

production management مدیریت عملیات

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# Operations Management

## Managing Quality

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## Outline

- **TOTAL QUALITY MANAGEMENT**
  - Continuous Improvement
  - Employee Empowerment
  - Benchmarking
  - Just-in-Time (JIT)
  - Taguchi Concepts
  - Knowledge of TQM Tools

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## Outline Continued

- **TOOLS OF TQM**
  - Check sheets
  - Scatter Diagrams
  - Cause-and-Effect Diagram
  - Pareto Charts
  - Flow Charts
  - Histograms
  - Statistical Process Control (SPC)

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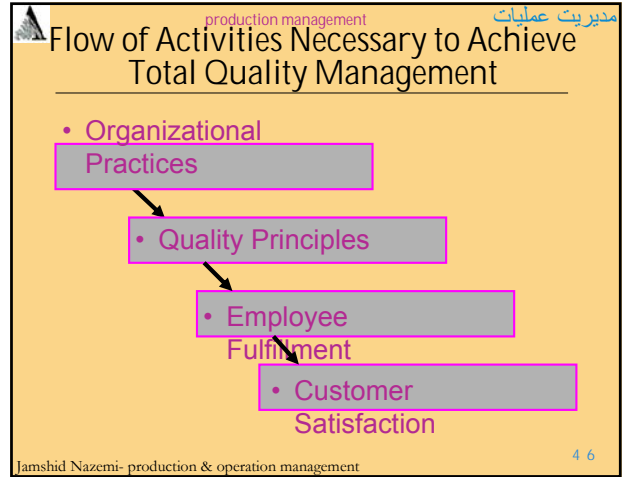
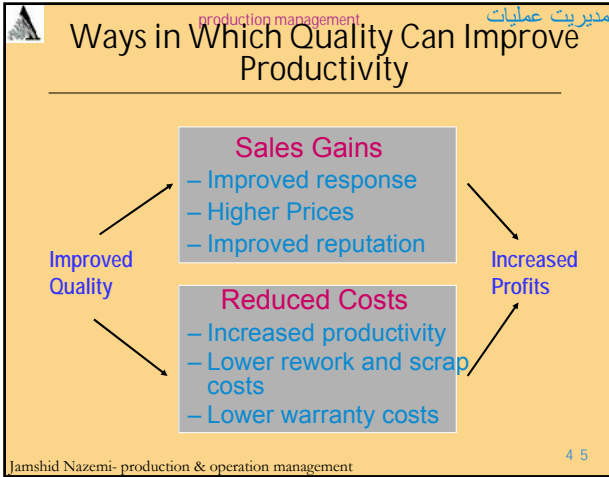
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## Outline Continued

- **THE ROLE OF INSPECTION**
  - When and Where to Inspect
  - Source Inspection
  - Service Industry Inspection
  - Inspection of Attributes vs Variables
- **TQM IN SERVICES**

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- ## Organizational Practices
- Leadership
  - Mission statement
  - Effective operating procedure
  - Staff support
  - Training
- Yields: What is important and what is to be accomplished*
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- ## Quality Principles
- Customer focus
  - Continuous improvement
  - Employee empowerment
  - Benchmarking
  - Just-in-time
  - Tools of TQM
- Yields: How to do what is important and to be accomplished*
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## Employment Fulfillment

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- Empowerment
- Organizational commitment

*Yields: Employees' attitudes that they can accomplish what is important and to be accomplished*

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## Customer Satisfaction

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- Winning orders
- Repeat customers

*Yields: An effective organization with a competitive advantage*

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## Definitions of Quality

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- ASC: Product characteristics & features that affect customer satisfaction
- User-Based: What consumer says it is
- Manufacturing-Based: Degree to which a product conforms to *design* specification
- Product-Based: Level of measurable product characteristic

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## Dimensions of Quality for Goods

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- Operation
- Reliability & durability
- Conformance
- Serviceability
- Appearance
- Perceived quality



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## Service Quality Attributes

Reliability      Responsiveness  
 Tangibles      Competence  
 Under-  
 standing      Access  
 Security      Courtesy  
 Credibility      Communication

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## Importance of Quality

- Costs & market share
- Company's reputation
- Product liability
- International implications

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## Malcom Baldrige National Quality Award

- Established in 1988 by the U.S. government
- Designed to promote TQM practices
- Some criteria
  - Senior executive leadership; strategic planning; management. of process quality
  - Quality results; customer satisfaction
- Recent winners
  - Corning Inc.; GTE; AT&T; Eastman Chemical.

