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Beyond Forecasting: Responsive Supply Networks

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The chemical industry has been hampered by poor forecasting for years. There are many reasons why this industry has lagged behind other industries in its adoption of advanced forecasting techniques, but a key reason is that the supply chain has been largely based upon petro-chemical feedstocks in a push-driven mode. Historically, large quantities of bulk product were manufactured and then pushed into the market place driven by the high cost of product transitions at the plant. In addition, the chemical industry is several steps away from the actual end consumer, meaning that point of sale (POS) information cannot be leveraged.

With the emerging economies in China, the Middle East and Eastern Europe, the chemical industry is thriving in a global environment. This globalization has added additional complexity to the supply chain as chemical companies have taken advantage of low cost country sourcing strategies and moved production to these emerging markets. The traditional supply chain has been replaced by multi-modal, multi-border complexity where demand fluctuations can be based upon numerous factors, including the unpredictable nature of the local currency. Teams are formed with Six Sigma black belts to drive better collaboration between Sales and the Supply Chain to improve the forecasting process and often yield only marginal improvements. If forecasting is not the answer, then what is?

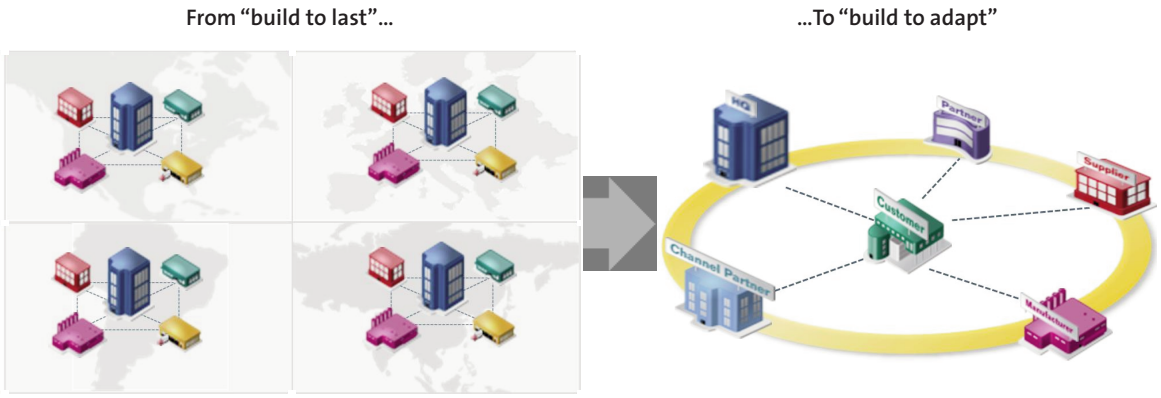
Responsive supply networks allow companies with fluctuating demand and high product complexity to sense and respond faster and smarter to demand and supply dynamics in a globally distributed environment. The core principles are based upon relying less on statistical forecasting and more on demand-pull generation through real time responsiveness and better collaboration. Improvements in forecasting will always yield results, however one must balance the effort required to obtain these results. The supply chain has to have the capability to sense changes that have occurred, both planned and unplanned events, and respond to these changes in a near real-time fashion in order to truly improve the fulfillment process.

The traditional supply chain was configured on a build to last model. Manufacturing plants were separated from the Corporation in a command and control organizational model where the focus was on lowering variable costs by maximizing volume and throughput. The plants would focus on a uniform product line and minimize product transitions to keep costs down. In the globalized marketplace, manufacturing had to become more agile and collaborative with the rest of the organization – the supply chain demanded responsiveness and adaptability.

Causal Factors – History doesn't always repeat itself

Statistical forecasting can be easily determined for high volume customers in a repeat buy mode. Some customers are very predicta-

Figure 1: Business networks will drive future competitive advantage



ble and this information should be leveraged. Products that are heavily influenced by seasonality (such as the building and construction industries (i.e. paints) or in the agricultural markets (herbicides, fertilizers, etc.)) can also be modeled in any reputable supply chain planning tool. However, the chemical industry has been heavily influenced by globalization, product innovation, and the unpredictability of the oil and natural gas markets. What little certainty that did exist in the chemical industry has further dwindled. In order to improve forecasting, the chemical industry must be able to anticipate changes to demand through other methods.

