Learning Objectives
- Understand Different Quality Definitions
- Identify Various Costs of Quality
- Explain Total Quality Management
- Understand Deming’s 14 Points
- Understand Six-Sigma Quality Approach
- Understand Benchmarking and Deming Wheel
- Describe Quality Awards and ISO 9000
- Understand Seven Quality Improvement Tools

What Is Quality?
- A degree or level of excellence
  (Oxford American Dictionary)
- The totality of features and characteristics that satisfies given needs
  (ASQ definition)
- Fitness for use: how well product or service does what it is supposed to
  (Joseph Juran's definition)
What Is Quality?

Consumer’s View

- Quality of Design
  - the degree to which quality characteristics are purposely designed into the product or service
  - An BMW and a Civic are equally “fit for use,” but with different design dimensions/features

Producer’s View

- Quality of Conformance
  - the degree to which the product or service design specifications are met
    - if new tires do not conform to specifications, they wobble
    - if a hotel room is not clean when a guest checks in, the hotel is not functioning according to its design specifications

What Is Quality?

A Complete View

- Meaning of Quality
  - Producer’s Perspective
    - Quality of Conformance
      - Conformance to specifications
      - Cost
  - Consumer’s Perspective
    - Quality of Design
      - Quality characteristics
      - Price
  - Marketing
  - Fitness for Consumer Use
What Is Quality?

Dimensions of Product Quality

- Performance (basic operating characteristics)
- Features (extra items added)
- Reliability (likelihood that product will perform normally over time)
- Conformance (meeting pre-specified standards)
- Durability (useful life span)
- Serviceability (ease of repair)
- Aesthetics (sensory characteristics)
- Perception (reputation and past performance)

Dimensions of Service Quality

- Reliability: perform promised service dependably and accurately
- Responsiveness: willingness to help customers promptly
- Assurance: knowledge and courtesy and the ability to convey trust and confidence
- Empathy: caring and approachable
- Tangibles: Physical facilities and facilitating goods

Cost of Quality

- Cost of achieving good quality
  - Prevention (quality planning and training, identify and removing poor quality source)
  - Appraisal (inspection, testing)

- Cost of poor quality
  - Internal failure costs (scrap, rework, repair)
  - External failure costs (returned products, warranty charges, complaints, liability)
Total Quality Management (TQM)

- Management of the entire organization so that it excels on all dimensions of products and services that are important to the customer

Total Quality Management Elements

1. Customer-driven quality
2. Top management leadership
3. Quality as a strategic issue
4. All employees responsible for quality
5. Continuous improvement (CI)
6. Shared problem solving
7. Statistical quality control (SQC)
8. Training & education for all employees

Total Quality Management Quality Gurus

- W. Edwards Deming (1900–1993)
  - After war, taught Japanese the statistical quality control techniques
  - Advocated continuous improvement via PDCA
  - Proposed famous 14 points for TQM

- Joseph M. Juran (1904–2008)
  - Followed Deming to Japan in 1954
  - Focused on strategic quality planning
  - Published “Juran’s Quality Handbook”

- Philip Crosby (1926–2001)
  - Published “Quality Is Free” and emphasized that costs of poor quality far outweigh the cost of prevention
  - Emphasized conformance to requirements, prevention, and “zero defects”
Total Quality Management
Deming’s 14 Points

1. Create a constancy of purpose toward improvement of product and service with a plan to be competitive, stay in business, and provide jobs.
2. Adopt the new philosophy of preventing poor-quality products instead of acceptable levels of poor quality.
3. Cease dependence on mass inspection to achieve quality, instead using statistical evidence that quality is being built into the product.
4. Select a few suppliers or vendors based on quality commitment rather than competitive prices.
5. Constantly improve the system of production and service, thus increasing productivity and reducing costs.
6. Institute modern methods of training, including statistical techniques and thinking.
7. Instill leadership among supervisors to help workers perform better.

8. Driving out fear from the workforce by encouraging employee involvement so that everyone may work effectively for the company.
10. Eliminate slogans and numerical targets that urge workers to achieve higher performance levels without first showing them how to do it.
11. Eliminate numerical quotas that employees attempt to meet at any cost without regard for quality.
12. Promote worker pride by improving supervision and the production process so that workers can perform to their capabilities.
13. Institute vigorous education and training programs in methods of quality improvement throughout the organization, from top management down, so that continuous improvement can occur.
14. Develop a commitment from top management to implement the previous thirteen points.

Continuous Improvement:
P-D-C-A Cycle (Deming Wheel)

- Identify problem and develop plan for improvement
- Implement plan on test basis
- Assess the plan: Is the plan working?
- Institutionalize improvement
Continuous Improvement: Benchmarking

- Process of measuring and improving a firm’s performance by learning from the best practices
  - identify processes needing improvement
  - identify the best practices or leaders
  - contact, visit, and study the benchmark organization
  - analyze data
  - take action

Six-Sigma Quality

- A philosophy and set of methods for eliminating defects in product/service production processes by reducing variation that leads to defects
- Sigma is a statistical term (standard deviation) that measures how far a given process deviates from perfection. Six-Sigma refers to the variation that exists within plus or minus three standard deviations of the process outputs
- Common performance metric: Defects Per Million Opportunities (DPMO)

Six-Sigma Quality

- Originated at Motorola in 1986 as a continuous improvement goal
- Six-sigma quality = 3.4 DPMO
- Quality improvement by variation reduction

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<th>Degree of Quality</th>
<th>Shift in Process Mean</th>
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Jack Welch on Six-Sigma Quality

“Six Sigma means fixing processes so they are nearly perfect ... and then controlling them so they stay fixed. The common objective in virtually all Six Sigma projects is the elimination of variance.”

