

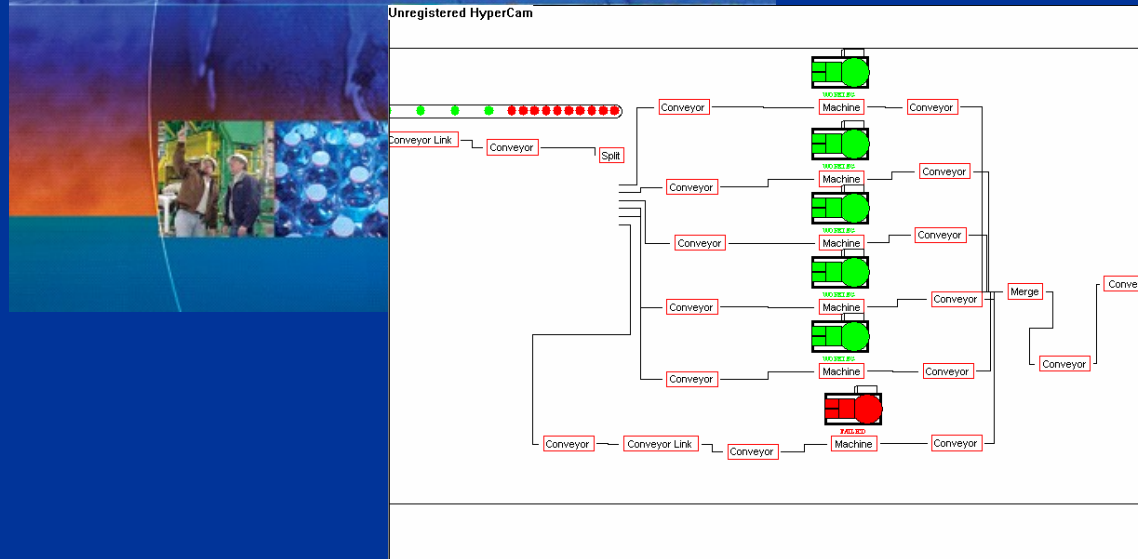
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Production Line Simulation



“A Valuable Tool for Process Improvement”



Presented by:
John Moore, VP of Operations
Roeslein & Associates, Inc.

