Process Capability
Relationship to Supply Chain

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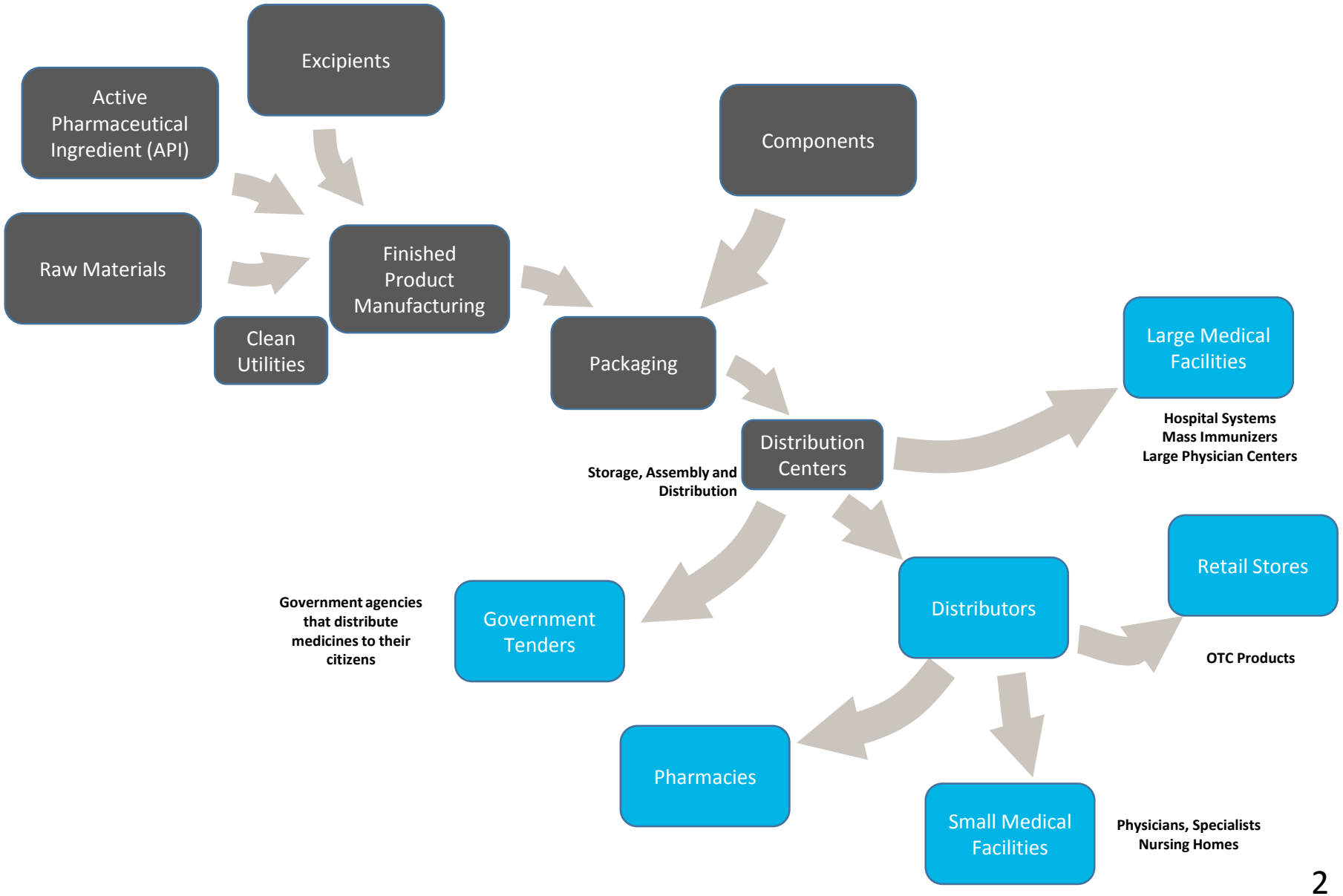
Process Capability Relationship to Supply Chain

