

# **Making a Habit of Hitting Production Numbers**

## **A Case Study in How to Improve THROUGHPUT without the use of a CAPEX**

*A Supply Chain Reality White Paper*



# 20% increase in Throughput\*

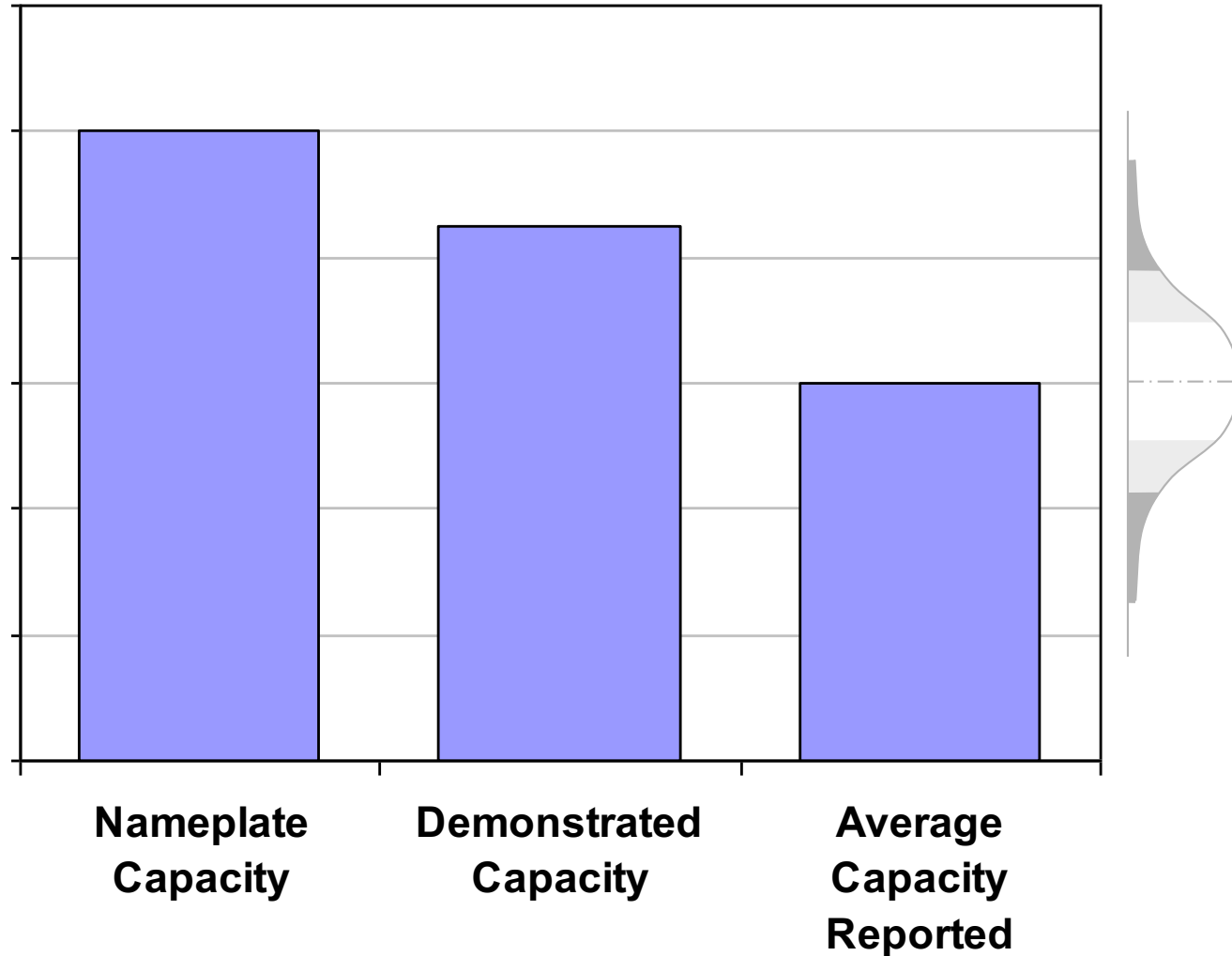
**EBIT increased by \$ 50 million pa \*\***

**Using existing infrastructure  
NO additional capital expense**

\* Based on YTD performance (10% on previous year)

\*\* Unaudited estimate using prevailing market price at the time project commenced

# Optimal throughput is a key objective for the successful operation of any processing business



“Why isn’t my best day the one I can have on average?”

Production Manager  
Supply Chain Reality Case Study

## Discussion Topics

A  
Supply Chain Reality  
Case Study

- ¶ Time-honoured, conventional approach
- ¶ The Supply Chain Reality approach
- ¶ Case Study (Mining Process)

# Presentation Topics

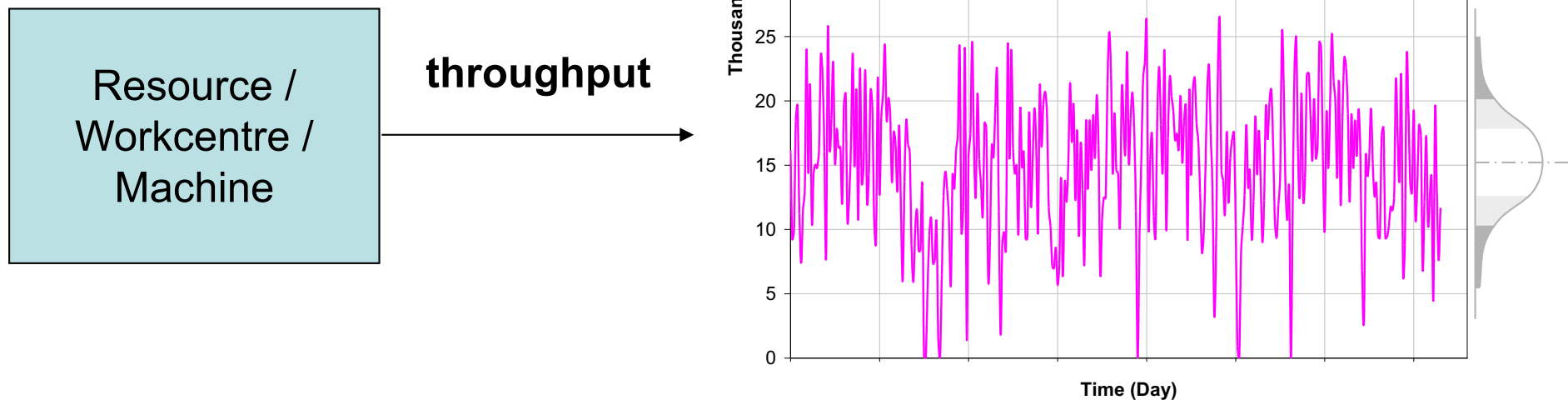
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## In every human endeavour, to solve the complex ...

