



## Lean AND Six Sigma

Together, they lead to greater success.

15 November 2007

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*Engineered for life*

### Learning Objectives

- Gain an understanding of Lean advantages
- Gain an understanding of Six Sigma advantages
- Through hands-on exercises, experience the synergy of Lean AND Six Sigma



## Integrating Lean and Six Sigma Initiatives

- Lean and Six Sigma can co-exist independently, but the benefits of integration are tremendous...
  - Single channel for employing limited resources
  - One improvement strategy for the organization
  - Highly productive and profitable synergy
- ...while the pitfalls of not integrating them are formidable
  - Divided focus of the organization
  - Separate and unequal messages for improvement
  - Destructive competition for resources and projects
  - “Re-inventing the wheel”

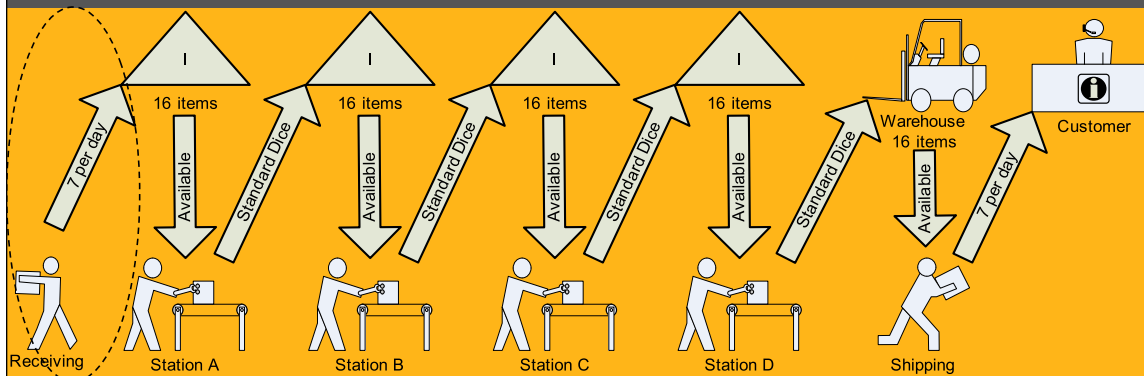


## Lean Six Sigma

- Six Sigma can improve the *effectiveness* of a system by stabilizing it and by reducing the scrap and variability so that...
- Lean can improve the *efficiency* of that system by reducing work in process, inventory, and waste.



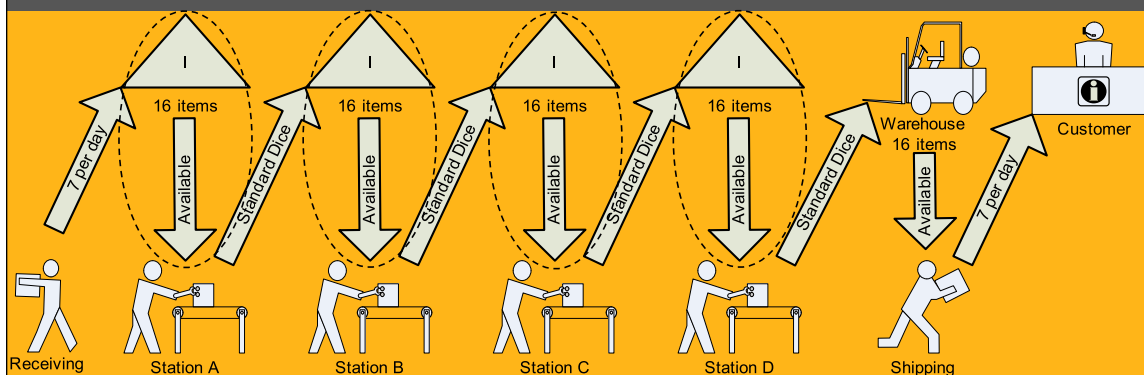
## Exercise, Round One Traditional Process



- “Receiving” places 7 units into the inventory of the first work station each day.



