Using Simulation and Optimization in Complex Manufacturing Operations

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**Presenters**

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Agenda

- **Case for Action – What was the problem to be solved?**
  - High level overview of the operation, its complexities and challenges

- **Solution Overview – Simulation & Optimization through ExtendSim**
  - Opstat Modeling overview

- **Lessons Learned – The Journey through multi-level advanced planning**
  - Resolved Roadblocks and collateral benefits
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High Level Manufacturing Processing Overview

- **Monomer**
  - Different Suppliers
  - Various Batch Sizes
  - UOM = Grams
  - 1 SKU

- **Polymer**
  - Various Customers
  - Long Lead-Time
  - UOM = Grams

- **Extrusion**
  - Multiple Lines & Capabilities
  - Short Shelf Life
  - UOM = Grams
  - Few SKUS

- **Annealing**
  - Ancillary equipment
  - Highly labor dependent
  - UOM = yards
  - Various SKUS

- **Scouring**
  - Process Bottleneck
  - Various Batch Sizes
  - UOM = yards
  - Several SKUS

- **Cutting**
  - Multiple Mfg. Cells
  - Multiple Customers
  - UOM = each
  - Many SKUS
Customer Service challenges and observed results

1. Process Implementation in Needles and PDS Sutures
2. Capacity Improvements in identified bottlenecks
3. Increased understanding of process interdependencies by the planning team
4. Process Capabilities Improvements
5. “Hand Shake” meetings for Plan Attainment and Aged Work Orders
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What decision can we drive with simulation?

1. **How the bottleneck moves?**
   Direct throughput impact by adding pockets of capacity in different steps of the manufacturing process

2. **The importance of planning parameters**
   Direct impact (Time/Throughput or Customer Service) by changing planning parameters such as Yields, OEE, Shift Availability, Batch Sizes, etc.

3. **How to best fulfill the demand**
   Through an iterative process, modeling of different demand fulfillment scenarios by varying demand timing or target inventory

   Where to invest company resources to maximize a given objective
Simulation & Optimization Modeling

**Inputs:**
- Demand
- BOM
- Routes
- Processing Times
- Change Over Matrix
- Yields
- Working Schedule
- Product Attributes
- Mfg. Rules
- Rhythm Wheels

**Output:**
- Synchronized Schedule on a Calendar format
- Machine Utilization
- Bottleneck views
- Projected Pipeline Inventory
- “All you can think” in terms of reports…
Snapshot of the model front page
One level down from the front page
1. Schedule takes into account the best sequencing following a pre-defined rhythm wheel

2. Respect manufacturing best practices, such as MOQ’s, Max number of change-Overs, etc.

3. Takes into account a change-over matrix to properly account for the timing of each operations

4. Generate a “by-the-hour” schedule in a calendar format

5. Enables the planning for preventive maintenance
Bottlenecks can move – Equipment and Inventory

1. Original key issue was availability of Fiber from Extrusion operation constraining the flow.

2. Solved the Extrusion problem with scheduling

3. The Scouring constraint became clear.
Equipment backlog and utilization tracked

- Racks & carriers are used across operations
  - Rackwind
  - Annealing
  - Scouring
  - Cutting
- Allocate racks & rackwinders
  - Deallocate racks

Each piece of equipment is tracked during run

Utilization projections include:
- Production,
- Changes,
- Waiting,
- Downtimes
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Lessons Learned

1. **The model is as good as the quality of the master data loaded into it**
   For certain areas, time studies were necessary, while for other, a good estimate was enough.

2. **Planners significantly increase their understanding of manufacturing complexities**
   Manufacturing interdependencies and the trade-off of parameters become extremely clear for planners.

3. **Don’t underestimate the importance of change management**
   The models enable clear exposure of operational gaps by comparing actuals vs. plans. Manufacturing must see the value of such initiative and partner during the solution implementation to minimize resistance.
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