What is COST of POOR QUALITY?

- The hidden cost of failing to meet customer expectations the first time
- The hidden opportunity for increased efficiency
- The hidden potential for higher profits
- The hidden loss in market share
- The hidden increase in production cycle time
- The hidden labor associated with ordering replacement material
- The hidden costs associated with disposing of defects

Fact:
- For most companies today, the cost of poor quality is likely to be 25% of sales.
- In almost every company where the COPQ is unknown, the COPQ exceeds the profit margin.

Total Quality Management (TQM)

“IF JAPAN CAN, WHY CAN’T WE?”

TQM is...

defined as managing the entire organization so that it excels on all dimensions of products and services that are important to the customer.

Quality Specifications

- **Conformance quality**: Degree to which the product or service design specifications are met
- **Design quality**: Inherent value of the product in the marketplace

Dimensions include...
- Performance
- Features
- Reliability/Durability
- Serviceability
- Aesthetics
- Perceived Quality
Costs of Quality (COQ)

- Appraisal Costs
- Prevention Costs
- Internal Failure Costs
- External Failure Costs

Six Sigma

Six Sigma is ...

... a highly structured strategy for acquiring, assessing, and applying customer, competitor, and enterprise intelligence for the purposes of product, system or enterprise innovation and design.

More About Six Sigma

Six Sigma was developed at Motorola in the 1980’s as a method to improve process quality.

It was first used to improve manufacturing process capability and then migrated to business processes capability.

The basic premise is, all processes have variation. Variation is the enemy.

Companies That Have Deployed Six Sigma:
Bank of America (BOA), Motorola, GE, IBM, Kodak and many more...

Six Sigma Quality

A philosophy and set of methods companies use to eliminate defects in their products and processes.

Seeks to reduce variation in the processes that lead to product defects.

The name, “six sigma” refers to the variation that exists within plus or minus three standard deviations of the process outputs.
**Six Sigma Process Philosophy**

- Know What’s Important to the Customer (CTQ)
- Reduce Defects (DPMO)
- Center Around Target (Mean)
- Reduce Variation (Standard Deviation)

Focus on the Customer!

**DPMO**

Six Sigma allows managers to readily describe process performance using a common metric:
Defects Per Million Opportunities (DPMO)

\[
DPMO = \frac{\text{Number of defects}}{\text{Number of opportunities for error per unit}} \times 1,000,000
\]

So, for every one million letters delivered this city’s postal managers can expect to have 1,000 letters incorrectly sent to the wrong address.

**Example of Defects Per Million Opportunities (DPMO) calculation.**

Suppose we observe 200 letters delivered incorrectly to the wrong addresses in a small city during a single day when a total of 200,000 letters were delivered. What is the DPMO in this situation?

\[
DPMO = \frac{200}{1} \times \frac{1,000,000}{200,000} = 1,000
\]

**Six Sigma as a Goal**

<table>
<thead>
<tr>
<th>(\sigma)</th>
<th>Defects per Million opportunities (DPMO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>308,537</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>5</td>
<td>233</td>
</tr>
<tr>
<td>6</td>
<td>3.4</td>
</tr>
</tbody>
</table>

**Process Capability**

Sigma is a statistical unit of measure which reflects process capability.
Six Sigma - Practical Meaning

- 99% Good (3.8 Sigma)
  - 20,000 lost articles of mail per hour
  - Unsafe drinking water for almost 15 minutes each day
  - 5,000 incorrect surgical operations per week
  - Two short or long landings at most major airports each day
  - No electricity for almost seven hours each month

- 99.99966% Good (6 Sigma)
  - Seven articles lost per hour
  - One unsafe minute every seven months
  - 1.7 incorrect operations per week
  - One short or long landing every five years
  - 68 wrong prescriptions per year

Six Sigma Quality: DMAIC Cycle

Define
- Define the problem and customer requirements.

Measure
- Measure defect rates and document the process in its current incarnation.

Analyze
- Analyze process data and determine the capability of the process.

Improve
- Improve the process and remove defect causes.

Control
- Control process performance and ensure that defects do not recur.

“Common sense” doesn’t mean “commonly done” or when done, done well.

Analytical Tools for Six Sigma and Continuous Improvement: Flow Chart

Material Received from Supplier → Inspect Material for Defects → Defects found? → Yes, Continue → Return to Supplier for Credit → No, Continue...

Analytical Tools for Six Sigma and Continuous Improvement: Run Chart

Can be used to identify when equipment or processes are not behaving according to specifications
Analytical Tools for Six Sigma and Continuous Improvement: Pareto Analysis

Can be used to find when 80% of the problems may be attributed to 20% of the causes.

- Frequency vs. Causes
  - 80%
  - Design
  - Assy.
  - Instruct.
  - Purch.
  - Training

Analytical Tools for Six Sigma and Continuous Improvement: Checksheet

Can be used to keep track of defects or used to make sure people collect data in a correct manner.

Monday

- Billing Errors
  - Wrong Account: [ ] [ ]
  - Wrong Amount: [ ]
- AR Errors
  - Wrong Account: [ ] [ ]
  - Wrong Amount: [ ] [ ]

Analytical Tools for Six Sigma and Continuous Improvement: Histogram

Can be used to identify the frequency of quality defect occurrence and display quality performance.