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## Costs of Quality

- Prevention costs - reducing the potential for defects
- Appraisal costs - evaluating products
- Internal failure - of producing defective parts or service
- External costs - occur after delivery

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*Costs of poor quality “are huge, but the amounts are not known with precision. In most companies, the accounting system provides only a minority of the information needed to quantify this cost of poor quality*

Juran on Quality by Design, The Free Press (1992), p. 119

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## EC Environmental Standard ISO 14000

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**Core Elements:**

- Environmental management
- Auditing
- Performance evaluation
- Labeling
- Life-cycle assessment

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## International Quality Standards

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- Industrial Standard Z8101-1981 (Japan)
  - Specification for TQM
- ISO 9000 series (Europe/EC)
  - Common quality standards for products sold in Europe (even if made in U.S.)
- ISO 14000 series (Europe/EC)
  - Standards for recycling, labeling etc.
- ASQC Q90 series; MILSTD (U.S.)

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## Traditional Quality Process (Manufacturing)

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graph LR
    subgraph TopRow [ ]
        direction LR
        C[Customer] --> M[Marketing]
        M --> E[Engineering]
        E --> O[Operations]
    end
    C --> CN[Specifies Need]
    M --> IN[Interprets Need]
    E --> DP[Designs Product]
    O --> PP[Produces Product]
    DP --> DQ[Defines Quality]
    PP --> PQ[Plans Quality]
    PQ --> MQ[Monitors Quality]
    SD[Quality is customer driven!]
  
```

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## TQM

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Encompasses entire organization, from supplier to customer

Stresses a commitment by management to have a continuing, company-wide, drive toward excellence in all aspects of products and services that are important to the customer.

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## Achieving Total Quality Management

Effective Business

Customer Satisfaction

Employee Fulfillment → Attitudes (e.g., Commitment)

Quality Principles → How to Do

Organizational Practices → What to Do

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## Deming's Fourteen Points

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- Create consistency of purpose
- Lead to promote change
- Build quality into the products
- Build long term relationships
- Continuously improve product, quality, and service
- Start training
- Emphasize leadership

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## Deming's Points continued

