The 7 Key Points for Designing Profitable Manufacturing Systems

Presented By: Kevin Kohls

www.leanontoc.com

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Kohls Consulting

www.Kohls-Consulting.com

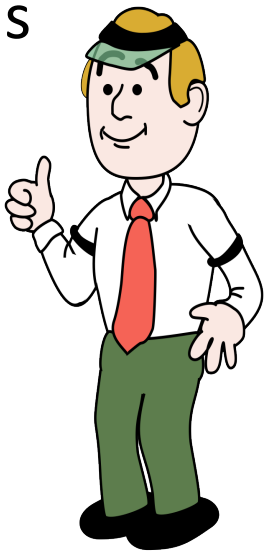
Goal & 7 Points

Ensure that new designs are implemented quickly and profitably.

1. Throughput Accounting
2. Murphy Exists – Embrace Him!
3. Use a Simulation
4. Design in the Bottleneck
5. Design out Management Constraints
6. Validate TOC and Lean “game changers”
7. All Analysis is wrong…

1. Throughput Accounting

- Use Throughput Accounting to evaluate success.
  - Training at beginning to gain agreement on method.
  - Include a Project Charter that specifies financial impact
    - Net Profit (NP) and Return on Investment impact (ROI)
    - Increased Throughput $, Reduced Inventory, Reduced OE, especially Overtime
  - Goal is to make Target Throughput under various demand situations.
  - Each will have a different ROI.
  - A system-wide perspective.



1. Throughput Accounting

- Most organizations do NOT know how to make financial decisions.
  - Current Operations
  - Future Operations
- This lack of knowledge causes a wide array of wrong answers.
- Metrics for self defense
  - "Yes, removing that machine will save on investment, but you will be unable to make demand without overtime. The Overtime Impact allow will cause the plant to go into the red in 6 weeks."

2. Murphy Exists

- Variability must be taken into consideration, despite our customer's attempts to ignore it.
  - Every element, including Input and Output systems, must have some variability in the model.
- Assume the demand forecast prediction are wrong.
  - Profit impact if Model Mix varies.
- We need to answer:
  - What is the smallest demand rate that makes us profitable?
  - What is the maximum throughput of the system once the Designed In Bottleneck is fully utilized.

3. Use a Simulation

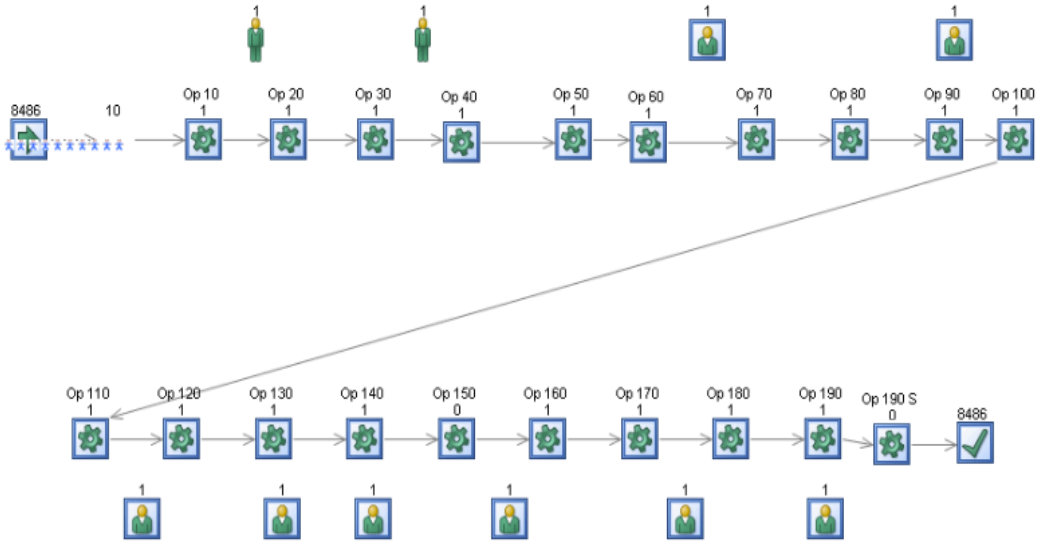
- Use for entire system dynamics, model variability, and to quickly answer "What If" brainstorms.
  - Attach to Throughput Accounting.
  - Use a Dice Game simulation for basic training.
    - Tie the observed effects with current design.
  - Variation variables don't have to be perfect, just representative of current conditions.
  - Don't let customers start with the answer and then change the input data to match.

