

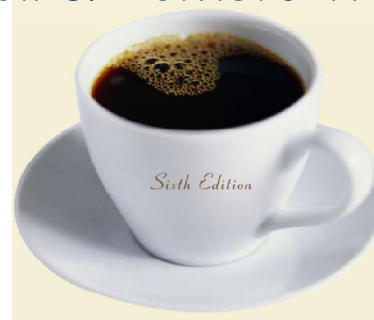


# *Chapter 2*

## *Quality Management*

***Operations Management - 6<sup>th</sup> Edition***

Roberta Russell & Bernard W. Taylor, III



# Lecture Outline

- ◆ What Is Quality?
- ◆ Evolution of Quality Management
- ◆ Quality Tools
- ◆ TQM and QMS
- ◆ Focus of Quality Management—  
Customers
- ◆ Role of Employees in  
Quality Improvement
- ◆ Quality in Service  
Companies
- ◆ Six Sigma
- ◆ Cost of Quality
- ◆ Effect of Quality  
Management on  
Productivity
- ◆ Quality Awards
- ◆ ISO 9000



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# What Is Quality?

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- *Oxford American Dictionary*
  - a degree or level of excellence
- American Society for Quality
  - totality of features and characteristics that satisfy needs without deficiencies
- Consumer's and producer's perspective

# What Is Quality: Customer's Perspective

- Fitness for use
  - how well product or service does what it is supposed to
- Quality of design
  - designing quality characteristics into a product or service
- A Mercedes and a Ford are equally “fit for use,” but with different design dimensions.



# Dimensions of Quality: Manufactured Products

- Performance
  - basic operating characteristics of a product; how well a car handles or its gas mileage
- Features
  - “extra” items added to basic features, such as a stereo CD or a leather interior in a car
- Reliability
  - probability that a product will operate properly within an expected time frame; that is, a TV will work without repair for about seven years

# Dimensions of Quality: Manufactured Products (cont.)

- Conformance
  - degree to which a product meets pre-established standards
- Durability
  - how long product lasts before replacement; with care, L.L.Bean boots may last a lifetime
- Serviceability
  - ease of getting repairs, speed of repairs, courtesy and competence of repair person

# Dimensions of Quality: Manufactured Products (cont.)

- Aesthetics
  - how a product looks, feels, sounds, smells, or tastes
- Safety
  - assurance that customer will not suffer injury or harm from a product; an especially important consideration for automobiles
- Perceptions
  - subjective perceptions based on brand name, advertising, and like



# Dimensions of Quality: Services

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- Time and timeliness
  - how long must a customer wait for service, and is it completed on time?
  - is an overnight package delivered overnight?
- Completeness:
  - is everything customer asked for provided?
  - is a mail order from a catalogue company complete when delivered?





# Dimensions of Quality: Service (cont.)

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- Courtesy:
  - how are customers treated by employees?
  - are catalogue phone operators nice and are their voices pleasant?
- Consistency
  - is same level of service provided to each customer each time?
  - is your newspaper delivered on time every morning?

# Dimensions of Quality: Service (cont.)

- Accessibility and convenience
  - how easy is it to obtain service?
  - does service representative answer you calls quickly?
- Accuracy
  - is service performed right every time?
  - is your bank or credit card statement correct every month?
- Responsiveness
  - how well does company react to unusual situations?
  - how well is a telephone operator able to respond to a customer's questions?