Concept to Completion



Roeslein Background



Consulting



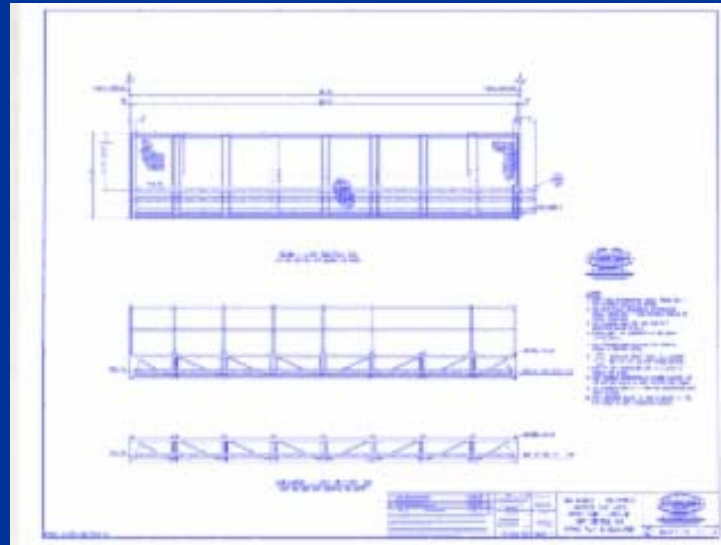
Engineering



Project Mgmt



Line Control & Data Mgmt



Unitizing



Pre-Assembly



Modularizing

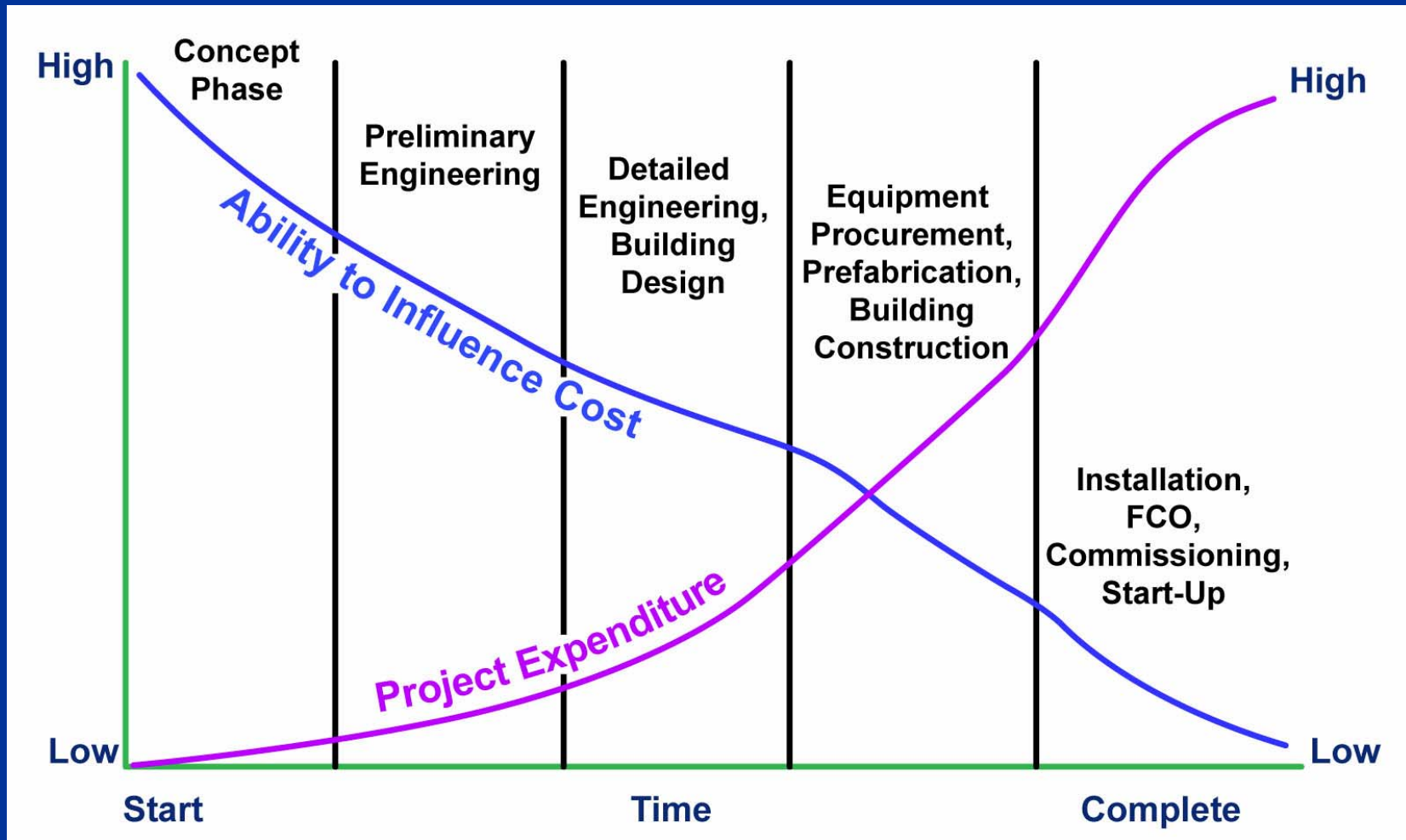


Construction Mgmt

- **Design/Build Engineering Solutions For:**
 - Metal Container Manufacturing
 - Beer & Beverage Filling
 - Food Packaging
- **System Integration Services Since 1990**



The Value of Planning



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Predictability in Business

- **We do pay for it!**
 - Cost to implement operating standards
 - Training costs
 - Consultants
 - Costs of NOT being consistent
- **We work very hard for it:**
 - Controlling quality and consistency
 - Statistical process controls, six sigma, trending analyses
 - Estimates, estimates, estimates...
- **We profit from it:**
 - Ideally: knowing the outcome before someone else does
 - Realistically: Proper investments of time and money

