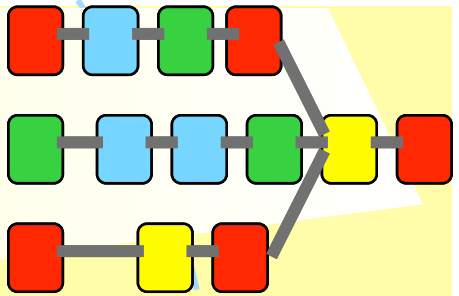
WASHINGTON STATE UNIVERSITY

World Class. Face to Face.

Please share this slide set with all those who would benefit. Dr Holt



Lecture 3a of 15

EM 530 Applications in Constraints Management

How to take advantage of Due-Date Performance-A financial view of the Job Shop Game.

(a PowerPoint supplement to the discussion in class.)

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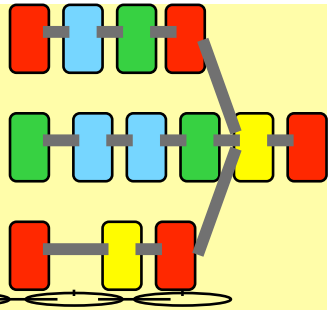
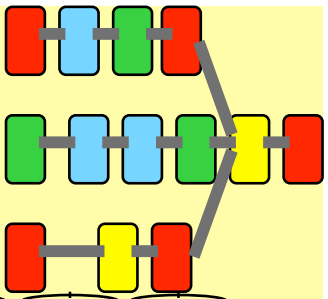
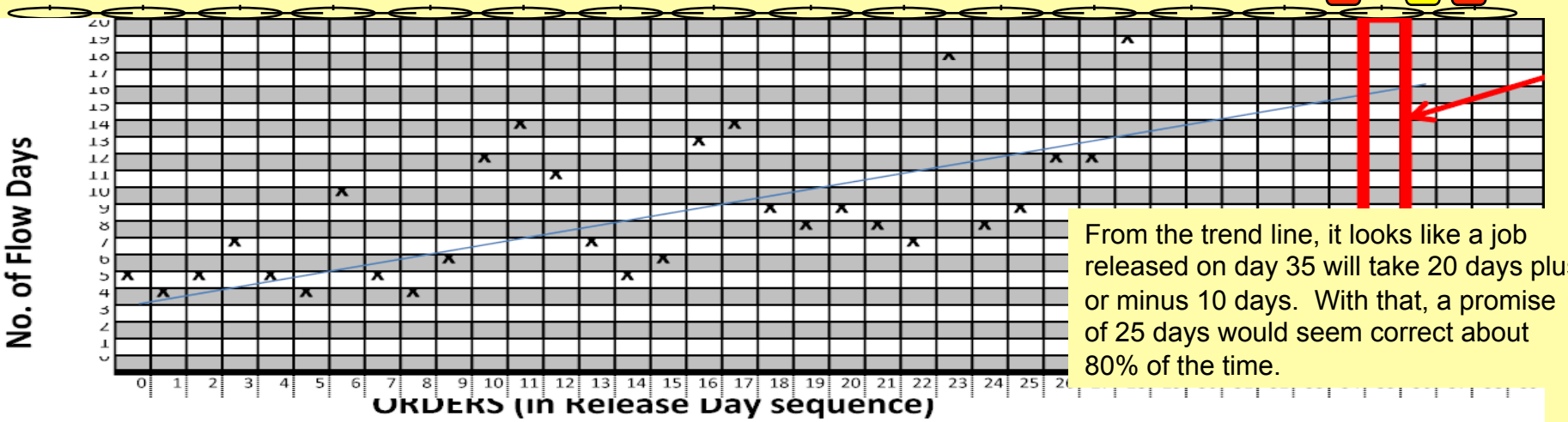
Establishing the Value of Predictable, Reliable, Fast Response.