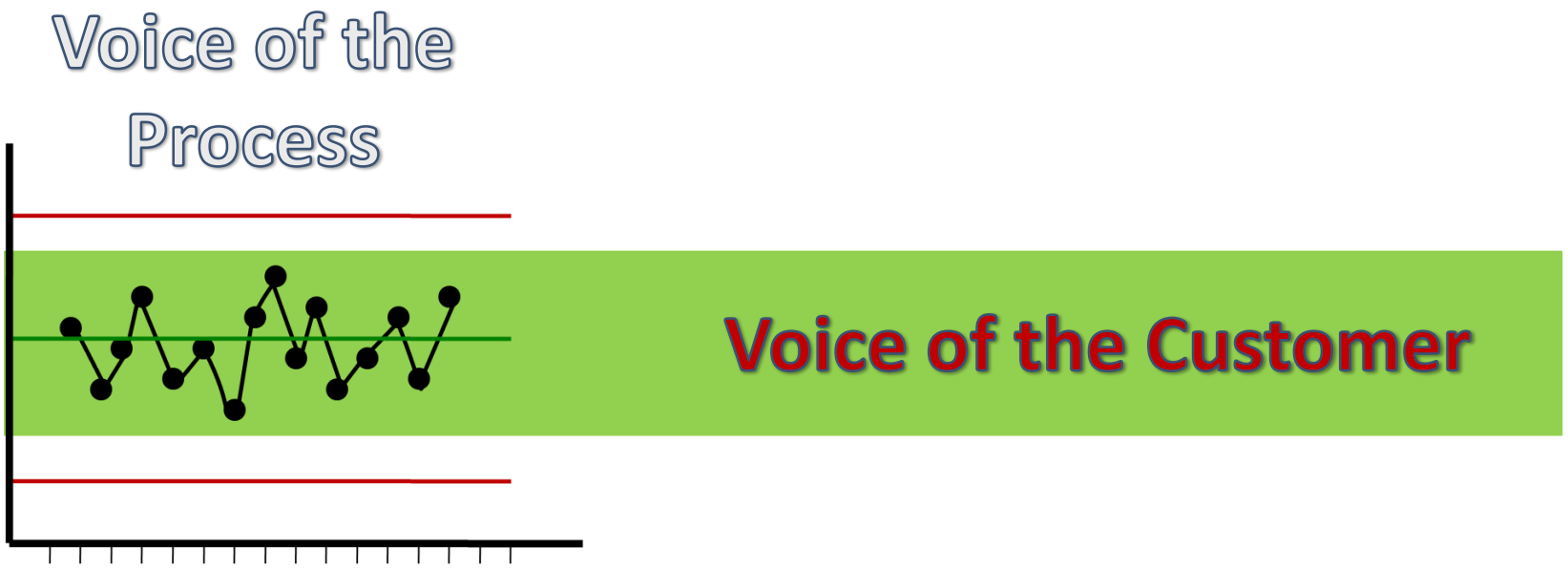
- Ppk and Cpk as dependability indicators for supply chain
- Process capability connection points to supply chain
- Impacts to production scheduling
- Impacts to inventory and supply chain cost
- Impacts to supply chain security
- Impacts to financial and quality resources
- Conclusions

Pharmaceutical Supply Chain



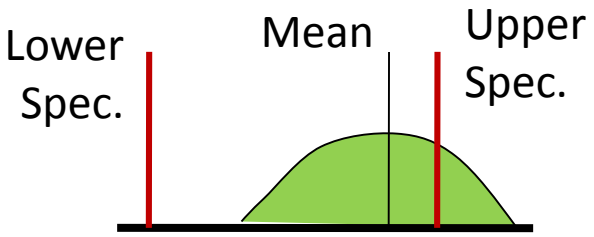
Introduction

- 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



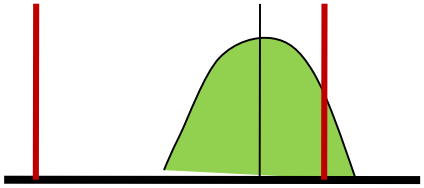
Process capability is a key early warning indicator for supply chain dependability, predictability and disruption

Ppk



Cpk

What Ppk would be if the special cause variation was removed



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

$$Cpk = \text{Which ever is lower} \begin{cases} \left[\dfrac{\text{Upper Specification} - \text{Mean}}{3 \times \text{Standard Deviation of Moving Range}}\right] \\ \left[\dfrac{\text{Mean} - \text{Lower Specification}}{3 \times \text{Standard Deviation of Moving Range}}\right] \end{cases}$$