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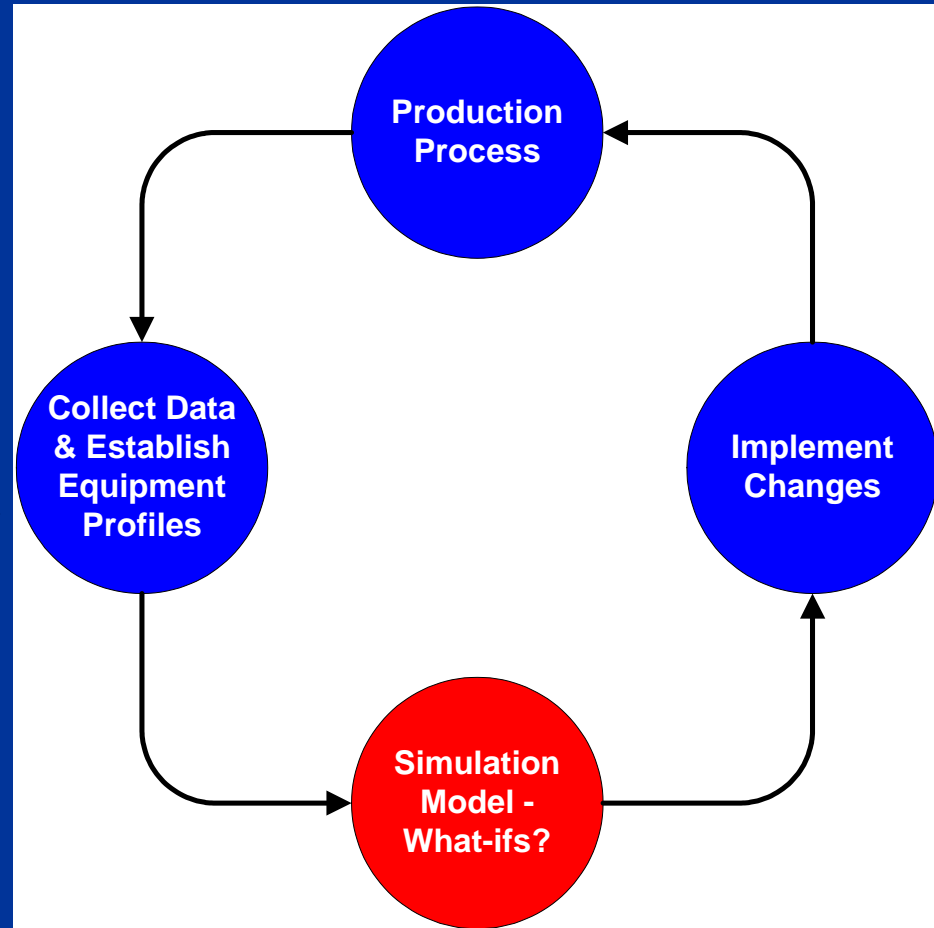




Production Improvement Cycle

1. Production process
2. Observe production and gather meaningful data
3. Simulate suggested changes, and select optimal
4. Implement changes

* REPEAT PROCESS*



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Line Simulation Overview

- The actual simulation process
- What recommendations are generated?
- How valuable is it?
- How else can it be used?

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The Line Simulation Process



- **Line Simulation Process (12-16 weeks):**
 - Project definition phase (starting point)
 - Data gathering phase (6-8 weeks)
 - Model development / validation (4-6 weeks)
 - Analysis and recommendations (2 weeks)
- **Implementation of Improvements**

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The Line Simulation Process



- **Project Definition Phase:**
 - Define line improvement goals & objectives
 - Examples:
 - Plant is oversold – need more volume
 - Targets for efficiency improvement
 - Spoilage reduction targets
 - Automation decisions, etc.
 - “Obvious” problems to be addressed
 - Get plant input!

