**Total Quality Management**

**Knowledge Check**

**Weekly Learning Objectives:**

* Identify many definitions of quality
* Calculate costs and benefits of reliability, prevention, and maintenance
* Explain:
	+ the concepts of Total Quality Management
	+ W. Edwards Deming’s 14 point
	+ Pros and Cons of the Six Sigma Methodology
	+ Understand how to apply Taguchi Method
* Enumerate International Quality Standards

**Key Concepts Summary:**

Quality is a term that means different things to different people. One of the definitions is “the totality of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs.” As defined by The American Society for Quality.

Defining quality expectations is critical to effective and efficient operations.

Quality requires building a total quality management (TQM) environment because quality cannot be inspected into a product.

There are seven TQM concepts:

* Continuous improvement
* Six Sigma
* Employee empowerment
* Benchmarking
* Just-in-time
* Taguchi concepts

The TQM tools include:

* Check sheets
* Scatter diagrams
* Cause and effect diagrams
* Pareto charts
* Flow charts
* Histograms
* SPC charts

**Key Definitions:**

**1. Total Quality Management:** A journey to excellence in which everyone in the organization is focused on continuous process improvement directed toward increased customer satisfaction. Management of an entire organization so that it excels in all aspects of product or service that are important to the customer.

**2. Pareto Principle:** 80% of the trouble comes from 20% of the causes. The estimate is that 85% of quality problems have to do with materials and processes, not with employee performance.

**Definitions of Quality:**

* User’s based: interpretation- quality lies in the eyes of the beholder. To customers, higher quality means better performance, more desirable features, and unexpected benefits.
* Manufacturing based: to production managers, quality means conforming to standards and “making it right the first time”.
* Product based: views quality as precise and measurable variable (i.e.: really good ice cream has 70% butterfat level).

**3. Quality Engineering:** An approach originated by Genichi Taguchi that involves combining engineering and statistical methods to reduce costs and improve quality by optimizing product design and manufacturing processes.

**4. The four major categories of costs associated with quality are:** prevention costs, appraisal costs, internal failure, and external costs.

**5. Cost of Quality:** the cost of doing things wrong; that is, the price of nonconformance.

**6. PDCA:** A continuous improvement model that involves for stages: plan, do, check, and act.

**7. Kaizen:** the Japanese word to describe the ongoing process of unending improvement

**8. Six Sigma:** A comprehensive and flexible system for achieving, sustaining, and maximizing business success by minimizing defects and variability in processes. The program to save time, improve quality, and lower cost. In statistical sense, Six Sigma describes a process with an extremely high capability – 99.9997% accuracy, or 3.4 defects per million.

**9. Six Sigma Improvement Model:** Define, Measure, Analyze, Improve, Control.

**10. Six Sigma Implementation:** Top-down commitment, Measurement systems to track progress, Tough goal setting, Education, Communication, Customer priorities.

**11. Employee empowerment:** enlarging employee jobs so that the added responsibility and authority is moved to the lowest level possible in the organization.

**12. Quality circle:** A group of employees meeting regularly with a facilitator to solve work-related problems in their work areas.

Benchmarking: selecting a demonstrated standard of performance that represents a very best performance for a process or an activity.

**13. Quality robust:** products that are consistently built to meet customer needs, in spite of adverse conditions in the production process.

**14. Just-In-Time (JIT):** is one of the philosophies of continuing improvement which is aims to produce and deliver goods as they are needed. JIT is related to quality in three ways:

* Cuts the cost of quality: this occurs because scrap, rework, inventory investment, and damage costs are limited to inventory at hand. Because there is less inventory at hand, costs are lower. In addition, inventory hides bad quality, whereas JIT immediately exposes bad quality.
* Improves quality: As JIT shrinks lead time it keeps evidence of errors fresh and limits the number of potential sources of error. JIT creates, in effect, and early warning system for quality problems, both within the firm and with vendors.
* Lowers inventory: Often the purpose of keeping inventory is to protect against poor production performance resulting from unreliable quality. If consistent quality exists, JIT allows firms to reduce all the costs associated with inventory.

**15. Taguchi Concepts:** states that most quality problems are the result of poor product and process design. There are three concepts aimed at improving both:

**17. Quality robustness :** quality robust products are products that can be produced uniformly and consistently in adverse manufacturing and manufacturing conditions. Taguchi’s idea is to remove the effects of adverse condition instead of removing the causes. Taguchi suggests that removing the effects is often cheaper than removing the causes and more effective in producing a robust product. In this way, small variations in material and process do not destroy product quality.

**18. Quality Loss Function:** A mathematical function that identifies all costs connected with poor quality and show how these costs increase as product quality moves from what the customer wants. These costs include not only customer dissatisfaction but also warranty and service costs, internal inspections, repair, and scrap work, and costs to society.

All the losses to society due to poor performance are included in the loss function. The smaller the loss, the more desirable the product. The farther the product is from the target value, the more severe the loss.

L = $D^{2}$C

L = loss to society

$D^{2}$ =square of the distance from the target value

C = cost of the deviation at the specific limit

**19. Target oriented quality**: Taguchi observed that traditional conformance-oriented specifications (product is good as long as it falls within the tolerance limits) is too simplistic. Conformance-oriented quality accepts all products that fall within the tolerance limits, producing more units farther from the target. Target-oriented quality, on the other hand, strives to keep the products at the desired specifications, producing more units near the target. Target-oriented quality is a philosophy of continuous improvement to bring the product exactly on target.

