INTRODUCTION TO QUALITY MANAGEMENT

WHAT ARE WE GOING TO DISCUSS?

- **Overview of Quality/Quality Management**
  - Importance of Quality Management
  - Quality Definition
  - Quality Inspection
  - Quality Control
  - Quality Control Tools
  - Quality Assurance
  - Quality Engineering
  - Quality Management

IMPORTANCE OF QUALITY MANAGEMENT

- Construction projects involve many participants
    - Owner, Designer, Contractor & Professionals from Construction related industries
- Construction Projects have become more complex and technical, and extensive efforts are required to reduce rework and costs associated with time, materials, and engineering.
- Research in the construction industry has proved that utilization of Quality Management concepts has a great influence on the cost-effectiveness results of construction projects and achieving successful project performance by Quality Procedures & Principles.

CONSTRUCTION PROJECT TRILOGY

QUALITY DEFINITION

- Quality can be defined as
  - "The characteristics of a product or service that bear on its ability to satisfy stated or implied needs."
  - A product or service free of deficiencies.

- In other words, five approaches for defining quality
  1. *Transcendent*
  2. *Product-based*
  3. *User-based*
  4. *Manufacturing-based*
  5. *Value-based*

QUALITY INSPECTION

- *"Most construction projects specify that all the contracted works are subject to inspection by the owner/consultant/owner's representative."*

- An inspection is a specific examination, testing, and formal evaluation exercise and overall appraisal of a process, product, or service to ascertain if it conforms to established requirements.

- The results are usually compared to specified requirements and standards for determining whether the item or activity is in line with the target.

QUALITY INSPECTION

- Inspections are usually Non-destructive

- Inspection accuracy depends on
    1. Level of human error
    2. Accuracy of the instruments
    3. Completeness of the inspection planning

QUALITY CONTROL

- *"Quality Control is process orientation that consists of product inspection and statistical quality control."*

- Steps in Quality Control for Projects
    1. *Setting Standards*
    2. *Appraising Conformance*
    3. *Acting When Necessary*
    4. *Planning of Improvements*

- Quality control in construction projects is performed at every stage through the use of various control charts, diagrams, checklists, etc.

QUALITY CONTROL

- *"Quality Control can also be defined as*

  - ✓ *Checking of executed/installed works to confirm that works have been performed/executed as specified to meet intended use*
  - ✓ *Controlling budget*
  - ✓ *Planning, monitoring and controlling project schedule"*

- There are a variety of methods, tools, and techniques that can be applied for Quality Control and the improvement process during various stages of a Construction Project.

QUALITY CONTROL TOOLS

- Most commonly used quality control tools for a variety of applications to improve the Quality Process

1. Cause-and-effect diagram *(Ishikawa/Fishbone diagram)*
2. Check sheet
3. Control chart
4. Data collection
5. Flow chart
6. Histogram
7. Pareto analysis
8. Pie chart
9. Run chart
10. Scatter diagram

Cause & Effect Diagram

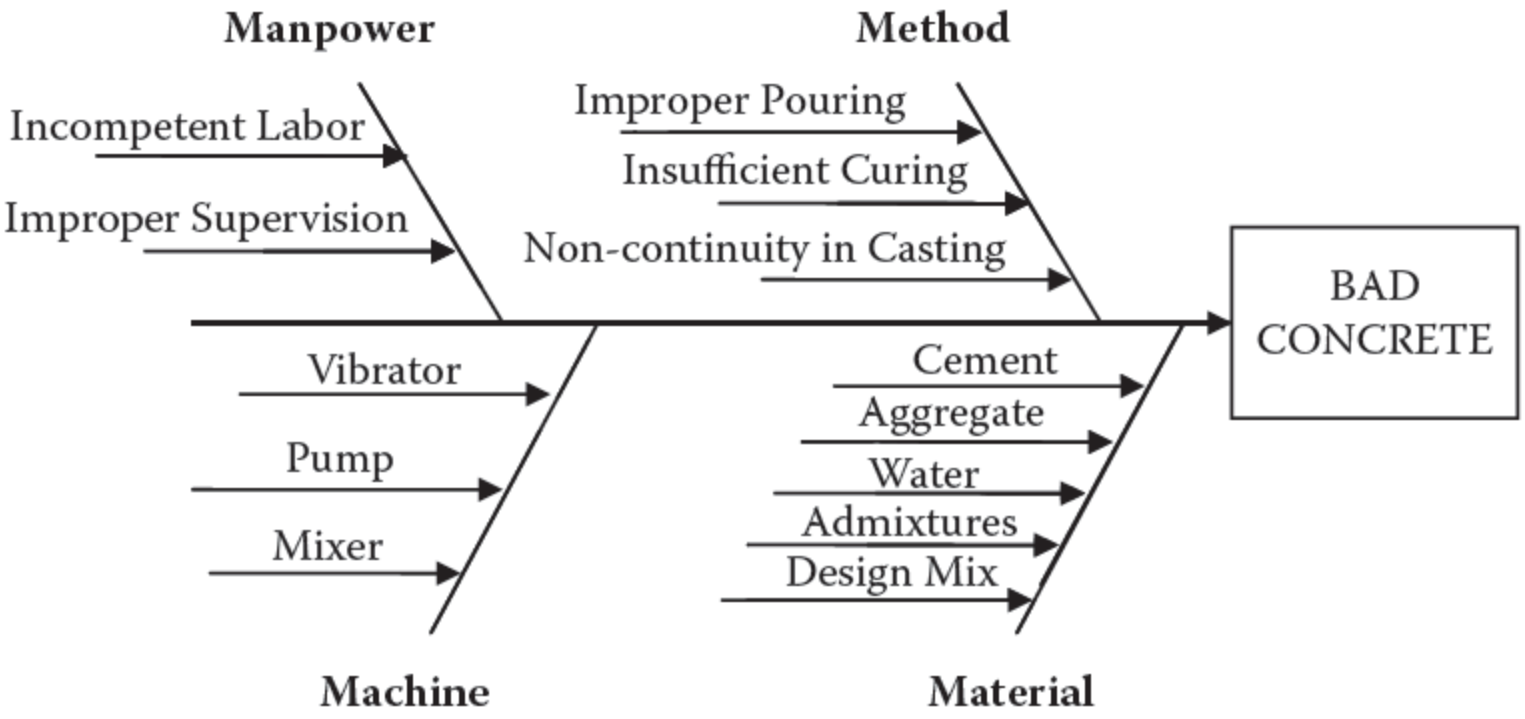


FIGURE 1.4
Cause-and-effect diagram for bad concrete.