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The Line Simulation Process



- **Data Gathering Phase (6-8 weeks):**
 - Gather basic line info – 1 week
 - Establish production data criteria – 1 week
 - Collect production data – 4-6 weeks
 - PLC, data collection system, or “black box” system inputs
 - Plant personnel input
 - Physical line observation

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The Line Simulation Process



Typical Data Collected

- Basic Equipment Information
- Rated Speed
- Observed Speed
- Mechanical Observations
- Electrical & Controls Observations
- Staffing
- Procedural Observations
- Data Analysis
- Downtime Log Analysis
- Employee Feedback and Recommendations

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The Line Simulation Process



Typical Data Collected

- Up time (%)
- Down time (%)
- Starve time (%)
- Block time (%)
- MTTR (Mean Time To Repair)
- MTBF (Mean Time Between Failure)

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The Line Simulation Process



Typical Data Collected

- Low/ medium/ high speed of all machines
- Location of line sensors and their operational parameters (i.e., low prime, block, restart, etc.)
- Any control logic sequences unique to the customer's product
- Width, length, & speeds of each conveyor
- Container dimensions, # of containers/case, pallet load patterns, etc.

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The Line Simulation Process



- **Simulation Model Development (4-6 weeks)**
 - Generate preliminary Base Case model
 - Validate Base Case against production with additional line observation
 - Develop What-If models

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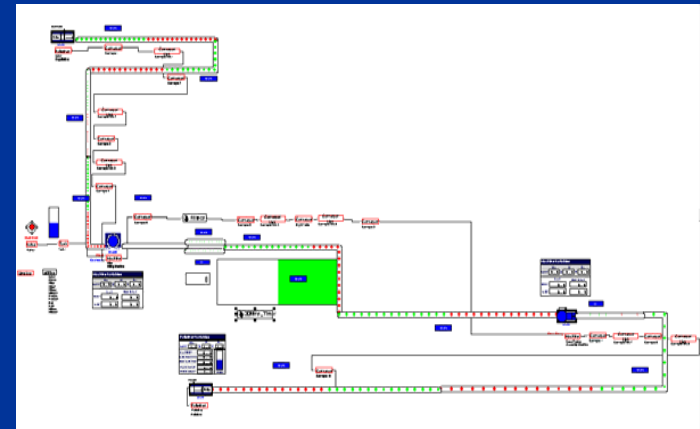


The Line Simulation Process



Arena Modeling Software

- Rockwell Arena Software, Packaging Edition
- Simon language-based application to model process flow systems
- Formerly Arena High-Speed Sim Module
- Originally developed by American-National can in 1990's for can line simulations
- Specific for high-speed packaging lines (most simulation software uses discrete event simulation (Automod, Simul8))



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The Line Simulation Process



Arena Modeling Software

- 1 hour = 1 day
(typical can line model running on a dual-processor PC)
- Too fast to “see” the multitude of interactions
- Long-term analysis can identify subtle but large causes of inefficiency
 - Uses both discrete events and continuous process
 - 30 days of production can be simulated in 1 – 2 days
(30 days used to statistically improve accuracy)

Production Summary

| | |
|------------------------------------|---------|
| Total Units Processed (units): | 1667591 |
| Total Good Units Produced (units): | 1658755 |
| Total Units Lost (units): | 8336 |
| Current Units Inside (units): | 500 |

| | |
|----------------------------|----|
| Number of Failures: | 29 |
| Number of Changeovers: | 0 |
| Number of Scheduled Stops: | 0 |

| | |
|--|--------|
| Total Time Fast (min): | 0.00 |
| Total Time Working (min): | 537.93 |
| Total Time Slow (min): | 613.89 |
| -- Total Time Starved (min): | 13.48 |
| Total Time Blocked (min): | 240.08 |
| Total Time Failed (min): | 48.10 |
| Total Time Changeover (min): | 0.00 |
| Total Time Stopped (min): | 0.00 |
| -- Total Time Waiting for Operators (min): | 0.00 |

| | |
|---|---------|
| Total Time Speed Factor Greater Than 0 (min): | 1151.82 |
| Average Run Speed (units/min): | 1481.97 |
| Average Speed Factor: | 0.82 |