1. Simplify
2. Break the problem down into the constituent parts
3. Find a solution for the simple
4. And re-assemble

¶ Let's look at the problem at an individual piece of equipment level



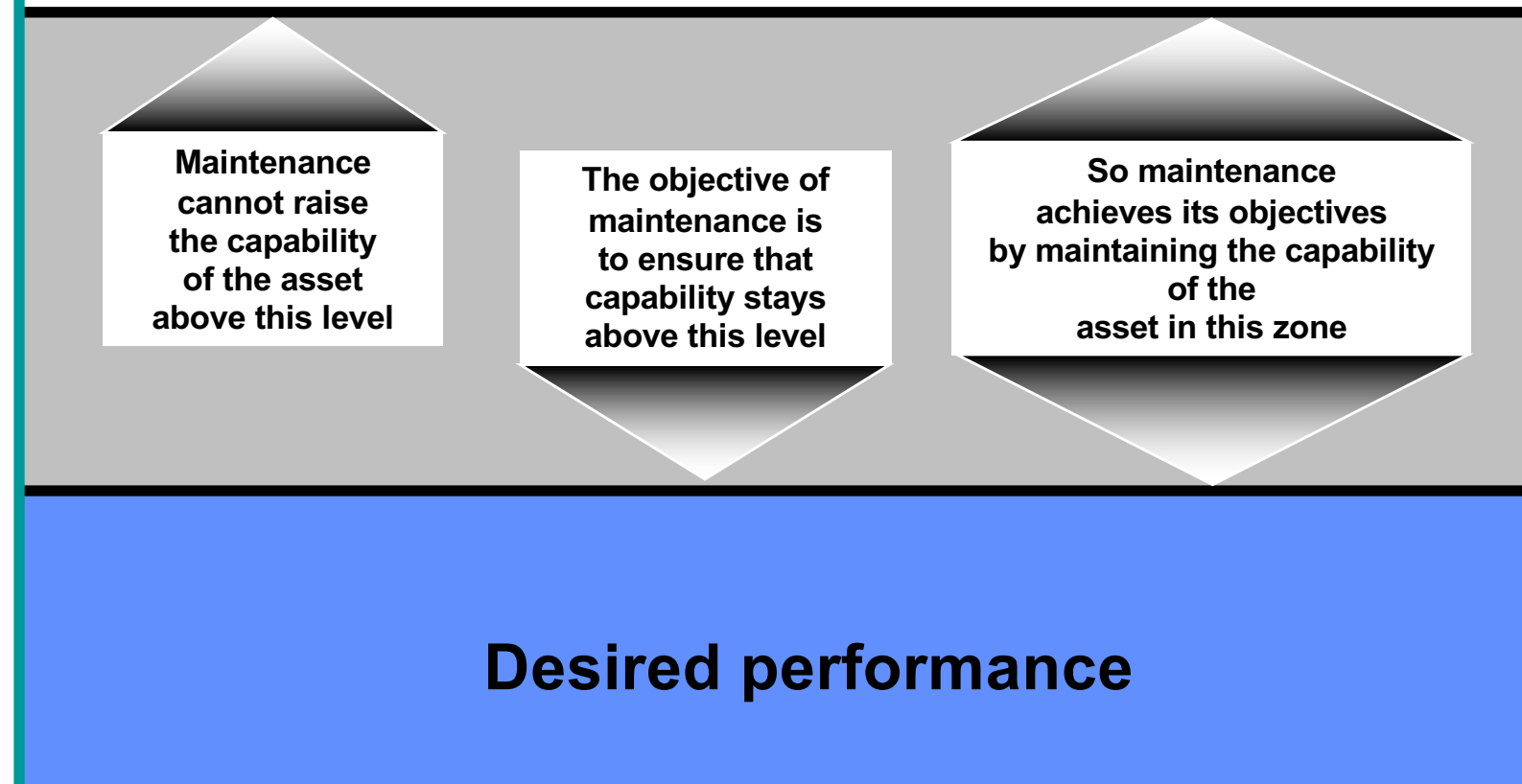
¶ What impacts the throughput capability of the Resource?

¶ Design Specification (Nameplate or Demonstrated Capacity)

¶ Ability to maintain this level of capability (Maintenance Performance)

Let's define maintainable asset ...

