Lecture #2

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Sept. 1, 2004
Our View of Quality

- Today’s attitude much different (hopefully) than two decades ago.

- The statistical theory has remained the same....

- Philosophy underlying quality has changed.

Quality movement.

We must understand why we wish to pursue quality improvement.
Status - early 1980s

- Competitive position U.S. companies eroded - Japan dominates marketplace - some industries lost
- How did we end up in this situation??

![Graph showing quality effort in Product Development, Design, Manufacture & Assembly, and Problem Solving]
• Let’s take a look (focus on quality) at what has happened in the past
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1875</td>
<td>Birth of &quot;Taylorism&quot;</td>
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<tr>
<td></td>
<td>- Mass production and division of labor</td>
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<tr>
<td></td>
<td>concepts.</td>
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<td></td>
<td>- F. W. Taylor develops the principles</td>
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<td></td>
<td>of scientific management.</td>
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<td></td>
<td>- &quot;Workers are lazy.&quot;</td>
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<td>- Wage incentive plans and time standard</td>
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<td></td>
<td>- only production counts.</td>
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<td>1925</td>
<td>Shewhart Introduces Statistical Process</td>
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<td>Control</td>
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<td></td>
<td>- Walter Shewhart develops a statistical</td>
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<tr>
<td></td>
<td>approach to improve processes - emphasis</td>
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<td></td>
<td>on fault elimination.</td>
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<td></td>
<td>- Focus is on economic control of the</td>
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<tr>
<td></td>
<td>process</td>
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<td></td>
<td>- People don’t accept his idea.</td>
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<td>1930</td>
<td>Dodge and Romig</td>
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<td>- &quot;Acceptance sampling.&quot;</td>
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<td>- Lot-by-lot inspection.</td>
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<td>- Probabilistic approach.</td>
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</table>
F. W. Taylor

- Prior to his efforts, all manufacturers “equally bad”.

- People that adopt his ideas achieve success -- others fall by the wayside. Playing field is “un-leveled”.

- Phenomenon played out again during the quality revolution.

- Math class (20 students) -- 5 students given calculators. Who will succeed??
Product Control

Process \[\rightarrow\] Inspection \[\rightarrow\] Scrap

OR

Process \[\rightarrow\] Inspection \[\rightarrow\] Scrap

LSL \[\rightarrow\] USL

D, D, D

N, N, N, N, N, D, N, N, ....
Quality Cost

- Defective Cost
- Inspection Cost
- Total Cost

Optimal Quality Level
Acceptance Sampling

Process

Batch of Parts

"small" sample

Dodge & Romig Sampling Insp. Strategy

Decision to Accept / Reject Batch
Dodge - Romig Plan

Dodge & Romig: pick the sample size & allowable # of defectives

OC Curves

Probability of Acceptance

Incoming Quality Level of Batch
### History (cont.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1950</td>
<td>Deming Approach to Quality/Productivity Improvement</td>
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<td>Statistical process management.</td>
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<tr>
<td></td>
<td>Follows the work of Shewhart.</td>
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<td>Emphasizes the responsibilities of top management.</td>
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<td>Doesn’t get attention in the U.S. but is welcomed in Japan</td>
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<td>1980</td>
<td>United States Recognizes Deming Approach and Taguchi Methods</td>
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<td>U.S. industry begins to adopt Deming’s philosophy, Taguchi methods, and statistical design of experiments.</td>
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<td>Emphasizes engineering design.</td>
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</table>
Introduction to Deming

- Fallacy of “Optimal Quality Level” Concept
- Product versus Process Control

Monitor process output, identify process faults, take corrective actions
More Deming

• 14 Points (Obligations of Top Management)

• Manage for the long view

• Workers want to do their job well -- monetary incentives aren’t everything

• Everyone participates

• Data based conclusions -- not subjective

• People are assets
Engineering Design

Traditional View

Customer needs

System design

Testing

Product design
Taguchi’s View of Engineering Design

Customer needs

System design

Definition of overall product structure
Product Feature

Parameter design

Selection of nominal value for design
parameters. Robust design

Tolerance design

Selection of tolerance. Employ loss
function idea

Robust product
Strengths of Taguchi’s Approach

- Center of Gravity: Engineering Design process
- Definition of the roles of factors that influence product/process performance
- Robust Design -- Parameter Design Concept
- Use of the Loss Function -- link between variation and economic performance