In this world, additional statistical factors must be reviewed in order to gain insight into market dynamics. Building permits, automotive inventory, PVC inventory, or consumer confidence and spending indices can all be modeled to yield an indication as to the direction of the market through multiple linear regression. These causal factors (and many others) must be reviewed to determine if there is a significant statistical relationship between the demand pattern and the potential causal factor. For example, Company X manufactures a resin that is sold to automotive companies to produce a bumper guard. By reviewing automotive inventories, Company X may be able to better predict when demand is going to pick up or when demand will trail off.

Once these variables are identified, they can then be used to predict the demand of a product or a product family. This information can then be used in your planning tool to yield an alternative statistical view of the anticipated demand. With a traditional statistical view of the forecast based on history and an alternative view of the forecast based on causal factors, an agreed upon plan can then be determined in the Sales and Operations Planning meeting. With multiple views of anticipated demand and knowing the financial goals of the organization, a business can make better decisions to meet the agreed upon goals by setting more strategic pricing, for example. In addition, general managers love to talk about causal factors and market dynamics.

From Safety Stock Planning to Multi-echelon inventory optimization

The concept of the ABC analysis was first derived from the 19th century Italian economist Pareto, who stated that 80% of the land in Italy was owned by 20% of the population.

He then applied this principle to many other events where 80% of the effects come from 20% of the causes – the most common being that 80% of your sales tend to come from 20% of your clients. The use of the Pareto Chart graphically depicted the relationship between cause and effect and has become one of the basic tools for quality control.

The 80-20 principle was then applied to logistics and inventory management where the category of inventory was characterized by the number of turns[1] and the quantity or dollar value of the items. Each product or stock keeping unit (SKU) was given a classification – 'A' items would tend to have lower safety stocks in terms of days on hand because they were replenished more frequently.[2]

'A' items would also be cycle-counted more frequently to drive inventory record accuracy.[3] By having the entire product line characterized, there was then a formal method to classify safety stocks. 'A' items would typically represent 70% of the volume followed by 'B' items at 20% and 'C' items at 10%. The exact break point for each classification was determined by many other factors, including customer service goals, costs, and demand variability. However, as the product line grew in complexity, this process became very onerous – technology could help make inventory classifications, but the ABC analysis was limited in considering demand variability based upon poor forecasts.

Note: it is important to differentiate cycle stock from safety stock. Cycle stock is the amount of inventory available to cover planned demand for a given period, and safety stock is the amount of inventory maintained in addition to cycle stock to buffer against stock outs (i.e. to cover variability). If demand were 100% deterministic, there would be no need for safety stock (for example, I receive one order for a full container every Wednesday).

The safety stock settings, once known, would then have to be entered into the planning tool being used for each manufacturing plant which was often a spreadsheet. Advanced planning and simulation tools would automatically update the ERP system to further optimize material requirements planning (MRP), however the setting of safety stocks became a master data nightmare that occurred annually at best and normally at the hands of a summer intern. Thus, safety stock settings were often out-dated and did not consider changes in supply or demand variability. A different type of hedging strategy must be used in order to minimize net working capital without sacrificing customer service.