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- Drive out fear
- Break down barriers between departments
- Stop haranguing workers
- Support, help, 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

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## Concepts of TQM


- Continuous improvement
- Employee empowerment
- Benchmarking
- Just-in-time (JIT)
- Taguchi concepts
- Knowledge of TQM tools

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## Continuous Improvement

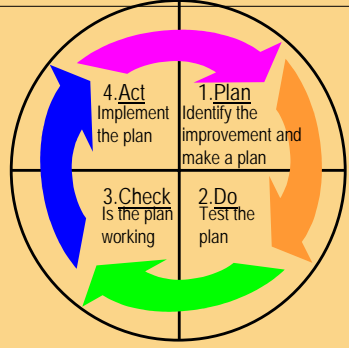
- Represents continual improvement of process & customer satisfaction
- Involves all operations & work units
- Other names
  - Kaizen (Japanese)
  - Zero-defects
  - Six sigma



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## Shewhart's PDCA Model




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## Employee Empowerment

- Getting employees involved in product & process improvements
  - 85% of quality problems are due to process & material
- Techniques
  - Support workers
  - Let workers make decisions
  - Build teams & quality circles




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## Quality Circles

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- Group of 6-12 employees from same work area
- Meet regularly to solve work-related problems
  - 4 hours/month
- Facilitator trains & leads with meetings



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## Benchmarking

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Selecting best practices to use as a standard for performance

- Determine what to benchmark
- Form a benchmark team
- Identify benchmarking partners
- Collect and analyze benchmarking information
- Take action to match or exceed the benchmark

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## Resolving Customer Complaints Best Practices

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- Make it easy for clients to complain
- Respond quickly to complaints
- Resolve complaints on the first contact
- Use computers to manage complaints
- Recruit the best for customer service jobs

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## Just in Time (JIT)

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Relationship to quality:

- JIT cuts cost of quality
- JIT improves quality
- Better quality means less inventory and better, easier-to-employ JIT system

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## Just in Time (JIT)

- 'Pull' system of production/purchasing
  - Customer starts production with an order
- Involves 'vendor partnership programs' to improve quality of purchased items
- Reduces all inventory levels
  - Inventory hides process & material problems
- Improves process & product quality

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## Just In Time (JIT) Example

Work in process inventory level (hides problems)

Unreliable Vendors Scrap Capacity Imbalances