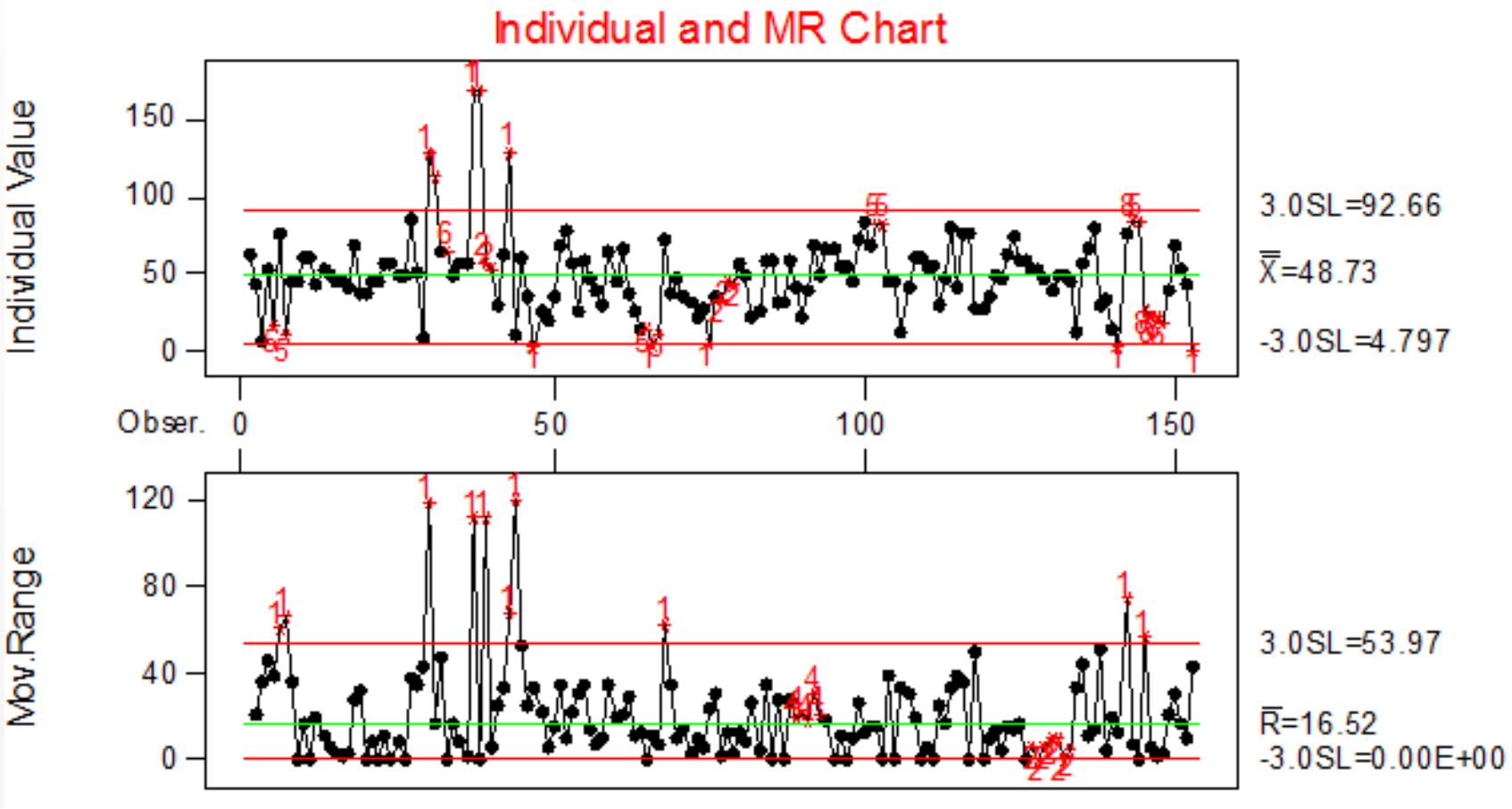
By using the standard deviation of the Moving Range, instead of the standard deviation of the data, Cpk removes special cause from the calculation

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)