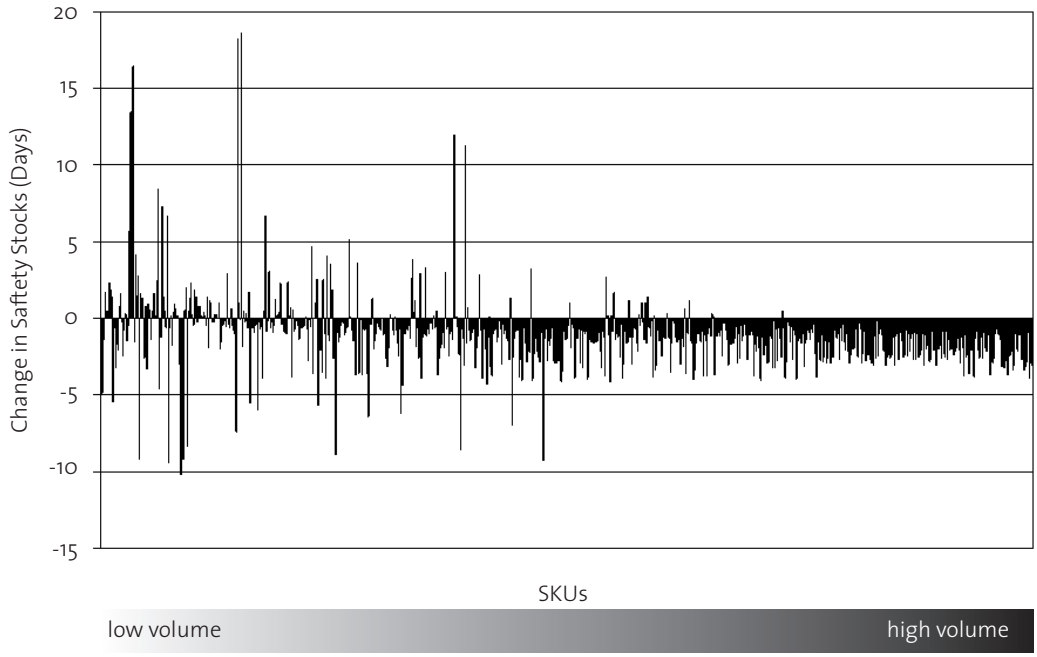
Variability IS Intelligence

Multi-echelon inventory optimization takes safety stock planning to an entirely new level. The fact is there is variability in the world, thus embrace the variability and use it as intelligence. Safety stock settings are constantly changing and are not static. The demand forecast is variable, the plant production is variable, transportation lead times are variable, as are other factors. However, some factors are known: current on-hand inventory, on-hand orders, batch sizes, batch cycle times, etc. The production schedule is reasonably fixed within a given time fence. The key point is to take the information that is deterministic and factor in the information that is variable to determine what changes should be made to safety stock parameters to improve the fulfillment process with a dynamic planning cycle.[4] Customer responsiveness must also be factored into meet strategic requirements and any contractual obligations. Instead of changing safety stocks on an annual basis (or less frequently), change them as part of a routine master production schedule (MPS) planning cycle. By right-sizing inventory and not just setting random reduction targets, on time deliveries will actually improve with less working capital.

As shown in the example below, multi-echelon inventory optimization (MIPO™ by Smart-

1) Inventory turns measure the number of times the average stock level of an item is sold in a given period – the higher the turns, the more rapid the turnover of stock.
2) Safety stock is the amount of product held in inventory to buffer against the uncertainty in demand or supply to prevent a possible stock-out. Days on hand is a measure of the amount of product in stock divided by the average demand per day.
3) Inventory record accuracy (IRA) is a measure of the amount of inventory 'on the books' versus the amount actually present – the higher the IRA, the greater the ability to commit to customer orders (and of course to prevent accounting surprises...). IRA is obtained by cycle-counting the inventory on a routine basis.
4) Master production schedule is the short term planning horizon (normally 8-13 weeks) that defines production, inventory and procurement requirements as part of materials requirements planning (mrp).

Figure 2: MIPO Recommended change in Safety Stock



Ops) will make recommendations based on advanced algorithms to modify existing inventory settings and then synchronize these settings automatically with the base ERP platform. This synchronization is a key step in the master data management of complex supply chains and product portfolios.

