Hands-On Activities For Training Staff In Operational Performance Improvement Tools

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Our Objective

- Identify hands-on simulations that introduce concepts of lean/6-Sigma that are of greatest use in healthcare settings
- Emphasize activities can be completed in two hours or less
- Activities have zero or low cost– no commercial activities are included
- Topics that are most appropriate for manufacturing omitted (e.g. cells)

Strategy

For each activity we will:

- Introduce activity
- Highlight primary concept that it introduces
- Summarize the steps of the activity
  (Often with a demonstration/video)
- Summarize typical results

Some details appear in the annotated presentation or on referenced sources.

Activity 1: Why Do We Need Poke-Yoke?

How many times does the letter ‘e’ appear below? You have 1 minute to decide.

USD Engineering is dedicated to providing student-centered education emphasizing engineering fundamentals and design, to advancing scholarship in engineering education and to pursuing application-driven research. The unique dual BS/BA degree results from a combination of intensive technical education and the USD emphasis on a broad liberal education.

Purpose

Emphasizes the futility of relying on inspection to catch errors. Highlights the importance of designing accuracy into any process and mistake-proofing (Poke-Yoke).

Activity 2: Muda Scavenger Hunt

Purpose

Get people used to looking for waste.

Procedure

1. Discuss types of waste in workshop
2. Distribute digital cameras
3. Have teams of people search the facility for an example of each type of waste
4. Collect images and use to start the next session

Activity 3: PDCA Card Game

Purpose

Demonstrate the principles of Plan-Do-Check-Act

Procedure

Create decks of cards by combining the A-10 from two decks. Form teams of 4-5 players.

- Tell players that they have to distribute the cards so that each player has the same number of pips
- Explain PDCA, then let them try it again
- Repeat for several cycles

Activity 4: Goldratt Game

Purpose

- Demonstrating importance of reducing process variation

- Applicable to a variety of systems, manufacturing and service

- Let's Play

Activity 4: Goldratt Game (cont.)

- Two Teams (A and B)
- Each team is a production line with 5 stations.
- The work flows in a linear fashion from station 1 to station 5, where finished products leave the system.
- The “amount of work” is randomly determined by the role of a die.
- The “work” is the number of pennies you pass to the next station.
- Station 1 is always replenished with 4 units of WIP
- Evaluate and improve the system
- Run again incorporating participant suggestions