Performance Summary

| | |
|--|---------|
| Total Time Output Rate Greater Than 0 (min): | 1138.06 |
| -- Utilization (%): | 79.03 |
| Average Output Rate (units/min): | 1465.64 |
| -- Average Output Factor: | 0.81 |
| Average Good Output Rate (units/min): | 1458.31 |
| -- Average Good Output Factor: | 0.81 |
| Yield (%): | 99.50 |
| Performance Index: | 64.03 |

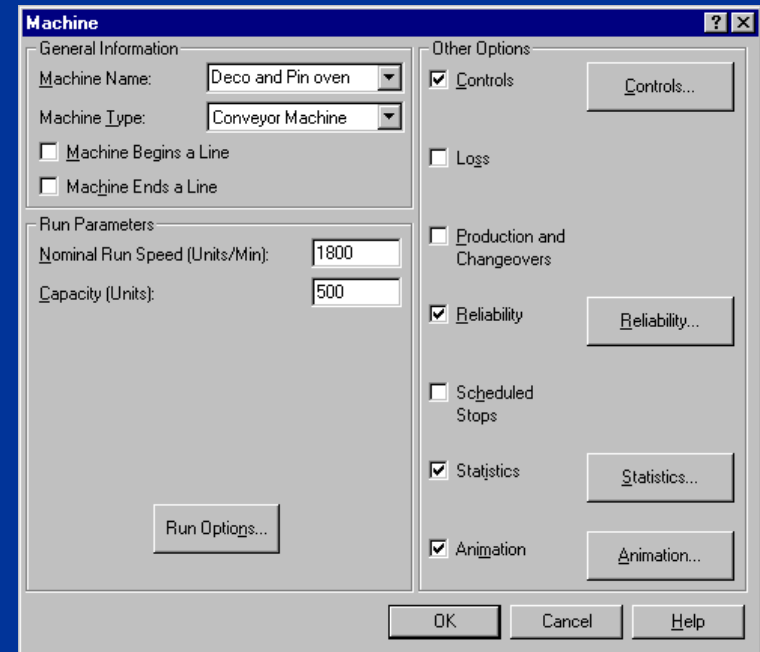
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The Line Simulation Process



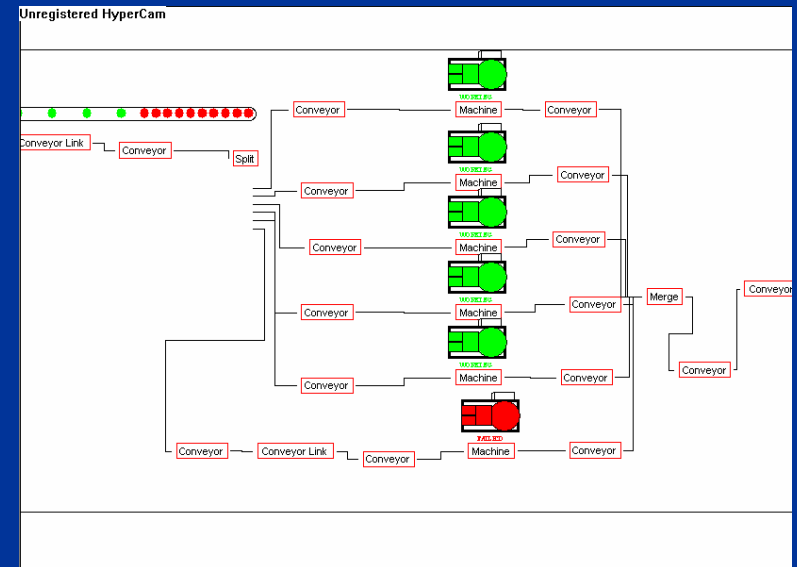
- **Develop What-If Scenarios & Test Hypotheses for:**
 - Layout constraints
 - Bottleneck issues
 - Unbalanced line controls
 - Improper procedures
 - Customer requests for a revised layout



The Line Simulation Process



- Analysis & Recommendations (2 weeks)
 - Run models & compare with Base Case
 - Analyze the impact on production for each case
 - Develop costs and ROI for each case
 - Select optimal cases





Recommendations

- **Five Categories of Recommendations:**
 - Equipment
 - Line Controls
 - Maintenance
 - Operational/ Procedural
 - Materials
- **Further Categorized by Expense**
 - No Capital (operational, procedural, “soft” costs)
 - Maintenance Expense
 - Capital Expense

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How Valuable Is It?