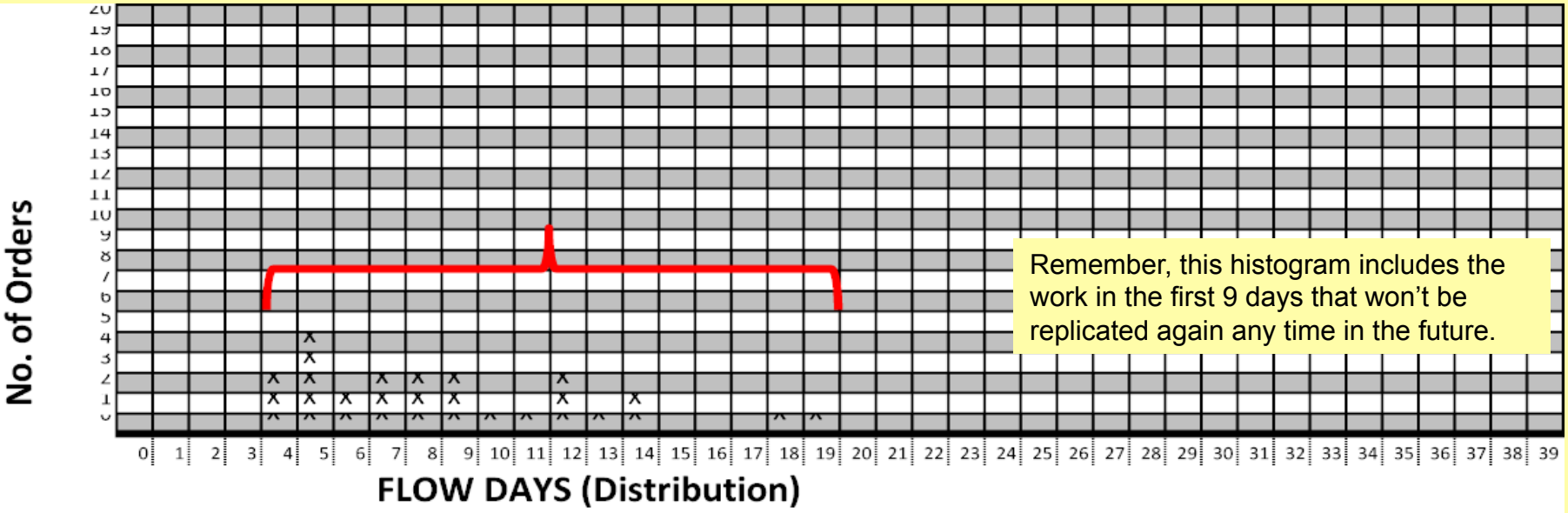
- **An explanatory Note about this slide Set:**
  - **Many of you have played the Job Shop Game.**
  - **(http://www.vancouver.wsu.edu/fac/holt/em530/Docs/JSGInstinfo.htm)**
  - **The Job Shop Game is a class assignment in EM 530.**
  - **The Job Shop Game is designed to show the impact of releasing too much work. Since it's deterministic, now matter how you play the game, the amount of work produced over time is about the same (B only has so much capacity and it's easy to use it 100%, so nothing changes much as far as work flow goes.)**
  - **However, there is tremendous value in being predictable and fast. This slide set attempts to show that.**
  - **Let me set the stage to make this appear logical.**
  - **In a traditional job shop, work load is rather unpredictable. Hence, most job shops accept too much work. When work does back up and delivery become slow and chaotic, customers go away. For this case, assume that the average customer demand, which started at 1 per day, is later reduced to somewhere between .5 to .75 per day. The traditional shop will still release work as soon as it arrives. This means that Work-in-Process (Inventory) will stay high and in the same state as shown on the next slide (without going down much or up much); a continuing state of chaos.**
  - **In the DBR Job Shop (in two slides), we see a dramatic improvement. The DBR Shop (in the Job Shop Game) cuts off release of the work to the floor completely until the Buffer size is reached. And, then the released work averages about .66 per day.**
- **(Note further: The comparison here is for simple demonstration. You mind can understand the simple and then expand it to the reality of your situation. When you do, remember, when the Market is the Constraint, a TOC company will maintain an internal Capacity Control Constraint with capacity of 20% more than the market. And the non-constraint capacity should have 20% more capacity than the Capacity Control Constraint.)**

Using Ioana Ursescu's Traditional Results from the Job Shop Game





From the trend line, it looks like a job released on day 35 will take 20 days plus or minus 10 days. With that, a promise of 25 days would seem correct about 80% of the time.

