Value Stream Mapping with Process Simulator

Session Agenda
- Materials for this Session
- Value Stream Mapping vs. Process Simulation
- Discuss Case Model
- Transforming Value Stream Maps to Process Simulations
  - General Methodology
  - Specific steps for transforming Acme model
  - How to transform each VSM icon to Process Simulator
- Analysis of Current-State Model (Methodology)
  - High-level metrics
    - Throughput, WIP, Cycle/Lead Time, Labor & Equipment Utilization
    - Drill down metrics
    - Activities, Resources (Labor), General Report
- VSM Constructs for Building Future State Model
  - Supermarkets & Kanbans
  - FIFO Lanes
  - Pacemaker Processes
- Analysis of Future State Model

VSM Materials
- Learning to See – Lean Enterprise Institute
  - Authors: Mike Rother, John Shook
  - To Purchase: ($50) www.lean.org

Value Stream Mapping vs. Process Simulation
- **Value Stream Map**
  - Static model that describes the states of current and/or future processes
  - Tells what is happening in the process now and what the process could be later
  - Reports on cycle/lead times, and value added time
  - Requires general information regarding material arrivals, operation times, labor and equipment availability.
    - e.g. average time = 15 sec

- **Process Simulation**
  - Dynamic model that predicts the behavior of current and/or future processes
  - Tells why a process behaves the way it does or how it could behave in the future
  - Reports on throughput, inventory, cycle/lead times, VA and resource utilization
  - Requires specific information about material arrivals, batch constraints, operation times, labor and equipment uptime & availability, transportation methods and times, and any other capacity constraints.
    - e.g. Time = T(5,10,25) sec
Transforming VS Maps to PCS Simulations

• Focus on Material Flow
  – Information flow will take place through PCS constructs such as Storages, Send Routes, and Order Statements, or, in some cases, by using additional (dummy) activities and trigger entities to control the flow of materials.
• Convert non-functional icons (e.g. “go see”) to Plain Graphics in Process Simulator
• Collect and enter the missing behavioral data from your Value Stream Map.

Actions to Transform Acme VSM to Simulation

• Arrivals
  – Make assumptions regarding material delivery times and starting quantities
• Entities
  – Make assumptions regarding # Parts/Coil
• Inventory Buffers
  – Make assumptions regarding maximum storage capacities
• Activities
  – Leave times constant or make assumptions regarding op variability
• Resources
  – Make assumptions regarding dedication to station
• Routings
  – Make assumptions regarding movement methods and times

Transforming Specific VSM Icons

Model these icons as Activities in PCS

Model Inventory Signs, FIFO Lanes and Sequenced Pull Balls as Buffers in PCS

Model Supermarkets and Safety Stock icons as Storages.

Model operator icons as Resources in PCS. Model transport icons as Resources or Plain Graphics.
Analysis Methodology

- Begin with Systemic (high-level) Metrics
  - Throughput (Can we meet the required rate?)
    - Examine Cumulative and Periodic charts
  - WIP (Is it stable? Are there trends up or down)
    - Where is WIP building up? (In front of the turtles)
    - Where is WIP being depleted? (In front of rabbits)
  - Cycle/Lead Time
    - Is it growing over time? (yes = systemic constraint)
    - Note: it should not be a time-weighted calculation
  - Resource Utilization
    - Is there a balance across Labor and Equipment?

Analysis Methodology (cont.)

- Drill down to other statistics as necessary
  - Activities
    - Single-capacity shows % setup, waiting, down, idle
    - Multi-capacity shows % empty, full, partially full
  - Resources (Labor)
    - % in use, % down, % idle (do these make sense?)
    - Off-shift time is not considered down time!
  - General Report (other things to consider)
    - Entity failed arrivals (due to insufficient capacity at the arrival activity/buffer/storage)
    - Entity/Resource/Activity cost summary
Current State Analysis: Average Lead Time

Note: Lead Times for initial inventory in the system are “cut off” in order to prevent skewing the average lead time calculation with partial times.

First parts through entire process (starting as Coil material) leave the system at about 16.4 hours.

Here we see that average lead time of the parts is rising, indicating a systemic constraint or “bottleneck”.

Current State Analysis: Entities (Parts)

% Blocked = Waiting as semi-finished parts in WIP buffers
% Waiting = Waiting as Finished Goods at Shipping/Staging

Current-State Analysis: Activities

Significant imbalance among processing stations

These resources are all “maxed out”, indicated by no idle time (dark blue).

Current-State Analysis: Activities (cont.)

Significant imbalance among inventory buffers

% Empty time for these buffers signals upstream constraints

Current-State Analysis: Labor

Significant imbalance among operators

These workstations are both “maxed out”, indicated by no idle time (dark blue).

Current-State Analysis: Conclusions

• The Good
  – Met required production rates for LH, RH parts across the simulation timeframe (4 weeks).
• The Bad
  – Drawdown of Finished Goods inventory cannot be sustained indefinitely.
  – Imbalance in both Labor and Equipment usage
• The Ugly
  – Excessive inventory across entire process!
Supermarkets & Kanbans

### Learning to See

"Production" KANBANS

1. CUSTOMER PROCESS: goes to supermarket and withdraws what it needs when it needs it.
2. SUPPLYING PROCESS: produces to replenish what was withdrawn.

PURPOSE: Controls production of supplying process without trying to schedule. Controls production between flows.

### Acme Stamping: Future-State VSM

Supermarket Pull System with Pacemaker Process and Downstream FIFO Lane

### Acme Stamping: Current-State Simulation

Customer Orders arrive every 30 min:
10 to 20 LH
5 to 10 RH

### First-in, First-out Lanes

an example of a "FIFO Lane"

### Pacemaker Processes

Selecting the "Pacemaker Process"
Analysis Methodology (Review!)

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  - Where is WIP being depleted? (In front of rabbits)
- Cycle/Lead Time
  - Is it growing over time? (yes = systemic constraint)
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Future-State Analysis: Throughput

Future-State Analysis: WIP & Inv Buffers

Future-State Analysis: Average Lead Time

Current State Analysis: Entities (Parts)
Current-State Analysis: Activities

Stamping activities for this cell still a small part of stamping capacity. Weld and Assembly stations are full 90% of the time.

Future-State Analysis: Labor

Labor is near full capacity

Future-State Analysis Conclusions

• The Good
  – Average Total WIP reduced from over 20,000 parts to about 3,000!
  – Average Lead Time reduce from 20 days to 3.5
• The Bad
  – Still significant room for improvement.
    • Cut inventory and cycle time by another 50%
• The Ugly
  – None

Summary & Conclusions

• Value Stream Maps are an important tool for understanding and quantifying the opportunities for system improvement.
• Process Simulator can take an existing map as the starting point for a simulation model, but some work will be required to supply the missing behavioral data.
• In many cases it’s easier to start over and develop a new model for dynamic analysis, rather than to modify an existing VSM.