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## Just In Time (JIT) Example

Reducing inventory reveals problems so they can be solved.

Unreliable Vendors Scrap Capacity Imbalances

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## Tools for TQM

- Quality Function Deployment
  - House of Quality
- Taguchi technique
- Quality loss function
- Pareto charts
- Process charts
- Cause-and-effect diagrams
- Statistical process control

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## Quality Function Deployment (QFD)

- Determines what will satisfy the customer
- Translates those customer desires into the target design

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## Taguchi Techniques

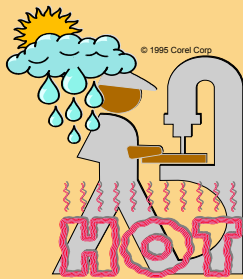
- Experimental design methods to improve product & process design
  - Identify key component & process variables affecting product variation
- Taguchi *Concepts*
  - Quality robustness
  - Quality loss function
  - Target specifications

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## Quality Robustness

- Ability to produce products uniformly regardless of manufacturing conditions
- Put robustness in House of Quality matrices besides functionality



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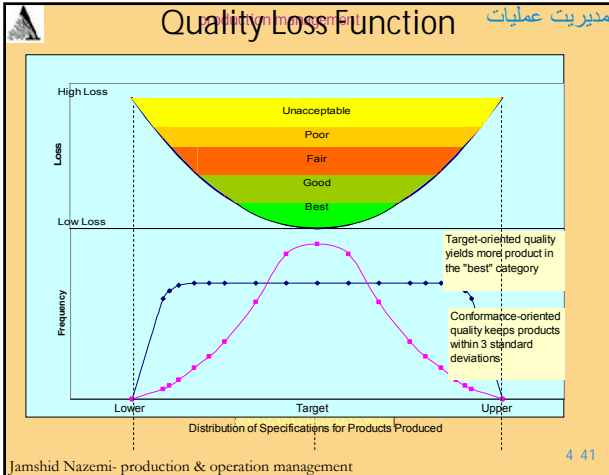
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## Quality Loss Function

- Shows social cost (\$) of deviation from target value
- Assumptions
  - Most measurable quality characteristics (e.g., length, weight) have a target value
  - Deviations from target value are undesirable
- Equation:  $L = D^2C$ 
  - L = Loss (\$); D = Deviation; C = Cost

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### Quality Loss Function Example

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The specifications for the diameter of a gear are  $25.00 \pm 0.25$  mm

If the diameter is out of specification, the gear must be scrapped at a cost of \$4.00. What is the loss function?

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### Quality Loss Function Solution

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- $L = D^2C = (X - \text{Target})^2C$ 
  - L = Loss (\$); D = Deviation; C = Cost
- $4.00 = (25.25 - 25.00)^2C$ 
  - Item scrapped if greater than 25.25 (USL = 25.00 + 0.25) with a cost of \$4.00
- $C = 4.00 / (25.25 - 25.00)^2 = 64$
- $L = D^2 \cdot 64 = (X - 25.00)^2 64$ 
  - Enter various X values to obtain L & plot

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### Target Specification Example

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A study found U.S. consumers preferred Sony TV's made in Japan to those made in the U.S. Both factories used the same designs & specifications. The difference in quality goals made the difference in consumer preferences.

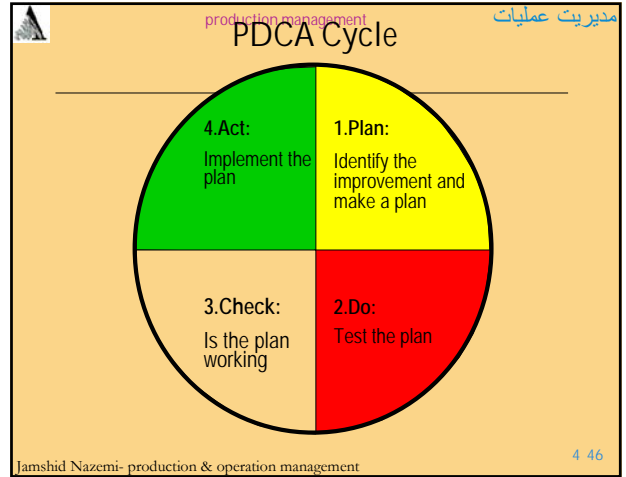