**20. Reliability:** is the probability that a product or system will satisfactorily perform its intended function for a defined period of time under stated set of operating conditions.

**21. Maintenance:** Poor maintenance can be disruptive , inconvenient, wasteful, and expensive. The objective of maintenance and reliability is to maintain the capability of the system. Tactics for improving reliability: improving individual components and providing redundancy.

Tactics for improving maintenance: preventive maintenance and increasing repair capabilities and speed. Basic unit of reliability: product failure rate

The activities involve in keeping a system’s equipment in working order.

Techniques for enhancing maintenance: simulation, expert systems, and sensors. Preventive maintenance: A plan that involves routine inspections, servicing, and keeping facilities in good repair to prevent failure.

**22. MTBF:** The expected time between a repair and the next failure of a component, machine, process, or product.

**23. MTTR:** the period of time between failure and repair

**24. Availability:** the interval of time when units are operating.

**25. Breakdown maintenance:** Remedial maintenance that occurs when equipment fails and must be repaired on an emergency or prior basis.

**26. Infant mortality:** The failure rate early in the life of a product or process.

Redundancy: The use of components in parallel to raise reliability.

**22. International Quality Standards:**

* **The ISO 9000:** A set of standards governing documentation of a quality program. Compliance with ISO 9000 standards says nothing about the actual quality of a product. Rather, it indicates to customers that companies can provide documentation to support whether claims they make about quality.
* ISO 9000 consists of five documents: ISO 9000 – 9004.
* ISO 9000: is an overview document, which provides guidelines for selection and use of other standards.
* **ISO 9001:** is a standard that focuses on 20 aspects of a quality program for companies that design, produce, install, and service products. These aspects include management responsibility, quality, quality system documentation, purchasing, product design, inspection, training, and corrective action.
* **ISO 9002:** is a standard for companies that produces to the customer’s designs and have their design and service activities at another location. This standard covers the same areas as ISO 9000.
* **ISO 9003:** is the most limited in scope and addresses only the production process.
* **ISO 9004:** contains guidelines for interpreting the other standards.

**23. Benefits and cost of ISO Certification:**

* Competing the certification process can take as long as 18 months.
* It involves an extensive demand on managerial attention.
* The cost of certification can exceed $1,000,000 for large companies.
* Certified companies will do business with other certified companies. Hence, having this certification represents significant competitive advantage.
* It results in a documented increase in efficiency, profitability, and customer satisfaction.

**24. ISO 14000: is an environmental management system :**

* It requires participating companies to keep track of their raw materials use and their generation, treatment, and disposal of hazardous waste.
* ISO 14000 is a series of five standards that cover a number of areas including the following:
* Environmental Management System: requires a plan to improve performance in resource use and pollutant output.
* Environmental Performance Evaluation: specifies guidelines for the certification of companies.
* Environmental Labeling: determines terms such as recyclable, energy efficient, and safe for the ozone layer.
* Life-cycle Assessment: Evaluates the lifetime environmental impact from the manufacture, use, and disposal of a product.

**25. Malcolm Baldrige National Quality Award:**

* The application and review process for this award is rigorous. However, the act of preparing the application itself is often a major benefit to organizations because it helps firms define what quality means to them.
* The seven major criteria for the award are the following:
* Leadership: examines how senior executive guide the organization and how the organization addresses its responsibilities to the public and practices good citizenship.
* Strategic Planning: examines how the organization sets strategic direction and how it determines key action plans.
* Customer and market focus: examine how organizations determine requirements and expectations of customers and markets; builds relationships with customers; and acquires, satisfies, and retains customers.
* Measurement, Analysis, and Knowledge Management: examines the management, effective use, analysis, and improvement of data to support key organizational processes and the organization’s performance management system.
* Human Resource Focus: examines how the organization enables its workforce to develop its full potential and how the workforce is aligned with the organization’s objectives.
* Process Management: examines aspects of how key production/delivery and support processes are designed, managed, and improved.
* Business results: examines organization’s performance and improvement in its key business goals (relative to its competition) including:
* Customer satisfaction
* Financial performance
* Marketplace performance
* Human resources
* Suppliers and partner performance
* Operational performance
* Governance
* Social responsibility

Customer satisfaction underpins these criteria. Business results criterion is given the most weight.

**26. Deming Prize:** awarded in Japan and named after an American , Dr. W. Edwards Deming.

Deming insited management accept responsibility for building good systems. The employee cannot produce products that on average exceed the quality of what the process is capable of producing.

**27. Deming’s 14 points guides the TQM implementation:**

* Create consistency of purpose
* Lead to promote change
* Build quality into the product; stop depending on inspection to catch problems
* Build long-term relationship based on performance instead of awarding business on the base of price.
* Continuously improve product, quality, and service
* Start training
* Emphasize leadership
* Drive out fear
* Break down barriers between departments
* Stop blaming workers
* Support, help, and improve
* Remove barriers to pride in work
* Institute a vigorous program of education and self-improvement
* Put everybody in the company to work on the transformation