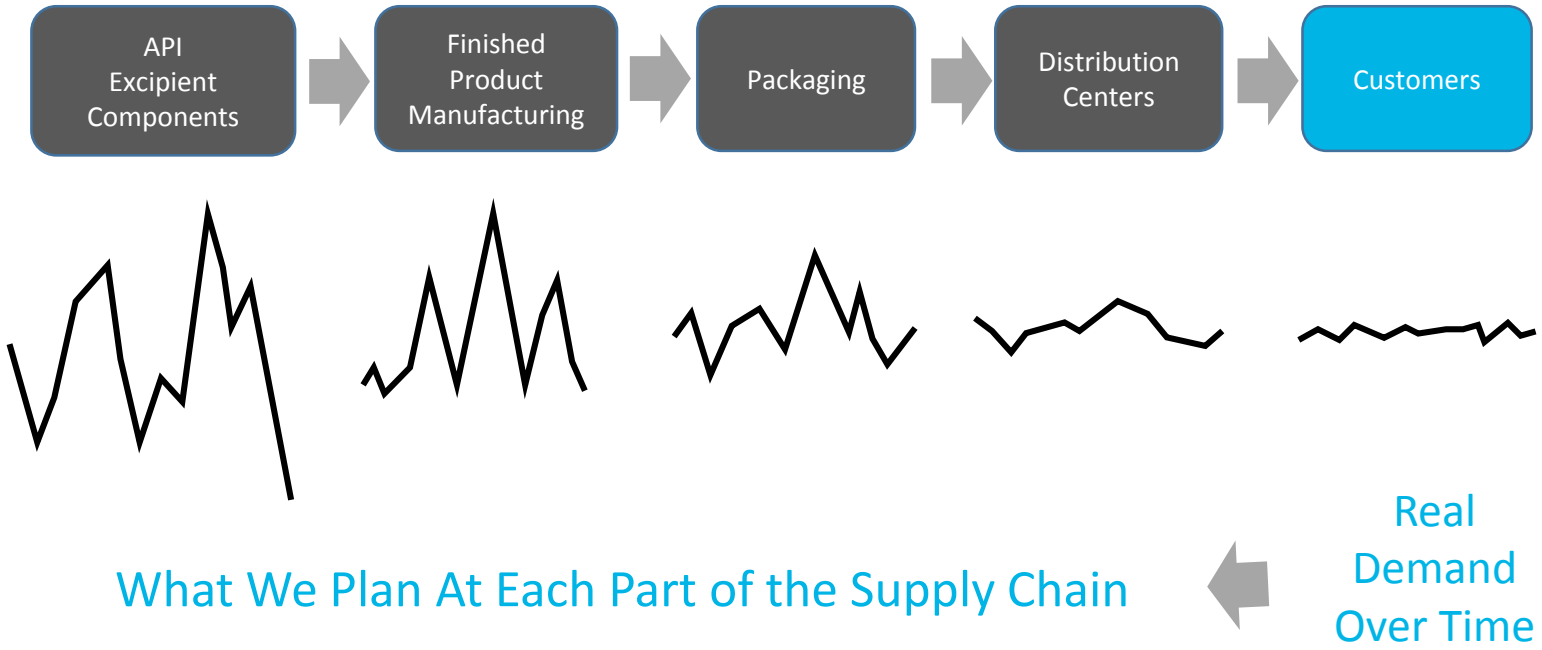
Process Capability to Hit 80% Service Level