## Design capability (e.g. Nameplate Capacity)

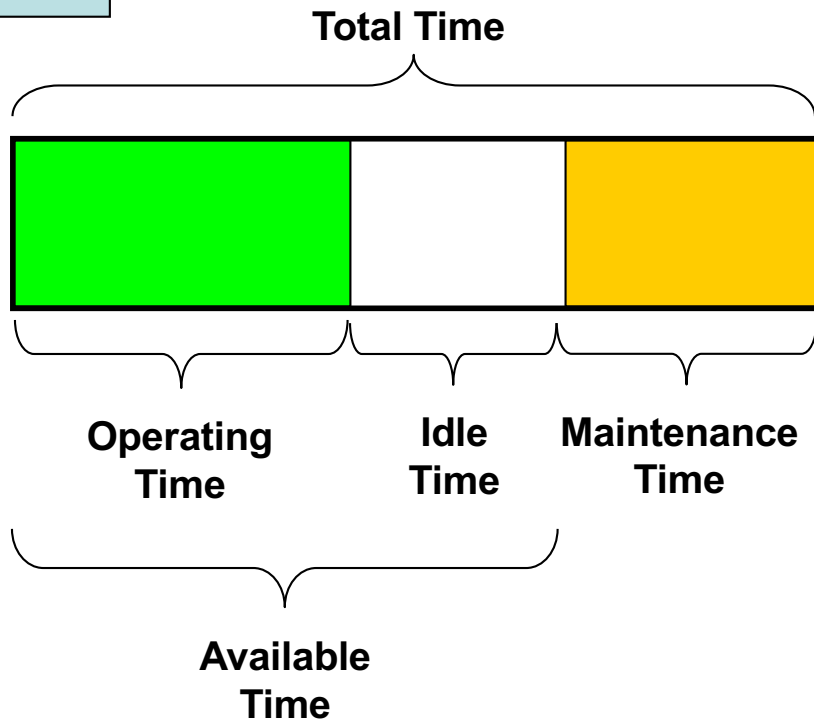


Source: Reliability-centred Maintenance, J Mowbray 1992



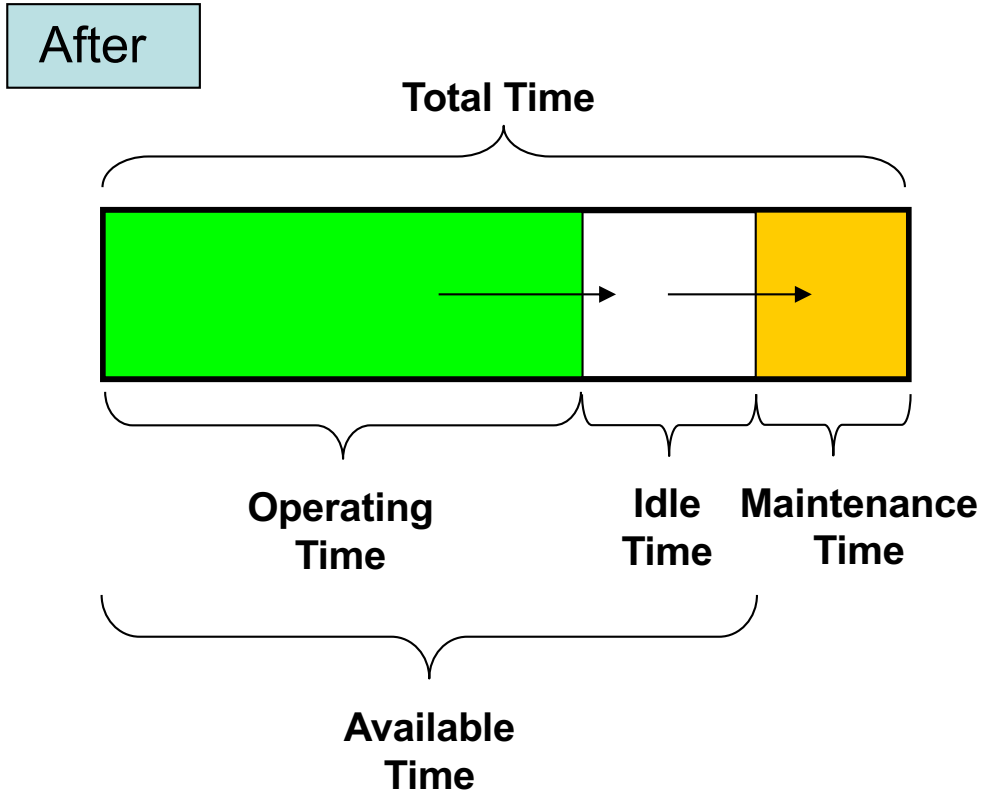
# Conventional, bottom-up approach to analyse operational performance of an individual Resource

Before



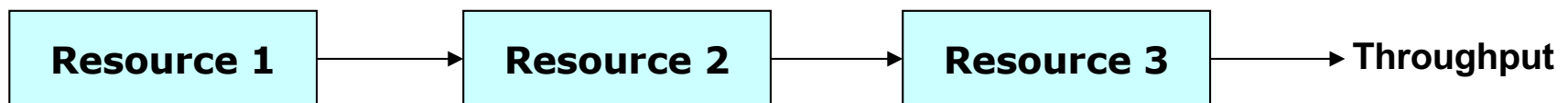
Mean Time Between Failures (Stoppages)	
MTBF =	$\frac{\text{Available Time}}{\text{Number of Stoppages}}$
Mean Time to (Service &) Repair	
MTTR =	$\frac{\text{Maintenance Time}}{\text{Number of Stoppages}}$
Availability	
Availability =	$\frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$
Or	$\frac{\text{Available Time}}{\text{Total Time}}$
Reliability	
Reliability =	$e^{-\lambda t}$ <p style="text-align: center; margin: 0;">where <math>\lambda = 1 / \text{MTBF}</math></p>
Utilisation of Available Time	
Utilisation =	$\frac{\text{Operating Time}}{\text{Available Time}}$

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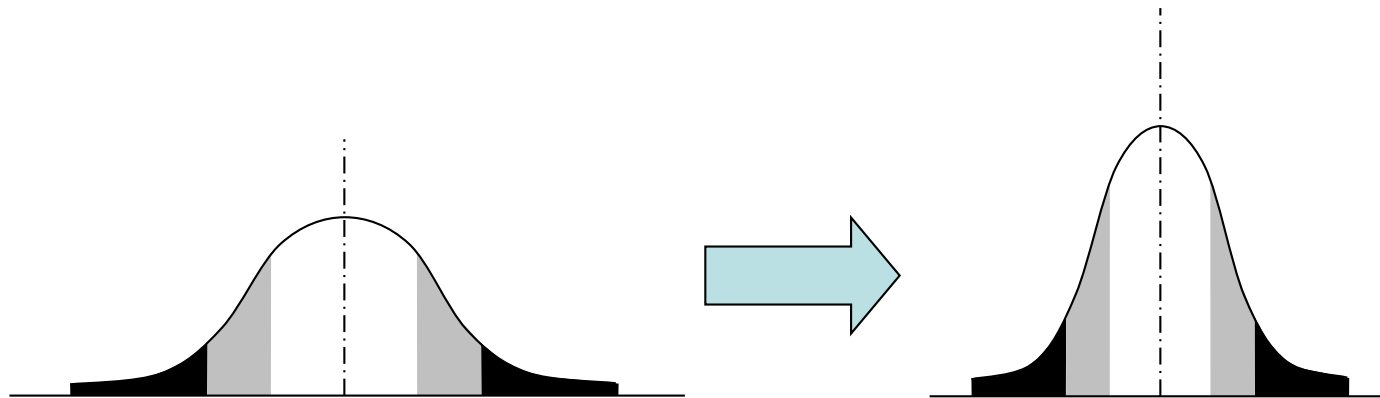
- ¶ Through careful application of conventional improvement techniques, the productive capabilities of a piece of equipment can be increased
- ¶ But its throughput is dependent on the capabilities of other equipment within the process
- ¶ So, irrespective of gains made in **individual** productive capabilities, the inherent interplay constrains the **overall process Throughput**



## Under this approach, the ultimate questions are ...

- ¶ If the availability of my Resource is 72%, is that good?
- ¶ If I can increase the availability to 75%, is that better?
  
