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SUPPLEMENTARY DOCUMENT

Title:	**SIMCON Simulation Case Study for a Construction Equipment Manufacturer**		
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To:	Prospective and Existing Clients	**Date:**	04/30/2020
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Description:	This document provides a case study for a SIMCON simulation project for a construction equipment manufacturer.		

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1. Purpose

This document describes a case study of a SIMCON simulation project for a construction equipment manufacturer undertaken between January 2012 and April 2012. This case study was prepared by SIMCON in conjunction with our client and outlines the client challenges, the SIMCON solution approach, and the key takeaways from the project. It both reflects our experience working on the project and our client's perspective of working with SIMCON on this particular simulation project. Because of surviving NDA terms and our client's corporate policies, we are not able to provide the company name or direct contact information for client key personnel.

2. Client Challenges

A construction equipment manufacturer was designing the layout for a new (Greenfield) facility and needed to estimate their machine spacing requirements. The machines in transit were large and would have been extremely costly to move after installation, so management needed to ensure the plant layout allocated enough space for staging work in-process (WIP) inventory. The client knew the characteristics of their system, but needed help translating that information into reliable in-process inventory estimates to inform machine placement for the new facility. The machines were already in transit overseas, so the client needed these answers quickly.

The manufacturer also sought answers to several supplementary questions about their proposed system, including:

- Will the proposed system meet annual production targets?
  - If so, when? With what margin of safety?
- How fast should materials be released for production?
- What system configurations minimize in-process inventory?
- What operating conditions have the greatest impact on system performance?
- How should products be batched and routed through the system?

3. SIMCON Solution Strategy

After working with the client to define their challenges and desired outcomes, we proposed developing a simulation model of the future production system. Our engineering team went to work collecting prerequisite data and developing a 3D model to simulate their baseline configuration. Some of the features captured by the model include:

- Projected demand and annual production targets
- Material handling policies (product batching, transport, and routing logic)
- Machine properties for turning, milling, shaping, and washing operations
    - Part-specific loading, unloading, and processing times
    - Sequence-dependent changeover procedures, setup and teardown times
- Operator staffing and scheduling requirements

The model also tracked key performance metrics specific to the client's unique challenges, such as:

- In-process inventory by machine
- Staging clearance time (time all raw materials released into production)
- Completion time and margin of safety
- Utilizations of operators, vehicles, machines, and equipment
- Holding costs for in-process inventory

We then began experimenting with alternative system configurations and operating policies to determine the impact on system performance. Attributes found to have the greatest effects were batch sizes, release rates, and routing sequences. We utilized the optimization module within the simulation software to minimize the client's in-process inventory and holding costs subject to meeting annual demand. Lastly, we documented the results and submitted a revised production plan and system configuration that optimized system performance.

4. Results and Key Takeaways

Simulation modeling and analysis was able to generate a wealth of knowledge about the client's future manufacturing system. Simulations of the baseline configuration were able to illustrate exactly how their facility would operate over time and provide reliable quantitative data to support all of their design decisions. Some key takeaways from simulating the client's original production plan include:

- Estimates of in-process inventory (and, in turn, spacing requirements) at each machine
- Projected annual order fulfillment at 75% of the year, leaving a safety margin of 3 months
- Identified material release rates, batch sizes, and routing sequences as key contributors to total in-process inventory

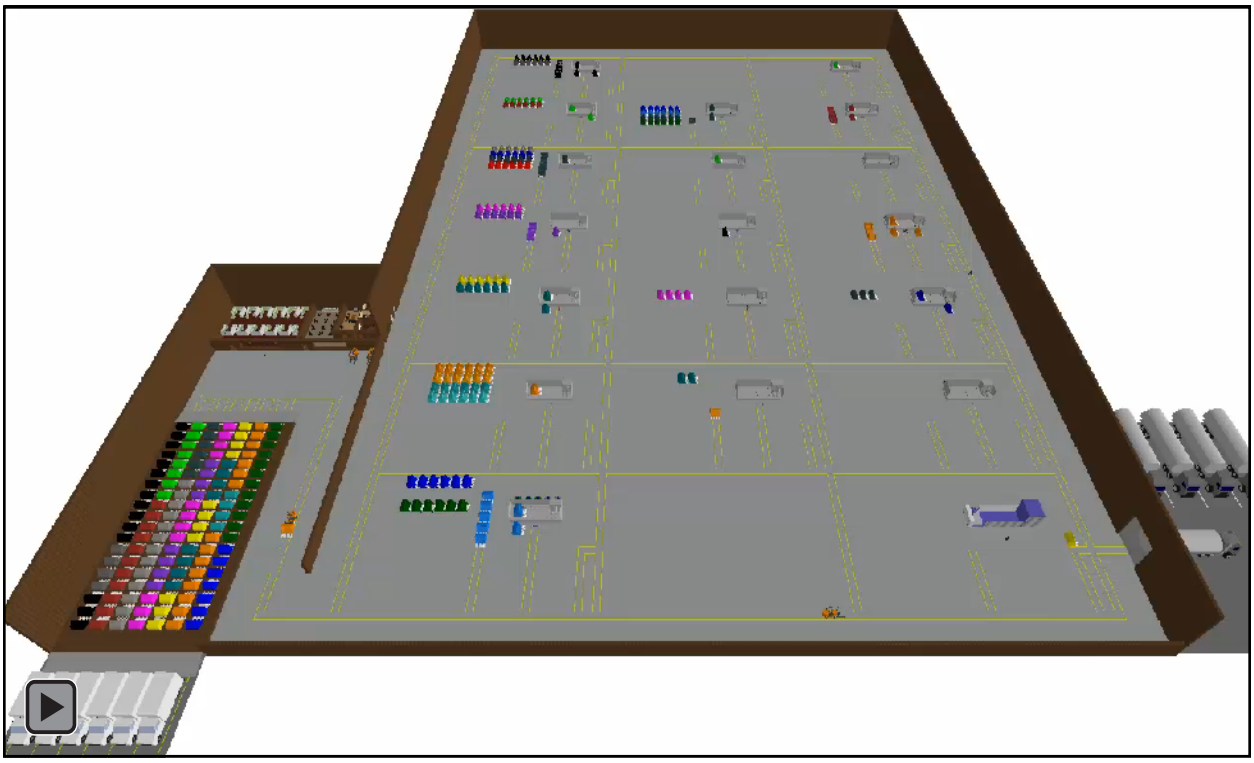
More importantly, the simulation model allowed us to experiment with alternative system configurations and optimize performance specific to their objectives. Changes to the client's product routings, material release rates, and batch sizes drastically improved system performance:

- Optimizing batch sizes reduced in-process inventories by 55% for the baseline configuration compared with the proposed batch sizes
- Rerouting select parts, adjusting material release, and optimal batching reduced WIP by 85% compared with the proposed batch sizes, routings, and material release rates
- The optimal configuration reduced estimated annual holding costs by over $600,000

The simulation model allowed the client to visualize their manufacturing system, track material flow and accumulation across the production lines, monitor their system performance over time, test alternative configurations and operating policies, and optimize performance – all before installing their first machine.

5. Simulation Model Video

A narrated video overview of the simulation model SIMCON developed to help this construction equipment manufacturer address the challenges of their new production facility is provided in the embedded video below (Video 1). In order to play the video in full screen mode, click the play button and then right-click on the video and select 'Full Screen Multimedia.' In the event that the video provided below will not play, try downloading and installing the Adobe Flash Player plugin here. Once installed, right-click the video and select 'Enable Content.' Alternatively, the video can be downloaded directly by clicking here.



Video 1. Simulation Model Video – Construction Equipment Manufacturer