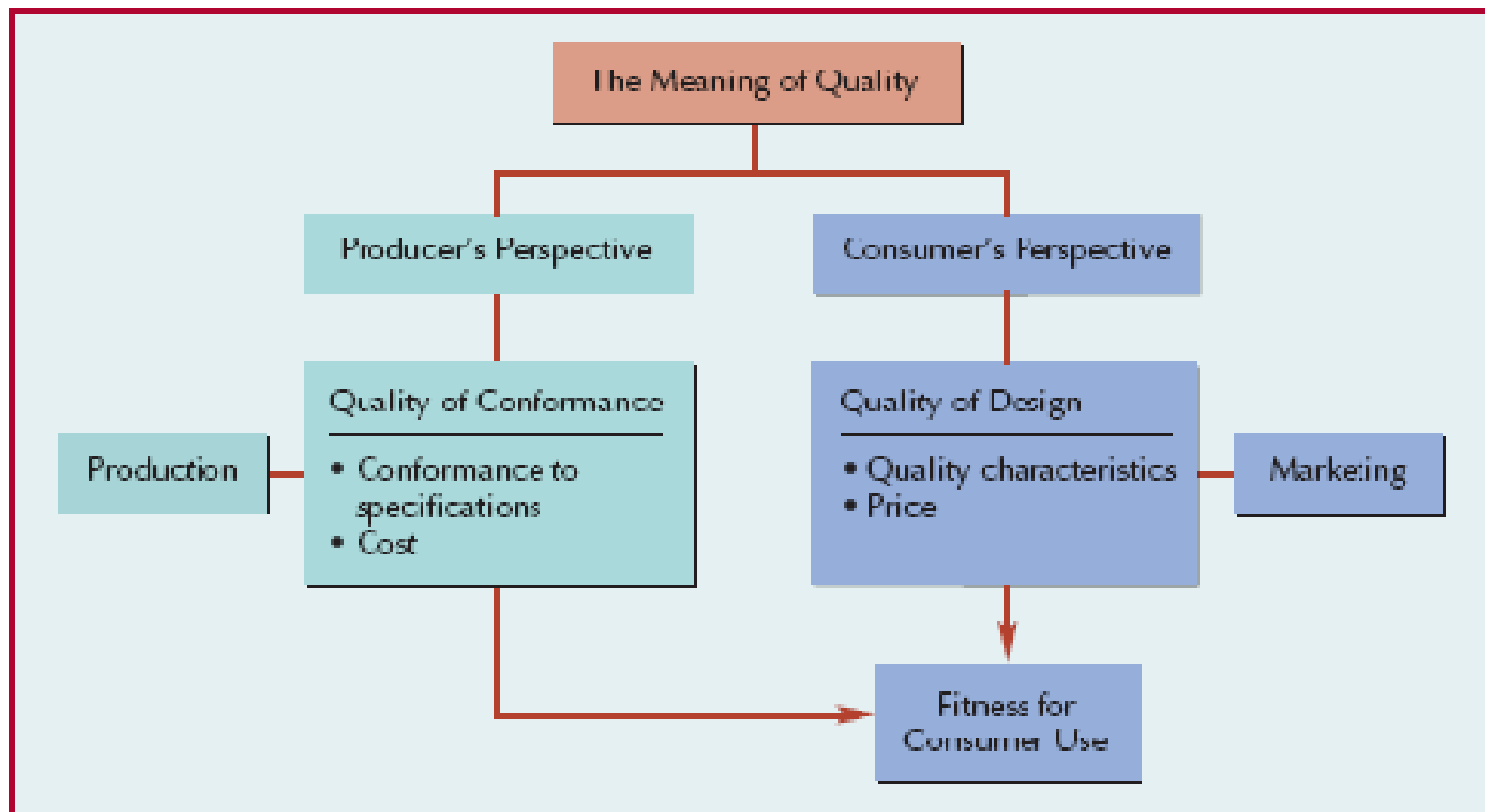


# What Is Quality: Producer's Perspective

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- Quality of conformance
  - making sure product or service is produced according to design
    - if new tires do not conform to specifications, they wobble
    - if a hotel room is not clean when a guest checks in, hotel is not functioning according to specifications of its design

# Meaning of Quality





# What Is Quality: A Final Perspective

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- Customer's and producer's perspectives depend on each other
- Producer's perspective:
  - production process and COST
- Customer's perspective:
  - fitness for use and PRICE
- Customer's view must dominate

# Evolution of Quality Management: Quality Gurus

- ◆ Walter Shewart
  - In 1920s, developed control charts
  - Introduced term “*quality assurance*”
- ◆ W. Edwards Deming
  - Developed courses during World War II to teach statistical quality–control techniques to engineers and executives of companies that were military suppliers
  - After war, began teaching statistical quality control to Japanese companies
- ◆ Joseph M. Juran
  - Followed Deming to Japan in 1954
  - Focused on strategic quality planning
  - Quality improvement achieved by focusing on projects to solve problems and securing breakthrough solutions

# Evolution of Quality Management: Quality Gurus (cont.)

- Armand V. Feigenbaum
  - In 1951, introduced concepts of total quality control and continuous quality improvement
- Philip Crosby
  - In 1979, emphasized that costs of poor quality far outweigh cost of preventing poor quality
  - In 1984, defined absolutes of quality management—conformance to requirements, prevention, and “zero defects”
- Kaoru Ishikawa
  - Promoted use of quality circles
  - Developed “fishbone” diagram
  - Emphasized importance of internal customer

# Deming's 14 Points

- 1. Create constancy of purpose***
- 2. Adopt philosophy of prevention***
- 3. Cease mass inspection***
- 4. Select a few suppliers based on quality***
- 5. Constantly improve system and workers***



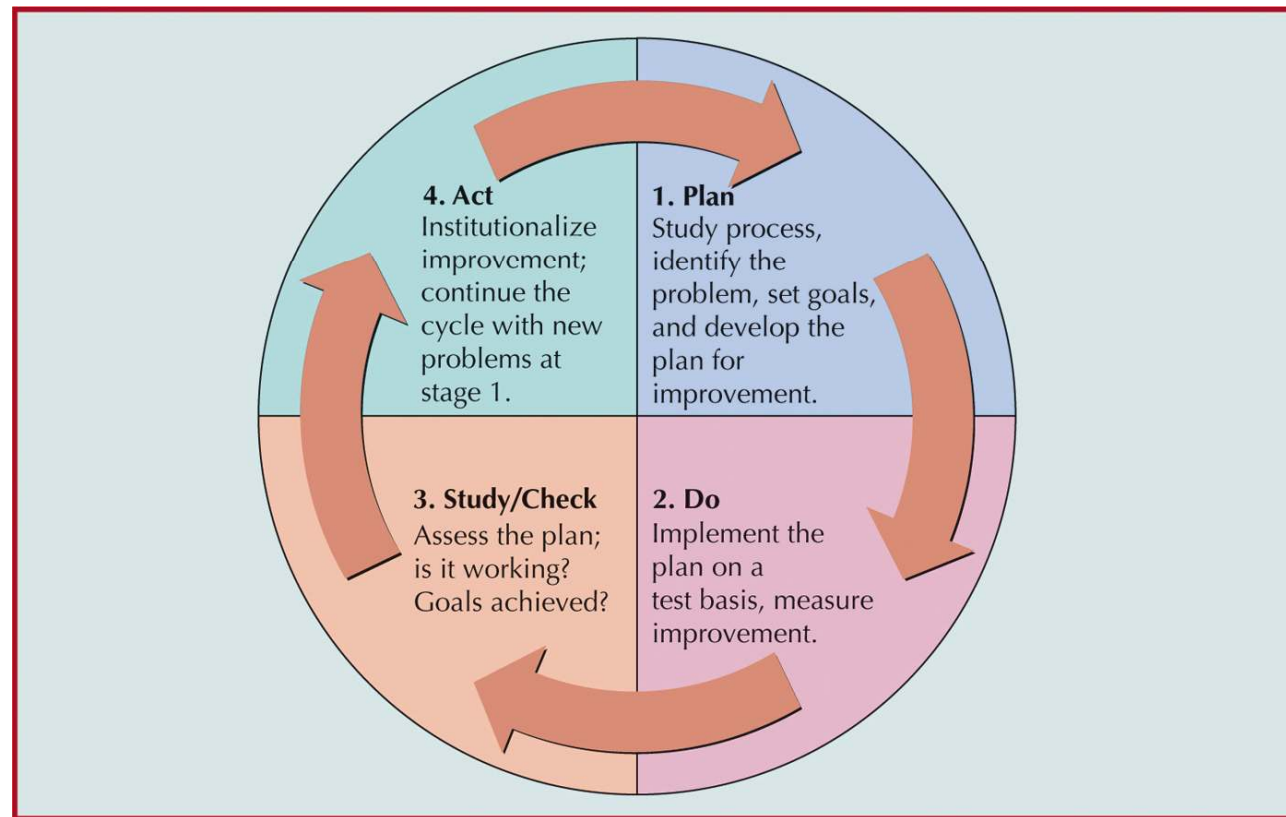
## Deming's 14 Points (cont.)

