

How AI-Based Simulation Can Help Enterprises Navigate SCM Uncertainties

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One thing is certain in business that it is full of uncertainties. How can enterprises plan their operations and supply chain in case of uncertainties? Earlier, enterprises would use optimization methods, but, in the face of uncertainties, they aren't always useful. Here, integrating artificial intelligence (AI) with simulation can help. This PoV discusses how AI-based simulation can help enterprises navigate SCM uncertainties and provides some examples.

Enterprises face different types of demand and supply uncertainties while doing supply chain planning, improvement, and prediction

Enterprises need to plan many supply chain activities and make many decisions. Some of these activities are:

Exhibit 1: SCM Activities

Areas	Detail Activities
Planning and design	<ul style="list-style-type: none"> ● Schedule creation and evaluation ● Production planning ● Supply chain design ● Supply chain risk & control tower ● Fleet and network planning ● Warehouse operation planning
Improvement and optimization	<ul style="list-style-type: none"> ● Material flow improvement ● Inventory optimization ● Warehouse optimization ● Fleet and network optimization
Prediction and estimation	<ul style="list-style-type: none"> ● Plant load prediction ● Machine failure prediction ● Capacity estimation ● Production prediction ● Facility load prediction

Source: EIRTrend, ITC Infotech

The planning of the above activities is a complex process because enterprises face different types of demand and supply uncertainties. These uncertainties are:

- **Dynamic changes.** Often, there are sudden changes in demand and supply due to external factors such as geopolitics, epidemics, natural calamities, terrorism, civil unrest, regulations, economic changes, technological advances, etc. Demand is also impacted by sudden product recalls and external factors related to customers and competitors. Similarly, supply is impacted by factors related to suppliers and labor. Enterprises cannot be prepared for all external events, but should have the agility to react quickly. This is possible only when one has thought of all the scenarios and potential mitigation options.
- **Interdependency and Complexity.** Supply chains are so interdependent and complex now that even a small event can have a cascading impact on the whole supply chain. There is a need to understand this web of complexity and interdependency to plan properly. What could be a better way than to run different simulations and understand the relationships and their impact?

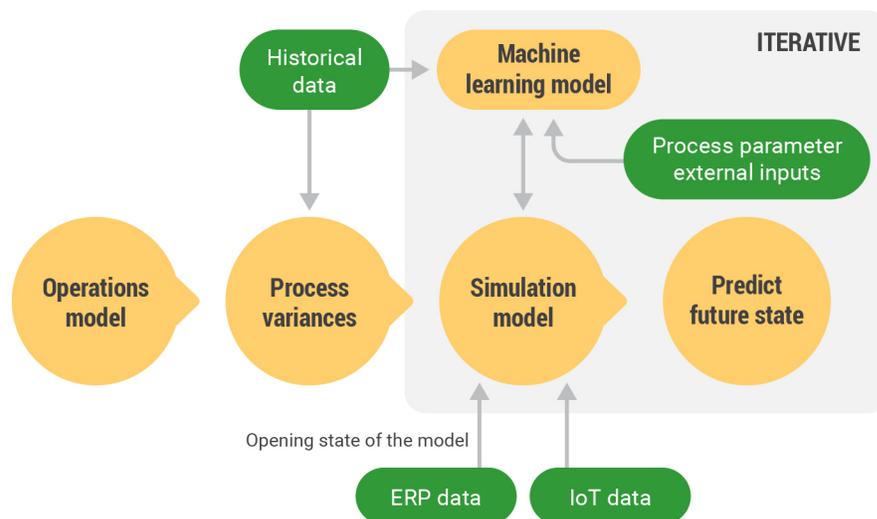
- **Bottlenecks.** Temporary bottlenecks frequently appear in different nodes or locations in supply chains because of external or internal factors, and they create uncertainties across the supply chain. For stable operations, we assume that processes are under control. In real life, however, there are always minor or major variations that create small or large bottlenecks temporarily. These variations create uncertainties across supply chains.

Due to these uncertainties, supply chain planning by optimization techniques is tough because these techniques often do not produce optimum or realistic solutions in a timely fashion. One of the reasons for the ineffectiveness of optimization techniques in a real-life scenario is that they are rule-based, and in real life, rules are often violated. The other reason is that it takes a lot of time to simulate permutations and combinations of multiple scenarios with hundreds of variables. Hence, modeling of real life is required where AI-based simulations can help. Such simulations can assist in navigating the above uncertainties while planning supply chain activities.

AI-based simulation process, examples, and selection of simulation partners

The AI-based simulation process is a four-step process consisting of operations model, process variance, simulation model, and prediction. The simulation model can be made faster and more realistic by integrating it with iterative machine learning models that can learn from past data quickly. There are many stages and many model possibilities or options in simulation. AI or machine learning is used to predict or decide the most relevant system state at each stage. This AI-based model state selection helps improve speed, accuracy, and applicability of the simulation.