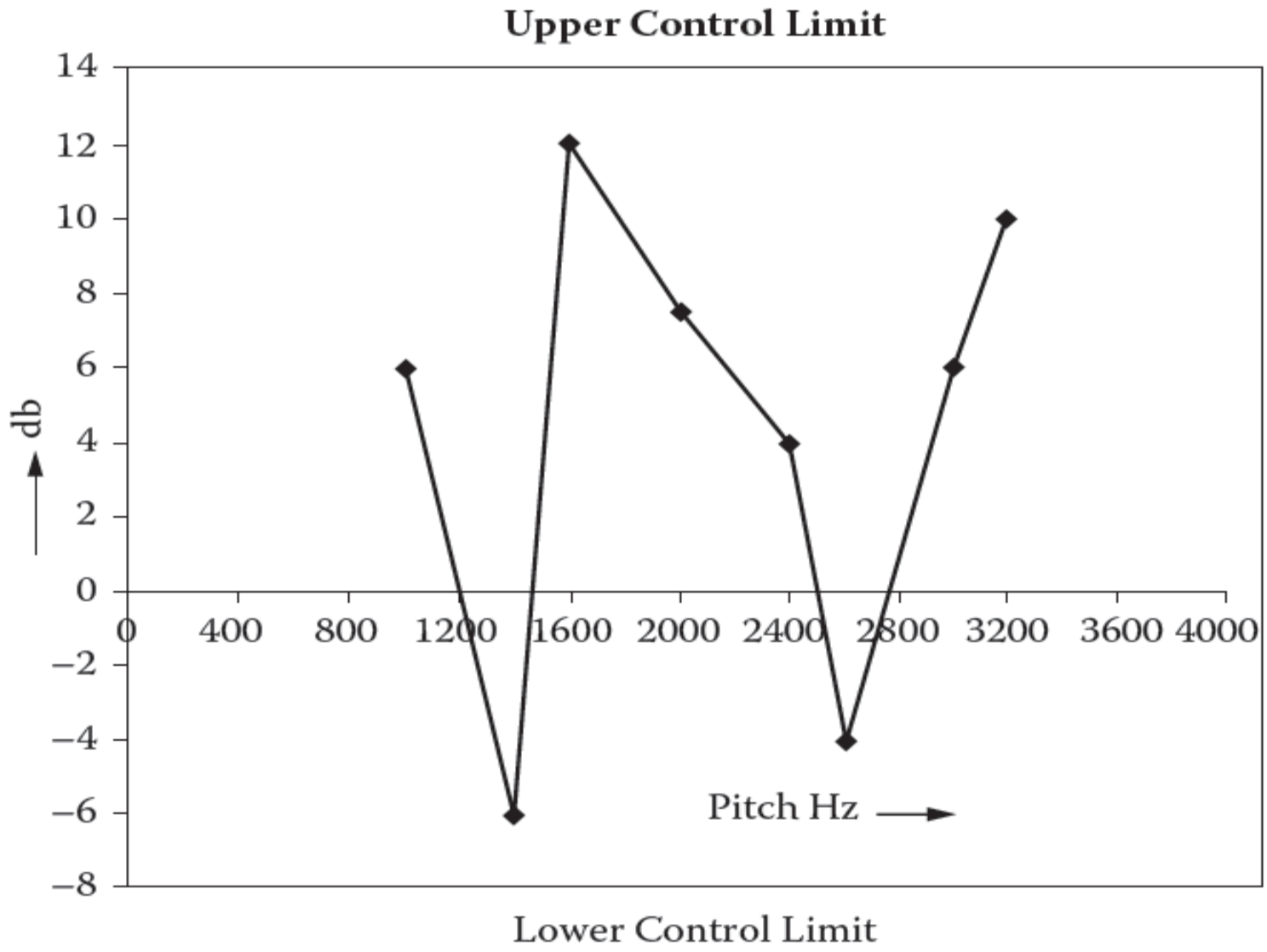
Check Sheet

TABLE 1.2

Check Sheet

	Approval Record for a Particular Month			
	Approved	Not Approved	Total	% Not Approved
Shop drawing			15	20
Material			10	30
Checklists			25	12

Control Chart



Data Collection

- The objectives are to

    1. Identify the problem
    2. Report the problem
    3. Verify the problem
    4. Analyze the problem
    5. Correct the problem

Flow Chart

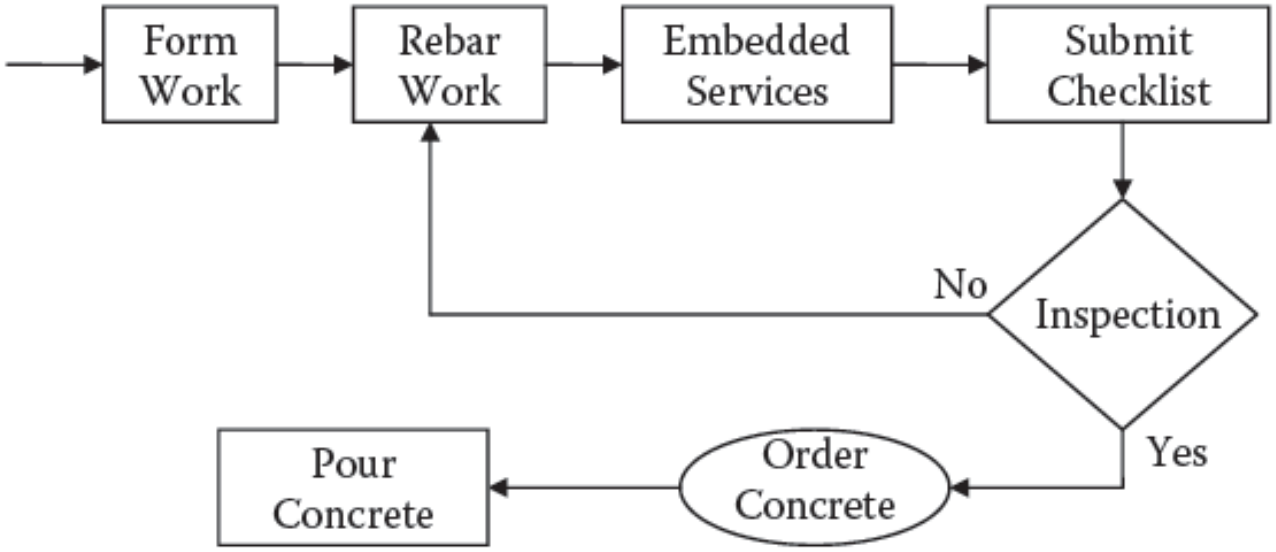


FIGURE 1.6
Flowchart for concrete casting.

