WEEK 5
PROJECT QUALITY MANAGEMENT

TCM 545/645 – Project Control Systems
Dr. Richard Gebken

The Concept of Quality

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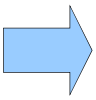
1950's

Screening out defects

Inspection



Current

Preventing defects & failures

Processes

The Concept of Quality

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- **Meeting specifications …**
  - Prevents being taken to court
  - Ensures payment
- **But is not sufficient to ensure:**
  - Customer satisfaction
  - Good reputation
  - Repeat business

The Concept of Quality

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Quality implies:

- Fitness for the intended purpose
  - Performance
  - Safety
  - Reliability
  - Ease of handling
  - Logistical support
  - Environmental safety
  - …
- Value for money
- Absence of defects

The Concept of Quality

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Quality implies that everybody:

- Knows what is expected
- Is able & willing to meet those expectations
- Knows the extent to which the project meets the expectations
- Has the ability & authority to take required corrective actions

The Concept of Quality

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- **Quality does not necessarily imply:**
  - Most expensive
  - Most sophisticated, most features
  - Most reliable
- **Good quality implies cost-effectiveness and fitness for a specific intended purpose**
- **Quality is not the same as Grade**
  - Grade is a rank or category of type of item e.g. grades of steel include categories such as stainless steels, tool steels, steels for pressure vessels, etc.

Quality Movements

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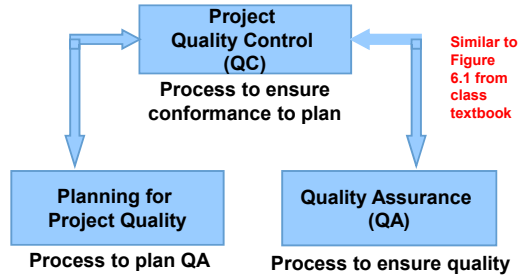
- 1950s Dr Deming in Japan
- Total Quality Management (TQM)
- Just in Time (JIT)
- Six Sigma

Project Quality Management Process



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Tools & Techniques for **Quality Planning**

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Inputs	Tools & Techniques	Outputs
• Enterprise environmental factors • Organizational process assets • Project scope statement • Project management plan • Other in-house factors	• Cost-benefit analysis • Benchmarking • Experiment design • Cost of Quality (COQ) assessment • Group decision making techniques • Other in-house tools	• Quality management plan • Quality metrics • Quality check lists • Process improvement plan • Quality baseline • Project management plans and updates • Reports and analyses

Quality Planning

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- Company-wide planning of quality systems
  - ISO 9001 specifies requirements for system
- Planning for specific project
  - Integrated with rest of project plan: provided for in schedule & budget
  - Also integrated with risk management plan, safety plan, procurement plan, communications plan, …)

Tools & Techniques for **Quality Assurance**

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Inputs	Tools & Techniques	Outputs

• Quality management plan
• Quality metrics
• Process improvement plan
• Work performance information
• Approved change requests
• Quality control measurements
• Implemented
  • Change requests
  • Corrective actions
  • Defect repair
  • Preventative repair
• Other in-house factors
	• Quality planning tools and techniques
	• Quality audits
	• Process analysis
	• Quality control tools and techniques
	• Other in-house tools/techniques
		• Requested changes
		• Recommended corrective actions
		• Organizational process assets and updates
		• Project management plans and updates
		• Other in-house outputs and reports

Techniques for QA during System Development

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Quality Assurance (QA) on a Project → Close-out & Continuous Improvement

QA toolbox:
- Training of project team members
- Configuration management system
- Configuration identification
- Design reviews and audits
- Quality function deployment
- Classification of characteristics
- Failure mode and effect analysis
- Modeling and prototyping
- Laboratory tests and other experiments
- Inspection
- Checklists

Learning opportunities:
- Project close-out meeting
- Phase close-out meetings
- Close-out reports
- Report of non-quality costs

Techniques for QA during System Development

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- Configuration Management
- Design Review
- Audit
- Classification of Characteristics
- Failure Mode and Effect Analysis
- Modeling & Prototyping

