Ministry of Micro, Small and Medium Enterprises, Government of India

MSME –TDC, Chennai

CERTIFIED LEAN SIX SIGMA

GREEN BELT TRAINING

FACILITATION CENTRE

GOVERNMENT COLLEGE OF TECHNOLOGY

COIMBATORE

Dr.Gopal Sivakumar

Speaker's Profile

Dr.GOPAL SIVAKUMAR, B.E.(Distn.),M.E.,Ph.D,
Author/Trainer/Principal Consultant-LSS
Head-Campus to Corporate Program,
MSME-Technology Development Centre, Chennai

- **Lean Six Sigma Black Belt** with expertise is Statistical Process Control, DoE, MSA, Hypothesis testing, 5S, Lean and Six Sigma deployment
- **Research interest:** Diesel combustion, Thermal barrier coating, alternate fuels, performance optimization
- **18+ years Experience** in Teaching, Lean Six Sigma Training, Industrial Research and Consulting
- Has about **6600 hours of training experience** on Lean and Six Sigma tools and techniques
- Authored many research articles, books and book chapters in **Mechanical Engineering, Mathematics and Statistics**
- During his academic tenure, he developed many **Industry Collaborative PG programmes** for Automotive, Manufacturing, IT and Electronics Industries
- Demonstrated highly successful DMAIC projects for his clients - **Nokia Networks and Solutions, IP Rings, Devendra Autocomm Pvt. Limited, PH Automotive, Murugappa Group etc.**

PROJECT IDENTIFICATION METHODS

VOC Analysis
(problems identified on the basis of Customer's Voice)

VOB Analysis
(problems identified on the basis of Business problems)

COPQ Analysis
(problems identified on the basis of Cost of Poor Quality i .e. Process Defects)

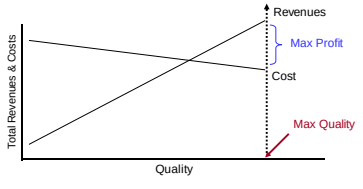
→ Identification of CTQs → List Down the Potential Problems /Projects of Organization on the basis of the above analysis.

VOC → Voice of Customer
VOB → Voice of Business
COPQ → Cost of Poor Quality

IDENTIFY THE CTQ

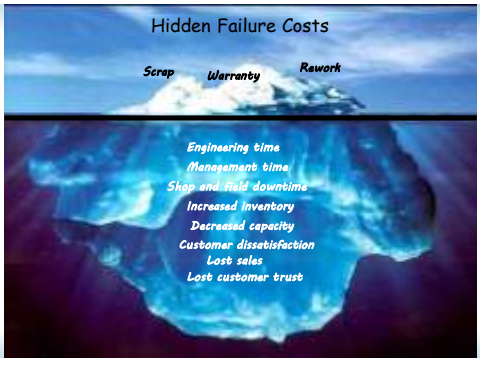
VOC/VOB	CTQ
"I want the pizza delivered hot" Pizza to be delivered at 80 degree Celsius	VOC
"Last year, we spent a lot of money to fix products in warranty" We spent 500K dollars in warranty claims last year	VOB
"I had to wait for so long to get an operator to answer my query"	VOC
"We aren't able to process transactions within the time promised to the customer"	VOB
"Loan application forms submitted by loan officers have too many errors"	VOB

Cost of quality



W. Edwards Deming proposed that improving quality reduces cost and improves profitability.

Quality can be and should be improved continuously.



Preventive costs:

Preventive costs are the cost of all activities specifically designed to prevent poor quality product or service.

These costs are incurred to keep appraisal and failure costs at minimum.

Examples of preventive costs

- Process Capability studies
- Market surveys
- Pilot scale projects and testing
- Procedure writing
- Vendor evaluation and testing
- Training and education
- Quality improvement projects
- Customer survey
- House keeping
- Design review

Appraisal costs

These are the costs associated with measuring, evaluating or auditing product or service to assure conformance to standard or performance requirement.

Examples of Appraisal costs:

- Internal audits
- Incoming material inspection
- Laboratory testing
- Calibration costs
- In process material inspection
- Equipment calibration
- Procedure evaluation
- Final product inspection (Samples)
- Automated testing tools

Internal failure cost

These are the costs incurred when product or service fail to meet quality requirements prior to the transfer of ownership to the customer.

Examples of internal failure costs

- Rework
- Scrap
- Overtime
- Downtime
- Excess inventory
- Excess material handling
- Redesign
- Retesting
- 100% sorting inspection
- Scrap & rework - supplier

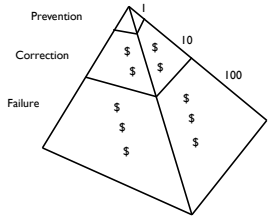
External failure cost

These are the costs incurred by a business due to failure of product or service at the customer end. These costs results into warranty claims and loss of reputation.