Histogram

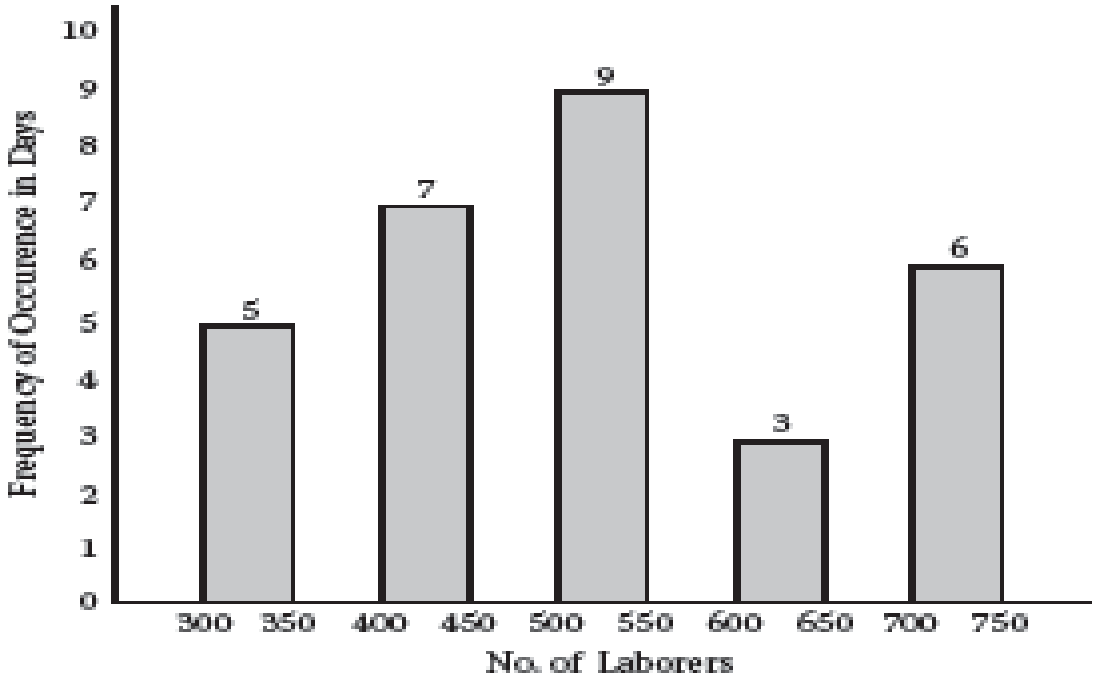


FIGURE 1.7
Histogram for manpower.

Pareto Analysis

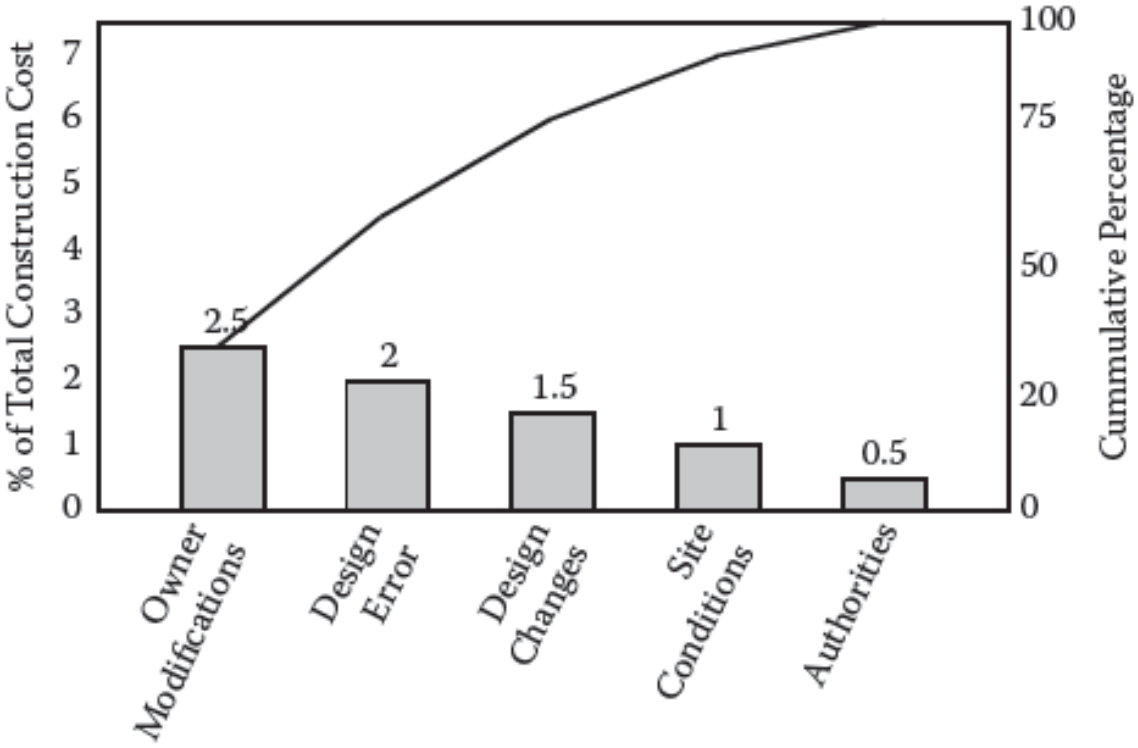


FIGURE 1.8
Pareto analysis for variation cost.