Event Manager – Tracking and Tracing is not enough

2005 was a very trying year for the chemical industry. Hurricanes Katrina and Rita crippled the ports of New Orleans and the Gulf Coast. Thousands of shipments and containers were held hostage for most firms, but some companies had better visibility and intelligence than others. These companies were able to sense and respond to anticipated gridlock on the ports and re-route their shipments to safer harbours. The concept of event management is certainly not new (Fed-Ex tracking numbers, for example), however event management extends beyond tracking and tracing. Event management can be used to compare expected events to actual events to better identify cycle time improvement opportunities – these improvements have a direct impact on asset utilization in a constrained industry. Flags can be setup to trigger an event based on a transactional posting (such as a shipment issue or shipment receipt) or on an actual device such as a RFID or a GPS. As incremental legs are identified, then further analysis can be done to pin-point improvement opportunities by following a Six Sigma methodology. Event management can also indicate if a shipment has been tampered with by having a device located on a valve or dome to determine open/close status. Devices can also be configured to determine if a railcar has been jolted or in an accident – with Event Management the appropriate personnel can be immediately notified of any of these unplanned events.

Payment terms are often based upon shipment receipt in the chemical industry. In many chemical yards, railcars may be staged beyond the gate waiting for a spot. If the customer has not 'received' the railcar shipment, the payment terms may not be initiated yet. With event management, the triggering event could be the posting to a geo-spatial area based on

a GPS reading – thus as soon as the device hits the geo-spatial fence, the shipment could be received and payment terms commence. This is just a simple example of how to leverage event management capabilities to improve payment conditions by analyzing a specific portion of the entire ship to receive process.

With constrained fleets, many firms incur large demurrage charges when the amount of 'free' time for a container is exceeded – if a container is held up at a customer's location, the rail company or logistics service provider will often issue a demurrage charge on an hourly or daily basis. With event management, the assets can be tracked to assign the demurrage charge to the responsible party. In addition to reducing the demurrage charges, this process will help improve asset utilization to help keep these constrained fleets moving and improve over-all customer service.

Collaboration: Extending the Traditional Supply Chain

Communication is often the weakest link in the supply chain. Chemical manufacturers have always used toll manufacturers to supplement capacity shortfalls or for alternative technologies, but dealing with tollers is often a manual process based more on relationships. Suppliers are often the whipping-post of a wonderfully-executed marketing plan to increase product sales, yet their planned preventative maintenance outage was never factored into the equation. The manufacturer must have some type of visibility into the supplier's plans in order to execute flawlessly. With the number of force majeure's increasing annually, manufacturers must consider the limitations of their suppliers and can no longer assume that they can execute any plan. And these limitations cannot be verbal in this globalized marketplace. The supply and demand plans from all suppliers and contract manufacturers must be visible to the chemical manufacturer to ensure that they can commit to the downstream customer. Without this visibility, chemical manufacturers will continue to disappoint the marketplace.

Collaboration today must extend to contract manufacturers, suppliers, customers and logistics service providers in order to execute a flawless supply chain. Through web-based portal technologies, companies can be informed of forecasts, supply plans, order changes, inventory levels and other supply chain triggers with a mere internet connection. It is clear that more and more transactions are being done over the web at reduced costs with fewer errors and with timely information exchange. This portal-based collaboration is a key enabler to responsive supply networks and is no longer wrought with high barriers to entry.

Whereas the initial wave of collaboration services were designed for the consumer products industry to satisfy demands from Wal-Mart (RFID) and to satisfy EPC standards for the pharmaceutical industries to combat counterfeits, the new class of applications is having a wide-reaching affect on numerous processes in all industries. In order to truly determine the optimum point of operation, the aforementioned three elements (causal factors, multi-echelon inventory optimization and event management) must be balanced with real time information by leveraging collaboration across the extended supply chain network.

Conclusion

The traditional plan and execute supply chain is being replaced by responsive supply networks that extend to all partners in the order fulfillment process, including contract manufacturers, suppliers, customers and other service providers. There are key technology enablers that have addressed the inherent problems of statistical forecasting, supply and demand variability, and the expensive and time-consuming EDI or B2B connections. These technology enablers have often been piloted by other leading edge industries such as high-tech or consumer products. The chemical industry has thus benefited from these trials and is ready to embrace these enablers to satisfy its own business processes. The chemical industry is shifting to a collaborative environment that relies heavily on event management triggers that yield true intelligence to a connected, innovative and secure supply chain.