6. *Institute worker training*
7. *Instill leadership among supervisors*
8. *Eliminate fear among employees*
9. *Eliminate barriers between departments*
10. *Eliminate slogans*

## Deming's 14 Points (cont.)

- 11. Remove numerical quotas*
- 12. Enhance worker pride*
- 13. Institute vigorous training and education programs*
- 14. Develop a commitment from top management to implement above 13 points*

# Deming Wheel: PDCA Cycle





# Quality Tools

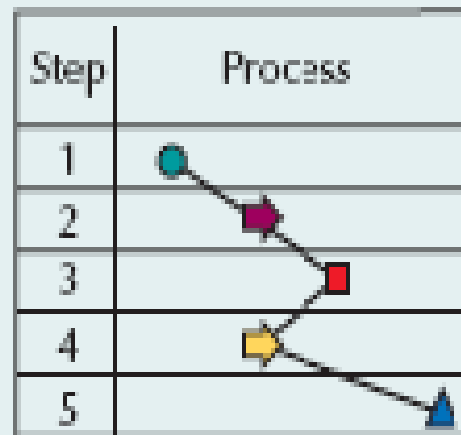
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- ◆ Process Flow Chart
- ◆ Cause-and-Effect Diagram
- ◆ Check Sheet
- ◆ Pareto Analysis
- ◆ Histogram
- ◆ Scatter Diagram
- ◆ Statistical Process Control Chart

