Intelligent Agents for Supply Chain Management

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Supply Chain Mayhem

It used to be simple. You made a small number of products to stock, put them into your warehouse, and shipped these products to customers from your warehouse. When needed, you scheduled another production run and ordered the needed raw materials, which you kept in the stock room until needed.

You always had plenty of inventory in stock, with lead times for making more products or ordering more raw materials typically being several months.

Then along came China, joining the WTO (World Trade Organization) in 2001, and the "Amazon Effect".

In order to compete with China's low wage cost (under $1/hour in 2001but now over $5/Hour) many US Manufacturers either shifted their make-to-stock production to China or switched to make-to-order semi-custom manufacturing in the USA.

The ability to deliver semi-custom orders quickly gave US based manufacturers a distinct competitive advantage (at least for products too big or heavy to be economically air freighted) as it takes about 6 weeks for delivery of such parts by Ocean Freight container from China to the USA.

Then along came Amazon, offering a wide variety of products delivered in a few days. Initially this was for consumer products but the Amazon Effect quickly spread to industrial products.

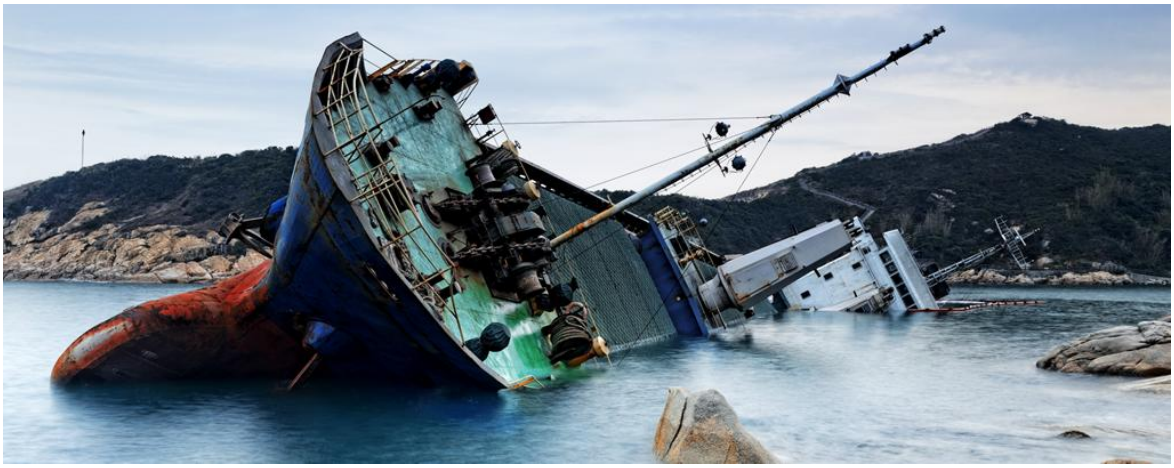
US manufacturers were well positioned for this shift but now had to offer a much wider array of semi-custom products, which required a much larger variety of raw materials and parts, many of which were sourced from China.

In order to follow "Lean" inventory practices, with limited quantities of each component on hand, and to keep costs down, manufacturers in the USA came to rely on industrial distributors to stock the products they needed with only a small amount of "safety" stock (if any) for needed components to meet an ever more complex flow of incoming customer orders.

Also, production planning and scheduling time horizons had dropped from what were weeks or months, using a classic MRP (ERP Materials Requirements Planning) approach, to now a few days with materials planning mostly done using Excel spreadsheets.

This worked well, with finely tuned and very lean supply chains, until along came the Covid19 pandemic and start of the breakdown of global supply chains. Then protectionism reared its ugly head and tariffs (on all sides) and other protectionist trade policies completed the supply chain breakdown and mayhem ensued.

Intelligent Agents to the Rescue



It used to be that each part came from a single manufacturer and, often, internal BOMs (Bills of Material) and drawings to make products used that manufacturer's part number. Also, such parts could be reliably ordered from distributors on just a few-days-notice.

Then, suddenly, parts that used to be readily and reliably available were/are no longer available as factories in China closed or moved to elsewhere in Asia or Mexico. In the short-term, some of this mayhem was driven by tariffs but in the longer term this has been much more driven by supply chain managers realizing that, at $5/hour, China's labor rates were no longer competitive with those of other countries, at under $2/hour; and, as a result, the supply chain shifted and became more complex.

Now sourcing parts has become a scramble.

Ideally, if the part from a primary supplier is not available, when needed, then interchangeable or alternate parts may be available. But typically, the replacement parts will have different part numbers. So, the BOMs and drawings for making assemblies or other products, which specified the primary supplier part numbers are now incorrect and need to be changed.

This situation is made worse, if only substitute parts are available, which only work in specific situations, or even worse require changes to the assembly or product in which they are used. We have even seen companies stripping parts from old assemblies and refurbishing them so they can be reused, when no other substitutes are available with less than a 6 month lead time.

Managing all of the resultant engineering change orders (ECOs) can quickly turn into a paperwork nightmare if not delegated to intelligent agents, for example, to automatically change kitting and work orders, and possibly drawings, to reflect available part numbers rather than simply referring to the preferred supplier part number.

Then there is the issue of parts delivery. Previously, delivery of needed parts for production could be scheduled a few days ahead of when needed. Now parts may be randomly delayed without warning. This requires that production work order steps be dynamically scheduled based

on available parts as well as customer delivery priorities. This, again is a complex task best left to a scheduling algorithm in an intelligent agent.

With such volatility, it is important to communicate automatically with supplier systems to periodically get updated delivery status information. This is to provide the decision support information needed by materials managers, when ordering needed parts based on the materials planning being performed dynamically by other intelligent agents, in response to the incoming flow of customer orders.

It is also critical, in such circumstances to keep customers and downstream distribution warehouses updated as to the status of their orders. This is to avoid customers endlessly calling customer service and expediters having to roam the floor to find the status of customer orders.

Again, this is a task best left to intelligent agents which can automatically detect when changes have occurred or are planned to occur and send text or Email alerts to customers and update systems used by downstream supply chain partners.

Commentary

Back in the "Good Old Days" of make-to-stock manufacturing, it was possible to manage a company's supply chain with an ERP system, or even an accounting system, supplemented by Excel spread sheets and paper forms.

But now the level of complexity has increased by an order of magnitude or more. Also, the time available to make decisions has shrunk to hours or even minutes. As such, it is now becoming impossible for even a large team of people to manage industrial supply chains without the aid of intelligent agents to do the real-time "Intelligent Grunt Work".

Author

This white paper was written by Dr. Peter Green, who serves as the Technical Director of a number of software companies. Dr Green obtained his BSC (Hons) in Electrical Engineering and his Ph.D. Degrees in Electronics and Computer Science from Leeds University in England. Subsequently Dr. Green was a senior member of technical staff at Massachusetts Institute of Technology and a Professor of Computer Engineering at Worcester Polytechnic Institute.

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