Pie Chart

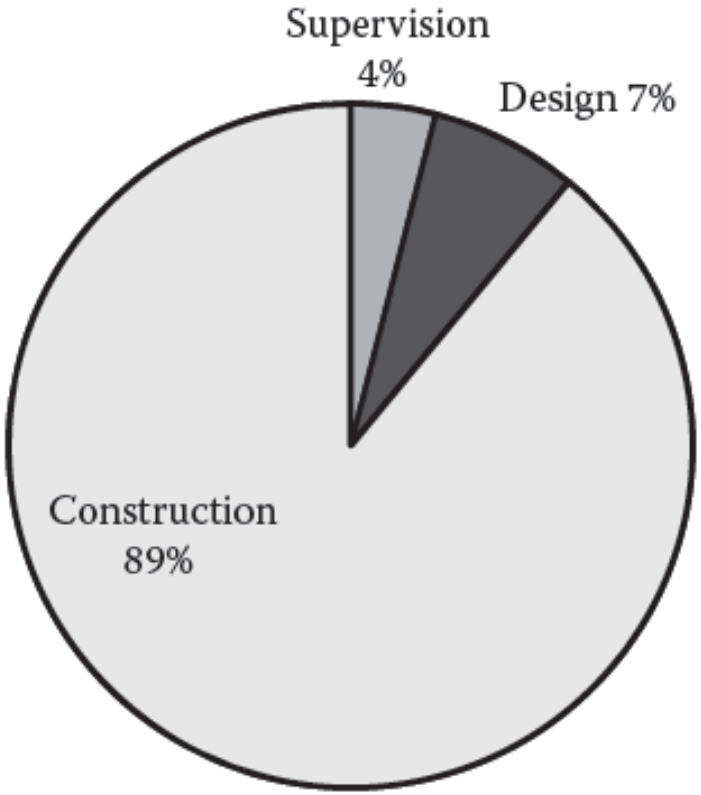


FIGURE 1.9
Pie chart for content of construction project cost.

Run Chart

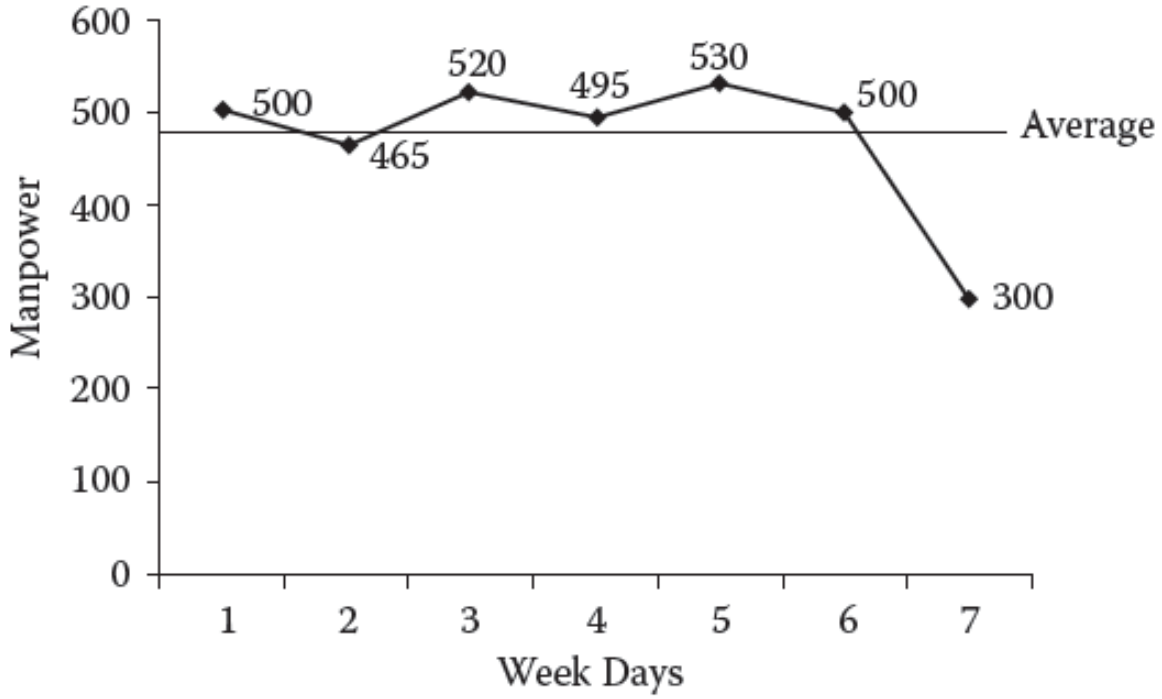


FIGURE 1.10
Run chart for manpower.