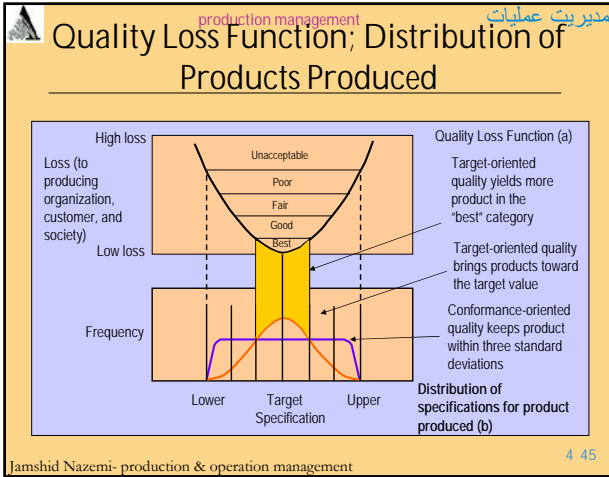
Freq.

LSL Target USL X

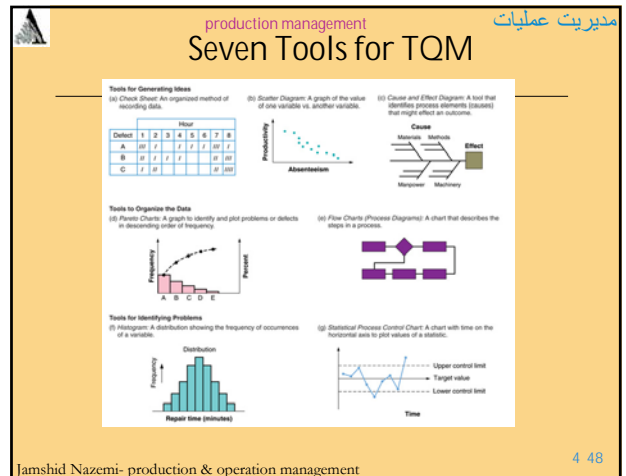
Japanese factory (Target-oriented)

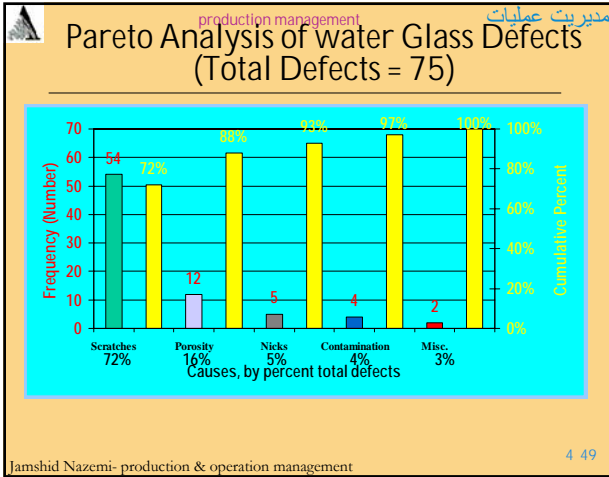
U.S. factory (Conformance-oriented)

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- ## Tools of TQM
- **Tools for generating ideas**
    - Check sheet
    - Scatter diagram
    - Cause and effect diagram
  - **Tools to organize data**
    - Pareto charts
    - Process charts (Flow diagrams)
  - **Tools for identifying problems**
    - Histograms
    - Statistical process control chart
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- ### Process Chart
- Shows sequence of events in process
  - Depicts activity relationships
  - Has many uses
    - Identify data collection points
    - Find problem sources
    - Identify places for improvement
    - Identify where travel distances can be reduced
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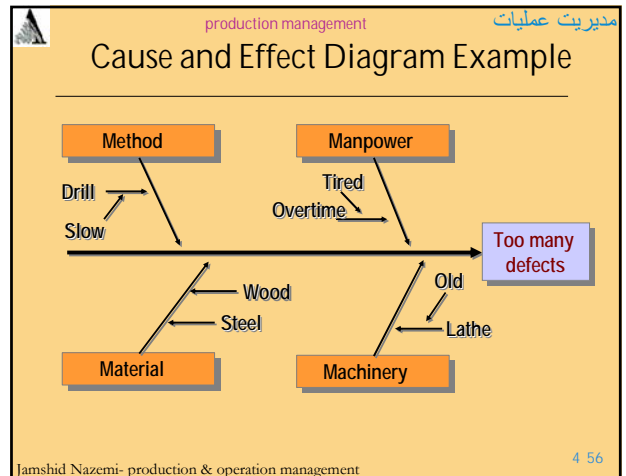
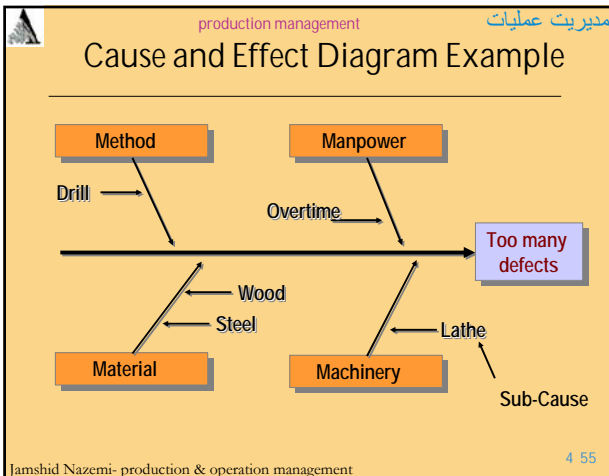
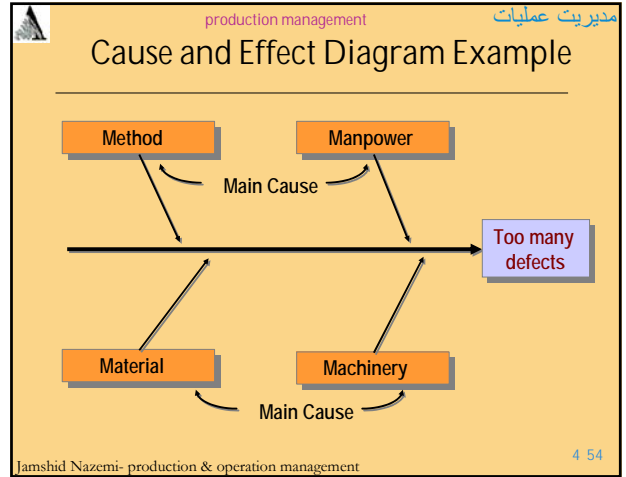
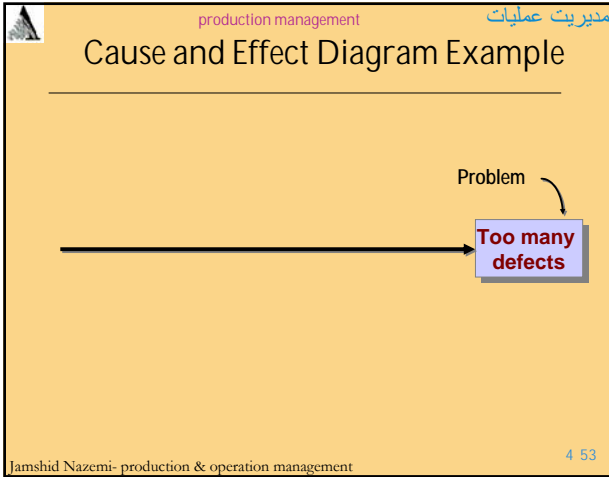
### Process Chart Example

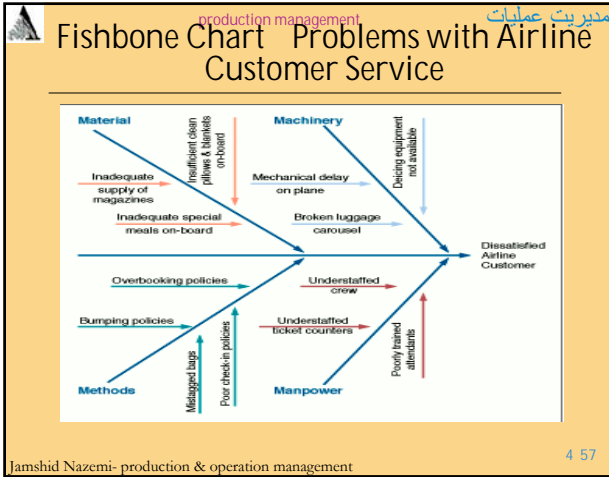
SUBJECT: Request tool purchase			
Dist (ft)	Time (min)	Symbol	Description
		●⇒□D∇	Write order
		○⇒□D∇	On desk
75		○⇒□D∇	To buyer
		○⇒■D∇	Examine

○ = Operation; ⇒ = Transport; □ = Inspect;  
D = Delay; ∇ = Storage

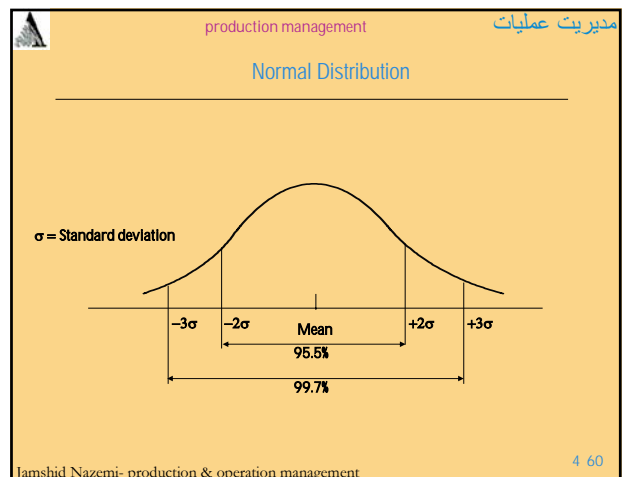
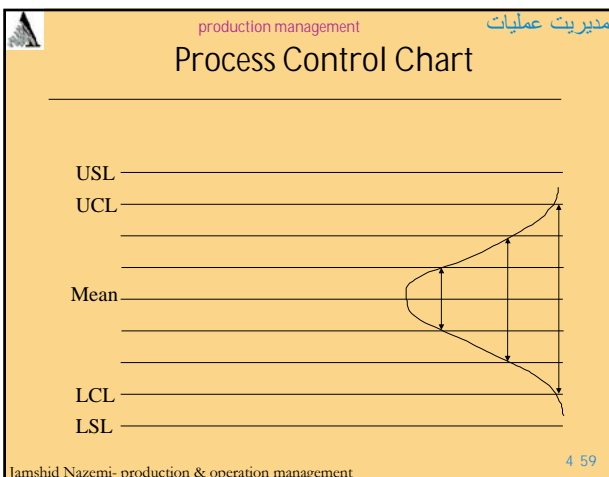
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- ### Cause and Effect Diagram
- Used to find problem sources/solutions
  - Other names
    - Fish-bone diagram, Ishikawa diagram
  - Steps
    - Identify problem to correct
    - Draw main causes for problem as 'bones'
    - Ask 'What could have caused problems in these areas?' Repeat for each sub-area.
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- ### Statistical Process Control (SPC)
- Uses statistics & control charts to tell when to adjust process
  - Developed by Shewhart in 1920's
  - Involves
    - Creating standards (upper & lower limits)
    - Measuring sample output (e.g. mean wgt.)
    - Taking corrective action (if necessary)
  - Done while product is being produced
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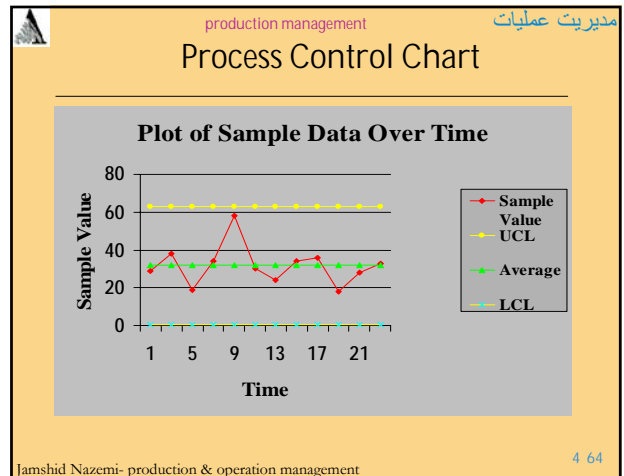
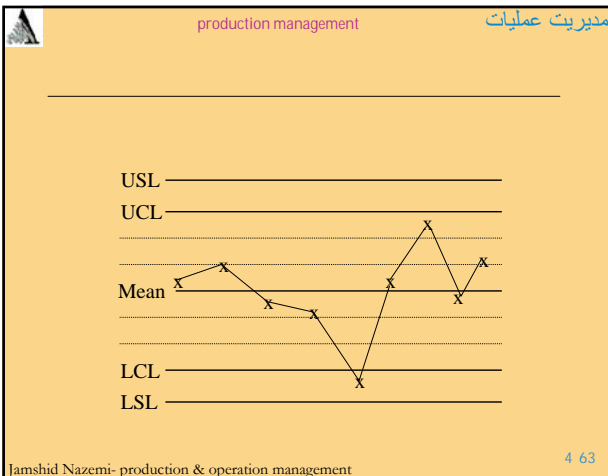
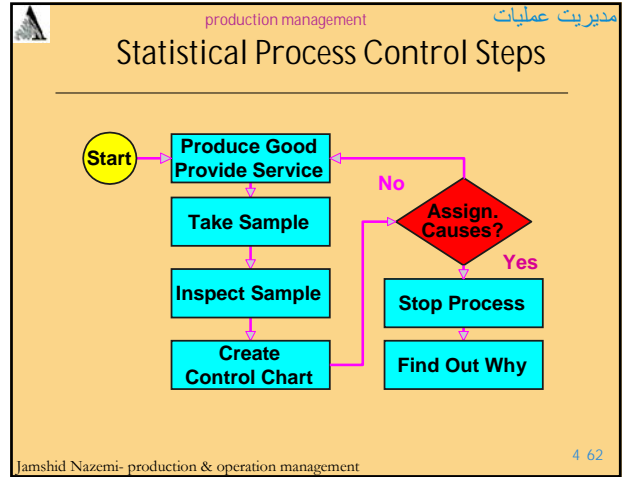


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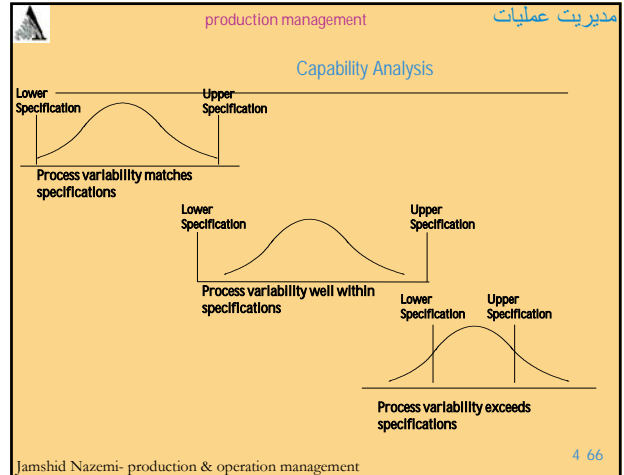
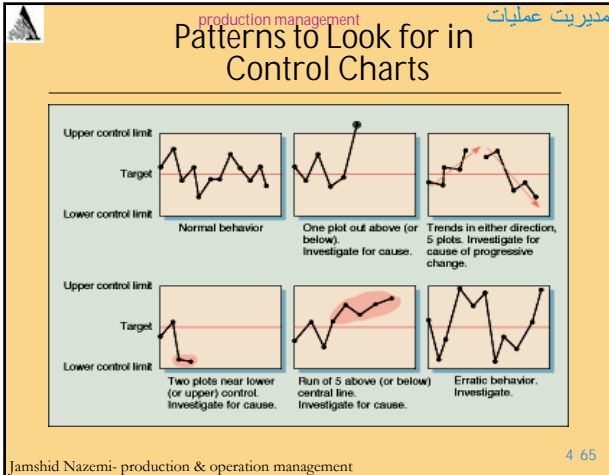
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- Control charts
  - Variables (continues statistics)
    - Mean chart
    - Range chart
  - Attributes (discrete statistics)
    - p chart
    - c chart
- Run tests

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- ### Inspection
- Involves examining items to see if an item is good or defective