Techniques for QA during System Development

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Configuration Management

- Configuration Identification (defining the system)
  - Configuration Item (CI) – an item to be tracked & controlled as individual entity (Also see Chapter 2)
  - Master copies maintained in secure configuration center
- Configuration Control (defining "as built" status)
  - Discussed under "Quality Control"

Techniques for QA during System Development

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- **Design Reviews**
- Insure that design is acceptable in all respects:
  - Design assumptions valid
  - No omissions or errors
  - Cost of ownership
  - Safety & product liability
  - Reliability
  - Availability
  - Manufacturability
  - Shelf life
  - Operability
  - Maintainability
  - Patentability
  - Ergonomics
- Attended by representatives form several functions:
  - Construction / Manufacturing
  - Operations
  - Maintenance
  - Procurement
  - Legal
  - Quality
  - …

Techniques for QA during System Development

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- **Design Reviews**
  - **Formal Design Review**
    - Preliminary Design Review: Does concept fit requirements?
    - Critical Design Review: Do details meet specifications?
    - Functional Readiness Review: Is manufacturing process OK?
    - Product Readiness Review: Do products meet requirements when manufactured according to design documentation?
  - **Informal Design Review**

Techniques for QA during System Development

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- **Audits**
  - Verify that management processes comply with requirements
  - Verify that technical processes (e.g. welding) comply with specifications
  - Determine project status

Techniques for QA during System Development

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Audits versus Design Reviews

Design Review	Audit
Internal or external	Internal or external
Design aspects	Variety of aspects
Formal or informal	Formal
Room for innovation	Strictly verification

Techniques for QA during System Development

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Classification of Characteristics

- Large numbers of characteristics
- Pareto principle: small number of characteristics have most serious impact
- Basis for decisions regarding modifications, waivers and deviations
- Classification of characteristics in high-level systems guide designers of lower-level systems
- Not to be confused with classification of defects

Example Classification of Characteristics

- Critical
- Major A
- Major B
- Minor

Techniques for QA during System Development

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FMEA

(Failure Mode & Effect Analysis)

Determine:

- Ways (modes) in which system may fail
- Effect of identified failure modes

Techniques for QA during System Development

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FMEA

1. List relevant components
2. Identify possible ways of failure
3. Describe effects of failure
4. Assess probability of failure
5. Assess seriousness of failure event
6. Rate criticality, based on 4 and 5 above
7. Prepare plan to prevent failure

Techniques for QA during System Development

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Modeling & Prototyping

To assess and reduce specific risks – typically linked to specific project phase

- Physical models
  - Full-scale, functioning models
  - Mockups
  - Scale models
- Mathematical & computer models

Tools & Techniques for Quality Control

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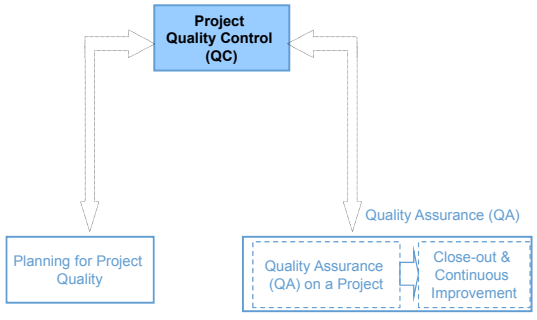
Inputs	Tools & Techniques	Outputs
• Quality management plan • Quality metrics • Process improvement plan • Work performance information • Approved change requests • Deliverables • Other in-house factors	• Cause & Effect (fishbone) diagram • Control Chart • Flowcharting • Histogram • Pareto Chart • Run chart • Scatter diagram • Statistical sampling • Quality inspection • Defect repair review • Other in-house tools	• Quality control measurements • Validated defect repair • Quality baseline and updates • Recommended corrective & preventative actions • Requested changes • Recommended defect repairs • Organizational process assets and updates • Validated deliverables • Other in-house outputs and reports

Project Quality Management Process



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Quality Control

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Techniques for Quality Control

