

SUPPLEMENTARY DOCUMENT

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Title:	SIMCON Scheduling Case Study for a Plastic Compounds Manufacturer		
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1. Purpose

This document provides a case study for a SIMCON scheduling project for a plastics compounds manufacturer undertaken between October 2017 and October 2018. This scheduling solution still currently being used by the client for daily scheduling activities. 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 scheduling 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 mid-sized plastic compound manufacturer was spending hours scheduling production each day. Among many other value-added job functions, their scheduler spent hours creating manufacturing orders and reviewing the production schedule on a daily basis. Relying almost entirely on experience and intuition, the scheduler had to account for raw material availability, product inventories, and sequence-dependent changeovers – all while trying to estimate and meet customer delivery dates.

Complicating matters further, the client did not have an industry-standard ERP or MES system. They instead used a customized database program to manage operations, with custom views used for reviewing and updating customer orders and the production schedule. As a result, they did not have extensive data on their production system, and their scheduler needed to create and schedule all orders manually to determine the delivery dates quoted to their customers.

The client sought an automated scheduling solution that could:

- Alleviate the burden on their scheduler
- Generate actionable production schedules in seconds
- Manage finished goods inventories
- Manage both make-to-order and make-to-stock products
- Generate stock orders for make-to-stock products automatically based on the current inventory level and upcoming orders
- Accommodate new products and material routings
- Account for machine, laboratory, and staff schedules
- Reduce late orders and sequence-dependent changeovers
- Fully integrate with existing software systems
- Eliminate manual order creation
- Quote customer delivery dates quickly and reliably
- Implement a customized scheduling algorithm
- Define and standardize scheduling objectives, constraints, exceptions, and decision logic

Last but not least, the client wanted a scheduling solution that could grow with the company. Their business growth was not constrained by capacity, but by scheduling. As customer demand grew, scheduling times grew exponentially and it became increasingly difficult to reliably estimate and fulfill delivery dates based on human experience and intuition.

3. SIMCON Solution Strategy

After working extensively with the client to define their challenges and desired outcomes, we proposed a simulation-based scheduling solution. Simulation-based scheduling offers several advantages over traditional scheduling solutions. It has the ability to:

- Account for an unlimited number of custom constraints and special cases
- Capture all sources of uncertainty and variability in the production system
- Produce feasible, actionable, and effective schedules
- Generate reliable and risk-informed delivery date estimates
- Integrate with existing software, including spreadsheet, database, ERP, and MES systems
- Account for unexpected delays, resource schedules, material routings, inventories, and more

Once a consensus was reached on the solution approach, our engineering team worked with the client to define the production data and decision logic needed to generate an actionable production schedule. We developed a data interface to integrate the scheduling model with their existing software, so the model could access live production data and the client could review the resulting schedules in the format most familiar to them.

A custom scheduling algorithm was developed to reduce changeover times by sequencing orders based on product properties such as color and hardness, while grouping orders sharing common raw material components. Orders approaching their due dates were expedited in the schedule to maintain on-time deliveries. Custom rules and exceptions were enforced to ensure feasible and actionable schedules. The model includes custom user controls, such as the ability to lock orders into the schedule, allowing the schedulers to override the algorithm as needed.

The process for developing the scheduling algorithm and the data interface is an iterative process that required several rounds of meetings and communication between the SIMCON development team and client key personnel. The solution was continuously developed until the schedules produced by the model were reviewed by client key personnel and deemed valid and actionable for numerous production scenarios.

4. Results and Key Takeaways

With a simulation-based scheduling approach we were able to achieve all of the client's desired outcomes. The scheduling model effectively:

- Eliminates manual order creation, inventory management, and production scheduling
- Creates and schedules stock orders automatically to keep pace with customer demand
- Reduces the scheduling burden from several hours per day to a few minutes per day
- Integrates with existing software systems
 - The model is driven by live production data
 - Simulation-generated schedules are reviewed and revised exactly as they were before
- Generated reliable delivery date estimates within minutes of receiving a customer order
- Produced schedule summary reports, including for on-hand inventory levels

Key client personnel reviewed the schedules generated by the simulation model for accuracy, and confirmed the schedules were both valid and actionable in all cases. If the scheduling model needs to be updated for any reason, the client communicates that to SIMCON and the development team works to issue a new version of the model as soon as possible.

Automation of the scheduling process permitted the schedulers to greatly reduce the time they spent creating and planning work, and to commit several more hours per day toward other value-added job functions. The client also hedged their turnover risk by obtaining a standardized and documented record of their scheduling process, including the constraints, objectives, and exceptions most critical for developing viable production schedules.

Most importantly, the client now has a digital model of their manufacturing system that any employee (after reviewing the accompanying User Guide) can use to generate actionable and effective production schedules. This model is a permanent fixture of their operations management suite, and is equipped to grow with the company. The model can accommodate new materials, finished goods, customers, and resources without intervention by the SIMCON development team. If the scheduling algorithm needs to change in the future, the model can easily be adapted to account for any number of new objectives, constraints, or exceptions.

The scheduling solution described in this case study was developed during winter 2017 and is still being used today for daily production scheduling.