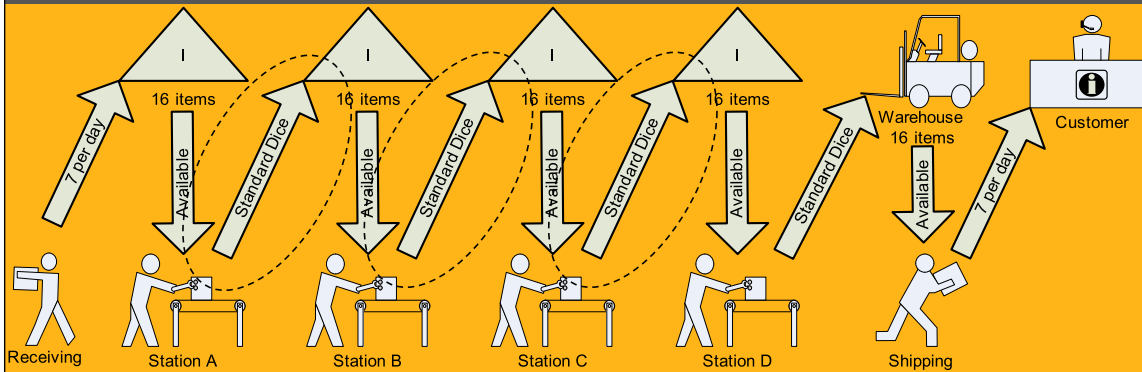
## Exercise, Round One Traditional Process



- The inventory of each workstation starts with 16 units. The four work stations draw from their individual inventory of product.



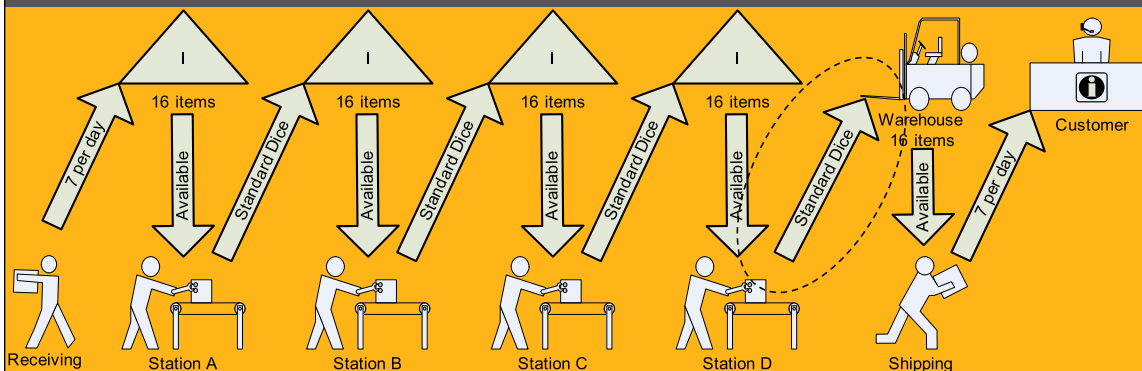
## Exercise, Round One Traditional Process



- The number of units they complete is based on the roll of a pair of dice. That amount is placed in the inventory of the next station.



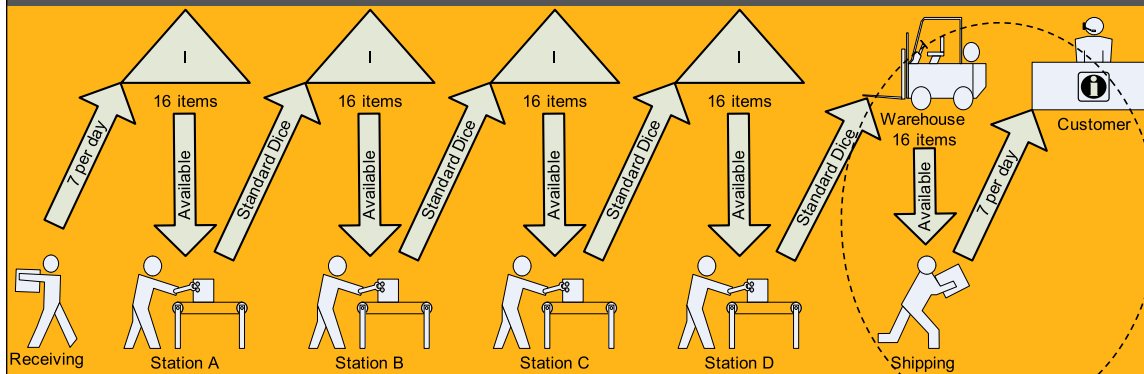
## Exercise, Round One Traditional Process



- The last station moves product to the “warehouse”, again based on the roll of the dice.



## Exercise, Round One Traditional Process



- “Shipping” sends 7 units each day from the “warehouse” to the “customer”



## Exercise, Round One Traditional Process

- Run the factory for 10 days.
- How much WIP do we have?
  - At the beginning?
  - At the end?
- What is the PCT?
  - At the beginning?
  - At the end?
- Was the customer satisfied?
  - What percentage of units were delivered?