  - Detect a defective product
    - Does not correct deficiencies in process or product
  - Issues
    - When to inspect
    - Where in process to inspect
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- ### When and Where to Inspect
- At the supplier's plant while the supplier is producing
  - At your facility upon receipt of goods from the supplier
  - Before costly or irreversible processes
  - During the step-by-step production processes
  - When production or service is complete
  - Before delivery from your facility
  - At the point of customer contact
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### Inspection Points in Services

Organization	What is Inspected	Standard
Jones Law Office	Receptionist performance	Is phone answered by the second ring
	Billing	Accurate, timely, and correct format
	Attorney	Promptness in returning calls

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### Inspection Points in Services

Organization	What is Inspected	Standard
Hard Rock Hotel	Reception desk	Use customer's name
	Doorman	Greet guest in less than 30 seconds
	Room	All lights working, spotless bathroom
	Minibar	Restocked and charges accurately posted to bill

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### Inspection Points in Services

Organization	What is Inspected	Standard
Bayfield Community Hospital	Billing	Accurate, timely, and correct format
	Pharmacy	Prescription accuracy, inventory accuracy
	Lab	Audit for lab-test accuracy
	Nurses	Charts immediately updated
	Admissions	Data entered correctly and completely

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### Inspection Points in Services

Organization	What is Inspected	Standard
Hard Rock Cafe	Busboy	Serves water and bread within 1 minute
	Busboy	Clears all entrée items and crumbs prior to desert
	Waiter	Knows and suggest specials and desserts

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## Inspection Points in Services

Organization	What is Inspected	Standard
Nordstrom's Department Store	Display areas	Attractive, well-organized, stocked, good lighting
	Stockrooms	Rotation of goods, organized, clean
	Salesclerks	Neat, courteous, very knowledgeable

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## Inspection Points in Services

Organization	Some Points of Inspection	Issues to Consider
Bank	Teller stations	Shortages, courtesy, speed, accuracy
	Loan accounts	Collateral, proper credit checks, rates, terms of loans, default rates, loan rates
	Checking accounts	Accuracy, speed of entry, rate of overdraws

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## Inspection Points in Services

Organization	Some Points of Inspection	Issues to Consider
Retail store	Stockrooms	Clean, uncluttered, organized, level of stockouts, amply supply, rotation of goods
	Display areas	Attractive, well-organized, stocked, visible goods, good lighting
