Supply Chain Performance Enhanced Using Simulation

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Effective supply chain management is critical to the survival of corporations today. To assess supply chain strategies and evaluate proposed changes that impact the entire enterprise, supply chain managers must be able to confidently predict their network's performance under a variety of conditions. This seemingly impossible task has spurred a search for better software methodologies to help decision makers analyze the design and operation of their supply chain. Computer simulation models are increasingly becoming the tool of choice. Because simulation captures real-world system variability and sub-system event interactions through time, a model helps managers better understand the supply chain as it currently exists. Most importantly, a model gives planners a realistic view of what will happen in their supply chain under circumstances that do not currently exist, but might occur.

Recently a third party logistics provider that manages the distribution network for one of the "big three" US automakers initiated a joint venture with a simulation group to develop a computer simulation of their supply chain. Their business objectives include reducing the order-to-delivery times of vehicles by increasing the efficiency of their distribution chain. The goal of the simulation project was to give their planners a tool for supporting both tactical (short-term and contingency planning) and strategic (long-term) supply chain decisions.

The model the team built has proven to successfully predict future network performance and status. Performance metrics include transit times; railcar, truck and facility utilization; bottlenecks, etc. Tactically, the model is used by the planning team to determine the best way to react to anomalies by estimating the impact of such events and the corresponding management actions required to deal with those events.

The model can answer questions of carriers and facility operators (such as "What's coming at me?" and "When will it get here?") by projecting future volumes and expected times of arrival. It can predict surges in volume to help plan for equipment and manpower increases. When a new vehicle launch and/or marketing campaign is announced, the model is used to evaluate release strategies to minimize the impact on the distribution network. The model has also been used to determine the impact of pending crises on the network, such as hurricane contingency planning and labor strikes.

The model has the added ability to track and report bottlenecks as they move around the distribution network. A custom feature allows the user to identify a bottleneck, pause the simulation run, and look upstream and downstream of the bottleneck to further investigate and analyze.

Long-term supply chain decisions of network configuration and policy (such as closing old facilities or opening new facilities or changing routes or carriers) are first analyzed in the model prior to implementation within the real supply chain. The model aids in long-term resource planning, such as shift rotations and fleet sizing. Since the model estimates future performance, it has also proven to be an excellent tool for goal setting and budgeting.

To predict the future, the model must faithfully represent the supply chain as it currently exists. The simulation incorporates the complex routing (a mixture of truck, rail, and boat routes) of the supply chain it models. Vehicles are transported from assembly lines to dealers using trucks or a combination of trucks and rail. Their journey can involve more than one railroad. The general route a vehicle takes is determined by the origination of the vehicle and its final destination (called an OD pair). The actual route is further determined by the type of railcar onto which a vehicle is loaded, because some route segments have height restrictions that the taller railcars cannot meet. Furthermore, these routes have many points in common where they can interact. For instance, a rail loading facility is a starting point for many routes. There are also various constraints along the way, i.e., rail loading facilities have resource constraints such as vehicle parking spaces, rail car docks, labor, and a finite loading rate. All of these intricacies are included in the model.

A key feature of the model is its integration with a corporate database containing the status of all vehicle shipments. This vast database is a record of vehicles from the time of planned production to dealer delivery. The database receives and processes EDI transaction messages from all parties handling vehicles and uses the information to update the location and status of each individual vehicle. In other words, the database is a “snapshot” of the current state of the network, containing every vehicle in the system, its origin, final destination, a history of vehicle “events” (a record of locations the vehicle passed through), and current vehicle location. The database can be imported into the model at startup; the information is then used to distribute vehicles and resources (trucks, railcars, etc.) throughout the network. In short, every vehicle, railcar, truck, and boat can be placed into the model prior to the model run.

Custom applications were developed to query the proprietary database, cleanup the data, and import it into the model. The raw data is first extracted into an appropriately formatted text file. Since this can take as long as half an hour, a feature of the extraction utility allows the user to scheduled a time when it will run automatically – typically at the start of each business day. The export utility creates data tables that will be used to “fill-in” (populate?) existing tables in the model database.

To import the data to the model, the user opens the model and clicks on a button. The raw data from the import can contain errors or missing or contradictory data (for example, a real-world shipment may have been mis-shipped and its location is inconsistent with its destination data). Thus, a critical feature of the import process is “grooming” the imported data and reporting errors.