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

Scheduling Time Fences

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

Planning recommended schedule

Production schedule is Mostly certain

Can change

Materials are available, but documentation may not be ready

Planning recommended sequence

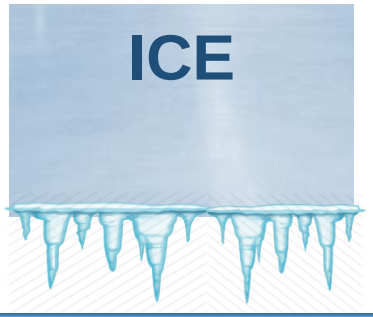
Production sequence is somewhat certain

Changes are fluid

Everything needed is known, but is not necessarily ready nor released

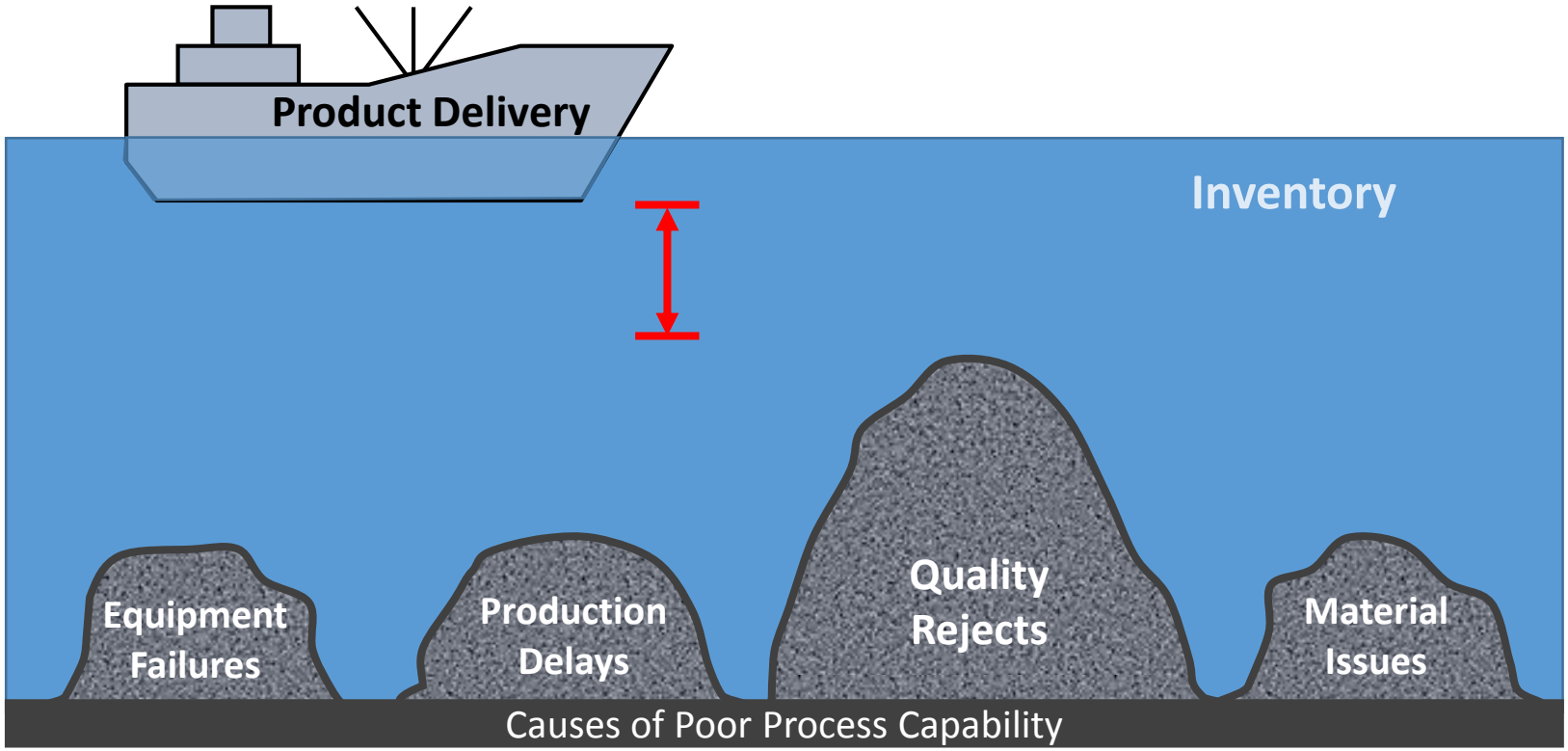
Process Capability Impact on Scheduling

Scheduling Time Fences



	ICE	SLUSH	WATER
High process capability	30 days	+60 days	+60 days
Low process capability	≤ 2 days	+7 days	+14 days

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 elicit purposes
- More Americans abuse prescription drugs than cocaine, heroin, hallucinogencs and inhalants combined[1]
- Public heath impact not withstanding, the estimated impact of prescription pain killer abuse only in 2006 was $53 Billion[2]