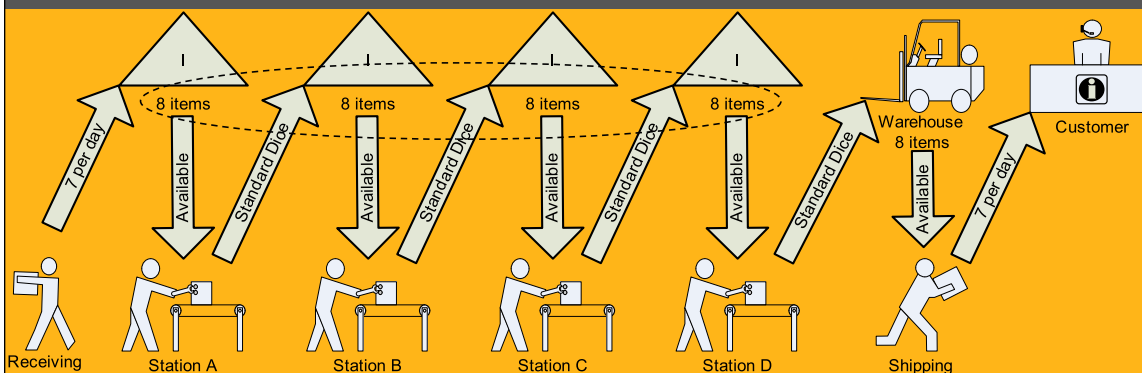


## How can Lean help us with this exercise?

- Reduce inventory (the “I” in T.I.M. W.O.O.D.)
- Improve Process Cycle Time (the “W” in T.I.M. W.O.O.D.)



## Exercise, Round Two Lean Only Applied



- The inventory of each workstation now starts with 8 units. Everything else remains the same.



## Exercise, Round Two Lean Only Applied

- Run the factory for 10 days.
- How much WIP do we have?
  - At the beginning?
  - At the end?
- What is the PCT?
  - At the beginning?
  - At the end?
- Was the customer satisfied?
  - What percentage of units were delivered?

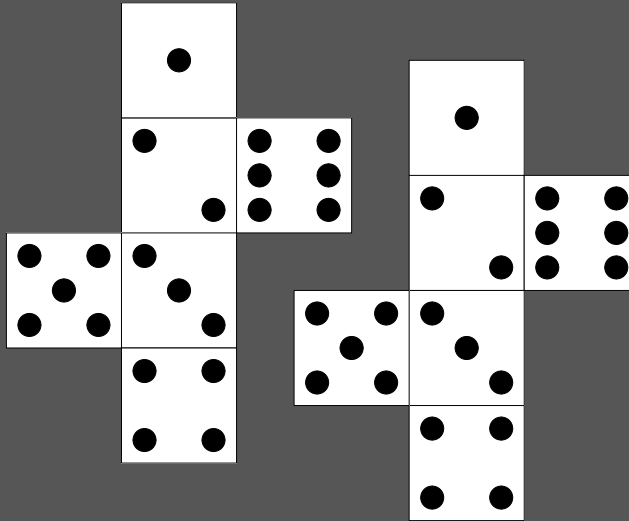


## How can Six Sigma help us with this exercise?

- Remember, Six Sigma can help reduce variability.
- Let's review our current process in detail.



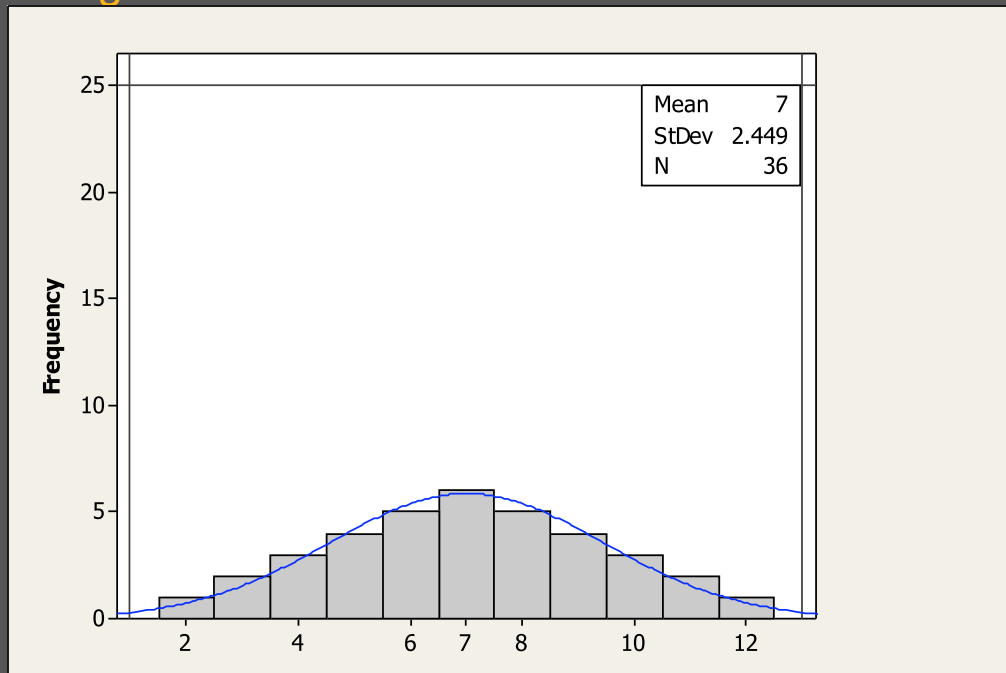
## Standard Dice (unfolded)