- ¶ If the reliability of my Resource is 83% is that OK?
- ¶ If I spend time and money to make it 88% is that a good investment?
  
- ¶ If the utilisation of available time of Resource is 55% is that bad?
- ¶ If I have a day at 45%, does that make a difference?

- ¶ The performance of individual piece of equipment is measured as an **average** over a **period** of time
- ¶ Whereas, in reality, the **inherent interplay** happens in **real-time**
- ¶ Real improvements can only happen when the **processes understand** and the **disciplines compensate** for the law of averages

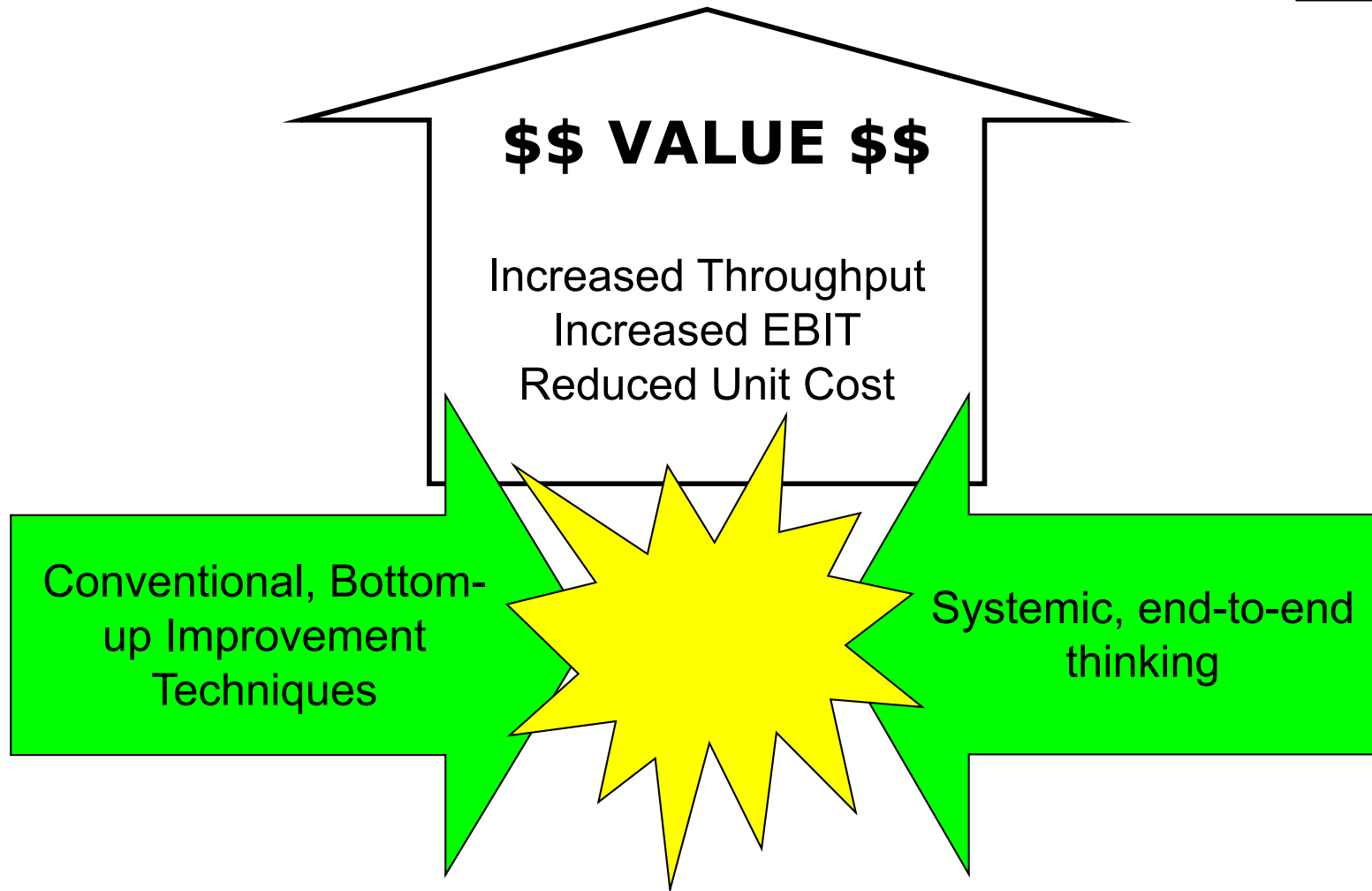


# Presentation Topics

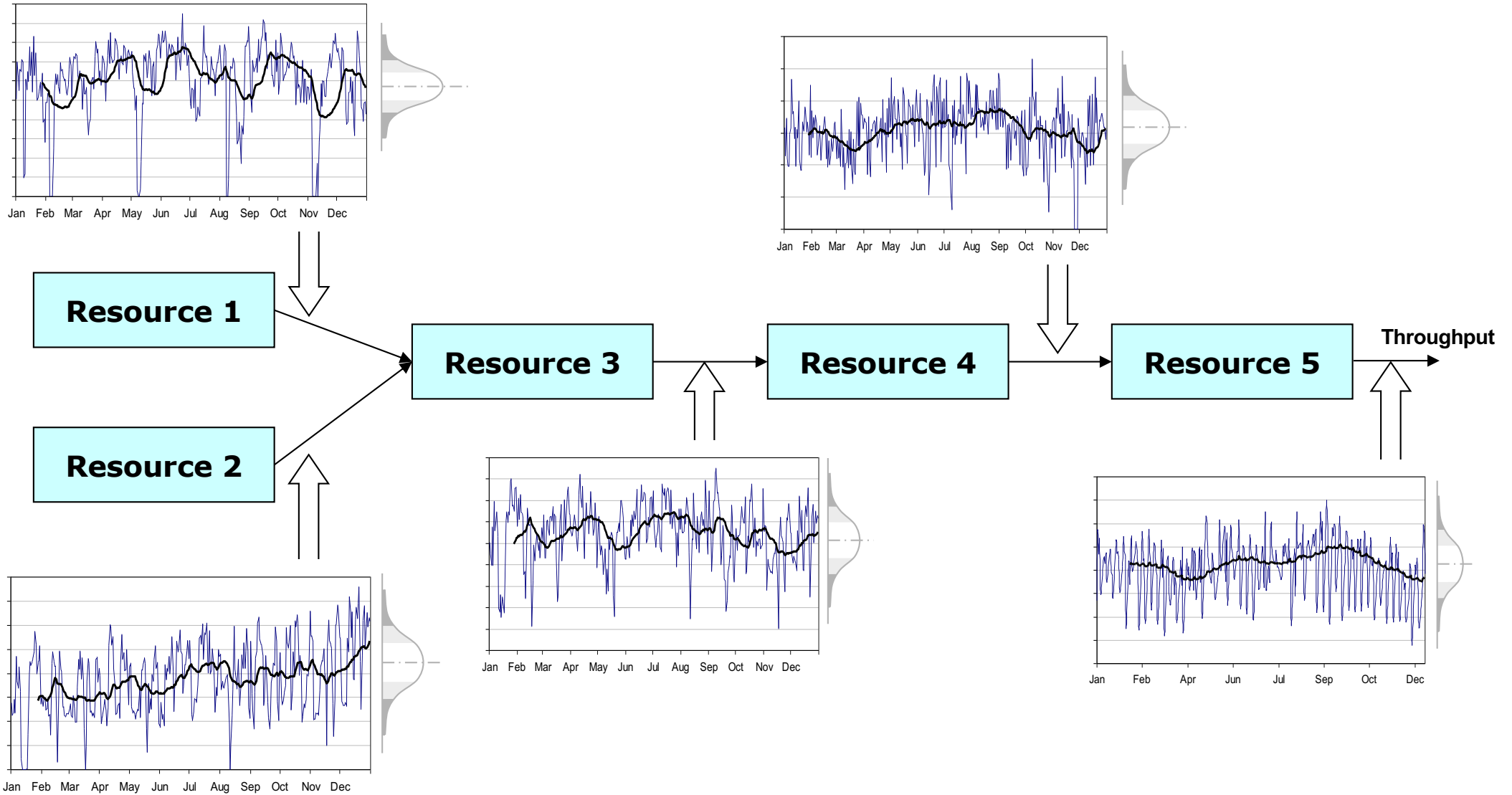