Priming the model with in-transit shipments eliminates the lengthy warm-up period usually required by simulation models. For large supply chain models this can be a non-trivial matter (it can take as long as 45-60 days of run time for the model to reach stability without the data upload). This “warm-start” mode of initializing the model with current data and then projecting forward from the current situation is essential for tactical planning.

Another crucial aspect to making the model tactically useful is the development of a custom User Interface (UI). The UI allows the user to rapidly construct and run new scenarios. The UI gives the user the ability to manipulate large amounts of data prior to running the model.

The end result is a simulation model that has become a corporate asset. The model is used on a daily basis. Studies using the model have been conducted that range from simulating the impact of closing a destination ramp to generating supporting data for fleet size negotiations. Volume forecasts have become a valuable benefit for facility planners.
Building a simulation tool that mimics the behavior of a complex global distribution system is no small investment, but the paybacks are enormous. Increased confidence in long range decisions that impact the entire supply chain and improved short term planning can, in today’s marketplace, mean the difference between merely surviving and leading the pack.

SDI provides simulation and optimization technologies and services for supply chain and manufacturing process analysis. The company focuses on building custom technology solutions to complex business problems that allow corporate decision makers to assess scenarios in a risk-free environment before implementing change. SDI’s simulation models give users improved understanding of their systems and the forecasting power for anticipating the effects of decisions on processes and networks.

VinLogic® Supply-Chain Simulation Tool

Total Visibility.

Total Collaboration.

Total Solution.

VinLogic simulation technology enables INL logistics managers to provide in-depth support for finished-vehicle supply-chain planning and decision making. Using VinLogic network modeling, managers can forecast resource requirements more accurately, test design options without risk or capital investment, and anticipate bottlenecks in order to develop contingency plans.

VinLogic can be initialized with live inventory data from VinVision®, INL's finished-vehicle supply-chain management system. This allows integration of the most current network operating and performance characteristics within various VinLogic modeling scenarios.

Supply-Chain Planning

Tactical Forecasting VinLogic enables INL to provide short-range (6-8 weeks) volume outlooks for service providers and terminals within the vehicle-distribution network. By having visibility into the future, tactical decisions can be made to avoid network delays or bottlenecks.

Strategic Forecasting Looking even farther in the future, VinLogic's ability to forecast one to several years out allows logistics engineers to study how changes in volume, vehicle design or mix, network design, resource availability and destination mix affect the dynamics and behavior of the delivery network.

Network Bottleneck Analysis Synthesized results from strategic and tactical planning forecasts allow INL to determine where and when network constraints will occur, which enables more effective contingency planning.

Resource Allocation and Planning VinLogic modeling enables detailed analysis of railcar, haulaway truck equipment, manpower, and facility requirements. Information may include a gap analysis depicting where resource adjustments are necessary to satisfy volume surges, vehicle or network design changes, and long-term equipment planning (fleet sizing).

Crisis and Contingency Planning VinLogic offers emergency simulation analysis of various extraordinary network events that are forecast on the horizon, or where effects are yet unknown. Some of these events include forces of nature (hurricanes, floods, snow storms, etc.), service breakdowns, labor disruptions, or quality-containment actions. VinLogic not only estimates the impact of these events, it supports analysis of contingencies and predicts when the network will normalize.

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Additional VinLogic Functionality

Facility Rationalization VinLogic provides detailed facility rationalization, without having to make commitments or invest capital. Simulation modeling allows users to clearly evaluate the effects of adding or removing distribution locations. Based on proposed carrier resources, volumes and facility operating characteristics, VinLogic users will test feasibility and provide decision-support evidence.

Network Design Testing VinLogic has the flexibility to adjust and test various network design scenarios, provided by an optimization-modeling tool. Design alterations may include routing changes, modal shifts, new facilities, or a combination of the three. VinLogic allows users to provide concise information pertaining to these changes and their potential impact on the vehicle-distribution network.

Accurate Supply-Chain Budgeting Users can employ INL's supply-chain simulation model to provide precise and detailed budgets that reflect current and anticipated operating conditions and network performance. This allows operational managers to make smarter tactical and strategic spending decisions, support more effective cost budgeting for new-product launches or other business priorities, and help align and adjust operations to offset cost fluctuations resulting from unexpected occurrences. Budgeting using VinLogic allows for risk-free network design testing and cost-impact analysis before designs are implemented.

VinLogic Simulation can help VinVision users effectively resolve short- and long-term performance, cost and operational issues, as well as optimize overall network design.

VinLogic: part of INL's Total Visibility, Total Collaboration, Total Solution approach to finished-vehicle supply-chain management.

insight network logistics

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