Exhibit 2: AI-based SCM Simulation Process



Source: EII RTrend, ITC Infotech

AI-based simulation is not just theory; enterprises have started using it in their decision-making. Given below are five examples of ITC Infotech's AI-based simulation engagement with its customers:

Exhibit 3: SCM Simulation Examples Completed by ITC Infotech

Challenges	Solution	Benefit
Customer: A leading bullion producer		
<ul style="list-style-type: none"> • Bullion production is a set of complex processes consisting of dore melting, anode casting, refining, and bullion melting operations. • The marketing team wanted visibility of production capacity in the next 15 days based on dore receipt plan. • Production wanted a tool to aid production planning and save time. 	<ul style="list-style-type: none"> • The various production processes were studied, and an AI-based simulation model of the entire operation was created in AnyLogic software. • Multiple reports were created as the output of the simulation model. • Scenarios were tested to provide decision support for capital expenditure. 	<ul style="list-style-type: none"> • The marketing team now has a prediction of the bullion production based on the AI-based simulation output. • Planners use this simulation output in production planning. This simulation reduces the time taken to plan from about 4 hours to 1 hour. • By testing different scenarios for expansion plans, the management was able to arrive at the optimum CAPEX decision.
Customer: A leading manufacturer of minted precious metal products based in Switzerland		
<ul style="list-style-type: none"> • The work-in-process inventory and flow time was quite high, and the client wanted to reduce the WIP by 20%-25%. • Mapping of SKUs into product family and allocating machines to the respective product family, determination of crucial planning parameters like planning horizon, planning bucket size, etc. for each product family was very complicated. 	<ul style="list-style-type: none"> • Identifying and solving issues in execution of production plan using concepts of lean such as cellular manufacturing, takt time, line balancing, SMED, etc. • The threshold inventory level for CONWIP was tuned using the AI-based simulation. 	<ul style="list-style-type: none"> • Along with other lean manufacturing initiatives, we could reduce the WIP inventory by about 20% and lead time by about 15%. • Improvement in on-time delivery compliance from 62% to 85% • A CONWIP-based production control system was implemented.

Customer: A leading pharmaceutical company

- For a particular medicine with low shelf life, the client was facing high write-offs and low service levels.
 - The AI-based simulation was used to model the entire supply chain for this product (with country-specific SKUs) and arrive at the appropriate production policy.
 - The whole supply chain from plants to distribution centers (DC) to hospitals was modeled.
 - Multiple production policies were tried, and finally, the one with the lowest write-offs and a good service level was chosen.
 - The AI-based simulation in AnyLogic was fully integrated with multiple data tables and simulation options in Excel. A basic dashboard was designed in AnyLogic and the output exported in Excel format for further analysis and visualization.
 - The best production policy with optimized parameters (coverage days for various SKUs) could be selected and put into production.
 - A complete tool like functionality was created in AnyLogic to try out multiple scenarios, and hence, use the model on a day-to-day basis.
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Customer: A large CPG manufacturer

- There are frequent shortages and excess inventory due to disruptions.
 - Most of the time was spent by the production and supply chain team in corrective actions to achieve the desired fulfillment and KPIs.
 - Creating a digital twin of the entire supply chain
 - Integrating with the ERP system to get the current state of the supply chain (inventory, forecast, fleet data, etc.)
 - AI-based root cause analysis of predicted failures
 - Automated recommendations and prescriptive actions for anticipated failures
 - Order fulfillment improvement from 89% to 94%
 - Improved order acceptance and resource planning
 - Inventory reduction by 12%
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Customer: A large airport system integrator

- There is a need to predict the passenger load and waiting time at different sections of the airport.
 - Real-time alerts and dashboards need to be present which can suggest expected waiting times.
 - Capture the current passenger status and locations at all service stations of the airport.
 - Use AI-based simulation to predict the passenger load at a future time like the next 30 mins.
 - Integrate the solution with other airport systems like flight schedule for improved predictions.
 - Passenger waiting and queuing time reduction by more than 28% with the given facilities (as per simulation analysis)
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Source: *EIIRTrend, ITC Infotech*

For effective implementation of AI-based simulation, selecting simulation service providers who have both technical as well as business expertise is essential.

- **Technical expertise.** Knowledge of AI/ML and simulation products such as AnyLogic is critical in technical expertise. Experience of AI/ML is common in leading service providers now, but deep platform knowledge is something that doesn't come easily unless service providers have strong partnerships and have delivered several engagements. A steel manufacturer has partnered with ITC Infotech for its experience and expertise in AnyLogic.
- **Business expertise.** Knowledge of the industry, business, and supply chain processes is paramount in business expertise. SCM simulation is complex, and in some simulation assignments, knowledge of hundreds of variables, their variations, and interdependency is required. This knowledge can come either from experience gained with several customers or from a group company. Take the case of ITC Infotech, which is managing the simulation of the complex supply chain of its parent company ITC, one of the leading CPG firms in India. Enterprises should check the provider's modeling experience by the depth of the modeling assignments completed with the number of variables and nodes, the percentage accuracy obtained in modeling, and the number of reusable model components developed. A CPG customer partnered with ITC Infotech for SCM simulation because of ITC Infotech's deep SCM simulation work involving 200+ variables.

Bottom line: Enterprises should consider AI-based simulation to navigate uncertainties and select a simulation specialist diligently.

In an uncertain world, AI-based simulation can help enterprises make better decisions. Enterprises should evaluate service providers diligently for AI-based simulation. Effective service providers will have both technical and business expertise, as discussed in this PoV. Instead of a one-time exercise, enterprises should look for simulations continuously because new challenges and uncertainties keep emerging. The latest uncertainty is coronavirus, which is disrupting global supply chains. AI-based simulation can help enterprises navigate uncertainties quickly and effectively.

About the Author

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Pareekh Jain is Founder and Lead Analyst of EIIRTrend and Pareekh Consulting.

EIIRTrends.com is a neutral platform to discover emerging engineering, IoT, Industry 4.0 and R&D (EIIR) trends across 12 industry verticals. Pareekh Consulting is a focused analyst and advisory firm for EIIR.

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Pareekh is a thought leader, having authored various publications on topics related to EIIR outsourcing. He loves business fiction writing in his free time, and has authored a novel, *Who Is That Lady?*

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