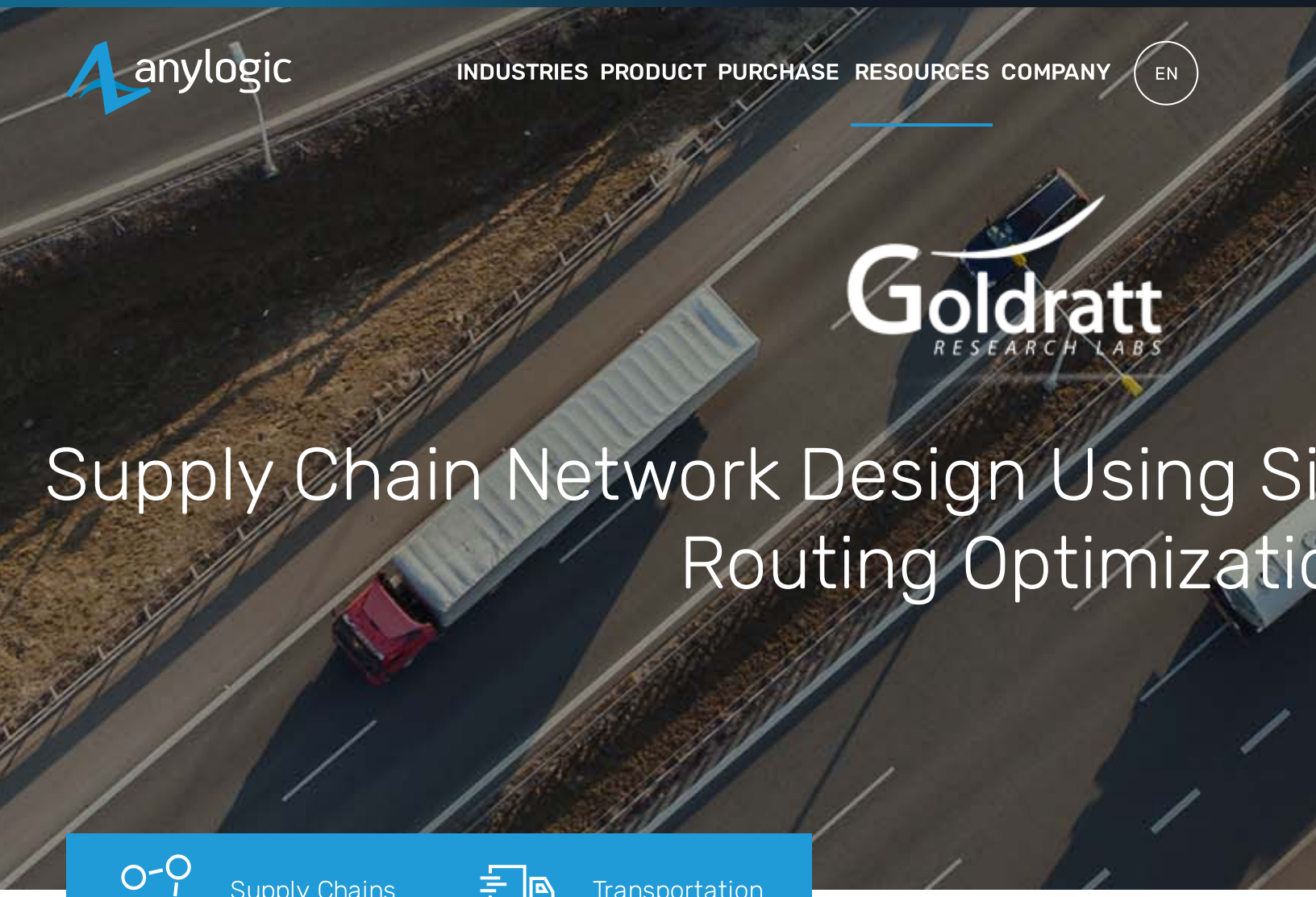


Supply Chain Network Design Using Si Routing Optimizatio

Supply Chains Transportation

Problem

One of the world's largest book distributors faced three major challenges.

Firstly, over the past decade, to meet growing demand, the distributor experienced significant growth in the number of depot locations they used to service customers. This resulted in an increasingly complex

design unsustainable and fragile to any negative stressors.

The company hired two different consulting companies to do a high-level network optimization study to identify the most optimum network design and distribution practices. Both consulting companies found that using the Drop-and-Hook method and 40-foot trailers instead of straight trucks, would reduce depot locations by 25%-30%, with a Project Net Present Value (NPV) of an estimated $18m. However, both studies used calculations based on averages, raising management concerns about whether the predicted benefits would be realized under real-world conditions.

Solution

Goldratt Research Labs (GRL) was contracted to validate (or invalidate) the key assumptions of the two studies as well as the predicted operational and financial performance improvements using dynamic simulation modeling.

