Black Belt:

- Have extensive training and project experience
- Conduct and oversee black belt program training.
- Coach black belts / Green belts during projects
- Works with steering team and champions in formulate project-selection strategies, approving completed projects, and leveraging projects and resources..

1.10 Creating An S⁴/IEE Business Strategy with Roles and Responsibilities

Important Skills when Selecting s Black Belt:

- Fire in the belly: unquenchable desire to improve the way an organization does its business.
- Soft skills: ability to work effectively with people in teams and other organizations.
- Project management: ability to get things done well and on time.
- Multitasking: ability to manage multiple tasks at one time and maintain focus.
- Big picture: seeing big picture, not insignificant details.
- Analytical skills

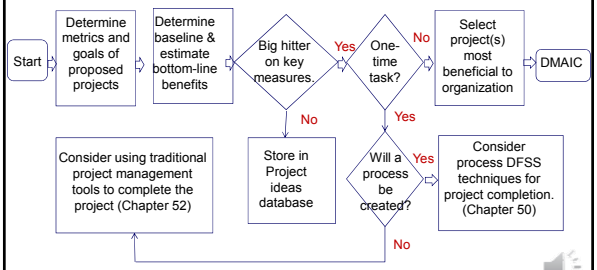
1~2% of total number of employees.

1.11 Integration of Six Sigma with Lean

S⁴/IEE approach integrate six sigma with lean practice.

- By focusing on measures of processes that you want to improve, select the right tool lean or six sigma approach
- During Measure phase – consider lean tools is a step in the roadmap
- Lean Tools are covered in Chapter 44 – beyond scope of this course

1.13 S⁴/IEE Project Initiation and Execution Roadmap



Modified Figure 1.19 Project Identification Subprocess

1.13 S⁴/IEE Project Initiation and Execution Roadmap: Sample S⁴/IEE Project Charter

Project Charter requirements

- Project Description
  - Problem Statement, Purpose, Scope of Project
- Baseline Metrics: Primary and Secondary Metrics
- Goal & Projected Benefits
- Start and Completion Date
- Phase Milestones/Deliverables
- Team Members: Black belt, team members and roles
- Support: Sponsor, Champion, MBB, Process Owner

1.14 Project Benefit Analysis

Traditional COPQ Calculations

Prevention:
- Training
- Capability Studies
- Vendor Surveys
- Quality Design

Appraisal:
- Inspection and Test
- Test Equipment and Maintenance
- Inspection and Test Reporting
- Other Expense Reviews

Internal Failure:
- Scrap and Rework
- Design Changes
- Retyping Letters
- Late Time Cards
- Excess Inventory Cost

External Failure:
- Warranty Costs
- Customer Complaint Visits
- Field Service Training Costs
- Returns and Recalls
- Liability Suits

Cost of Quality Categories

What category would each of the following tasks/costs be associated with? (Click on the letter of your answer – there is a voice clip behind it.)

A part was found out of tolerance and had to be reworked and re-inspected.
A. Prevention B. Appraisal C. Internal Failure D. External Failure

The complaint department arranges for a replacement product to be sent to a customer.
A. Prevention B. Appraisal C. Internal Failure D. External Failure

Equipment used for testing an established product requires maintenance at regular intervals.
A. Prevention B. Appraisal C. Internal Failure D. External Failure

Extensive training is required of all sales personnel prior to interacting with customers.
A. Prevention B. Appraisal C. Internal Failure D. External Failure

1.14 Project Benefit Analysis

Cost of Doing Nothing Different (CODND): by Iomega

Bottom-line hard Dollar:
- Decreases existing business costs
- Takes cost off the books or adds revenue to the books

Cost Avoidance:
- Avoids incremental costs

Lost Profit Avoidance:
- Avoids lost sales

Productivity:
- Increases in productivity

Profit Enhancement:
- Potential sales increase

Intangible:
- Improvements to operations of business

Related Assignments

Please see Blackboard for related assignments