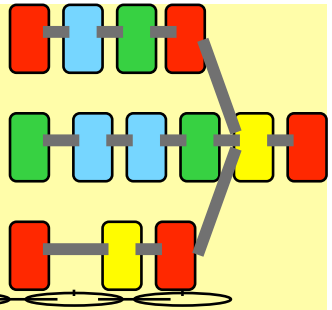


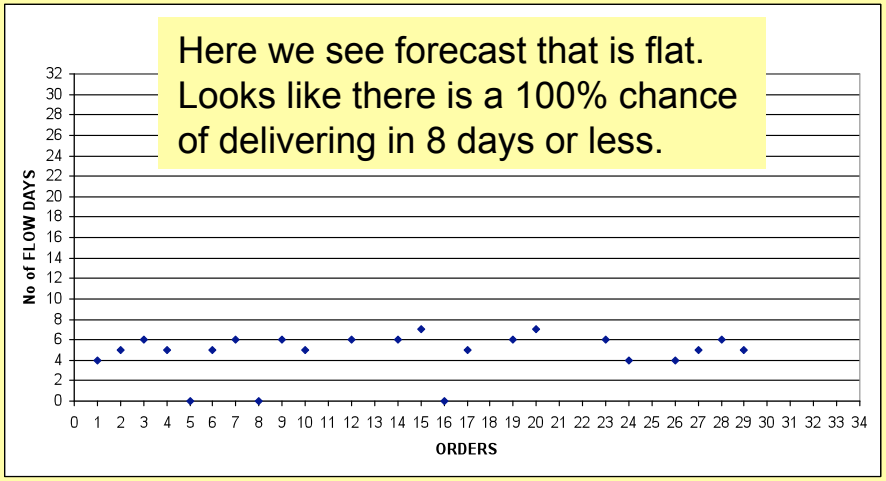
Remember, this histogram includes the work in the first 9 days that won't be replicated again any time in the future.

Julie Garcia

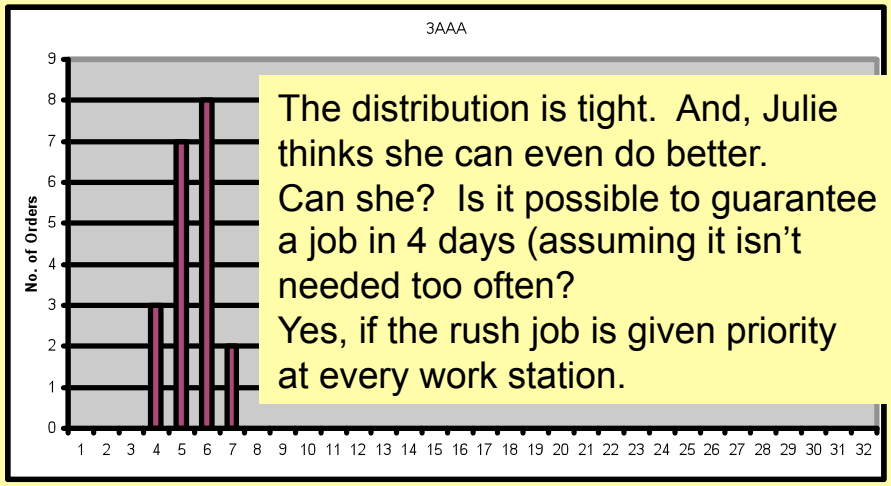
EM530

Job Shop Report/Results 2nd try





Here we see forecast that is flat. Looks like there is a 100% chance of delivering in 8 days or less.



The distribution is tight. And, Julie thinks she can even do better. Can she? Is it possible to guarantee a job in 4 days (assuming it isn't needed too often?
Yes, if the rush job is given priority at every work station.

Julie say, "Since the last email, I took your suggestion of : The Buffer is ALL uncompleted work for B released to the system (even if it is at A or C).