# Flow Chart

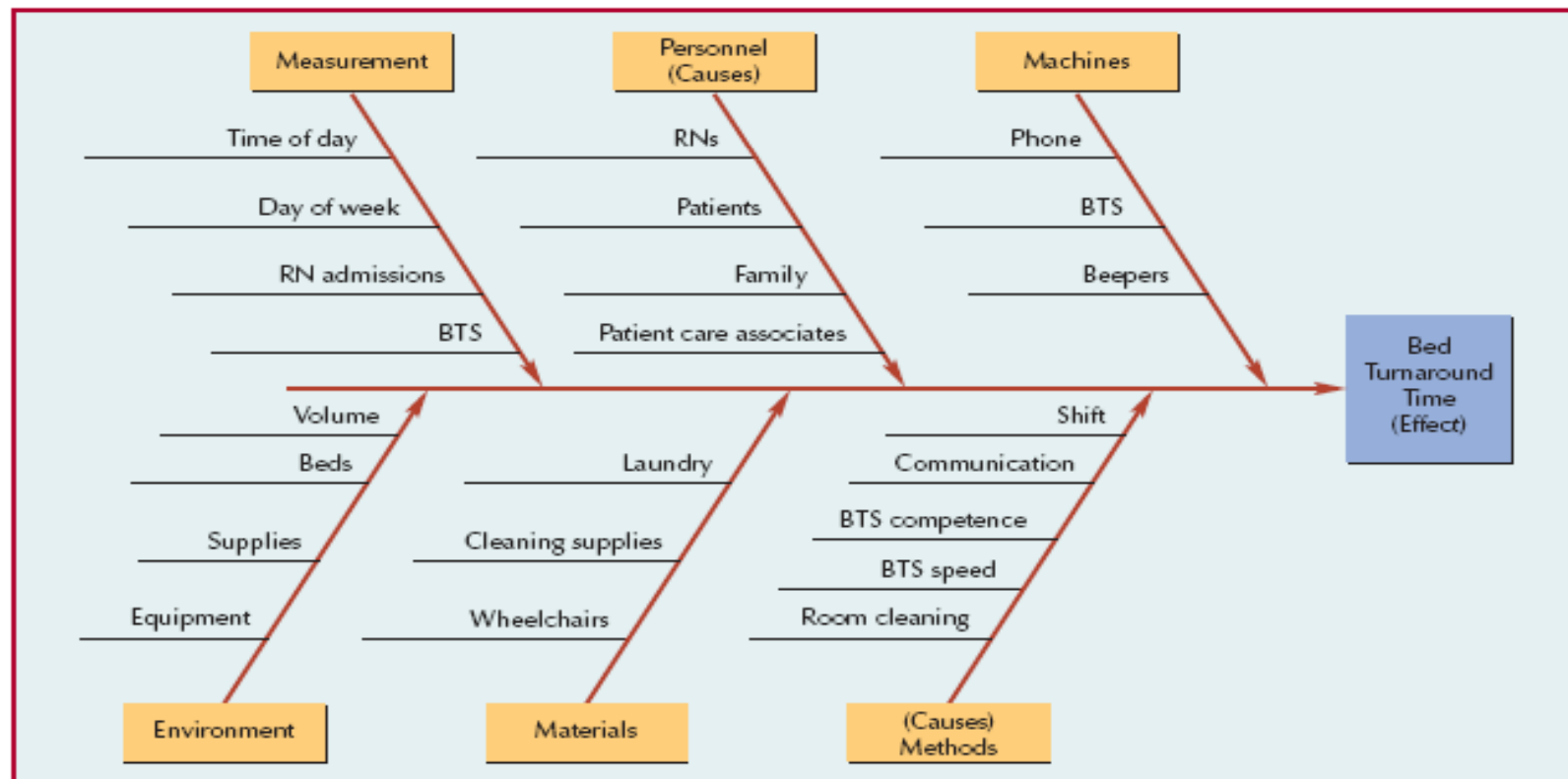
## Process Flowchart



A diagram of the steps in a process; helps focus on where in a process a quality problem might exist.

# Cause-and-Effect Diagram

- ◆ Cause-and-effect diagram (“fishbone” diagram)
  - chart showing different categories of problem causes



# Cause-and-Effect Matrix

- ◆ Cause-and-effect matrix
  - grid used to prioritize causes of quality problems

	Key Input (X) Variables	Customer rank Weight	Key Output (Y) Variables (CTQC's)						Score	Rank of X Variables/ Importance to Customer
			1 Turnaround time	2 Patient flow	3 Physician time	4 Emergency dept.	5 Patient time	6 Operating room		
1	BTS	9	9	8	10	8		5	348	3
2	Beepers	7	7	5	8		5		222	7
3	Volume	7	7	10	6	7	5	5	338	4
4	Beds	4	4		9				121	10
5	Time of day	3	3	4	5	4	10		209	8
6	Day of week	9	9	10	6			6	282	5
7	Communication	9	9	6	10	8	7	9	429	1
8	BTS competence	10	10	9	7		7	7	349	2
9	Room cleaning	7	7	5	3		8	4	230	6
10	Supplies	8	8	9					161	9

$(8)(10) + (9)(9) = 161$

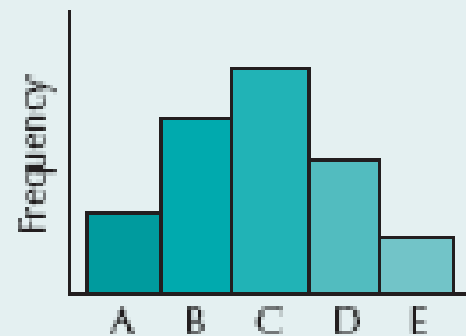
# Check Sheets and Histograms

## Check Sheet

Items	1	2	3	4
Dirt	✓✓			✓✓
Old		✓		✓
Temp.	✓	✓✓	✓✓	
Fault	✓✓✓		✓✓	

A fact-finding tool for tallying the number of defects for a list of previously identified problem causes.

## Histogram



A diagram showing the frequency of data related to a quality problem.