	Sales counters	Neat, courteous knowledgeable personnel; waiting time; accuracy in credit checking and sales entry

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## Inspection Points in Services

Organization	Some Points of Inspection	Issues to Consider
Restaurant	Kitchen	Clean, proper storage, unadulterated food, health regulations observed, well-organized
	Cashier station	Speed, accuracy, appearance
	Dining areas	Clean, comfortable, regular monitoring by personnel,

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## TQM In Services

- Service quality is more difficult to measure than for goods
- Service quality perceptions depend on
  - Expectations versus reality
  - Process and outcome
- Types of service quality
  - Normal: Routine service delivery
  - Exceptional: How problems are handled

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## Goods versus Services

<u>Good</u>	<u>Service</u>
• Can be resold	• Reselling unusual
• Can be inventoried	• Difficult to inventory
• Some aspects of quality measurable	• Quality difficult to measure
• Selling is distinct from production	• Selling is part of service

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## Goods versus Services continued

<u>Good</u>	<u>Service</u>
• Product is transportable	• Provider, not product is transportable
• Site of facility important for cost	• Site of facility important for customer contact
• Often easy to automate	• Often difficult to automate
• Revenue generated primarily from tangible product	• Revenue generated primarily from intangible service.

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## Service Quality Attributes

Reliability      Responsiveness

Tangibles      Competence

Under-      Access

standing      Courtesy

Security      Communication

Credibility

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## Determinants of Service Quality

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- Reliability – consistency and dependability
- Responsiveness – willingness/readiness of employees to provide service; timeliness
- Competence – possession of skills and knowledge required to perform service
- Access – approachability and ease of contact
- Courtesy – politeness, respect, consideration, friendliness of contact personnel

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## Determinants of Service Quality Continued

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- Communication – keeping customers informed in languages they understand
- Credibility – trustworthiness, believability, honesty
- Security – freedom from danger, risk or doubt
- Understanding/knowing the customer – making the effort to understand the customer's needs
- Tangibles – the physical evidence of the service

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### QM Key Contributors: W. Edward Deming

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- Statistics, New York University, 1940s. Went to Japan after WWII. Deming Prize, Japan.