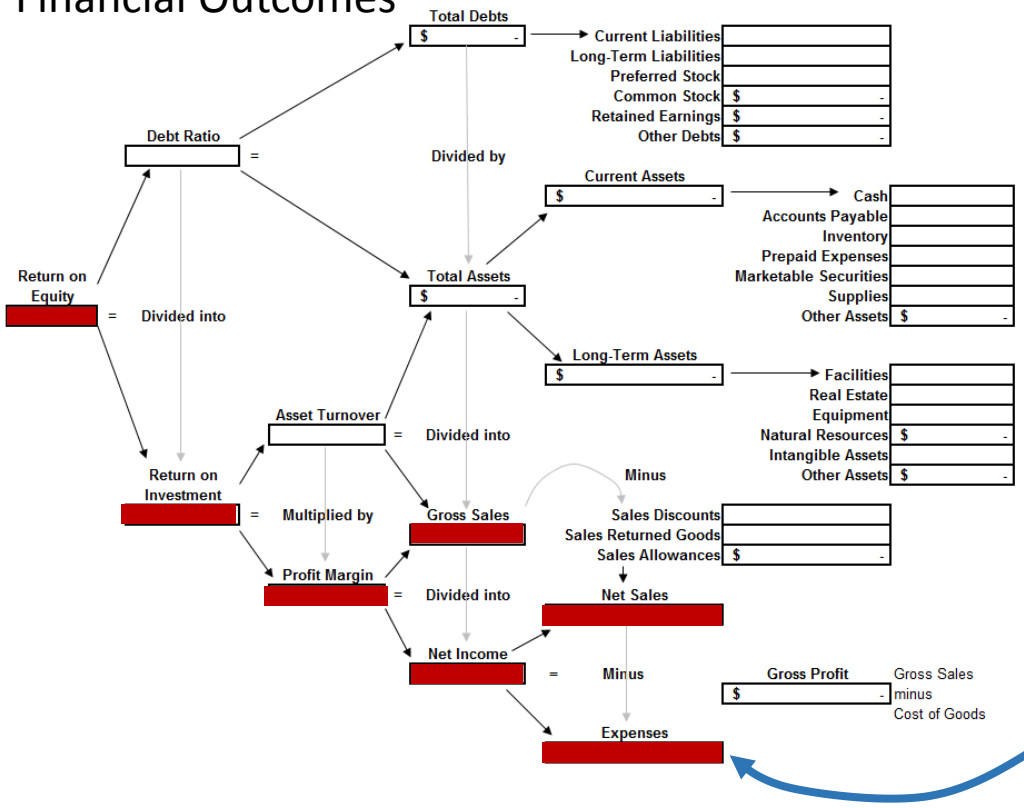
[1]CDC Drug Overdoes Deaths in the United States, October 2012

[2]Clinical Journal of Pain, December 2015, University of Washington, Hansen R.N., Oster G., Edelberg J., Woody G.E., and Sullivan S.D.

Financial Impacts

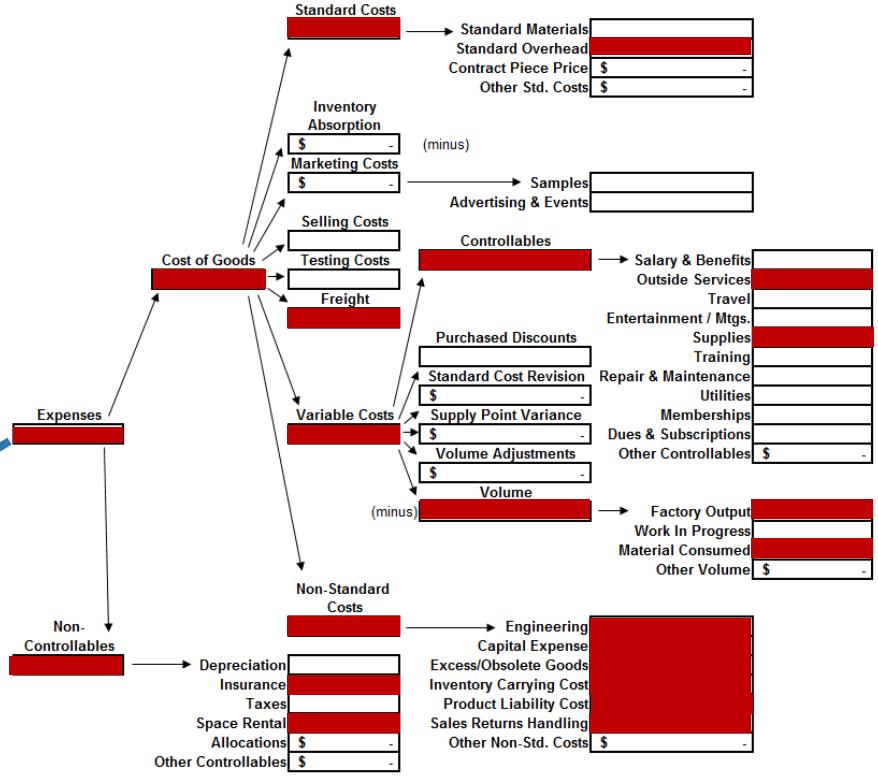
Typical standard cost financial model example