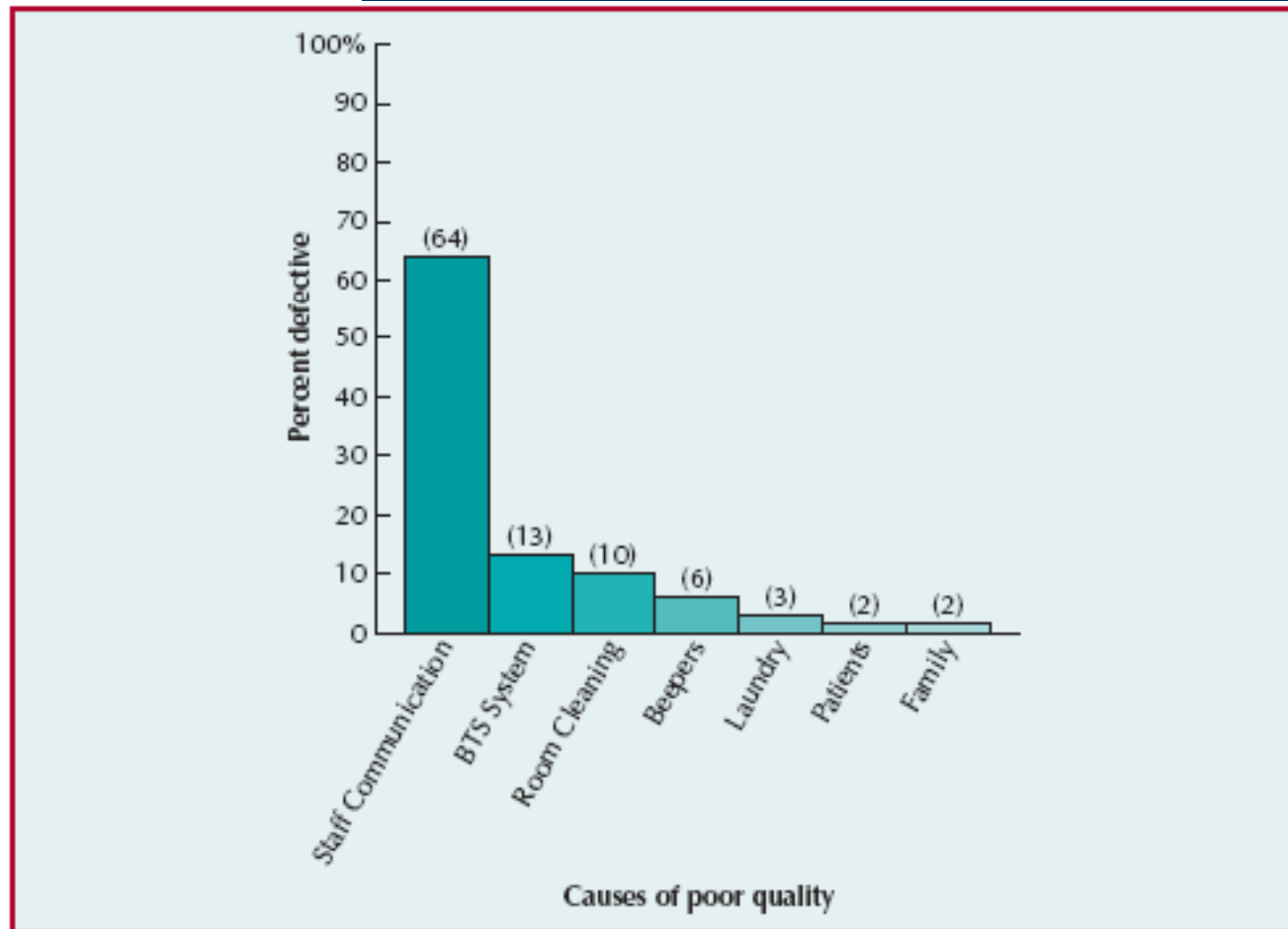


# Pareto Analysis

- ◆ Pareto analysis
  - most quality problems result from a few causes

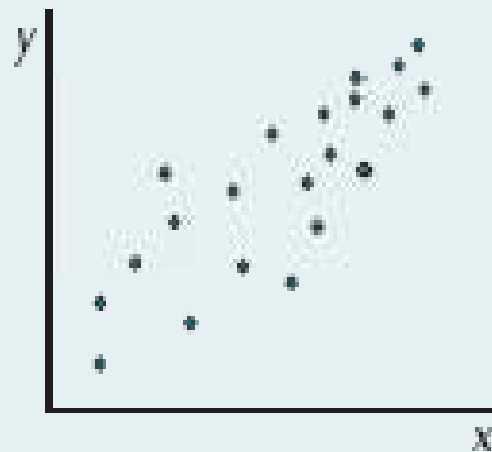
<i>Cause</i>	<i>Number of Defects</i>	<i>Percentage</i>
Staff communication	83	64%
BTS system	17	13
Room cleaning	13	10
Beepers	7	6
Laundry	4	3
Patients	3	2
Family	3	2
	<u>130</u>	<u>100%</u>

# Pareto Chart



# Scatter Diagram

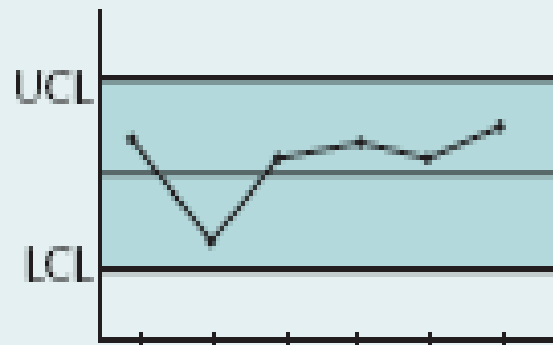
Scatter Diagram



A graph showing the relationship between two variables in a process; identifies a pattern that may cause a quality problem.

# Control Chart

## Statistical Process Control Chart



A chart with statistical upper and lower limits; if the process stays between these limits over time, it is in control and a problem does not exist.

# TQM and QMS

- ◆ Total Quality Management (TQM)
  - customer-oriented, leadership, strategic planning, employee responsibility, continuous improvement, cooperation, statistical methods, and training and education
- ◆ Quality Management System (QMS)
  - system to achieve customer satisfaction that complements other company systems

# Focus of Quality Management— Customers

- ◆ TQM and QMSs
  - serve to achieve customer satisfaction
- ◆ Partnering
  - a relationship between a company and its supplier based on mutual quality standards
- ◆ Measuring customer satisfaction
  - important component of any QMS
  - customer surveys, telephone interviews