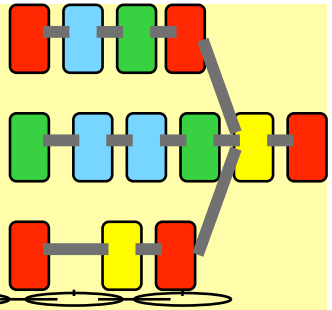
And I prioritized the system to lowest release date in order to get those old jobs to move quickly.

"WOW! DBR is working. No more spikes. A much more even distribution of work is in the plant when I used the buffer on B for 4 jobs in the whole plant.

"I finished the 20 jobs in 34 days. I released job 20 into the plant on day 28.

I still think I probably could improve my plant's process if I changed my order in which I entered into the plant."

Consider the Value of On-Time Deliver (Predictable, Reliable) and Rapid Response.

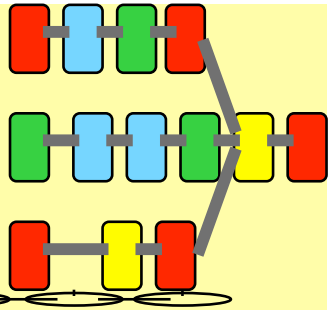


- Traditional (Industry Standard) Delivery time.
- (Assuming here that when we get to deliveries of 25 days and 80% on time that our sales have stagnated. That is, the number of jobs we get is averaging less than one per day. But, we continue to accept any work that comes meaning the average is at least 2/3rds per day. And at this rate, we continue to have the same glut of inventory as time goes on.)
- To make the math easy, let's say a traditional company sells ten items per week at $100 each. And total profit is $50 per week (5% on sales).
- Let's use some TOC calculations so we can figure things out without having to be an accountant.

(T, I, OE) in the Traditional Company.

- Sales = $1000 per week.
- Raw Material = $500 (assuming 50%)
- Throughput = Sales-RM = $500
- Profit=Throughput – OE = $50 (see left)
- So, Operating Expense (which is labor, lights, shipping, overhead and all) is then $500-$50 = $450 per week.
- Inventory in Traditional? High! It takes 25 days to make an item. We make 10 per week (each being in the system 25 days. If Inventory comes in and goes out at a constant rate, we can estimate IDD on the average flow time * Production Rate. Inventory is valued at $50 per item, that is 25*10*$50 days a week or $12,500 Dollar-Days of Inventory needed to sell $1000.

First Sales Offer:
ON TIME W/ PENALTY.



- **Remember this:** Traditional (Industry Standard) Delivery time.
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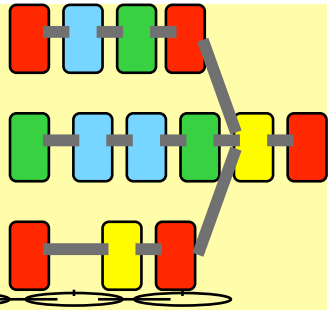
- To make it easy, let's say a traditional company sells ten items per week at $100 each. And total profit is $50 per week (5% of sales).
- T/wk = $500, OE/wk=$450, I=12,500 $D
- Profit=$50

- Now, we take the same company and use DBR (Julie's approach).
- We can deliver 100% inside of 8 days.
- Industry Standard is 25 days with 20% unreliable delivery at that.
- First Sales Offer:
  We deliver in 25 days and pay a 10% penalty each day if we are late!
- Competitors won't touch this since they only make 5% profit and if they are late, it's late by more than a day.
- As a result, we gain one more sale per week.
- Sales = $1100. OE = $450 (same) RM $550. Profit = $1100-$550-$450
- Profit = $100

Value of Selling Just One More.



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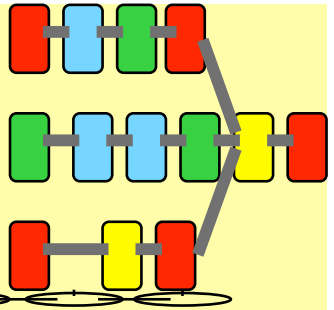
- To make it easy, let's say a traditional company sells ten items per week at $100 each. And total profit is $50 per week (5% of sales).
- T/wk = $500, OE/wk=$450, I=12,500 $D
- Profit=$50

- First Sales Offer:
  We deliver in 25 days and pay a 10% penalty each day if we are late!
- Sales = $1100. OE = $450 (same) RM $550. Profit = $1100-$550-$450
- Profit = $100
- To make this profit, we have also reduced inventory dramatically. It only takes 8 day max to produce a product.
- So Inventory-Dollar-Days would be about 8*11*$50=4,400 $D. This means at the same time we double profits, we cut our investment (Inventory) to about 1/3rd of what it was before.
- In a Cash Strapped economy; don't forget this!!