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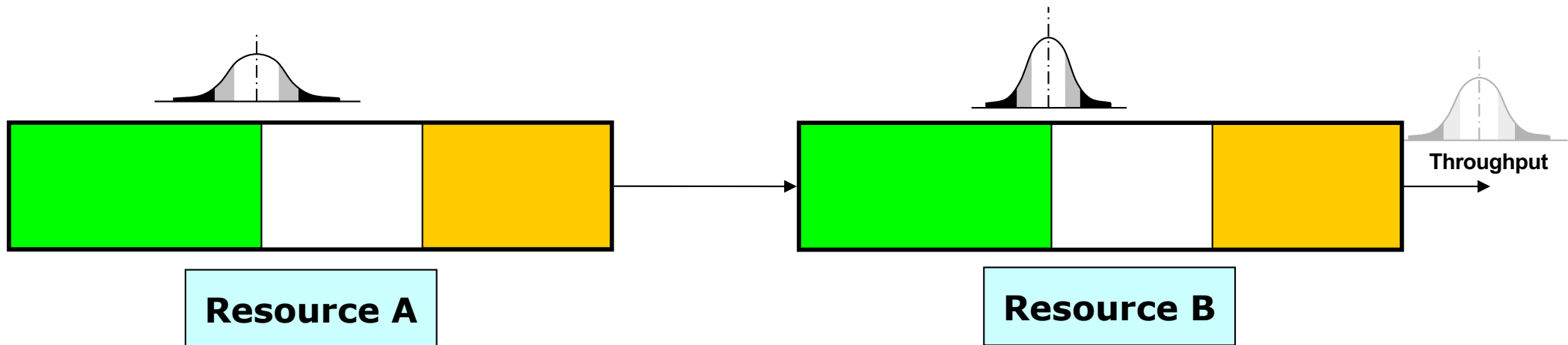
# Dependent events and statistical fluctuations make control at an individual equipment level difficult





The operational capability of an asset is not determined by its own potential but by some other constraint in the system

A  
Supply Chain Reality  
Case Study



- ¶ Individual asset availability and reliability become subservient to:
  - ¶ **Throughput Availability** – How quickly *Throughput* will be restored if it stops or is interrupted
  - ¶ **Throughput Reliability** – How often *Throughput* stops or is interrupted