Financial Outcomes



Process capability impacts all the financial areas highlighted in red below

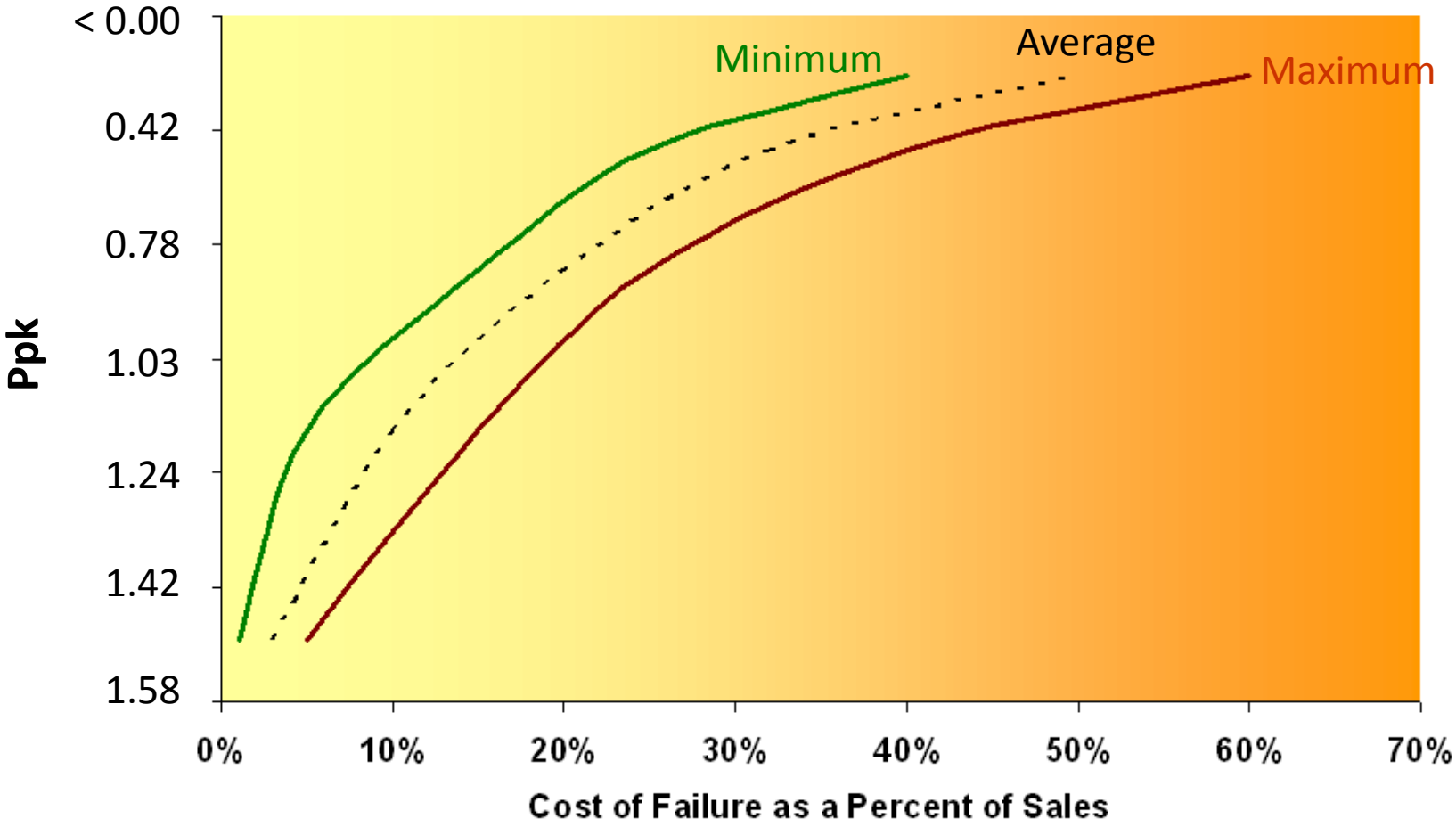
Financial Levers



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



Source: Motorola Study of Company Costs vs. Six Sigma Deployment. Cost includes scrap, repair, investigation, inspection, lost sales, warranty guarantees and remediation.

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