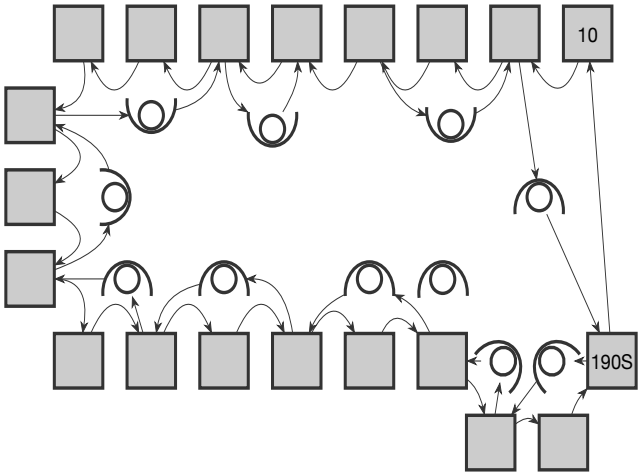
Simulation Software

- Simple simulation software exists that are much cheaper than full-blown 3D packages.
  - My favorite – Simul8
- Engineers with some programming background can pick up the process fairly quickly.
- Basic statistics course is recommended.
- Experienced simulation engineers can complete a basic model in a few days.
  - Can work off-site with teleconferencing software.
- The time consuming part is validating data and getting the finalized design.