- **Line simulation identifies:**
 - Current and maximum throughput potential
 - Equipment layout advantages and constraints
 - Line control constraints (i.e., is the line balanced?)
 - Equipment capabilities
- **It reduces risk and costs of implementing non-effective changes**
- **It is a non-biased, scientific approach**
- **It is a low cost way to predict measurable changes to the line**

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How Else Can it Be Used?

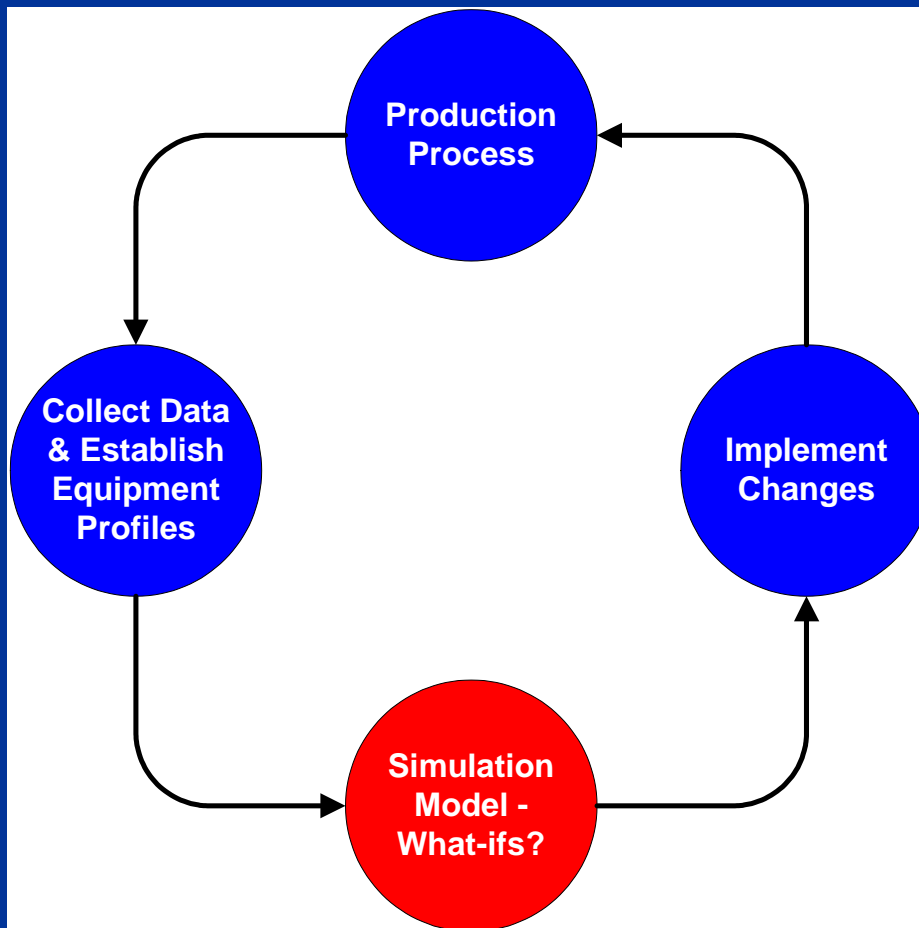


- **To develop efficient new line layouts**
 - New or modified production lines
 - Used to evaluate alternatives for new lines
 - Develop prior to committing capital
- **For future capacity scenarios**
 - Minor software changes required
 - Used to evaluate alternatives

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Line Simulation Summary



- Simulation is part of an overall production improvement cycle
- Identifies areas of potential improvement
- Low cost predictor of ROI for suggested improvements
- Low cost tool for capacity and/or product changes

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Thank You



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