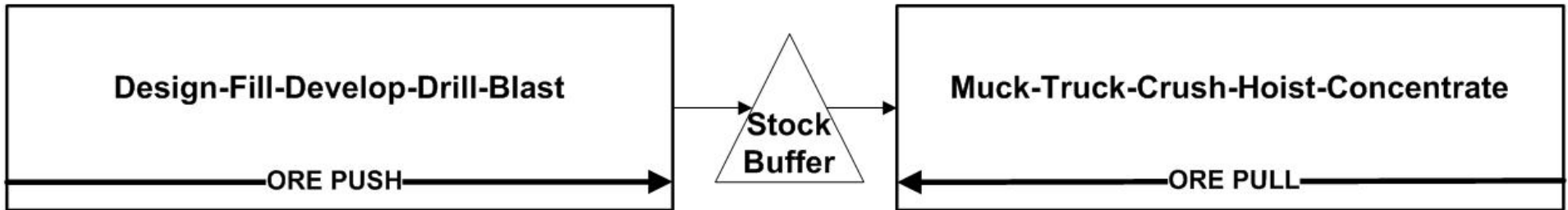
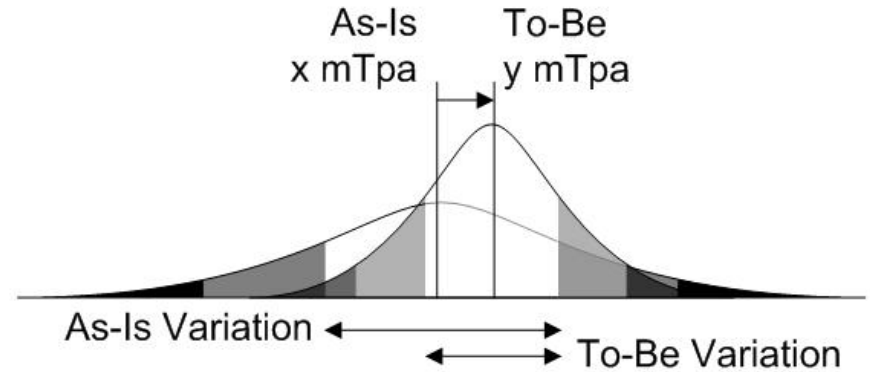
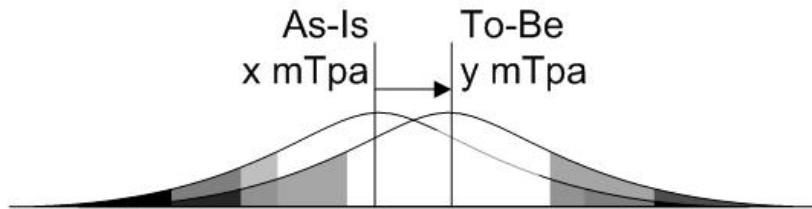
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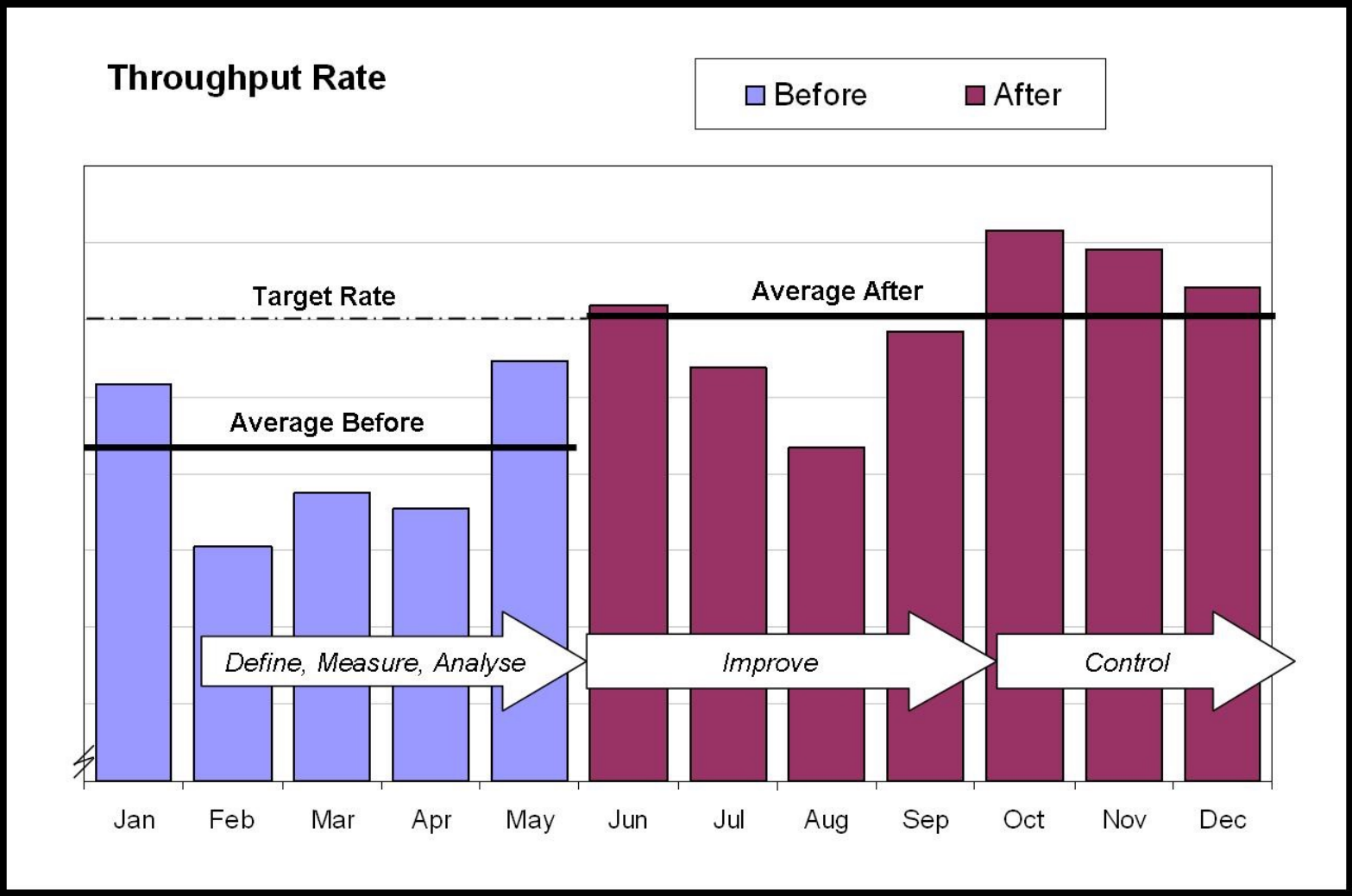
- ¶ Stope flow/pipeline
- ¶ Filling interaction
- ¶ Visibility of knock on effect
- ¶ Moving to a longer term outlook and plan

- ¶ Synchronising ore flow
- ¶ Reliability & utilisation
- ¶ Tonnes, grade and recovery
- ¶ Focus on a short term shift/day/week plan