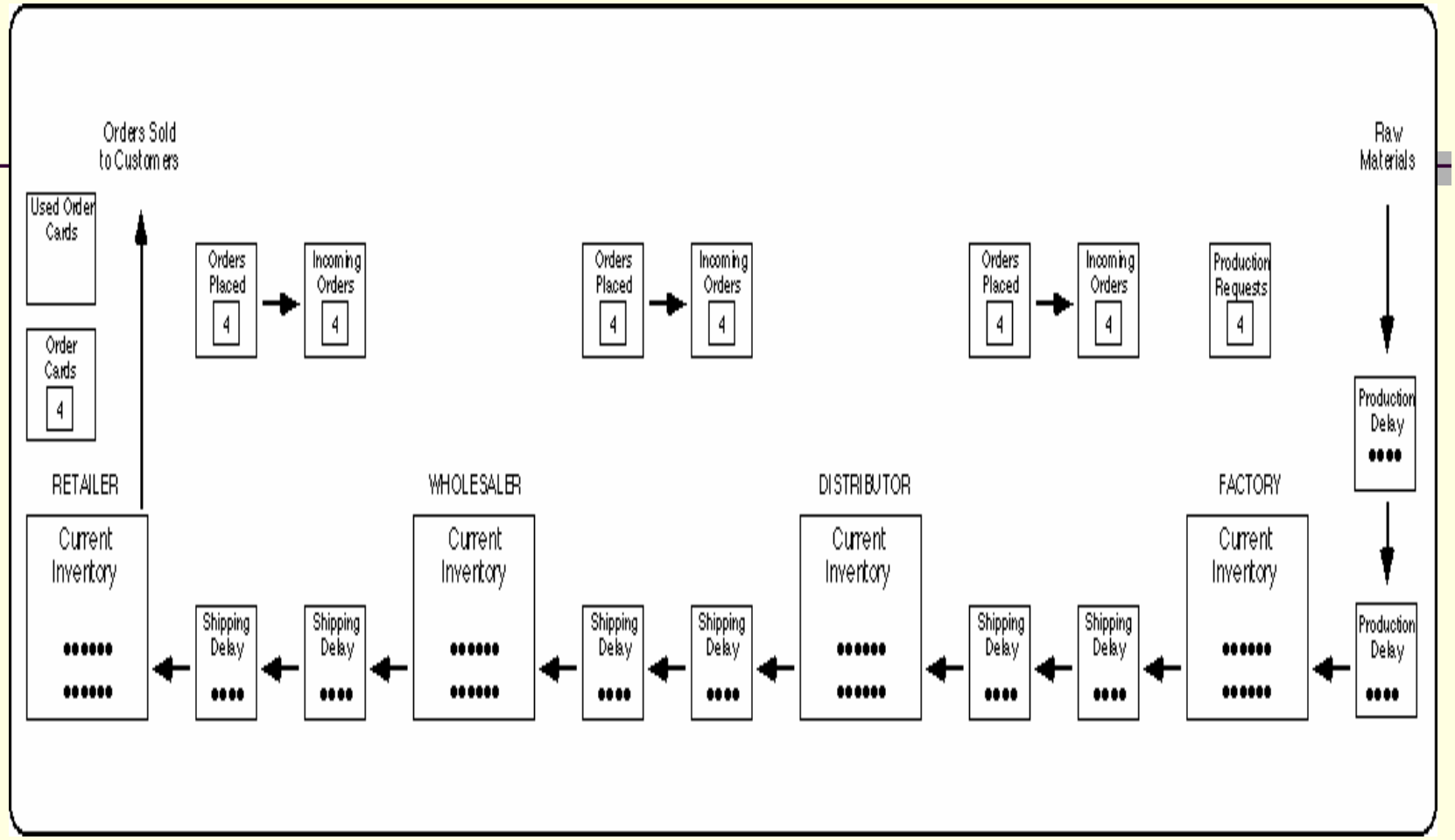
Activity 5: The Beer Game

Purpose:

- Demonstrate the Bullwhip effect
- Show the importance of cooperation and information flow in the multi-echelon systems
- Reveal the tendency to overreact and over-compensate.

