Process Capability
Relationship to Supply Chain

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Process Capability Relationship to Supply Chain

- Ppk and Cpk as dependability indicators for supply chain
- Process capability connection points to supply chain
- Impacts to production scheduling
- Impacts to inventory and supply chain cost
- Impacts to supply chain security
- Impacts to financial and quality resources
- Conclusions
Introduction

• Supply chain needs to be dependable and predictable
• Material and product flow that is not disrupted
• Products to customers aligned with customer needs
• Voice of the process aligned with the voice of the customer
• All of these are directly linked to process capability
Process capability is a key early warning indicator for supply chain dependability, predictability and disruption.

- **Ppk**: What Ppk would be if the special cause variation was removed.
- **Cpk**: Ppk represents the real performance of the process and thus can be an indicator of potential supply chain disruption.
Cpk represents what the process would look like if all the one-off issues were eliminated.

$$Cpk = \frac{\text{Upper Specification} - \text{Mean}}{3 \times \text{Standard Deviation of Moving Range}}$$

$$= \frac{\text{Mean} - \text{Lower Specification}}{3 \times \text{Standard Deviation of Moving Range}}$$

By using the standard deviation of the Moving Range, instead of the standard deviation of the data, Cpk removes special cause from the calculation.

What process capability would be if all the special cause was removed.

CpK represents “best-case” current process performance and thus can be an indicator of potential supply chain dependability and predictability.
Supply Chain Planner’s Perspective

Production Efficiency (% of Planned Output)

Process Capability to Hit 80% Service Level

Ppk = 0.35  Cpk = 0.63
Process Capability Impacts to Supply Chain

- Production planning and schedule horizons
- Safety stocks and inventory
- Supply chain security risk
Low Cpk Creates the Bullwhip Effect
Low Ppk Magnifies It

Low PpK indicates instability which will drive planners at each stage to over-schedule production in order to cover the instability.
Production Scheduling using Time Fences

**ICE**
Manufacturing confirmed schedule
Production schedule is frozen
No changes
Everything needed to manufacture is ready and released
Manufacturing knows what will be made and in what order
QA and QC knows what it needs to review, oversee and test with certainty

**SLUSH**
Planning recommended schedule
Production schedule is mostly certain
Can change
Materials are available, but documentation may not be ready

**WATER**
Planning recommended sequence
Production sequence is somewhat certain
Changes are fluid
Everything needed is known, but is not necessarily ready nor released
Process Capability Impact on Scheduling

Scheduling Time Fences

**ICE**

High process capability

- 30 days
- +60 days
- +60 days

**SLUSH**

Low process capability

- ≤ 2 days
- +7 days
- +14 days

**WATER**
Process Capability Impacts to Inventory
Impacts to Inventory

- Poor process capability forces more inventory in order to maintain promised customer service levels

- Inventory carrying costs
  - Capital to support storing and handling the inventory (shelving, equipment, inspection areas, environmental controls)
  - Storage space (rent, mortgage, lighting, HVAC)
  - Labor for material handling and quality oversight
  - Insurance – premiums rise the higher the inventory
  - Local taxes – often linked to type and volume of inventory

- More inventory means more Excess and Obsolete product management
Impacts to Supply Chain Security and Public Heath

- More product in distribution centers
- More excess or obsolete product being destroyed
- More short-dated product being donated
- More product in the hands of third parties
- More risk of product being diverted for illicit purposes
- More Americans abuse prescription drugs than cocaine, heroin, hallucinogens and inhalants combined\(^1\)
- Public health impact not withstanding, the estimated impact of prescription pain killer abuse only in 2006 was $53 Billion\(^2\)

\(^1\)CDC Drug Overdoes Deaths in the United States, October 2012
Financial Levers
Typical standard cost financial model example

Financial Outcomes

Process capability impacts all the financial areas highlighted in red below

Financial Levers

Money lost to poor capability represents diversion of resources that could be used to fund improved quality oversight, managerial controls, quality initiatives and modernization of facilities.
Financial Impacts
Cost of Poor Process Capability

Using Ppk and Cpk in Supply Chain

- Process capability has a big impact on supply chain
- Instinct might be to track and compare process capabilities across the entire supply chain
- Challenges with the usefulness of comparing sites
  - Process and technology specific
  - Ppk and Cpk are influenced by unit operation complexity
  - Differences in specifications
- Best used within a facility or a given product technology type
- Useful in identifying problem products at a supply chain planner level
- Useful in identifying problem materials and suppliers for remediation
- Useful in challenging safety stock and inventory levels
THANK YOU