Scatter Diagram

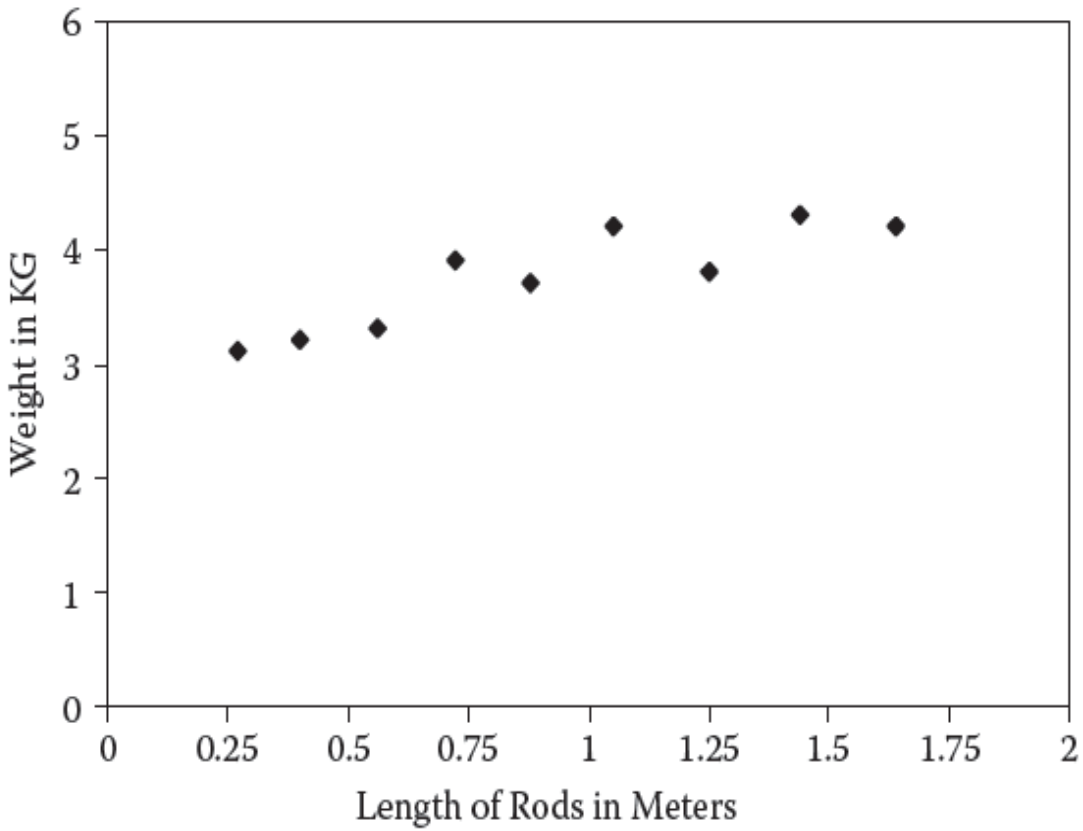


FIGURE 1.11
Scatter diagram.

QUALITY ASSURANCE

- Quality assurance in construction projects covers all activities performed by the design team, contractor and quality controller/auditor (supervision staff) to meet owners' objectives as specified and to ensure that the project/facility is fully functional to the satisfaction of the owners/end users.

- *Quality Assurance can be defined as "All the planned and systematic activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfill requirements for quality."*

QUALITY ENGINEERING

- *Quality Engineering is "The body of technical knowledge for formulating policy and for analyzing and planning product quality in order to implement and support that quality system which will yield full customer satisfaction at minimum cost."*

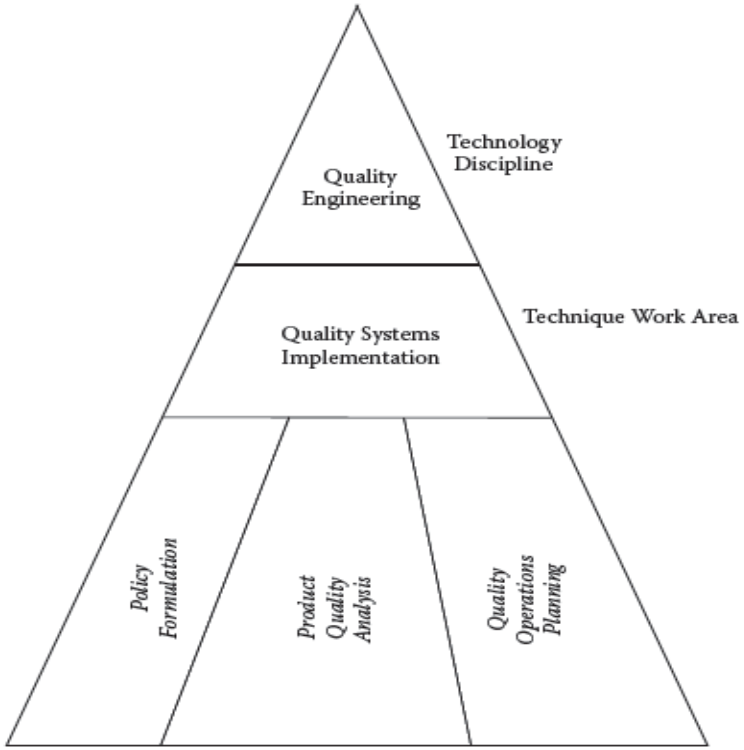


FIGURE 1.12
Quality engineering triangle. (From A.V. Feigenbaum, *Total Quality Control,* 1991. Reprinted with permission of The McGraw-Hill Companies.)

QUALITY MANAGEMENT

- *"The application of quality management system in managing a process to achieve maximum customer satisfaction at the lowest overall cost to the organization while continuing to improve the process."*