Second Sales Offer
EARLY DELIVERY (15 days)
For Extra Cost With Penalty



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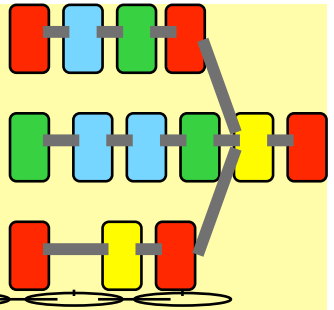
- To make it easy, let's say a traditional company sells ten items per week at $100 each. And total profit is $50 per week (5% of sales).
- T/wk = $500, OE/wk=$450, I=12,500 $D
- Profit=$50

- First Sales Offer:
  - 25 days with10%/day penalty T/wk=$550, OE/wk=$450, I=4,400$D
- Profit= $100.
- Second Sales offer:
  - Prompt Delivery at 15 Days with 10%/day penalty. (Remember, we will never pay a penalty, unless we choose to do so as a marketing stunt.)
  - Increase price to $150 for the faster delivery (Like sending UPS).
  - Assume we get one such sale each week.
- Sales = $1250. OE = $450 (same) RM $600. Profit = $1250-$600-$450
- Profit = $200

Third Sales Offer
URGENT SALES OFFER (8 days)
For Extra Cost With Penalty



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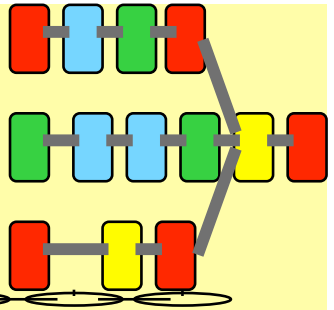
- To make it easy, let's say a traditional company sells ten items per week at $100 each. And total profit is $50 per week (5% of sales).
- T/wk = $500, OE/wk=$450, I=12,500 $D
- Profit=$50
- First Sales Offer:
  - 25 day with10%/day penalty T/wk= $550, OE/wk=$450, I=4,400$D
- Profit= $100.
- Second Sales offer:
  - 15 days with 10% penalty @ $150
  - T/wk=$650, OE/wk=$450, I=4,800$D
  - Profit $200.
- Third Sales Offer:
  - 8 day delivery with 10%/day penalty but price is now $200 per item for very rapid delivery.
  - Can you figure the profit out on your own yet?

Third Sales Offer
URGENT SALES OFFER (8 days)
For Extra Cost With Penalty



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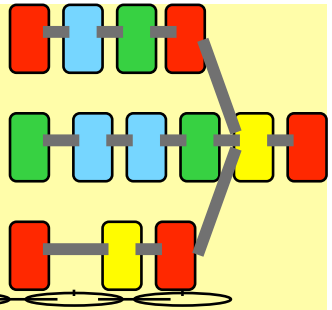
- T/wk = $500, OE/wk=$450, I=12,500 $D
- Profit=$50

- First Sales Offer:
  - 25 day with10%/day penalty Profit= $100.
- Second Sales offer:
  - 15 days with 10%/day penlty
  - Profit $200.
- Third Sales Offer:
  - 8 days with 10% penalty @ $200
- Sales = $1450. OE = $450 (same) RM $650. Profit = $1450-$650-$450
- Profit = $350
- Inventory with 13 is 13*8*$50 = 5,200 $D

