Symphony Consulting

White Paper

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Measuring and Reducing Inventory Exposure in the Supply Chain

Inventory can no longer stand by itself as an effective measure of business performance. It has two fundamental flaws that detract from its effectiveness. The first and most fatal flaw is that inventory is a post-performance metric. In other words, companies only recognize that there is a problem once they have the inventory on hand. By then, it is often too late to remedy the situation. The second flaw is a function of today's modern supply chain, which is outsourced and extends to multiple companies. Companies are delaying when they take inventory, so the numbers are artificially low. While there is less inventory on the books, there is not necessarily less inventory risk. The technology meltdown of 2001 demonstrated clearly that liability in the supply chain translates to a real expense when the market shifts. It is time to seek a better way of evaluating and measuring issues involving inventory.

All of the metrics that involve inventory (e.g., on-hand inventory dollars, inventory turns, inventory days of supply, excess and obsolete inventory) are lagging indicators. If there is a business shift, it may take weeks or months for a problem to register in the inventory metrics. In today's business environment, companies will be more successful if they begin to measure inventory risk instead of just inventory—and if they begin to look at the whole supply chain and not just the portion within their four walls.

By looking at Inventory Exposure as a metric, we can solve the two problems that arise from just using inventory as an indicator. We define Inventory Exposure as:

The amount of committed inventory within the total supply chain based upon expected demand and the cumulative lead-times associated with the current supply chain.

In other words, Inventory Exposure attempts to define the commitments that someone, somewhere in the supply chain has made in order to get materials to build product in the expected volumes. A simple way to view Inventory Exposure is that it represents the amount of money at risk at any given point in time. Inventory Exposure can be calculated in this way:

*Inventory Exposure = Price * Cumulative Lead-Time * Demand*

This can be calculated for each component and value-added step. The sum of the individual pieces then coalesces to show the exposure for a product, a product line, or a whole company.

A key element of Inventory Exposure is cumulative lead-time. This is an important concept to Inventory Exposure, so let us discuss it in more detail before we go any further. Each product comprises a set of materials that goes into it. That material must go through a set of value-added steps to be transformed into a product. All of the material and the value-added steps have an associated lead-time. Using a simple example, if a company requires a finished product on July 1, they might need to start assembling it on June 17. The start of final assembly becomes the due date for all of the lower-level assemblies. This back-off in timing continues to cascade down the supply chain as illustrated below.

In this example, an order is being placed for a component in February for expected demand in July. At the point a buyer places the first order, there is risk and exposure. Where companies use some type of Vendor Managed Inventory (VMI) program instead of an order, inventory is staged based on a forward-looking window of time in the forecast. In these instances, a company takes on risk and exposure when it sends the forecast and for an amount of time equal to the agreed upon forward-looking window. In either case, the cumulative lead-time is the mechanism that determines how far in advance action is taken to support a planned need.

Item	Start Date	Required Date	Lead-time Calendar Days	Cumulative Lead-time
Ship Product to the Customer	July 1, 2005			
Assemble Product	June 17, 2005	July 1, 2005	14	14
Build Sub-Assemblies	May 27, 2005	June 17, 2005	21	35
Receive Materials and Prep	May 24, 2005	May 27, 2005	3	38
Place Order for Component	February 15, 20005	May 24, 2005	98	136

Inventory Exposure is a good metric for describing the financial risk in a supply chain. From the formula it is clear that if demand grows, Inventory Exposure also grows. In order to compare inventory risk across different supply chains and in varying demand conditions, we need some metrics that normalize the data. Here are several metrics that serve this purpose:

- **Inventory Exposure Percentage = Inventory Exposure ÷ Cost of Goods Sold (COGS)**
  As demand rises, so does COGS. This cancels out the effect on Inventory Exposure, and the result is a normalized number that can be used to compare performance over time.
- **Inventory Exposure Turns = Cost of Goods Sold ÷ Inventory Exposure**
  This is just the inverse of Exposure Percentage. It has the same characteristics and is simply another way to view the data. One interesting note is that a company's inventory turns should always be higher than its Inventory Exposure Turns.
- **Inventory Worry Gap™ = Time between the point at which a company is 50 percent invested in a product and when a customer makes a commitment in the form of an order.**

