Quality Digest Webinar

Five Costly Mistakes Applying SPC
(and how to avoid them)

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#1 Capability before stability

- Check before you test
- Think SBC instead of SPC
  - Stability Before Capability
- Compare Cpk to Ppk
Capability before stability

Cp  2.3

Cpk  1.2
**Basic Statistics**
- Mean: 151.409

**Capability Statistics**
- $C_p$: 2.349
- $C_{pk}$: 1.205

**Specifications**
- Upper Spec: 155
- Target Spec: 148
- Lower Spec: 141
Basic Statistics
- Mean: 151.409
- Sigma of the individuals: 2.391
- Dpm (i): 66,595

Subgroup Statistics
- Estimated Sigma: 0.993

Performance Statistics
- Pp: 0.976
- Ppk: 0.501

Capability Statistics
- Cp: 2.349
- Cpk: 1.205

Specifications
- Upper Spec: 155
- Target Spec: 148
- Lower Spec: 141

Footnotes
- (i) = Uses Sigma of the individuals
Ideal Capability Summary

<table>
<thead>
<tr>
<th>Overall</th>
<th>Sigma(i)</th>
<th>1.047</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up</td>
<td>2.46</td>
</tr>
<tr>
<td></td>
<td>Ppk</td>
<td>2.07</td>
</tr>
<tr>
<td></td>
<td>Cp</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>Cpm</td>
<td>2.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Within</th>
<th>Sigma(e)</th>
<th>1.644</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cp</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td>Cpk</td>
<td>2.08</td>
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<tr>
<td></td>
<td>Upm</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Sigma Limits

| +3 Sigma(i) | 151.657 |
| +2 Sigma(i) | 142.440 |
| +1 Sigma(i) | 133.110 |
| -1 Sigma(i) | 143.091 |
| -2 Sigma(i) | 152.348 |
| -3 Sigma(i) | 161.607 |

Specifications

| Upper Spec | 144 |
| Target Spec | 144 |
| Lower Spec  | 141 |
#1 Capability before stability

To avoid Mistake #1:

- Don’t start with Cpk
- Review control charts first
- Compare Cpk to Ppk
#2 Misuse of control limits

• Relying on Excel
  – Wrong standard deviation (STDEV.P, STDEV, STDEV.S)
  – Wrong formula
X-bar
Set 1: UCL = 108.170, CL = 100.257, LCL = 92.340 (from: 1 to: 40)
#2 Misuse of control limits

- Relying on Excel
  - Wrong standard deviation (STDEV.P, STDEV, STDEV.S)
  - Wrong formula
- Never computing limits
- Never re-computing limits
#2 Misuse of control limits

- Relying on Excel
  - Wrong standard deviation (STDEV.P, STDEV, STDEV.S)
  - Wrong formula
- Never computing limits
- Never re-computing limits
- Waiting for enough data
- Confusing specification limits with control limits
To avoid Mistake #2

- Follow standards
- Revise limits when needed
- More is better, less will work
- Specification limits ≠ Control limits
#3 Not assessing the measurement system
Not assessing the measurement system
### Measurement Unit Analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeatability - Equipment Variation (EV)</td>
<td>0.2018</td>
<td>17.61</td>
</tr>
<tr>
<td>Reproducibility - Appraiser Variation (AV)</td>
<td>0.2298</td>
<td>20.05</td>
</tr>
<tr>
<td>Repeatability &amp; Reproducibility (R&amp;R)</td>
<td>0.3058</td>
<td>26.68</td>
</tr>
<tr>
<td>Part Variation (PV)</td>
<td>1.1044</td>
<td>96.37</td>
</tr>
<tr>
<td>Total Variation (TV)</td>
<td>1.1460</td>
<td></td>
</tr>
</tbody>
</table>
Not assessing the measurement system.
Not assessing the measurement system
Possible Woops!
#3 Not assessing the measurement system
To avoid Mistake #3

• Assess the measurement system
• Re-assess the measurement system
• When looking at a control chart - ask the question “are we assessing this measurement system?”
#4 Not managing the measurement system

Auditor asks what device took this measurement?
## Gages

<table>
<thead>
<tr>
<th>Gage number</th>
<th>Gage type</th>
<th>Calib due date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEP-823</td>
<td>Depth</td>
<td>2/23/2016</td>
<td>Storage</td>
</tr>
<tr>
<td>DEP-826</td>
<td>Depth</td>
<td>3/17/2016</td>
<td>Storage</td>
</tr>
<tr>
<td>DEP-832</td>
<td>Depth</td>
<td>4/21/2016</td>
<td>Storage</td>
</tr>
<tr>
<td>MIC-1001</td>
<td>Micrometer</td>
<td>8/4/2015</td>
<td>Past Due Calibration</td>
</tr>
<tr>
<td>MIC-1002</td>
<td>Micrometer</td>
<td>1/13/2016</td>
<td>In use</td>
</tr>
<tr>
<td>MIC-1003</td>
<td>Micrometer</td>
<td>1/30/2016</td>
<td>In use</td>
</tr>
<tr>
<td>MIC-1004</td>
<td>Micrometer</td>
<td>2/10/2016</td>
<td>Storage</td>
</tr>
<tr>
<td>RING-101</td>
<td>Ring</td>
<td>3/17/2016</td>
<td>Storage</td>
</tr>
<tr>
<td>RING-106</td>
<td>Ring</td>
<td>3/18/2016</td>
<td>Storage</td>
</tr>
</tbody>
</table>
To avoid Mistake #4

• Use software tools – to manage measurement devices systematically

• Implement feedback from audits
#5 Wasting time

TIME IS MONEY
#5 Wasting time
To avoid Mistake #5

• Use software tools
• Focus on the vital few
• Adapt Continuous Improvement
• *Statistical Process Control: SPC* (second edition), Automotive Industry Action Group, 2005


• PQ Systems – Quality Advisor
  [www.pqsystems.com/qualityadvisor/](http://www.pqsystems.com/qualityadvisor/)
Thank you!

Questions?

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Request the white paper
Five Costly Mistakes Applying SPC (and how to avoid them)
www.pqsystems.com/ApplyingSPC

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