- Compiled a famous list of 14 points.
  - The key elements are constancy of purpose, continual improvement, and profound knowledge.
- His message is that the cause of the inefficiency and poor quality is the system, not the employees. Management's responsibility is to correct the system to achieve the desired results.

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QM Key Contributors: Joseph M. Juran

- quality Control Handbook, 1951. Juran on quality, Juran Institute in Wilton. Idea is close to Deming's.
- Describe quality management in terms of a trilogy consisting of
  - quality planning: establish processes that are capable of meeting quality standards;
  - quality control: know when corrective action is needed;
  - quality improvement: find better ways of doing things.
- First to measure cost of quality.

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production management مدیریت عملیات

QM Key Contributors: Armand Feigenbaum

- Cost of Nonconformance. GE top expert on quality at 24. Total quality Control, 1961.
- 40 steps of quality principles.
  - When improvements were made in a process, other areas of the company also achieved improvements.
  - People could learn from each other's successes.
  - Open work environment led to cross-functional teamwork.
  - It is the customer who defines quality.

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production management مدیریت عملیات

QM Key Contributors: Philips Crosby

- Martin Marietta, 1960s. Corporate VP for quality at ITT, 1970s.
- quality Is Free (The costs of poor quality are much greater than traditionally defined.), 1979. quality without Tears: The Art of Hassle-Free Management, 1984.
  - Top management must demonstrate its commitment to quality and its willingness to give support to achieve good quality.
  - Management must be persistent in efforts to achieve good quality.
  - Management must spell out clearly what it wants in terms of quality and what workers must do to achieve that.
  - Zero defects. Do it right the first time.

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production management مدیریت عملیات

QM Key Contributors: Kaoru Ishikawa

- Cause-And-Effect / Fishbone diagram.
- quality Circles.
- First to call attention to internal customers --- the next person in a process.
- First to make quality control "user friendly" for workers.

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QM Key Contributors: Genichi Taguchi

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- Taguchi loss function --- determining the cost of poor quality.
- Combined effect of deviations of all parts from their standards can be large, even though each individual deviation could be small.
- Help Ford Motor Company to reduce its warranty losses by achieving less variation in the output of transmissions.