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A Lean Analysis Methodology Using Simulation

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abstract

This paper presents a case study where simulation was used to convert from a manufacturing resource planning (MRP) based push process to a demand-driven pull process in a single plant operation factory floor. Simulation is a software program that allows one to visually see and measure how processes perform over time, including materials, information and financial flows, and how probabilistic variables impact them.

terms

Lean
Simulation
Process
Methodology
Six Sigma
Manufacturing

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A Lean Analysis Methodology Using Simulation

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Introduction

This paper presents a case study where simulation was used to convert from an MRP based push process to a demand driven pull process in a single plant operation, factory floor.

Simulation is a software program that allows one to visually see and measure how processes perform over time, including materials, information and financial flows, and how probabilistic variables impact them.

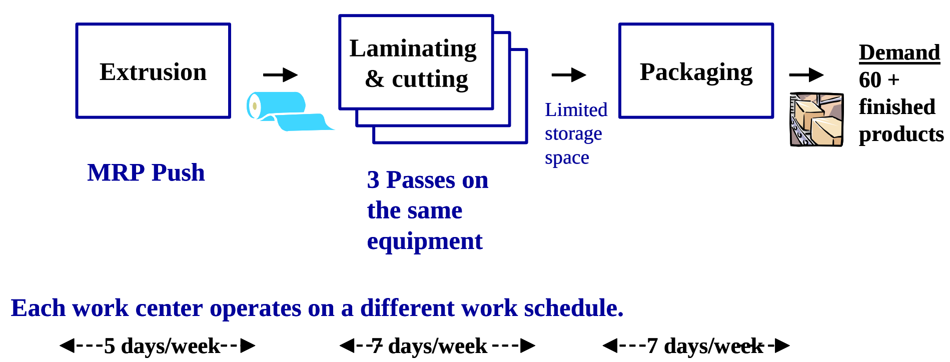
It is particularly valuable in where a mix of products share resources, and it is difficult to "get your head around" all the things that are happening asynchronously.
The devil is in the details when it comes to designing a workable new process

Two important takeaways from this case study:

1. Valuable for evaluating things other tools cannot – product mix, setups, variability, …
2. Internal people can be trained to use and develop these models, particularly people that have been trained in six sigma already. It becomes another key part of their toolbox.

Case study

Set Up Pull Process in a Flow Shop for Laminated Plastic Manufacturing



Units = lots/rolls of extruded plastic in this example
Unique things – cure time, several passes on same equipment, analogous to a job shop embedded in the middle
Make to Stock process - MRP driven

Methodology

- Value stream map was first developed
- Issues in the before process: service levels, labor cost over budget
- Describe data missing

- Start with demand & work back through the process to meet pull objective
- People & organization & how they worked together: Master black belts (MBBs) worked with supervisor of operation, planner/scheduler to develop ideas they had for improvement
- Train MBBs on the model
- Provide template to start with – configure for unique aspects of operation
- Run & review results with supervisor & planner/scheduler

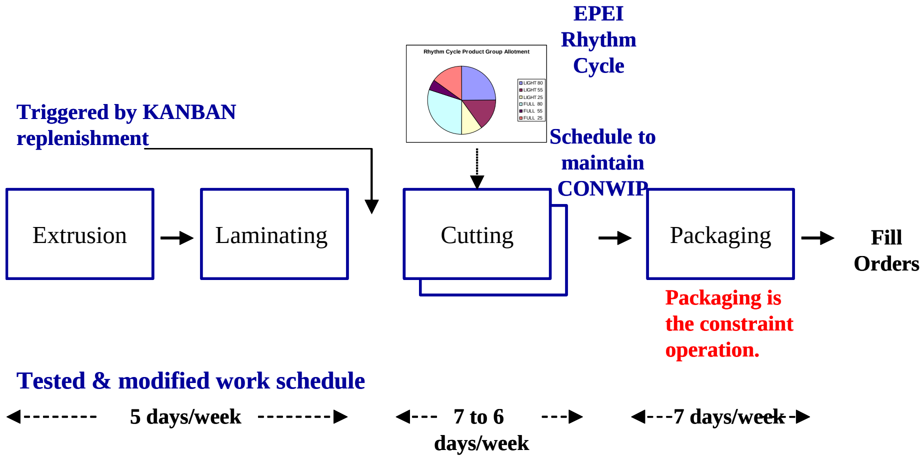
Analysis steps with model:

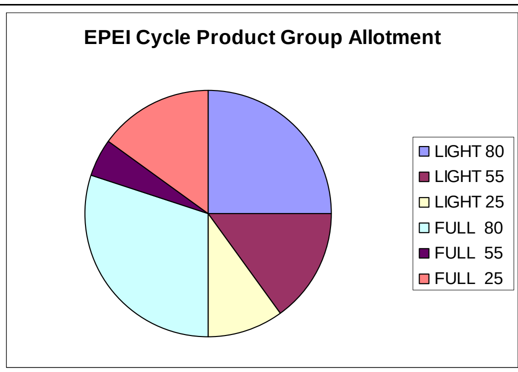
1. Replicate current process
2. Analyze work shifts & responsibilities
3. Try Make to Order – for finished goods
4. Try kanban for extrusion instead of MRP trigger
5. Try CONWIP to keep packagers busy with EPEI cycle to deal with the variety of products and setups between
6. Quality testing after the packaging was initially not included in the process. However, as the throughput was improved, quality testing became the bottleneck