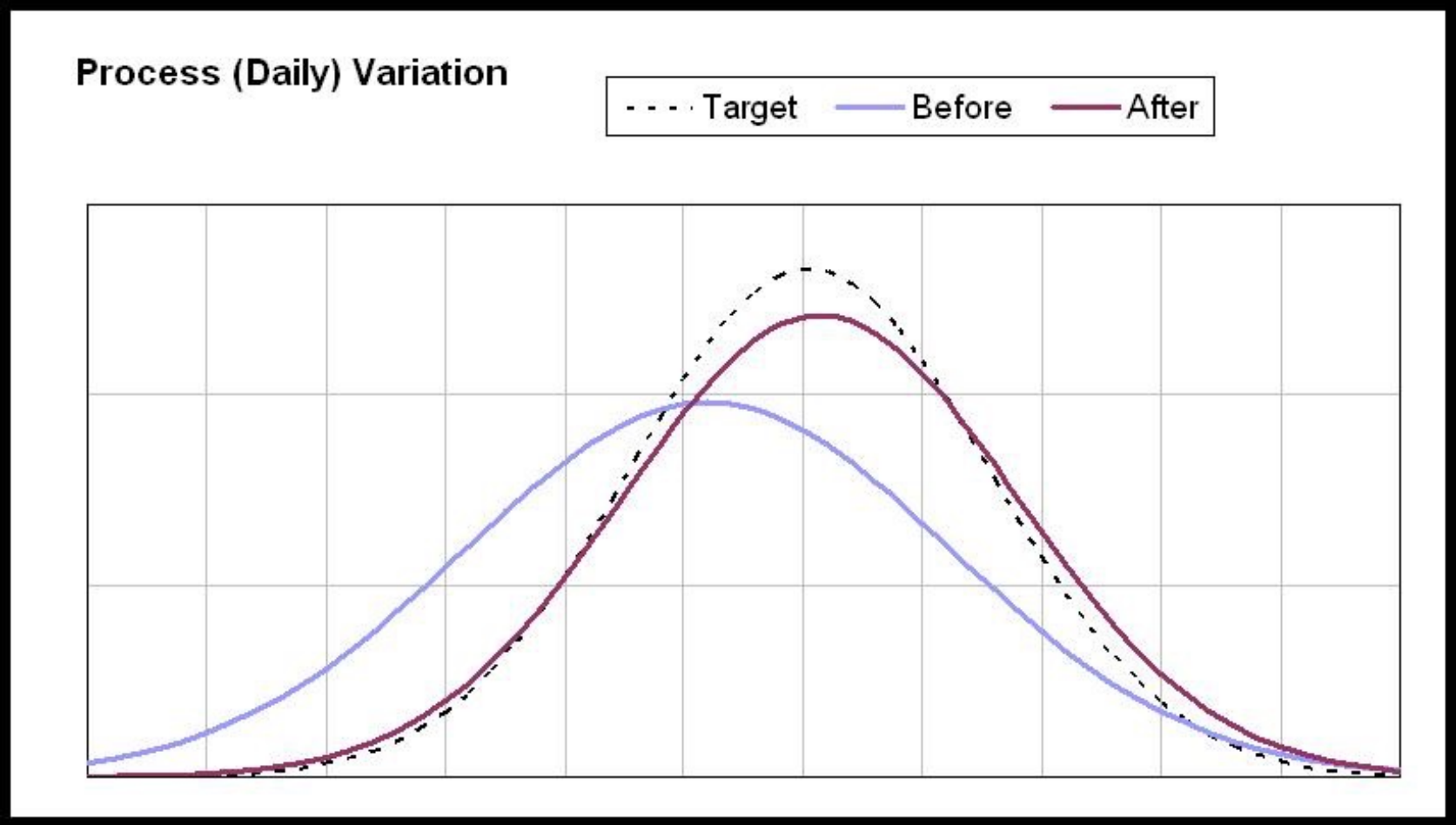
## Key aspects of making this *Business Model* work

- † Ability of the overall system to formulate a plan
- † Deliberate use of buffers – inventory and time
- † Management of “the white spaces”
- † Recognition of Next Operation as Customer
- † Process handoffs more important than yesterday’s production numbers
- † Mechanism to ensure communication and issue management