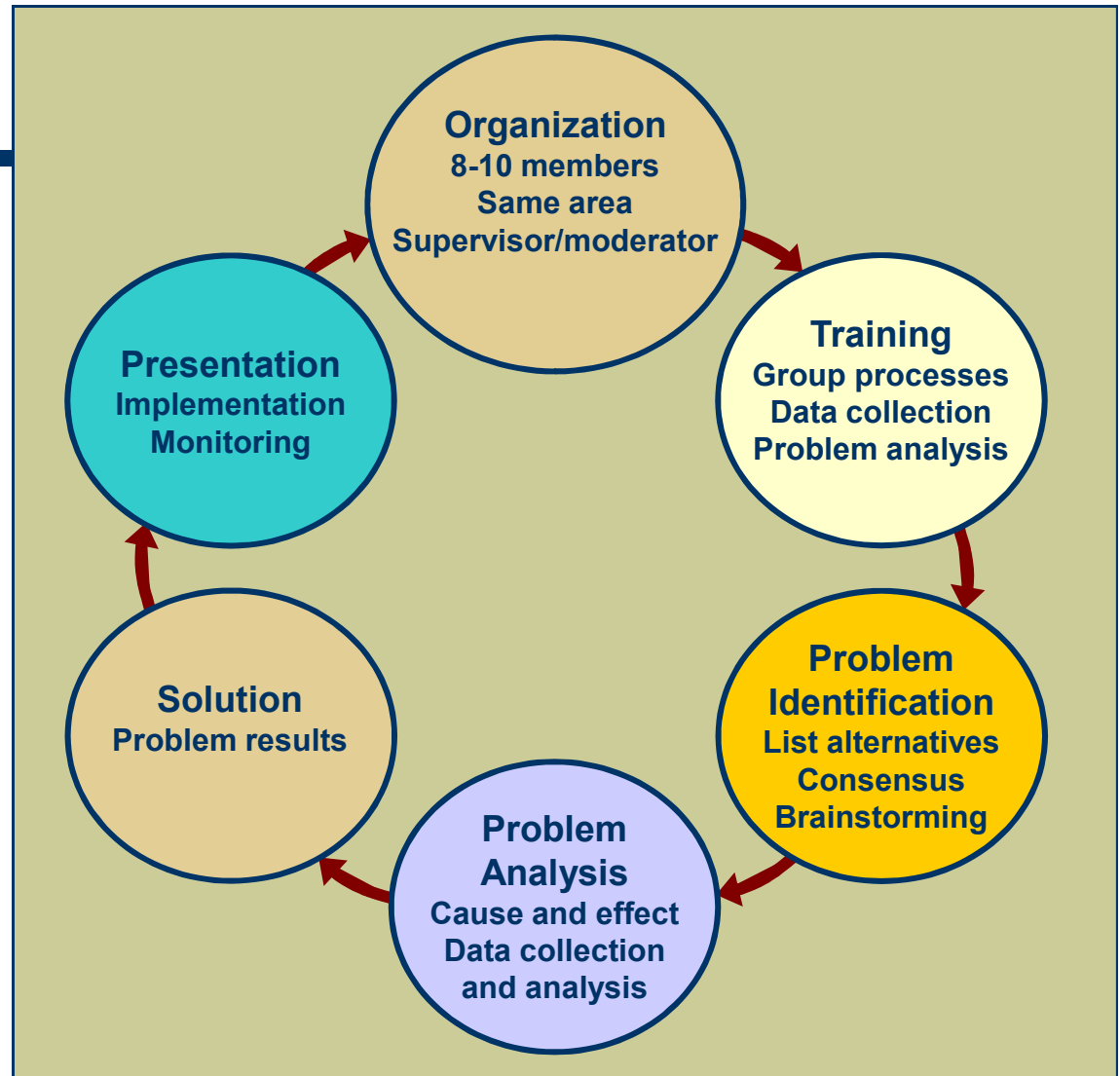
# Role of Employees in Quality Improvement

- ◆ Participative problem solving
  - employees involved in quality-management
  - every employee has undergone extensive training to provide quality service to Disney's guests
- ◆ Kaizen
  - involves everyone in process of continuous improvement



# Quality Circles and QITs

- ◆ Quality circle
  - group of workers and supervisors from same area who address quality problems
- ◆ Process/Quality improvement teams (QITs)
  - focus attention on business processes rather than separate company functions







# Quality in Services

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- ◆ Service defects are not always easy to measure because service output is not usually a tangible item
- ◆ Services tend to be labor intensive
- ◆ Services and manufacturing companies have similar inputs but different processes and outputs

# Quality Attributes in Services

- ◆ Principles of TQM apply equally well to services and manufacturing
- ◆ Timeliness
  - how quickly a service is provided?
- ◆ Benchmark
  - “best” level of quality achievement in one company that other companies seek to achieve