Fourth Sales Offer
EMERGENCY SALES OFFER (4 days)
For Extra Cost With Penalty



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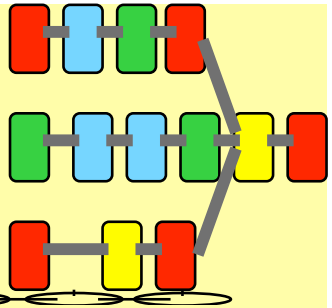
- First Sales Offer:
  - 25 day with10%/day penalty
  - Profit= $100.
- Second Sales offer:
  - 15 days with 10%/day penalty
  - Profit $200.
- Third Sales Offer:
  - 8 days with 10% penalty
  - Profit = $350
- One More Sales offer:
  - In the case of a Serious Emergency, we could deliver in 4 days. For such a deal we would really have to disrupt the factory giving emergency work first priority. We charge $400 each for the disruption.
  - Assume we get one such job /week but have to hire another B person at $50 per week in order to do it.
  - Can you figure out the profits?

Fourth Sales Offer
EMERGENCY SALES OFFER (4 days)
For Extra Cost With Penalty



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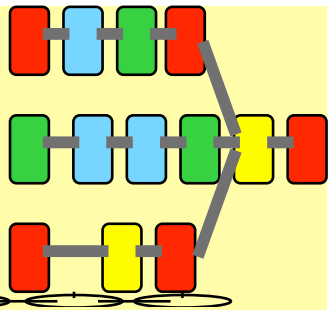
- Profit=$50

- First Sales Offer:
  - 25 day with10%/day penalty Profit= $100.
- Second Sales offer:
  - 15 days with 10%/day penalty
  - Profit $200.
- Third Sales Offer:
  - 8 days with 10% penalty
  - Profit = $350
- Selling 14 per week, 11@$100, 1@ $150, 1@$200, and now 1@$400.
  - We have to hire another B at $50/ wk. So, OE goes up.
- Sales = $1850. OE = $500 (higher) RM $700. Profit = $1850-$700-$500
- Profit = $650
- Inventory with 14 is 14*8*$50 = 5,600 $D (actually a bit less because one was only 4 days).

What is Really Possible On the Plus Side?



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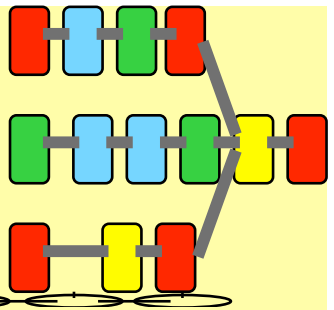
- Profit=$50

Hum? Is it profitable to be Reliably On-Time and FAST? I wonder if we could shift more than 3 of 14 into the more lucrative, rapid response area? Hum? What would profits be then? Even if we had to hire a few more people? Hum?

- Traditional Sales
  - 25 days delivery with 20% late (sell 10)
  - Profit = $50 ←
- First Sales Offer:
  - 25 day with10%/day penalty (Sell 11)
  - Profit= $100. ← 100% increase
- Second Sales offer:
  - 15 days with 10%/day penalty (Sell 12 with one at $150)
  - Profit = $200. ← 400% increase
- Third Sales Offer:
  - 8 days with 10% penalty (Sell 13 with 1 @ $150 and 1 @ $200)
  - Profit = $350 ← 700% increase
- Fourth Sales Offer
  - 4 days with 10% penalty (Sell 14 with 1@$150, 1@$200, 1@$400)
  - Profit = $650 ← 1300% increase

Keep Thinking! Dr Holt

What is Really Possible On the Negative Side?



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- Profit=$50

- Just to be complete…
- What if the Traditional Company decides to cut costs, reducing OE to $400 resulting in a slow down of the plant (now takes 30 days to produce a job) and direct reduction in ability to sale down to only 8 product per week?
- Sales = $800
- Materials = $400
- Operating Expense = $400 (reduced)
- Throughput = $800 - $400 = $400
- Profit = T-OE = $400 - $400 = $0
- Inventory = 8*30*$50 = 12,000 $D

Wow! The impact of reducing capacity is devastating.
We have Zero Profit on virtually the same Investment (Inventory-Dollar-Days).
It's not magic; it's clear thinking.
Study the full Rapid-Reliable-Response Strategy and Tactic Tree at:
http://www.vancouver.wsu.edu/fac/holt/em534/SandTRRR.pdf

Dr Holt