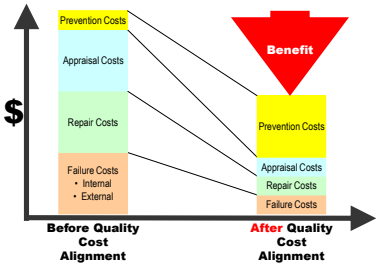
Examples of external failure costs:

- Warranty costs
- Customer dissatisfaction
- Loss of market share
- Price concession
- Premium freight
- Product recalls
- Time spent to resolve customer complaints
- Restocking costs
- Other penalties

1-10-100 Rule

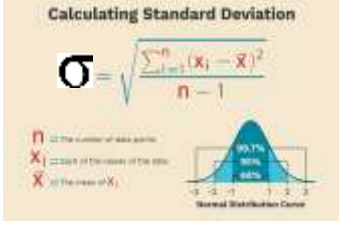


Preventing Poor Quality (Comparison)



16

STANDARD DEVIATION



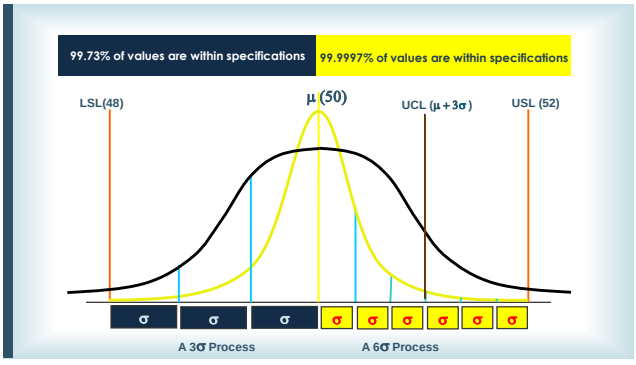
The **Standard Deviation** of a data set is a calculated number that tells you how close, or far, the values of that data set are in relation to the mean. **It's important because it can tell us more information about a data set than the mean** itself will provide.

17

What is Six Sigma ?

- **Goal** – Reduce defects by reducing variation to improve performance on CTQs
- **Method** – DMAIC / DMADV approach

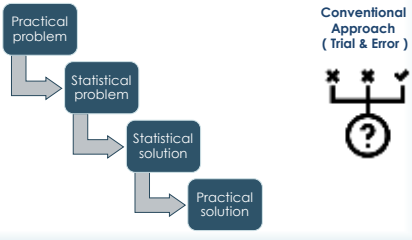
18



Variation Vs Sigma value

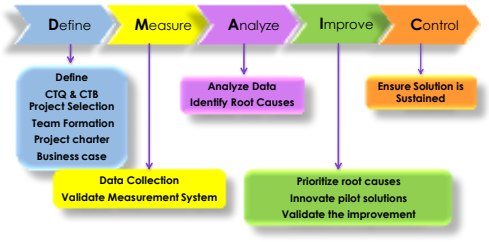
Amount of Variation (SD)	Effect	Process Sigma Level	Yield %	Defects / DPMO
TOO MUCH	Hard to produce output within customer requirements	Low (0–2)	Low	High
MODERATE	Most output meets customer requirements	Middle (2–4.5)	Moderate	Moderate
VERY LITTLE	Virtually all output meets customer requirements	High (4.5–6)	High	Low

The Six Sigma Approach



Conventional Approach (Trial & Error)

DMAIC Methodology



15 SIMPLE STEPS OF DMAIC PROJECT

- DEFINE
  - Step 1: Generate Project Ideas
  - Step 2: Select Project
  - Step 3: Finalize Project Charter & High Level Process Map
- MEASURE
  - Step 4: Finalize CTQ Performance Characteristics
  - Step 5: Validate Measurement System for Y
  - Step 6: Measure Baseline Performance and Target Gap
- ANALYZE
  - Step 7: Identify Potential Factors
  - Step 8: Validate Critical Factors
  - Step 9: Verify Sufficiency of Critical Factors
- IMPROVE
  - Step 10: Generate & Evaluate Solutions
  - Step 11: Select & Optimize Best Solution
  - Step 12: Pilot, Implement & Validate Solution
- CONTROL
  - Step 13: Implement Control System for Critical 'X'
  - Step 14: Document Solution & Benefits
  - Step 15: Handover to Project Owner, Project Closure

Few Tools used in Six Sigma

- Kano Model
- Project Charter
- SIPOC
- Prioritization Matrix
- Measurement System Analysis
- Control Charts
- Normality
- Process Capability
- Root cause Analysis
- Fishbone Analysis
- FMEA
- Pareto Analysis
- **Design of Experiments**
- Hypothesis Testing
- ANOVA
- ANOM
- Design
- Correlation Analysis
- Regression Analysis

What does Six Sigma methodology focus on?

A Defect reduction
- e.g. Reducing no of bugs in a software
- e.g. Reduction of defects in manufacturing component

B Yield improvement
- e.g. Increasing the % loan application processed versus loan application received
- e.g. Increasing Sales per hour

C Improved customer satisfaction
- e.g. Improving CSAT scores in an ITES process
- e.g. Reducing customer complaints
- e.g. Reducing transaction processing time, Average Handling time etc

D Higher profit
- e.g. Improving Occupancy % of a multiplex
- e.g. Reducing and controlling raw inventory
- e.g. Reduction of Non-value add time in a process

Six sigma is a Process Level Approach with prime focus on customer requirements

Six Sigma aims to reduce defects by eliminating part to part variation

Six Sigma supports data based decision making

Six sigma would ensure the process yields are higher (3.4 DPMO) and follows DMAIC Methodology for Continuous Quality Improvement

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SESSION OPEN TO QUESTIONS?

PROGRAM 6σ

Dr.Gopal Sivakumar
campustocorporateprogram@gmail.com