--- 1999 GE’s Annual Meeting

“Six Sigma--GE Quality 2000--will be the biggest, the most personally rewarding, and, in the end, the most profitable undertaking in our history. We have set for ourselves the goal of becoming, by the year 2000, a Six Sigma quality company, which means a company that produces virtually defect-free products, services and transactions.”

--- 1996 GE’s Annual Meeting

People Involved in Six-Sigma Projects

Black Belts and Green Belts

- Champion
  - an executive responsible for project success
- Black Belt
  - project leader
- Master Black Belt
  - a teacher and mentor for Black Belts
- Green Belts
  - project team members

Six-Sigma Methodology: DMAIC

1. Define (D)  
   - Customers and their priorities
2. Measure (M)  
   - Process and its performance
3. Analyze (A)  
   - Causes of defects
4. Improve (I)  
   - Remove causes of defects
5. Control (C)  
   - Maintain quality
Six-Sigma Process

Example

- We are the maker of cereal. Consumer Reports has just published an article that shows that we frequently have less than 15 ounces of cereal in a box.

- What should we do?

Step 1 – Define

- What are the critical-to-quality (CTQ) characteristics?
  - The CTQ (critical-to-quality) characteristic in this case is the weight of the cereal in the box.

Step 2 – Measure

- How would we measure to evaluate the extent of the problem and what are acceptable limits?
  - Assume that the government says that we must be within ± 5 percent of the weight advertised on the box.
    - Upper Tolerance Limit = 16 + .05(16) = 16.8 ounces
    - Lower Tolerance Limit = 16 – .05(16) = 15.2 ounces
  - We go out and buy 1,000 boxes of cereal and find that they weight an average of 15.875 ounces with a standard deviation of .529 ounces.
  - What percentage of boxes are defective (i.e. less than 15.2 oz)?
Step 2 – Measure (cont.)

\[ Z = \frac{(x - \text{Mean})}{\text{Std. Dev.}} = \frac{(15.2 - 15.875)}{.529} = -1.276 \]

\[ \text{NORMSDIST}(Z) = \text{NORMSDIST}(-1.276) = .100978 \]

Approximately, 10 percent of the boxes have less than 15.2 Ounces of cereal in them!

Step 3 – Analyze

- What are likely causes of defects?
  - Too much variations
  - Lack of adjustment of machines that causes process shift

Step 4 – Improve

- How can we improve the capability of our cereal box filling process?
  - Decrease variation
  - Center process
Step 5 – Control

- How do we maintain the improvements?
  - Statistical Process Control (SPC)
    - Use data from the actual process
    - Monitor the process over time to ensure the weight of boxes is within tolerance limits

Seven Quality Improvement Tools

1. Pareto charts
2. Flowcharts
3. Check sheets
4. Histograms
5. Scatter diagrams
6. Control charts
7. Cause & effect diagrams

80% of the quality problems can often be attributed to 20% of the causes.
Seven Quality Control Tools:

**Process Flowchart**

Identify the potential fail points

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Seven Quality Control Tools:

**Check Sheet**

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Seven Quality Control Tools:

**Histogram**

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Seven Quality Control Tools:

**Scatter Diagram**

Number of Defects vs. Hours of Training

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**Control Chart**

Number of defects vs. Sample number

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**Cause & Effect Diagram** (Fishbone Diagram)

Quality Problem

- Measurement
  - Faulty testing equipment
  - Incorrect specifications
  - Inaccurate temperature control

- Human
  - Poor supervision
  - Lack of concentration
  - Inadequate training

- Machines
  - Out of adjustment
  - Tooling problems
  - Old / worn

- Environment
  - Dust and Dirt

- Materials
  - Defective from vendor
  - Not to specifications
  - Material-handling problems

- Process
  - Poor process design
  - Ineffective quality management
  - Deficiencies in product design
Quality Awards

- The Malcolm Baldrige National Quality Award (USA, since 1987)
  - www.quality.nist.gov
- The Deming Prize (Japan, since 1951)
  - www.deming.org

The Baldrige Criteria for Performance Excellence (2007)

1. Leadership (120 points)
2. Strategic Planning (85 points)
3. Customer and Market Focus (85 points)
4. Measurement, Analysis, and Knowledge Management (90 points)
5. Human Resource Focus (85 Points)
6. Process Management (85 points)
7. Business Results (450 points)

ISO 9000 and ISO 14000

- A set of procedures and policies for international quality certification of suppliers
- ISO 9000 an international reference for quality, ISO 14000 is primarily concerned with environmental management
- Implications
  - A prerequisite for global competition
  - ISO 9000 accreditation
  - A total commitment to quality is required throughout an organization
Case: Hank Kolb

- Draw a fishbone diagram.
- What general steps should Hank follow in setting up a continuous improvement program for the company? What problems will he have to overcome to make it work?