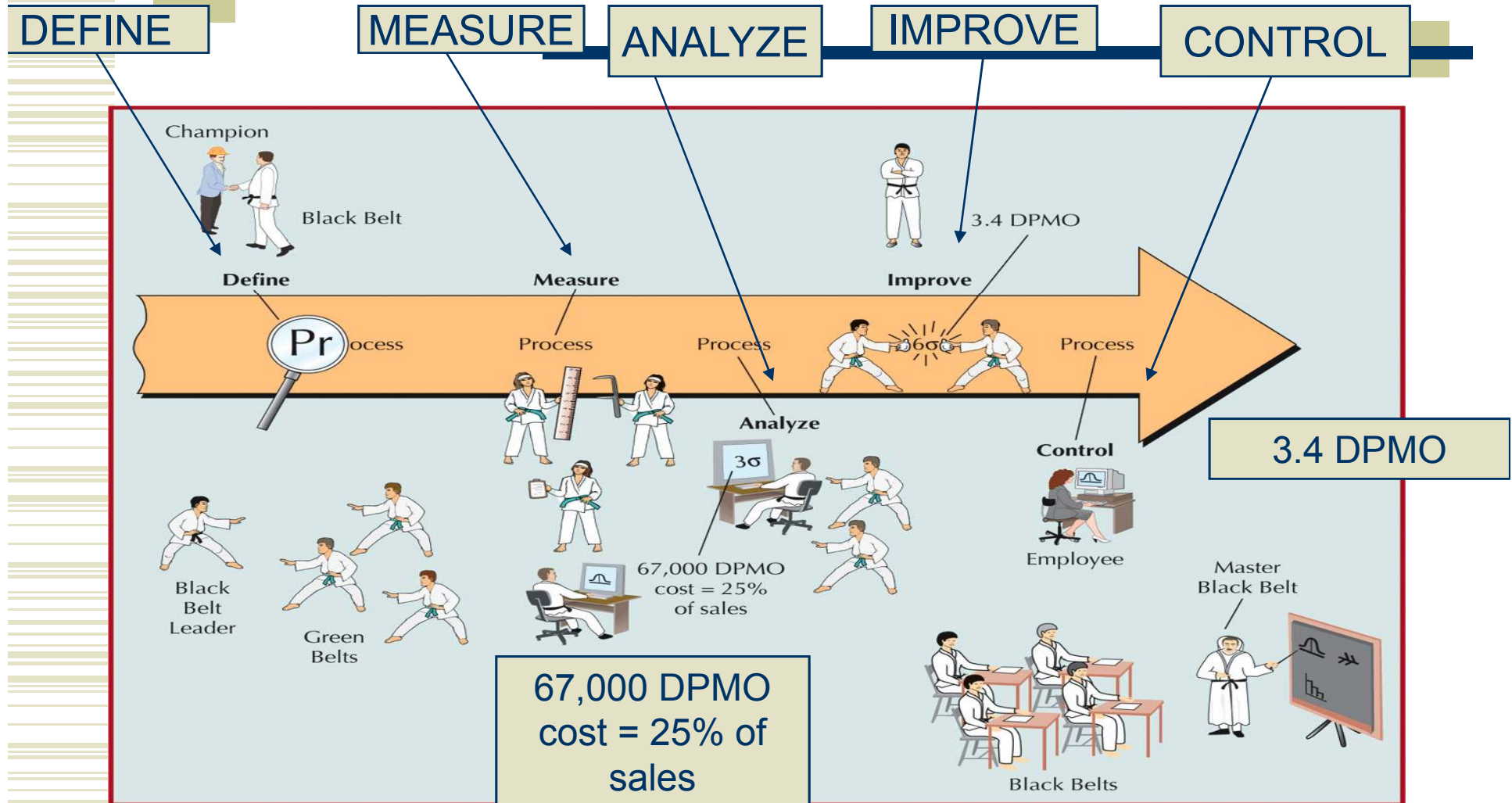


*“quickest, friendliest, most accurate service available.”*

# Six Sigma

- ◆ A process for developing and delivering virtually perfect products and services
- ◆ Measure of how much a process deviates from perfection
- ◆ 3.4 defects per million opportunities
- ◆ Six Sigma Process
  - four basic steps of Six Sigma—align, mobilize, accelerate, and govern
- ◆ Champion
  - an executive responsible for project success

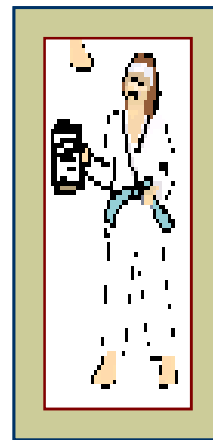
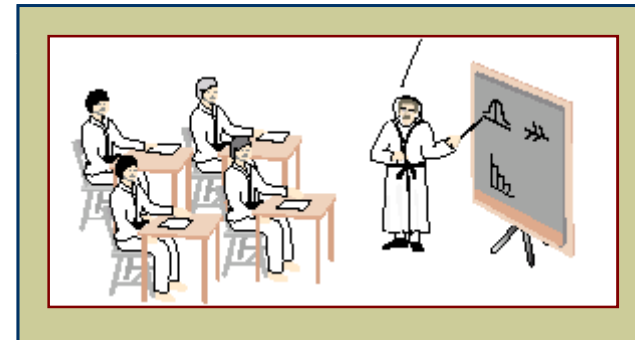
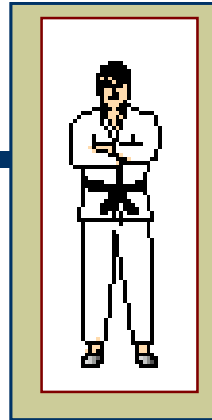
# Six Sigma: Breakthrough Strategy—DMAIC



# Six Sigma:

## Black Belts and Green Belts

- ◆ Black Belt
  - project leader
- ◆ Master Black Belt
  - a teacher and mentor for Black Belts
- ◆ Green Belts
  - project team members



# Six Sigma

- ◆ Design for Six Sigma (DFSS)
  - a systematic approach to designing products and processes that will achieve Six Sigma
- ◆ Profitability
  - typical criterion for selection Six Sigma project
  - one of the factors distinguishing Six Sigma from TQM
  - “Quality is not only free, it is an honest-to-everything profit maker.”