Basic Simulation – U Shaped Cell

Value Stream Map Layout



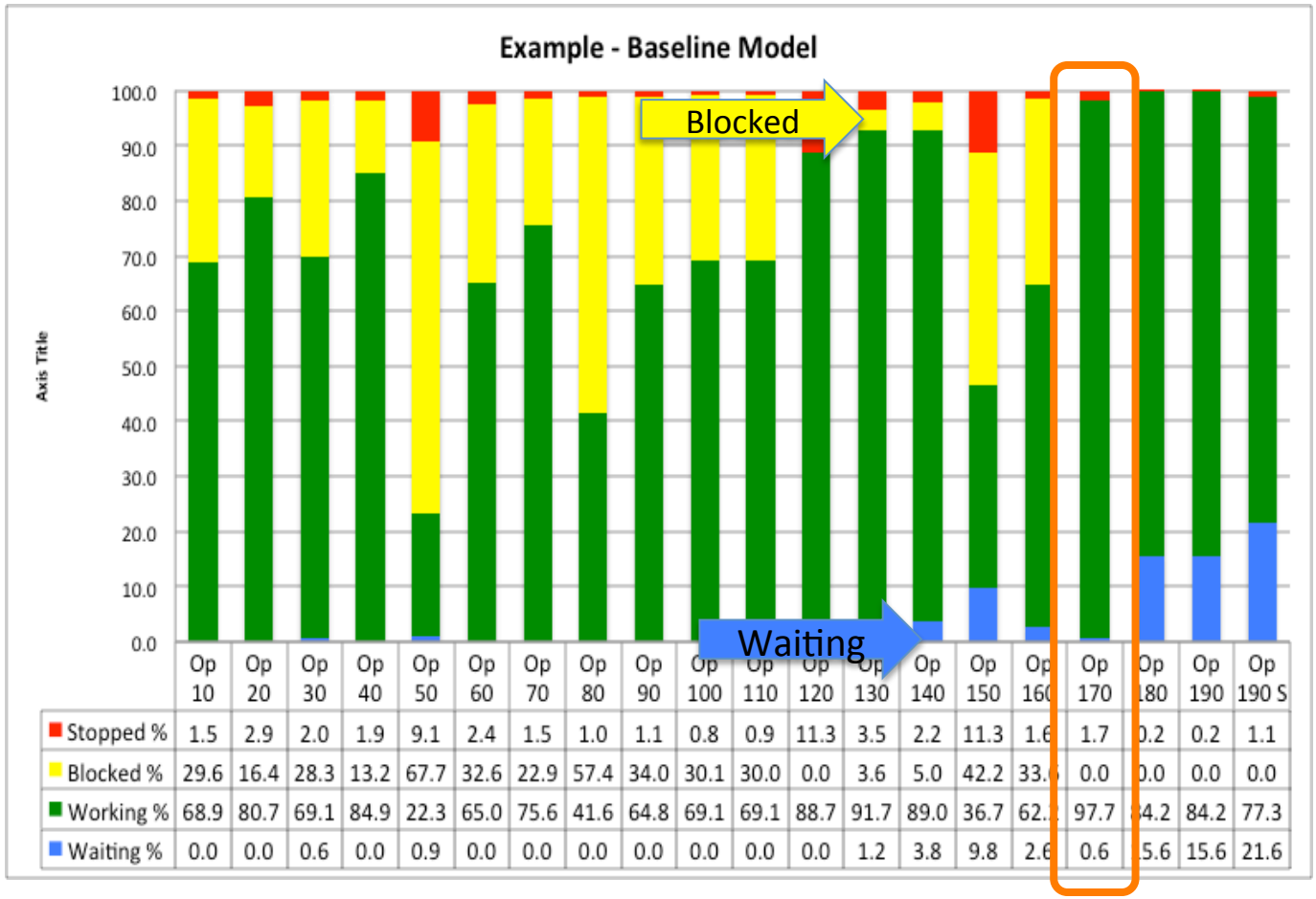


- Objective: Consistently produce 9000 jobs per week with expected variation and no overtime.
- Focus on moving work and adding buffer to the right locations.
- Baseline: 8493 JPW, a 5.6 percent gap.
- Current configuration: 4 rotating shifts, working 7 days a week.
- Financial Impact: Huge expedite fees – fly parts in. Potential loss of contract.

Looking at Results

Baseline for Model

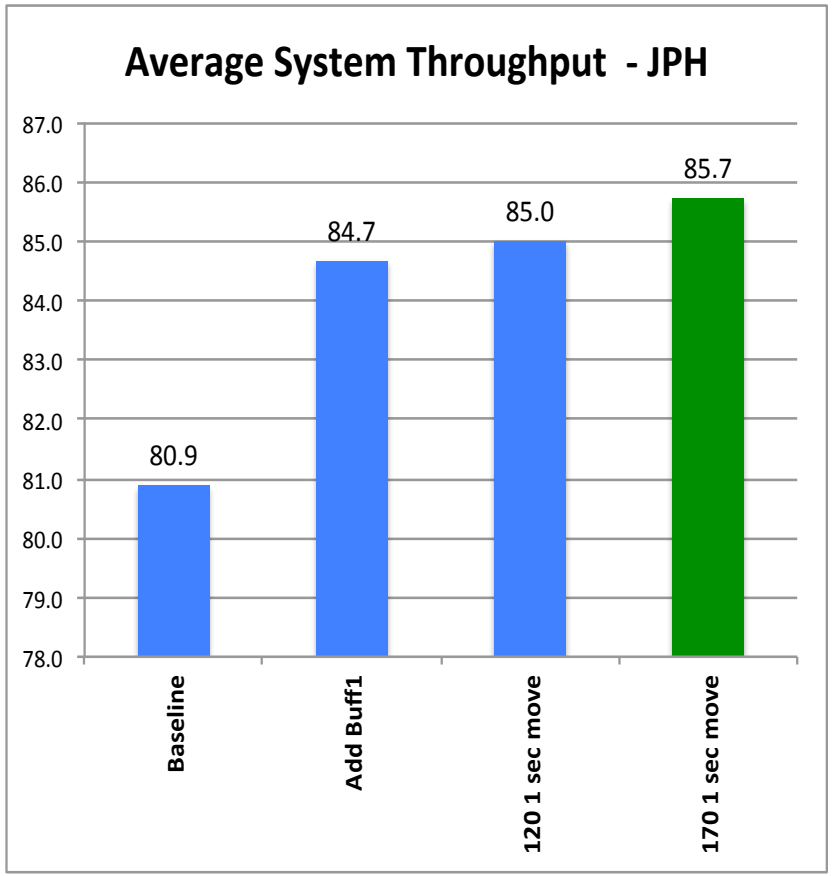
- Buffer Opportunities exist if every station has blocked or starved states.
- An opportunity exists during the change from Blocked to Waiting.
- Where is the bottleneck? How do you know?