- Each die has an equal chance of having the numbers 1 through 6 displayed. Together, they can display 2 through 12, BUT the chances for each number is different.

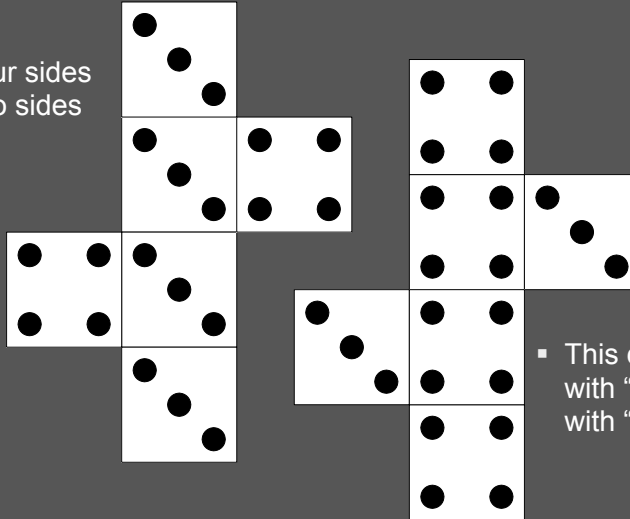


## Histogram of a Pair of Standard Dice



## Custom Dice (unfolded)

- This die has four sides with “3” and two sides with “4”.

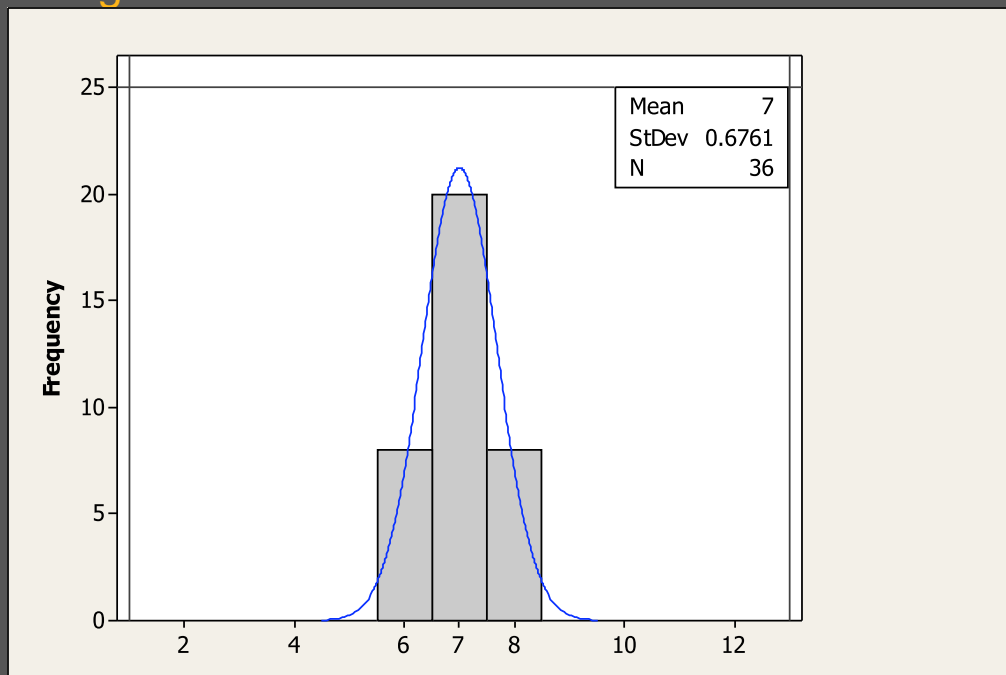


- This die has four sides with “4” and two sides with “3”.