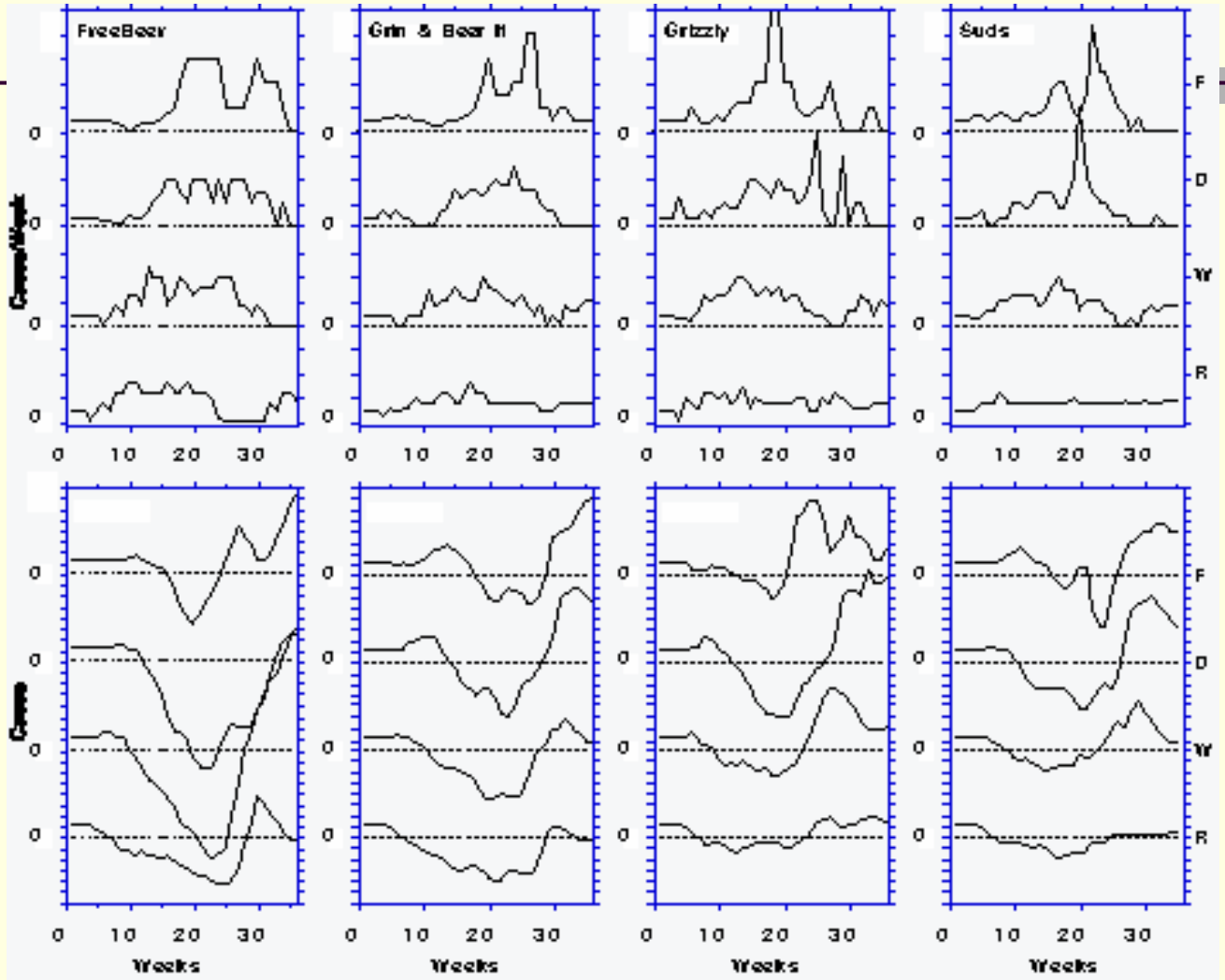
Beer Game Rules

- The supply chain consists of a retailer, a wholesale, a distributor, and a factory with unlimited capacity and raw material.
- Each component in the supply chain has unlimited storage capacity
- Each week, every stage of the supply chain meets the demand of the downstream component. Orders which cannot be filled are recorded as backorders
- Each station is charged a shortage cost of $2/backordered item.
- Excess inventory is charged inventory holding cost $1 per unit
- Items that are in transit between components have cost zero.
- Each week:
  - Stations order some amount from its upstream supplier.
  - It takes one week for this order to arrive at the supplier.
  - Once the order is shipped, it takes two weeks to arrive at the customer
- The goal of the retailer, wholesaler, distributor and factory is to minimize cost.



More details and on-line versions of the game can be found at: http://beergame.mit.edu/default.htm

Typical Results

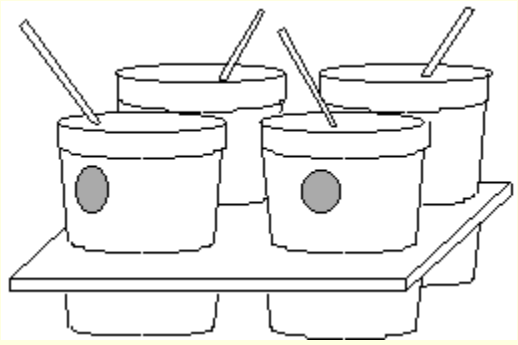


http://web.mit.edu/jsterman/www/SDG/beergame.html

Activity 6: Cups Game
(http://webserver.lemoyne.edu/~wright/cups.htm)

Purpose

Demonstrate how Push and Pull systems differ. Show how buffer inventories can hurt performance.