	Op 10	Op 20	Op 30	Op 40	Op 50	Op 60	Op 70	Op 80	Op 90	Op 100	Op 110	Op 120	Op 130	Op 140	Op 150	Op 160	Op 170	Op 180	Op 190	Op 190 S
Stopped %	1.5	2.9	2.0	1.9	9.1	2.4	1.5	1.0	1.1	0.8	0.9	11.3	3.5	2.2	11.3	1.6	1.7	0.2	0.2	1.1
Blocked %	29.6	16.4	28.3	13.2	67.7	32.6	22.9	57.4	34.0	30.1	30.0	0.0	3.6	5.0	42.2	33.[illegible]	0.0	[illegible].0	0.0	0.0
Working %	68.9	80.7	69.1	84.9	22.3	65.0	75.6	41.6	64.8	69.1	69.1	88.7	91.7	89.0	36.7	62.[illegible]	97.7	[illegible].2	84.2	77.3
Waiting %	0.0	0.0	0.6	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.8	9.8	2.6	0.6	[illegible].6	15.6	21.6

Green is running, Red is stopped, Blue is Starved,

Results in One Week



- Basic simulation validation
- Buffer location determined and added.
  - Increase in throughput validated.
- Plan to move work implemented.
- Rate achieved.
- What is the next financial opportunity?

Simulation Speed

- A single iteration takes less than a minute.
  - Iterations also run quickly.
  - 15 runs per hour can be accomplished with experienced engineers.
- Bottlenecks are found by determining increase in throughput by a “perfect fix”.
- Buffer locations and sizes are determined by increasing each location to “infinity” and tracking increased throughput.
- Workstation that “just make it” under Takt usually become bottlenecks.

“Battlefield” Simulation

- Simulation can also be used to teach how to run the facility under various conditions very safe conditions.
  - Run DBR and react to:
    - Sudden demand shifts.
    - Glut of black orders (a broken system).
    - Determine the bottleneck for Lean focus.
    - Quality crisis, major breakdown, loss of a supplier, recall, etc.
  - Reacting to Visual Signals, determining the need for additional communication methods.
    - Emphasis on saving trees, reducing IT requirements.
- In the end, this drives out fear.

4. Design in the Bottleneck

- Important Criteria for this Critical Workstation:
  - Considered a monument.
  - Difficult and time consuming to add capacity.
  - Attempting to modify system stops production for an extended period of time.
  - There is a very long lead time to acquire necessary equipment to improve capacity.
- Design considerations
  - Inbound parts buffer
  - Outbound space buffer
  - External setup

5. Design Out Management Constraints

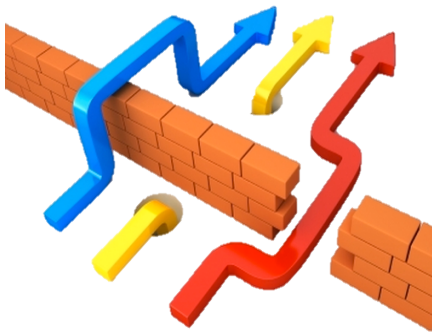
- Test management policies to see if they have the desired results or cause "damage" to the system profitability.
  - Overtime in another area that is tied too tightly to a system that is at or below capacity.
  - Impact of Push, Building to Forecast
  - Use of efficiency measures.
- Be neutral
  - Test ideas that you know will have a negative impact.

6. Validate TOC & Lean Concepts

- Include concept of “profitable waste” and the need to put buffers in the right place.
- Unbalanced systems that are “subordinate” to the designed in bottleneck.
- Increase surge capacity, add shipping buffers, etc.
- Demonstrate how SDBR and Buffer Management works, and how they can be used in the simulation with minimal intervention.
  - Allow users to create “worst case” scenarios to see how these systems react.
  - Inventory, throughput and lead time impact.

7. All Design Analysis is Wrong…

- But some are useful.
  - Don't claim to be able to predict the lottery.
- Focus on:
  - Validating common sense ideas.
  - Eliminating clearly damaging ideas.
- Anything that doesn't fall into these two categories and doesn't have an impact on the bottleneck probably has minimal effect on the results.



TOC Implementers

- Focus is on current production, while future designs are repeating the same mistakes.
  - These errors are cheap as compared to “opening the wallet” after production starts.
- Apply TOC concepts to design means the system will be profitable in a much smaller timeframe.
- TOC implementers can spend much less time on design, since changes are very fast to make.

Summary

- While the current crisis is typically in current production, be wary of a new system that is being designed or installed.
- The damage of a poor design lasts for years.
- A simulation takes a week to make, a month to generate practical solutions.
- Simulation has become a fast, low cost method of validating improvement efforts.
- The 7 Key Points are crucial for designing profitable manufacturing systems that incorporate new ideas with minimal risk.