- Number of Lots vs. Defects in lot
  - Data Ranges: 0, 1, 2, 3, 4

Analytical Tools for Six Sigma and Continuous Improvement: Cause & Effect Diagram

Possible causes:
- Machine
- Man
- Environment
- Method
- Material

The results or effect

Can be used to systematically track backwards to find a possible cause of a quality problem (or effect).
Analytical Tools for Six Sigma and Continuous Improvement: Control Charts

Can be used to monitor ongoing production process quality and quality conformance to stated standards of quality.

Other Six Sigma Tools

- **Failure Mode and Effect Analysis (DMEA)** is a structured approach to identify, estimate, prioritize, and evaluate risk of possible failures at each stage in the process.

- **Design of Experiments (DOE)** a statistical test to determine cause-and-effect relationships between process variables and output.

Six Sigma Roles and Responsibilities

- Executive leaders must champion the process of improvement
- Corporation-wide training in Six Sigma concepts and tools
- Setting stretch objectives for improvement
- Continuous reinforcement and rewards

Why Six Sigma? Example from BOA

“Six Sigma will enable Bank of America to make the breakthrough improvements in customer satisfaction and shareholder value that we must achieve to reach our goal of becoming one of the world’s most admired companies. That’s why I’m committed to using it as a performance management discipline throughout our company.”

Ken Lewis, Chairman and CEO
Bank of America
Result of BOA

“Sustaining the intensity of our Six Sigma work is critical for Bank of America to achieve its strategic goals. Six Sigma has enabled us to generate more than $300MM in first-year productivity gains for the company. It has also had a significant impact upon the leadership team with our personal education and certification as Six Sigma Green Belts. As we look to the future, our leadership charge is to keep Six Sigma a top priority and use it to produce organic customer revenue growth.”

Ken Lewis (10/9/02)

The Shingo System: Fail-Safe Design

Shingo’s argument:
- SQC (Statistical Quality Control) methods do not prevent defects
- Defects arise when people make errors
- Defects can be prevented by providing workers with feedback on errors

Poka-Yoke includes:
- Checklists
- Special tooling that prevents workers from making errors

Ref: Failsafing at Bernard Welding: LA5.avi

ISO 9000

Series of standards agreed upon by the International Organization for Standardization (ISO)

Adopted in 1987

More than 100 countries

A prerequisite for global competition!

ISO 9000 directs you to “document what you do and then do as you documented”

Others Practice

- Failsafing at Bernard Welding: LA5.avi
- Quality standards at Honda: MQ5.avi
- Quality/Tracking at Zyrtec Andon: QC6.avi
- Service/quality, performance at 1st National Bank: SE9.avi
- SPC at Detroit Diesel: QD7.avi
Three Forms of ISO Certification

- **First party**: A firm audits itself against ISO 9000 standards
- **Second party**: A customer audits its supplier
- **Third party**: A "qualified" national or international standards or certifying agency serves as auditor

External Benchmarking for Quality Improvement: Steps

1. Identify those processes needing improvement
2. Identify a firm that is the world leader in performing the process
3. Contact the managers of that company and make a personal visit to interview managers and workers
4. Analyze data

Service Quality Measurement: Servqual

**Servqual is...**
A perceived service quality questionnaire survey methodology

**Servqual examines...**
"Dimensions of Service Quality" including:
Reliability, Responsiveness, Assurance, Empathy, and Tangibles (e.g., appearance of physical facilities, equipment, etc.)

Service Quality Measurement: Servqual (Continued)

**Servqual New Version...**
Called "e-Service Quality" dealing service on the Internet

**Dimensions**
of Service Quality on the e-Service methodology include:
Reliability, Responsiveness, Access, Flexibility, Ease of Navigation, Efficiency, Assurance/Trust, Security/Privacy, Price Knowledge, Site Aesthetics, and Customization/Personalization
Question Bowl

Which of the following are Dimensions of Design Quality?

- Performance
- Durability
- Aesthetics
- All of the above
- None of the above

Answer: d. All of the above

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Question Bowl

Approximately what percentage of every sales dollar is allocated to the “cost of quality”?

- Less than 5%
- About 10%
- Between 15 and 20%
- More than 30%
- None of the above

Answer: c. Between 15 and 20% (for cost of reworking, scrapping, repeated service, etc.)

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Question Bowl

Which of the following are classifications of the “cost of quality”? 

- Appraisal costs
- Prevention costs
- Internal failure costs
- External failure costs
- All of the above

Answer: e. All of the above

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Question Bowl

Which of the following are functions of a quality control department?

- Testing product designs for reliability
- Gathering product performance data
- Planning and budgeting the QC program
- All of the above
- None of the above

Answer: d. All of the above
The DMAIC cycle of Six Sigma is similar to which of the following quality management topics?

- a. Continuous improvement
- b. Servqual
- c. ISO 9000
- d. External benchmarking
- e. None of the above

Answer: a. Continuous improvement

The “A” in DMAIC stands for which of the following?

- a. Always
- b. Accessibility
- c. Analyze
- d. Act
- e. None of the above

Answer: d. Analyze (Define, Measure, Analyze, Improve and Control)

Which of the following analytical tools depict trends in quality data over time?

- a. Flowcharts
- b. Run charts
- c. Pareto charts
- d. Checksheets
- e. Cause and effect diagrams

Answer: b. Run charts