QUALITY MANAGEMENT

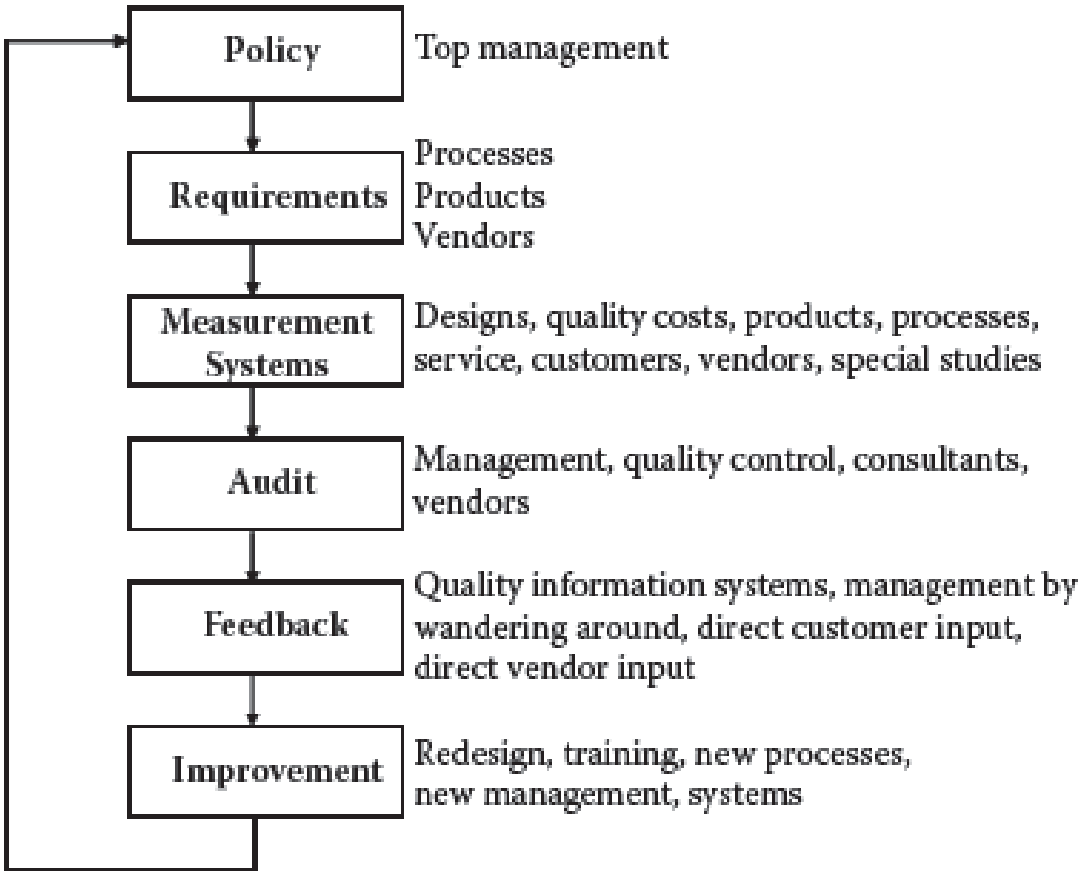


FIGURE 1.13
Total quality system. (From T. Pyzdek, *Quality Handbook*, 1999. Reprinted with permission from Quality America, Inc.)

THANK YOU

QUALITY MANAGEMENT GURUS & THEIR PHILOSOPHIES

WHAT ARE WE GOING TO DISCUSS?

- **Quality Management Gurus**
  - ***Philip B. Crosby***
  - ***W. Edwards Deming***
  - Armand V. Feigenbaum
  - ***Kaoru Ishikawa***
  - ***Joseph M. Juran***
  - John S. Oakland
  - Shigeo Shingo
  - Genichi Taguchi

PHILIP B. CROSBY

- Crosby's philosophy has five *"Absolute Truths of Quality Management"*.

    1. *Quality is defined as conformance to requirement, not as "goodness" or "elegance."*
    2. *There is no such thing as a quality problem.*
    3. *It is always cheaper to do it right the first time.*
    4. *The only performance measurement is the cost of quality.*
    5. *The only performance standard is zero defects.*

PHILIP B. CROSBY

- *Crosby's perspective on quality has three essential beliefs:*

    1. *A belief in qualification*
    2. *Management leadership*
    3. *Prevention rather than cure*

- *Crosby's principal method is his 14-step program for quality management.*

- *His main emphasis is the quantitative, that is, the performance standard of "zero defects."*

PHILIP B. CROSBY

Step	Description of Quality Program
Step 1	Establish management commitment
Step 2	Form quality improvement teams
Step 3	Establish quality measurements
Step 4	Evaluate the cost of quality
Step 5	Raise quality awareness
Step 6	Take action to correct problems
Step 7	Zero defects planning
Step 8	Train supervisors and managers
Step 9	Hold a "Zero Defects" day to establish the attitude and expectation within the company
Step 10	Encourage the setting of goals for improvement
Step 11	Obstacle reporting
Step 12	Recognition for contributors
Step 13	Establish quality councils
Step 14	Do it all over again

FIGURE 1.14
Fourteen-step quality program. (From P.B. Crosby, *Quality Is Free,* McGraw-Hill, 1979. Reprinted with permission of The McGraw-Hill Companies.)

W. EDWARDS DEMING

- Deming was perhaps the best-known figure associated with the quality field.
- He is considered as Quality founding father.
- His philosophy is based on four Principal Methods:

1. *The Plan–Do–Check–Act (PDCA) Cycle*
2. *Statistical process control*
3. *The 14 principles of transformation*
4. *The seven-point action plan*

W. EDWARDS DEMING – PDCA CYCLE

- PDCA cycle: Plan, Do, Check, and Act.
- This cycle is iterative; once it has been completed, it recommences without ceasing.
- Also known as the Plan–Do–Study–Act (PDSA) cycle.

Theory Description

✓ Four - step model for carrying out change

✓ Just as a circle has no end, the PDCA cycle should be repeated again and again for continuous improvement

✓ PDCA is a basic model that can be compared to the continuous improvement process, which can be applied on a small scale.

W. EDWARDS DEMING – PDCA CYCLE

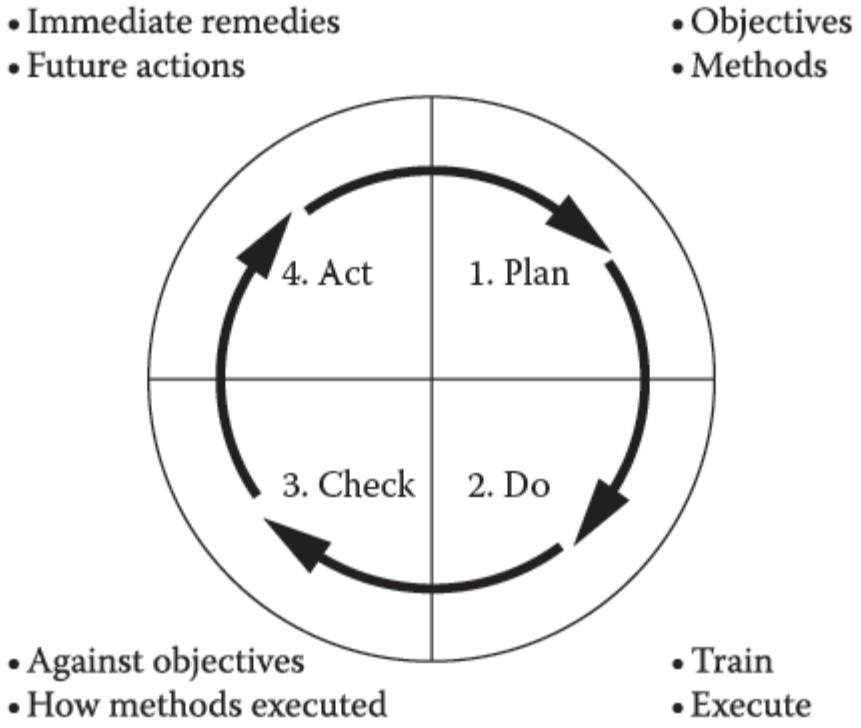


FIGURE 1.15
PDCA cycle. (Adapted from H. Kerzner, *Project Management*, 2001. Reprinted with permission of John Wiley & Sons, Inc.)