They were also asked to use the simulation model to determine, using scenario comparisons, if the operational and financial results could be improved with different supply chain network configurations, transportation practices, and fleet setups.

To fulfill the objectives, GRL engineers developed a fully self-configurable Supply Chain Digital Twin (SCDT) simulation model that could consider all critical system interdependencies, constraints, complexities, and demand and supply variability. This model was designed to determine the range of likely outcomes for a single scenario and provide sensitivity analysis and

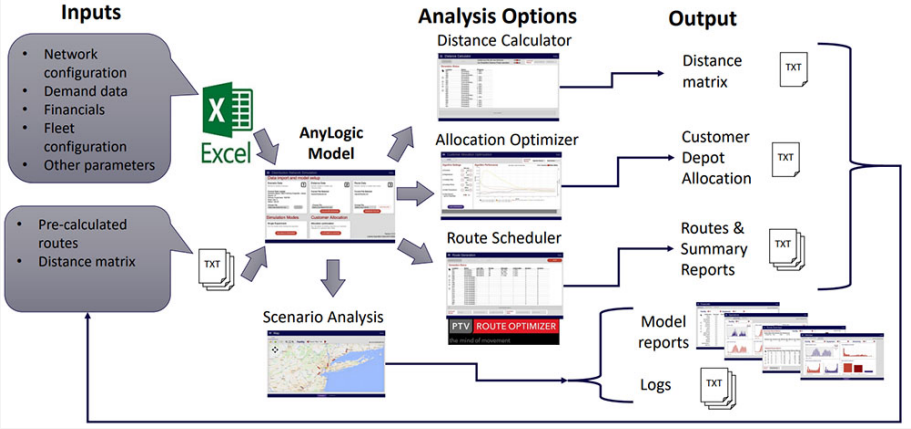
The resulting SCDT model gave the company's management team a low-risk, low-cost way of evaluating the likely operational and financial impact of all the proposed changes and scenarios BEFORE investing significant CapEx and time. This would ensure they would avoid the risk of reputational and financial damage if the project did not deliver the expected benefits.

GRL chose AnyLogic as the best-in-class simulation modeling software to develop the SCDT model. The main reasons for their selection included:

- To replicate the customer's real-world complexity, both agent-based and discrete event simulation methods were needed.
- The model had to be developed in a short amount of time and offer a wide range of system configurations.
- Considering the large number of scenarios to be evaluated and the model's size, the customer wanted to run the simulation model on their own computers and have access to a cloud option. Not only can AnyLogic models be exported as a standalone app, but they can also make use of the AnyLogic Cloud to complete resource-intensive model runs much faster.
- Considering the range of scenarios to be evaluated, the simulation model had to incorporate a Route Scheduling optimizer to determine, for each scenario, the optimized final mile routing of vehicles from depots to customers. AnyLogic's use of standard Java libraries allowed GRL to develop a simulation model that was fully integrated with a

analysis resulting in the final model reports and logs. The model is completely data-driven from an Excel file, making it really easy to change scenarios right inside the file. The scenario files contain the following input data:

- Geographical information
- Depot setup
- Customer order data
- Fleet setup and assignment
- Financial and operational parameters



Simulation model setup

Using these inputs, four main analysis options can be conducted:

- Distance Calculator

  The distance calculator was built to pre-calculate all the distances required during any of the other analysis options to reduce the execution time.

- Allocation Optimizer

depots to the allocated customers using the PTV Route Optimizer.

- Scenario Analysis

  This last step in the analysis process is the culmination of all the inputs from the previous steps of supply chain simulation The final result from this analysis is a detailed operation and financial set of results for every location, vehicle type, and customer location.

Some of the option's outputs can be used as the input to other analysis options.

The AnyLogic-based SCDT simulation model results revealed a number of key findings for this project. The model identified several flawed assumptions in previous studies. The most consequential being that the drop-and-hook method was not as cost-effective as predicted. In fact, it showed that the predicted NPV of $18m would never be realized. The NPV was likely to be negative $5m. That would mean that the CapEx investment would never have been recovered.

With this unexpected and concerning conclusion, the new project objective was to identify an improved supply chain network design and fleet setup that could improve their current performance, while adding resiliency and responsiveness to the expected uncertainty in future demand and supply.

Using their new SCDT model with the embedded Route Optimizer, the team identified a solution that would result in an NPV of $47M, even higher than originally thought possible.

In addition, the ability to easily modify parameters inside the model and the detailed output files, made it a decision support tool to additionally check assumptions on:

- Required driver's class (for small or big trucks)
- Required number of drivers (depending on the seasonality, per month and per location)
- Number of vehicles per day
- Details regarding the number of overnight routes, driver hours, and overtime

The customer has indicated that the model will

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