Model Capabilities used in the analysis

CAPABILITY	**USED**
Kanbans	√
Schedules	√
EPE (every-part-every …) interval	√
Campaign lengths vs. one lot flow	√
Setup reduction	
Routing changes	√
Shared resources	√
Postponement	
Variability impacts	√
Downtime impacts	√
Yield & scrap	√
Material lead time	

After Model





~60 total products; in 6 product groups

As demand arrives for each product, the production order is assigned to the next available cycle spot

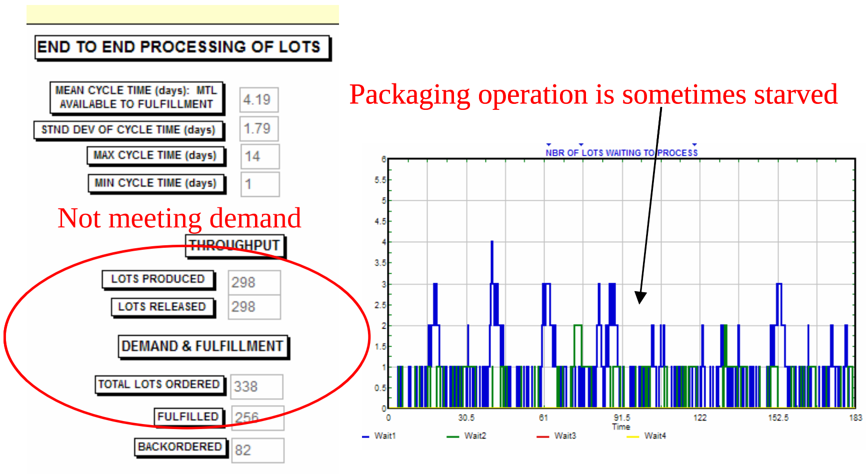
Fairly complex setup rules between product groups

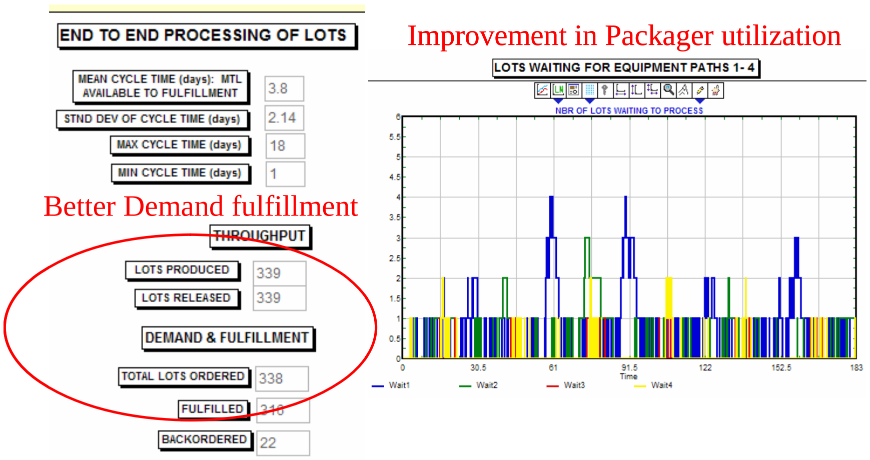
Data required

- Rules
- History
- Root cause analysis
- Service levels
- Facts

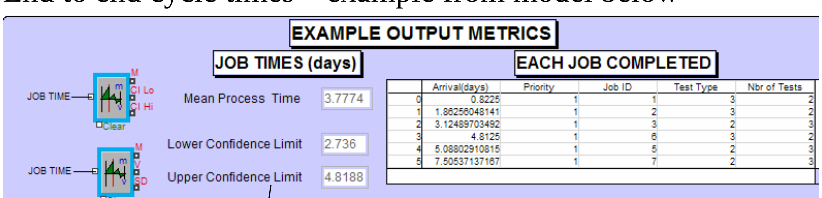
<u>Metrics important in a lean design to compare alternatives</u>

Service levels

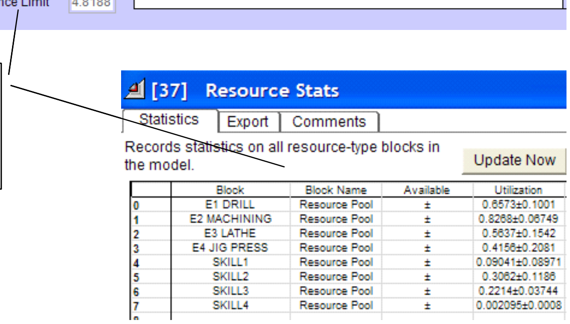




End to end cycle times – example from model below



Confidence intervals
for results, e.g.,
end-to-end time
& utilization



Note – this example needs to be one from the same model in the case

Takt times/rates for each work center – add example from model

Overall Equipment Effectiveness for each piece of equipment
    Define & show example outputs

Next steps – related activities in a methodology such as is proposed

Summary – potential other uses of a model developed in a project such as this:
- Continuous improvement
- Decisions about how to schedule vs doing it ad hoc on the floor
- Compare to MES & ERP systems
- Capacity planning

The examples in this case study are from models developed in Extend™, a discrete simulation program from Imagine That Inc. Following is one of many example models that come with Extend, for people to use in learning to model with it.