PDCA CYCLE APPLICATION

1. As a model for continuous improvement
2. When starting a new improvement project
3. When developing a new or improved design of process, product, or service
4. When defining a repetitive work process
5. When planning data collection and analysis in order to verify and prioritize problems or root causes
6. When implementing any change

PDCA CYCLE METHODOLOGY

1. *Plan*. Recognize an opportunity and plan the change.

2. *Do*. Test the change; carry out a small-scale study.

3. *Check*. Review the test, analyze the results, and identify learnings.

4. *Act*. Take action based on what you learned in the study step. If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate the learning from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again.When defining a repetitive work process.

PDCA CYCLE FOR CONSTRUCTION PROJECTS

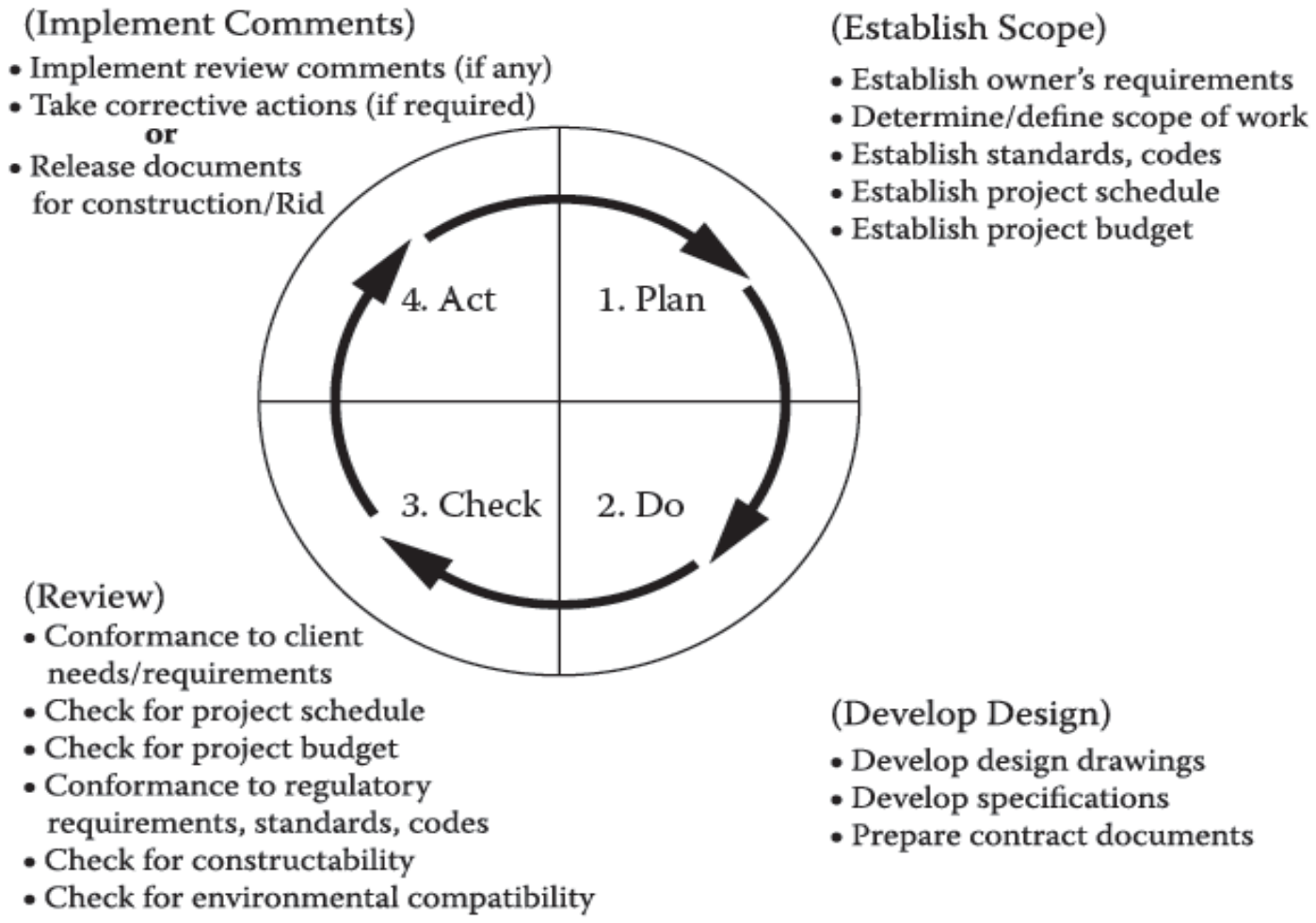


FIGURE 1.16
PDCA cycle for construction projects (design phases).

W. EDWARDS DEMING – 14 Principles of Transformation

14 Principles of Transformation: W. Edwards Deming

THE QUALITY GURUS W. Edwards Deming	
Principle 1	Create constancy of purpose to improve product and service.
Principle 2	Adopt a new philosophy for the new economic age with management learning what their responsibilities are and by assuming leadership for change.
Principle 3	Cease dependence on mass inspection to achieve quality by building quality into the product.
Principle 4	End awarding business on price. Award business on total cost and move toward single suppliers.
Principle 5	Aim for continuous improvement of the system of production and service to improve productivity and quality and to decrease costs.
Principle 6	Institute training on the job.
Principle 7	Institute leadership with the aim of supervising people to help them to do a better job.
Principle 8	Drive out fear so that everyone can work effectively together for the organization.
Principle 9	Break down barriers between departments. Encourage research, design, sales and production to work together to foresee difficulties in production and use.
Principle 10	Eliminate slogans, exhortations and numerical targets for the workforce since they are divisory and difficulties belong to the whole system.
Principle 11	Eliminate quotas or work standards and management by objectives or numerical goals; leadership should be substituted instead.
Principle 12	Remove barriers that rob people of their right to pride in their work.
Principle 13	Institute a vigorous education and self-improvement program.
Principle 14	Put everyone in the company to work to accomplish the transformation.

Source: Deming, W.E., *Out of Crisis,* 2000. Reprinted with permission of MIT Press.