# The results achieved ...

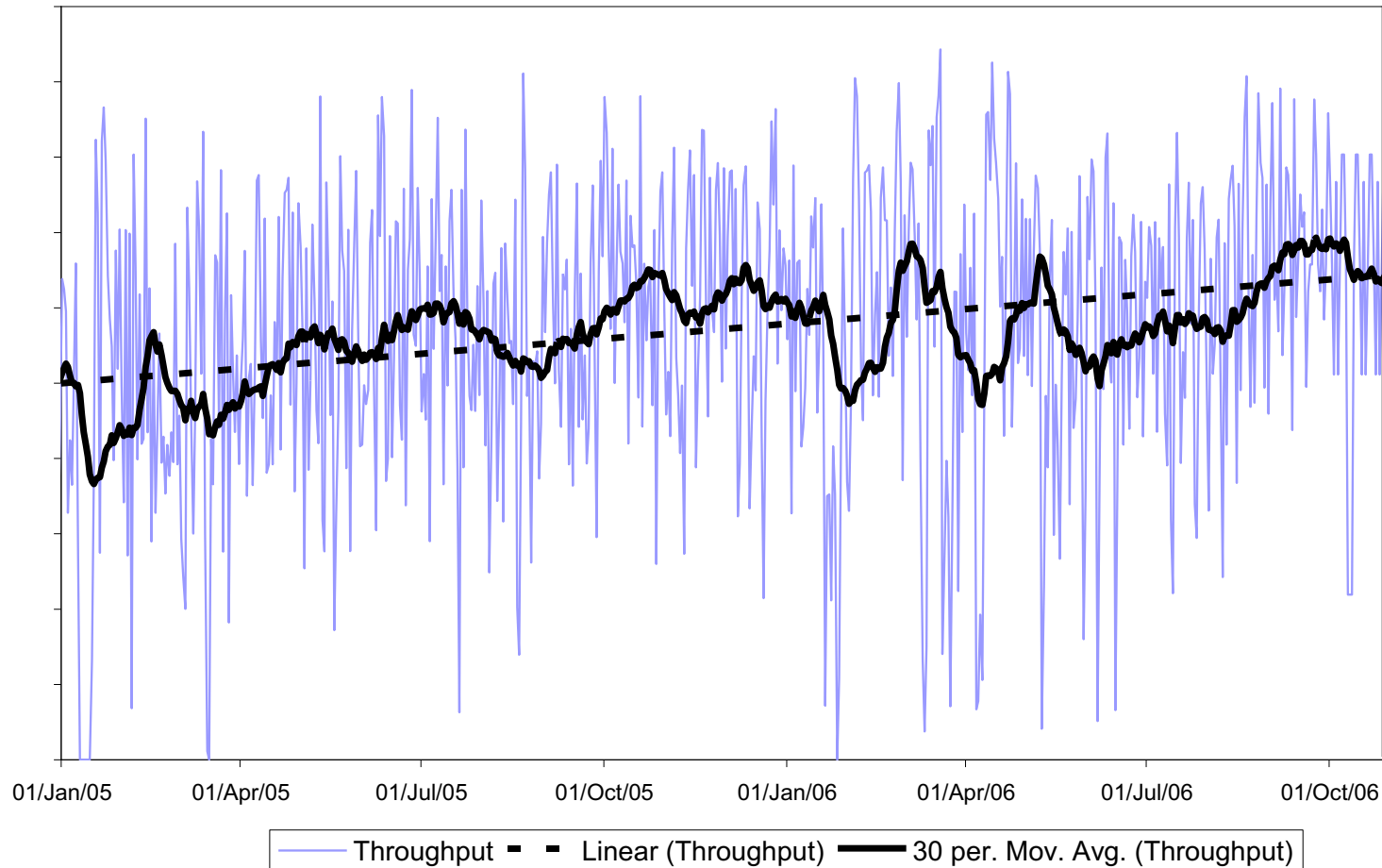


# The results achieved ...



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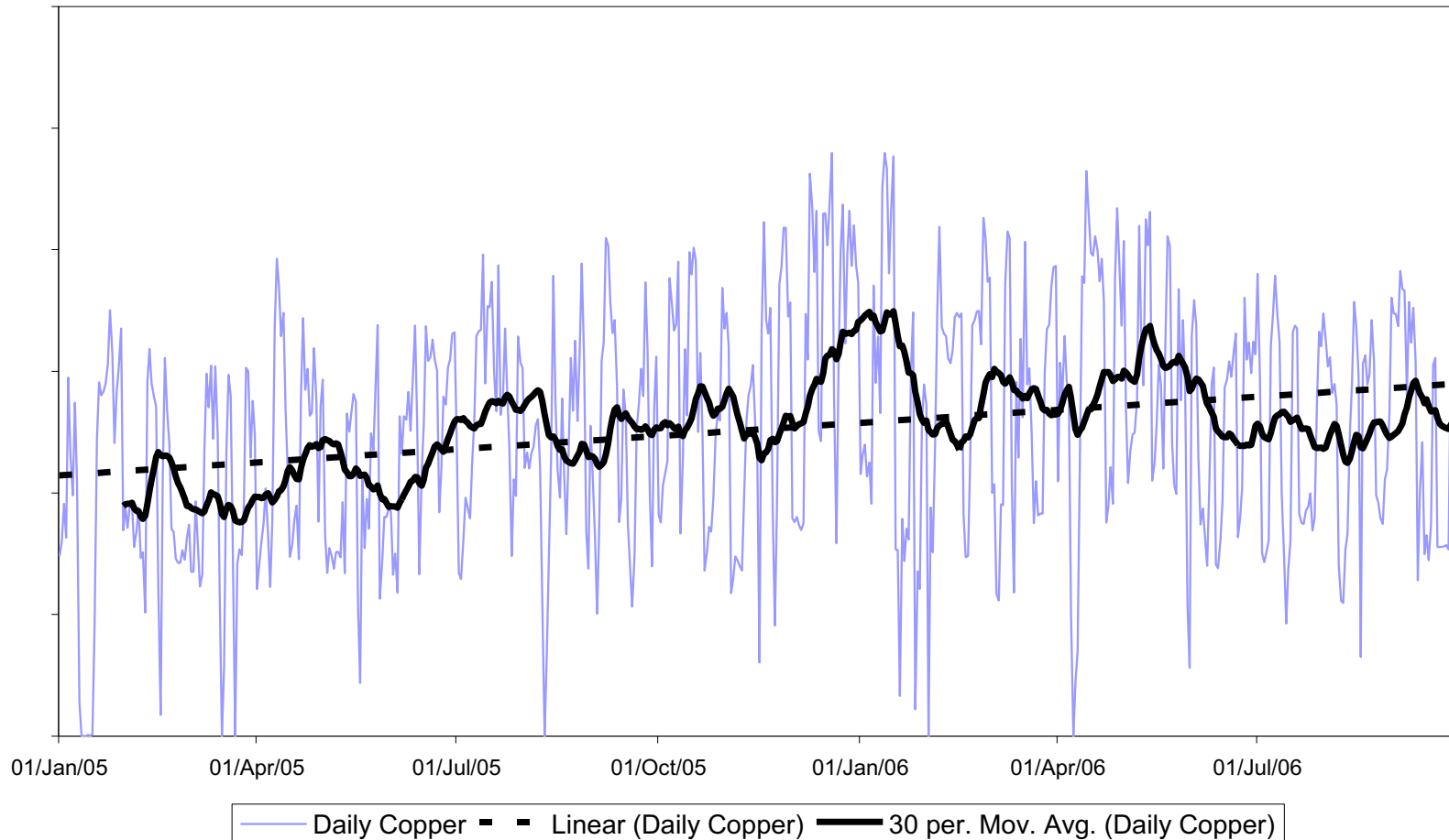
### Daily Throughput of Ore (2 year trend)





# The results achieved ...

### Daily Copper Tonnes (2 year trend)



## Conclusion

- ¶ Bottom-up improvements may be irrelevant in the greater goal of increased Throughput
- ¶ Process change drives organisational change
- ¶ Maintain a balance of technical focus and process thinking
- ¶ Ensure an ongoing focus on continuous improvement
- ¶ Less emotional reaction, more effort in getting the job done



## The Supply Chain Reality Habit

**Making your best day happen more often**  
(... predictably, more often)

and hence

**20% increase in Throughput**