# Cost of Quality

- ◆ Cost of Achieving Good Quality
  - Prevention costs
    - costs incurred during product design
  - Appraisal costs
    - costs of measuring, testing, and analyzing
- ◆ Cost of Poor Quality
  - Internal failure costs
    - include scrap, rework, process failure, downtime, and price reductions
  - External failure costs
    - include complaints, returns, warranty claims, liability, and lost sales

# Prevention Costs

- ◆ Quality planning costs
  - costs of developing and implementing quality management program
- ◆ Product–design costs
  - costs of designing products with quality characteristics
- ◆ Process costs
  - costs expended to make sure productive process conforms to quality specifications
- ◆ Training costs
  - costs of developing and putting on quality training programs for employees and management
- ◆ Information costs
  - costs of acquiring and maintaining data related to quality, and development and analysis of reports on quality performance



# Appraisal Costs

- ◆ Inspection and testing
  - costs of testing and inspecting materials, parts, and product at various stages and at end of process
- ◆ Test equipment costs
  - costs of maintaining equipment used in testing quality characteristics of products
- ◆ Operator costs
  - costs of time spent by operators to gather data for testing product quality, to make equipment adjustments to maintain quality, and to stop work to assess quality

# Internal Failure Costs

- ◆ Scrap costs
  - costs of poor-quality products that must be discarded, including labor, material, and indirect costs
- ◆ Rework costs
  - costs of fixing defective products to conform to quality specifications
- ◆ Process failure costs
  - costs of determining why production process is producing poor-quality products
- ◆ Process downtime costs
  - costs of shutting down productive process to fix problem
- ◆ Price-downgrading costs
  - costs of discounting poor-quality products—that is, selling products as “seconds”

# External Failure Costs

- ◆ Customer complaint costs
  - costs of investigating and satisfactorily responding to a customer complaint resulting from a poor-quality product
- ◆ Product return costs
  - costs of handling and replacing poor-quality products returned by customer
- ◆ Warranty claims costs
  - costs of complying with product warranties
- ◆ Product liability costs
  - litigation costs resulting from product liability and customer injury
- ◆ Lost sales costs
  - costs incurred because customers are dissatisfied with poor-quality products and do not make additional purchases

# Measuring and Reporting Quality Costs

- ◆ Index numbers
  - ratios that measure quality costs against a base value
  - labor index
    - ratio of quality cost to labor hours
  - cost index
    - ratio of quality cost to manufacturing cost
  - sales index
    - ratio of quality cost to sales
  - production index
    - ratio of quality cost to units of final product

# Quality–Cost Relationship

- ◆ Cost of quality
  - difference between price of nonconformance and conformance
  - cost of doing things wrong
    - 20 to 35% of revenues
  - cost of doing things right
    - 3 to 4% of revenues

# Effect of Quality Management on Productivity

- ◆ Productivity
  - ratio of output to input
- ◆ Quality impact on productivity
  - fewer defects increase output, and quality improvement reduces inputs
- ◆ Yield
  - a measure of productivity

**Yield=(total input)(% good units) + (total input)(1-%good units)(% reworked)**

**or**

$$**Y=(I)(\%G)+(I)(1-\%G)(\%R)**$$

# Computing Product Cost per Unit

$$\text{Product Cost} = \frac{(K_d)(I) + (K_r)(R)}{Y}$$

*where:*

$K_d$  = direct manufacturing cost per unit

$I$  = input

$K_r$  = rework cost per unit

$R$  = reworked units

$Y$  = yield

# Computing Product Yield for Multistage Processes

$$Y = (I)(\%g_1)(\%g_2) \dots (\%g_n)$$

where:

$I$  = input of items to the production process that will result in finished products

$g_i$  = good-quality, work-in-process products at stage  $i$



# Quality–Productivity Ratio

## QPR

- productivity index that includes productivity and quality costs

$$\text{QPR} = \frac{(\text{good-quality units})}{(\text{input}) (\text{processing cost}) + (\text{reworked units}) (\text{rework cost})} (100)$$



# Malcolm Baldrige Award

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- ◆ Created in 1987 to stimulate growth of quality management in United States
- ◆ Categories
  - Leadership
  - Information and analysis
  - Strategic planning
  - Human resource focus
  - Process management
  - Business results
  - Customer and market focus

# Other Awards for Quality

- ◆ National individual awards
  - Armand V. Feigenbaum Medal
  - Deming Medal
  - E. Jack Lancaster Medal
  - Edwards Medal
  - Shewart Medal
  - Ishikawa Medal
- ◆ International awards
  - European Quality Award
  - Canadian Quality Award
  - Australian Business Excellence Award
  - Deming Prize from Japan

# ISO 9000

- ◆ A set of procedures and policies for international quality certification of suppliers
- ◆ Standards
  - ISO 9000:2000
    - *Quality Management Systems—Fundamentals and Vocabulary*
    - defines fundamental terms and definitions used in ISO 9000 family
- ◆ ISO 9001:2000
  - *Quality Management Systems—Requirements*
  - standard to assess ability to achieve customer satisfaction
- ◆ ISO 9004:2000
  - *Quality Management Systems—Guidelines for Performance Improvements*
  - guidance to a company for continual improvement of its quality-management system

# ISO 9000 Certification, Implications, and Registrars

- ◆ ISO 9001:2000—only standard that carries third-party *certification*
- ◆ Many overseas companies will not do business with a supplier unless it has ISO 9000 certification
- ◆ ISO 9000 accreditation
- ◆ ISO registrars





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