W. EDWARDS DEMING – 7 POINT ACTION PLAN

Point 1	Management must agree on the meaning of the quality program, its implications and the direction to take.
Point 2	Top management must accept and adopt the new philosophy.
Point 3	Top management must communicate the plan and the necessity for it to the people in the organization.
Point 4	Every activity must be recognized as a step in a process and the customers of that process identified. The customers are responsible for the next stage of the process.
Point 5	Each stage must adopt the "Deming" or "Shewhart" cycle—Plan, Do, Check, Action—as the basis of quality improvement.
Point 6	Team work must be engendered and encouraged to improve inputs and outputs. Everyone must be enabled to contribute to this process.
Point 7	Construct organization for quality with the support of knowledgeable statisticians.

FIGURE 1.17
Seven-point action plan. (Adapted from Deming, W.E., *Out of the Crisis,* 2000. Reprinted with permission of MIT Press.)

Joseph M. Juran

- As per Juran, “Quality does not happen by accident; it has to be planned.”
- The emphasis is on
  - ✓ Planning Organizational Issues (Quality Planning)
  - ✓ Management’s responsibility for Quality (Quality Control)
  - ✓ The need to set goals and targets for improvement (Quality Improvement)
- Quality Planning, Quality Control & Quality Improvement are known as Juran’s quality trilogy.

Joseph M. Juran – Quality Planning

- Quality planning includes
  - ✓ Identifying internal and external customers
  - ✓ Determining Customer needs
  - ✓ Developing a product or service that responds to those needs
  - ✓ Establishing goals that meet the needs of customers and suppliers at a minimum cost, and
  - ✓ Proving that the process is capable of meeting quality goals under operating conditions

Juran – Quality Planning Steps

TABLE 1.8

The Quality Planning Steps

Step	Description
Step 1	Establish the project.
Step 2	Identify the customers.
Step 3	Identify the needs of those customers.
Step 4	Analyze and prioritize customer needs.
Step 5	Develop a product that can respond to customer needs.
Step 6	Optimize the product features so as to meet the organization's product range as well as customer needs.
Step 7	Identify process and goals.
Step 8	Develop a process that is able to produce the product.
Step 9	Optimize the process features and goals.
Step 10	Prove that the process can produce the product under operating conditions.
Step 11	Identify control needs.
Step 12	Transfer the process to operations.

Joseph M. Juran – Quality Control

- Quality Control includes
  - ✓ Collection and analysis of data for the purpose of determining how best to meet project goals under normal operating conditions.
  - ✓ To measure the difference between the actual performance before and after the process or system has been modified, the data should be statistically significant and the process or system should be in statistical control.
  - ✓ Task forces working on various problems need to establish baseline data so that they can determine if the implemented recommendations are responsible for the observed improvements.

Juran – Quality Control Steps

Step	Description
Step 1	Choose control subject
Step 2	Establish standards/objectives
Step 3	Monitor actual performance
Step 4	Compare objectives with achievements
Step 5	Take corrective action to reduce the differences

FIGURE 1.21
The quality control steps. (From J.M. Juran and A.B. Godfrey, *Juran's Quality Handbook*, 1999. Reprinted with permission of The McGraw-Hill Companies.)

Joseph M. Juran – Quality Improvement

- Quality Improvement includes
  - ✓ Process is concerned with breaking through to a new level of performance.
  - ✓ The end result is that the particular process or system is obviously at a higher level of quality in delivering either a product or a service.
- Juran's approach stresses
  - ✓ Involvement of employees in all phases of a project.
  - ✓ The philosophy and procedures require that managers listen to employees and help them rank the processes and systems that need improving.

Juran – Quality Improvement Steps

Step	Description
Step 1	Prove the need for quality improvement
Step 2	Identify project
Step 3	Set goals for continuous improvement
Step 4	Build a team to achieve goals by establishing a quality council, identifying problems, selecting a project, appointing teams and selecting facilitators
Step 5	Train team members
Step 6	Diagonize the causes
Step 7	Prepare report
Step 8	Formulate theories
Step 9	Provide remedial action
Step 10	Prove that the remedies are effective
Step 11	Deal with resistance to change
Step 12	Incorporate improvement into the company's regular systems and processes and control to hold the gain

FIGURE 1.22
Steps to continuous quality improvement. (From J.M. Juran and A.B. Godfrey, *Juran's Quality Handbook,* 1999. Reprinted with permission of The McGraw-Hill Companies.)

Comparison of Philosophies

The Quality Gurus Compared

	Crosby	Deming	Juran
Definition of quality	Conformance to requirements	A predictable degree of uniformity and dependability at low cost and suited to the market	Fitness for use (satisfies customer's need)
Degree of senior management responsibility	Responsible for quality	Responsible for 94% of quality problems	Less than 20% of quality problems are due to workers
Performance standard/ motivation	Zero defects	Quality has many "scales"; use statistics to measure performance in all areas; critical of zero defects	Avoid campaigns to do perfect work
General approach	Prevention, not inspection	Reduce variability by continuous improvement; cease mass inspection	General management approach to quality, especially human elements

Comparison of Philosophies

Structure	14 steps to quality improvement	14 points for management	10 steps to quality improvement
Statistical process control (SPC)	Rejects statistically acceptable levels of quality (wants 100% perfect quality)	Statistically methods of quality control must be used	Recommends SPC but warns that it can lead to tool-driven approach
Improvement basis	A process, not a program; improvement goals	Continuous to reduce variation; eliminate goals without methods	Project-by-project team approach; set goals
Teamwork	Quality improvement teams, quality councils	Employee participation in decision making; break down barriers between departments	Team and quality circle approach
Costs of quality	Cost of nonconformance; quality is free	No optimum; continuous improvement	Quality is not free; there is no optimum
Purchasing and goals received	State requirements; supplier is extension of business; most faults due to purchasers themselves	Inspection too late; sampling allows defects to enter system; statistical evidence and control charts required	Problems are complex; carry out formal surveys
Vendor rating	Yes; quality audits useless	No; critical of most systems	Yes; but help supplier improve

Source: R. Chase, N. Aquilano, and F. Jacobs. (2001). *Operations Management*. Reprinted with permission of The McGraw-Hill Companies.

THANK YOU