Activity 5: Cups Game (cont.)

Procedure

- Create 6 person team with 4 assembly stages
- Round 1- Push
- Round 2- Pull with buffer of 4 units
- Round 3- Pull with buffer of 2 units

Each round is 15 minutes long. Record WIP

Activity 7: Introducing Linear Programming

(from: Pendegraft, Norman, Lego My Simplex, OR/MS Today, Feb. 1997)

Purpose:

Demonstrate that some kinds of problems can be solved optimally.

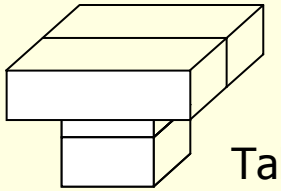
Procedure

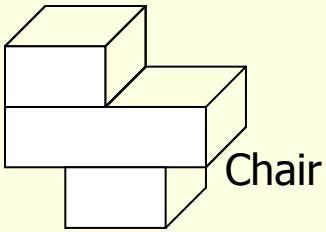
1. People use Legos to solve a simple allocation problem manually and learn about shadow prices
2. Build mathematical LP and solve it
3. Present a more complicated problem and let people try to solve it
4. Solve the more complicated problem as an LP

The mayor of Legopolis has declared that from this day forth all kitchen furniture shall be made of lego blocks.

Furthermore, to ensure uniformity, there shall only be two pieces of kitchen furniture: tables and chairs.

The table will be made of 2 large blocks and 2 small blocks.





The chair will be made of 1 large block and 2 small blocks.

You happen to have 6 large blocks and 8 small blocks.

If tables sell for $16 and chairs sell for $10, how many tables and chairs should you sell?

Be prepared to explain your decision process.

- What intermediate solutions did you make along the way?
- How did you improve your solution?

You have 2 minutes to decide.
How much would you pay for another large block?

The LP Model:

$$\begin{aligned} \text{Max:} \quad & 16\,T + 10\,C \\ \text{st:} \quad & 2\,T + C \leq 6 \\ & 2\,T + 2\,C \leq 8 \\ & T, C \geq 0 \end{aligned}$$

You might enter the model into Excel and use the solver to find the solution.

Nurse Staffing LP

- Nurses in your hospital work 12 hour shifts that start every 4 hours throughout the day.
- LPNs cost $20/hr and RNs cost $32/hr.
- RNs can do the work of LPNs or RNs.

Your staffing requirements are:

Midnight-4 am	3 LPN- 4 RN	Noon-4 pm	6 LPN- 7 RN
4 am-8 am	4 LPN- 5 RN	4 pm- 8 pm	5 LPN- 6 RN
8 am-Noon	6 LPN- 5 RN	8 pm- Midnight	4 LPN- 5 RN

How many nurses of each type do you need to minimize total costs?

Let: Ri = # RN's starting in interval *I*

Li = # LPN's starting in interval *I*

Minimize $12\sum_{i=1}^{6}\left(32R_i + 20L_i\right)$

St:

(Satisfy RN Demand)	*(Satisfy Total Demand)*
R5+R6+R1>=4;	*R5+R6+R1+L6+L6+L1=7;*
R6+R1+R2>=5;	*R6+R1+R2+L6+L1+L2>=9;*
R1+R2+R3>=5;	*R1+R2+R3+L1+L2+L3>=11;*
R2+R3+R4>=7;	*R2+R3+R4+L2+L3+L4>=13;*
R3+R4+R5>=6;	*R3+R4+R5+L3+L4+L5>=11;*
R4+R5+R6>=5;	*R4+R5+R6+L4+L5+L6>=9;*