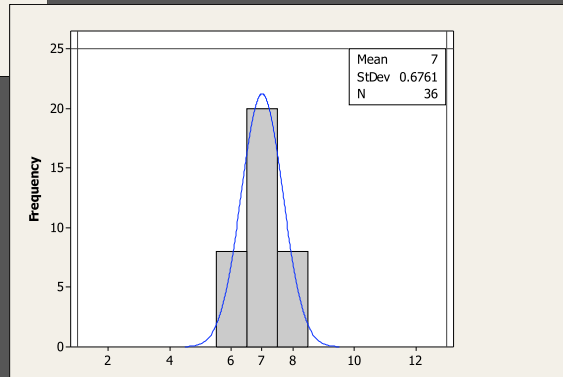
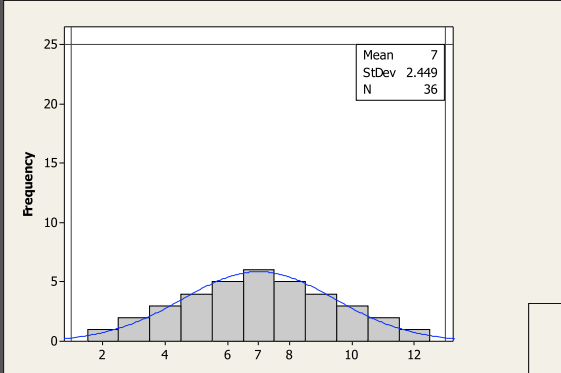
- Together, the Custom Dice will produce 6, 7, or 8. The number 7 is most likely. Variability is greatly reduced.



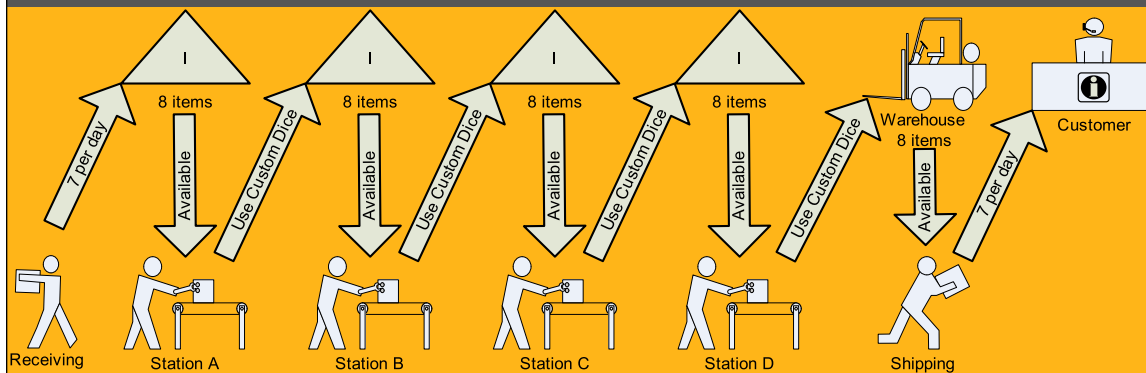
## Histogram of a Pair of Custom Die



# Comparison



# Exercise, Round Three Lean AND Six Sigma Applied



- Variability is reduced using the custom dice. Everything else remains the same as the start of Round Two.



## Exercise, Round Three Lean AND Six Sigma Applied

- Run the factory for 10 days.
- How much WIP do we have?
  - At the beginning?
  - At the end?
- What is the PCT?
  - At the beginning?
  - At the end?
- Was the customer satisfied?
  - What percentage of units were delivered?



## Discussion

- Round Three doesn't always deliver 100%. Should we allow more inventory, or tighten the variability even more?
  - Answer – Which ever is economically more feasible.
- Should Six Sigma or Lean be applied first?
  - Answer – They should be applied together.
- What would have happened if just Six Sigma had been applied?
  - Answer – The financial advantages of reduced WIP, and the improved responsiveness to the customer of reduced PCT, would not have been realized.



## Takeaways

- Six Sigma can improve the *effectiveness* of a system by stabilizing it and by reducing the scrap and variability so that...
- Lean can improve the *efficiency* of that system by reducing work in process, inventory, and waste.