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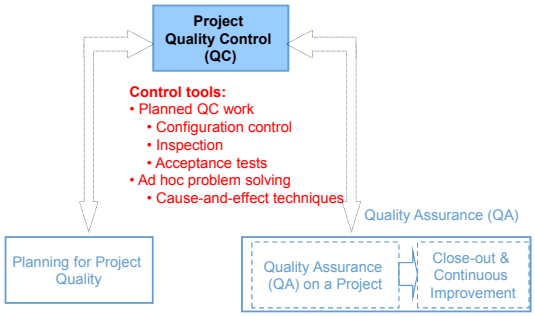

Techniques for Quality Control

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Configuration Management

- Configuration Identification (defining the system)
  - Discussed under "QA"
- Configuration Control
  - Modifications – permanent change of design
  - Waivers – unforeseen nonconformity
  - Deviations – planned, temporary deviation from specification

Techniques for Quality Control

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Configuration Control – Process

- Anyone may request change
- Change and motivation documented
- Impact evaluated (technical)
- Feasibility evaluated (resources, schedules, …)
- Change accepted or rejected by Configuration Board
- If approved, plan implementation
- Verify

Techniques for Quality Control

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Configuration Control – Process

- Class I requests – approved by contractor
- Class II requests – approved by customer

Techniques for Quality Control

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Inspection & Testing

- Critical characteristics always 100% inspected
- Sampling
- Destructive testing
- Non-destructive testing

Basic Tools of Quality Control

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1. **Check sheet** – Data on sheet analyzed using the other 6 tools
2. **Flowchart** – steps in process e.g. project network diagram
3. **Run chart & control chart** – observed results plotted versus time
4. **Scatter diagram** – tracking of repetitive events
5. **Pareto diagram** – discussion follows
6. **Histogram** – discussion follows
7. **Cause-and-effect diagram** – discussion follows

Pareto Diagram

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- 80/20 rule:
- 20% of people own 80% of wealth
- 80% of defects result from 20% of causes
- Separate vital few from trivial many

- Pareto diagrams should be organized in descending order of importance (e.g., biggest impacts first, then smaller and smaller)

Pareto Diagram

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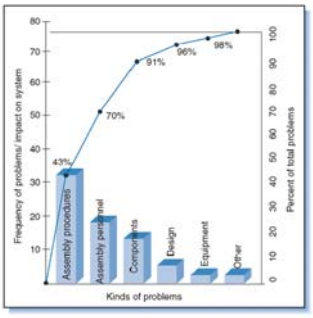

Pareto Diagram: Projects versus Operations

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- **Repetitive operations:** X-axis is typically a list of defects observed and the Y-axis is the frequency of occurrence of each defect
- **Projects:** X-axis is typically a list of types of problem and the Y-axis the impact on the system

Histograms

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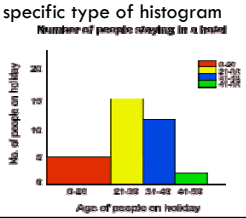
- Histograms are a "fancy" way to say bar chart
- Histograms can help represent relative comparisons of categorical data (e.g., indicate workload on resources)
  - Pareto Diagram is a specific type of histogram



Cause-and-Effect Diagrams

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- Quality tool to help identify possible causes for a problem/effect
- Three main types:
  - **Fishbone (Ishikawa) diagrams** – simplest **(explained next)**
  - **Causal loop diagrams** – illustrate structure of complex system and influences of variables on one another, used for computer modeling of system dynamics
  - **Current reality trees** – rigor of sufficiency of causes to result in effect; laborious process and only used for "major" issues

Fishbone (Ishikawa) Diagram

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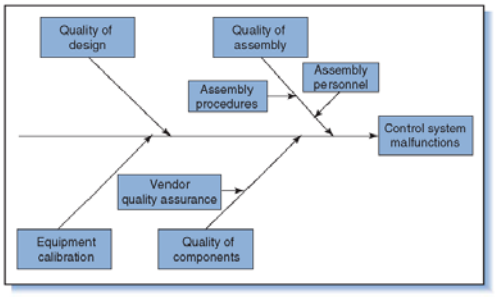

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