Optimal Nurse Schedule Solution

Min Cost: $6384/Day

R1=4

R2=1

R3=1

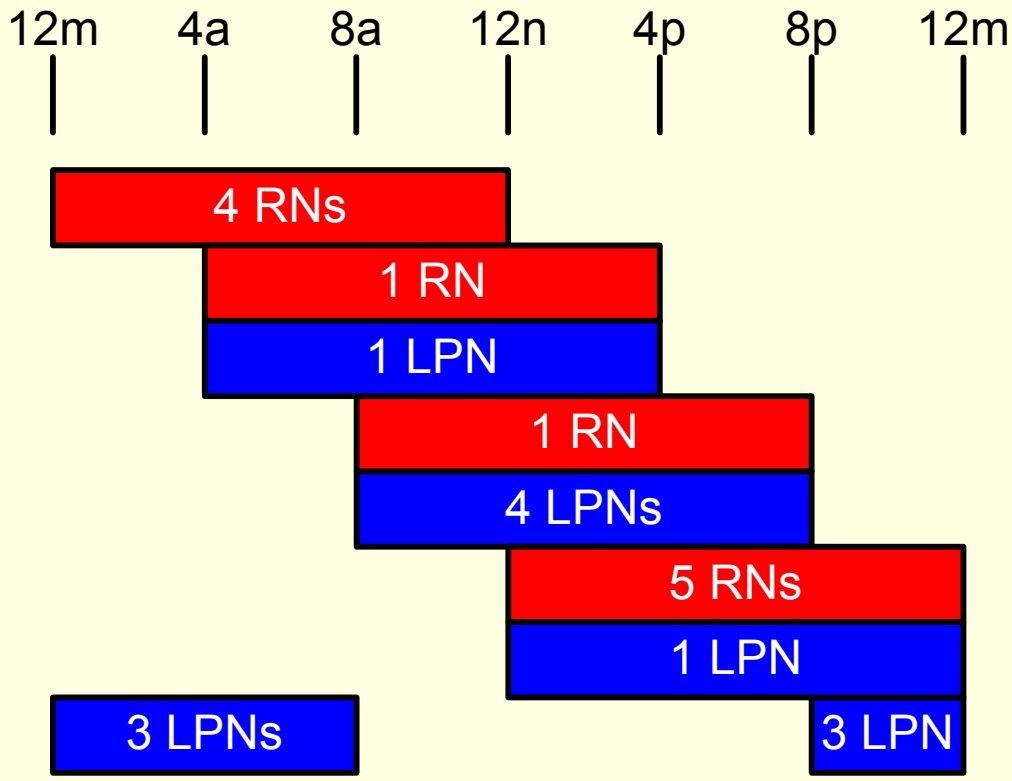
R4=5

L2=1

L3=4

L4=1

L6=3



Activity 8: Lean Office Simulation

Purpose

Introduce many elements of lean including:

- Minimizing movement
- Eliminating unnecessary/duplicated work
- Pull vs. Push

Objective

Process as many accurate, complete forms as possible

Procedure

- Introduce process consisting of several stages including. A typical process would include:
  - Write patient name on routing sheet and multipart form. Staple routing to form. Sign and time routing sheet.
  - Staple 5 labels containing patient info to document. Take middle form. Sign routing sheet.
  - Remove one label place on cup. Sign routing sheet.
  - Toss die until a 6 appears. Write a number on the cup. Sign routing sheet. Place label on log page.
  - Write number on cup onto form. Discard bottom page of form, and excess labels. Time routing sheet.

- Improve process through several rounds
  - Round 1: People spread throughout facility. At each stage people toss a die to decide how many forms to process at once (2, 4, or 6). Nobody knows what the others are doing.
  - Round 2: Bring people close together
  - Round 3: Eliminate wasted activities, routing form and unnecessary labels. One piece flow instead of batches.
  - Round 4: Pull system. Buffers of 2.

- This is similar to many of the *lean factory* simulations.
  - Try Googling “lean airplane factory simulation”
- Try to tailor to the audience you are training.
  - Use your forms
  - Label test tubes
- Include some fast stages (especially at the beginning) and some slower stages (in the middle).
- Talk to Karen Martin

Questions???

- Please email either one of us:
  - r_olson@sandiego.edu
  - bchase@sandiego.edu
- Tell us about other activities you've used
- Video of many of these activities are available at:
  - www.sandiego.edu/engineering