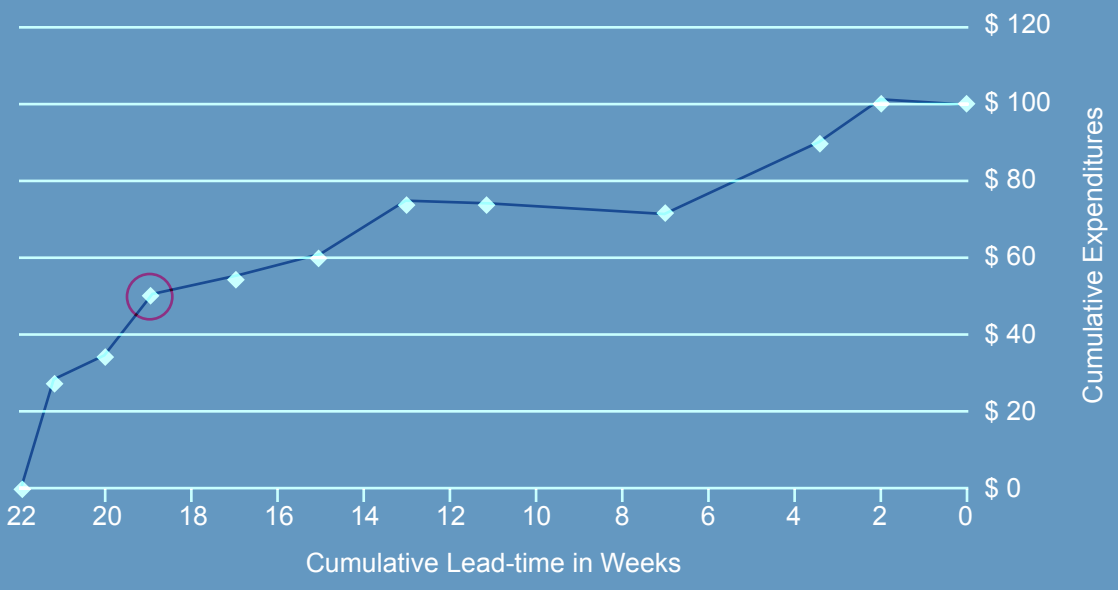
The Inventory Worry Gap needs further explanation. One way to look at a product is to build what we call the Product Time-Investment Curve. This plots the escalating investment in a product over time. As we mentioned before, each product has a set of materials that goes through value-added steps to transform the material into a product. All of the material and each of the value-added steps have an associated cost and lead-time. The Product Time-Investment Curve is simply a map of the increasing dollars over time. A typical curve will show that a company takes on significant financial exposure weeks or months before getting a customer order.

Here is an example based on a simple bill of materials. In this example, the company has chosen to keep a two-week supply of finished goods (FG) so they can ship the products to the customer "off the shelf." The cumulative lead-time is the sum of the lead-times for all the preceding steps.

Part Number	Cost	Lead-time	Cumulative Lead-time	Cumulative $
FG		2	2	$ 100.00
Process A	$ 10.00	2	4	$ 100.00
Process B	$ 15.00	3	7	$ 90.00
PN-01	$ 1.00	4	11	$ 75.00
PN-02	$ 4.00	6	13	$ 74.00
PN-03	$ 10.00	6	13	$ 70.00
PN-04	$ 1.00	8	15	$ 60.00
PN-05	$ 2.00	8	15	$ 59.00
PN-06	$ 2.00	8	15	$ 57.00
PN-07	$ 5.00	10	17	$ 55.00
PN-08	$ 15.00	12	19	$ 50.00
PN-09	$ 10.00	13	20	$ 35.00
PN-10	$ 25.00	14	21	$ 25.00

For the components (PN-01...PN-10), the cumulative lead-time of the first process in which they are used is added to the component lead-time. The chart below shows the cumulative expenditures plotted against the cumulative lead-time. The circle highlights the point at which commitments have been made equal to 50 percent of the product cost. The chart shows that the company is 50 percent invested at 19 weeks, or almost five months, in advance of shipping to a customer.

Product Time-Investment Curve



The other half of the Inventory Worry Gap (or any of the exposure metrics) has to do with how much notice a company gets from its customers. In this example, the company is selling its product with practically no customer lead-time, so the Inventory Worry Gap is the full 19 weeks. If the company instead sold its products with a customer lead-time of four weeks, the Inventory Worry Gap would be reduced to 15 weeks (i.e., 19 – 4 weeks). This makes sense, because the company can then set up its supply chain to rely less on forecast and more on actual orders, thereby reducing inventory risk.

In the end, we use metrics to monitor results and manage progress. We need to understand the various metrics and their role in the grander scheme of managing inventory. Inventory, as we discussed before, is a post-performance metric. Although a metric like this has some drawbacks with regards to proactive improvements, it does provide a clear result (i.e., whether or not a company ultimately has the inventory or the inventory write-offs). Inventory Exposure, on the other hand, is good at measuring the framework which ultimately leads to inventory. It shows risk and allows a company to measure improvements in its inventory risk profile.

The drawback is that lower risk does not always translate into reduced inventory. In the short term, sometimes companies get lucky. But over the long term, we know that more exposure translates into more inventory, especially in high-change environments. This diagram shows the model:

INVENTORY EXPOSURE + BUSINESS FLUCTUATIONS = INVENTORY

Business fluctuations are only increasing. In this high-speed, time-to-market-focused environment, companies are having to respond to sudden shifts in customer demand and an accelerating pace of product discontinuances and reconfigurations. In addition, it has become more critical to respond to supplier problems, delivery delays, inaccurate forecasts, and similar age-old issues. To be successful, a company's best option is to control Inventory Exposure and respond rapidly to changing events. By doing so, they can break the chain and take steps to prevent inventory.

To close the Inventory Worry Gap and improve the other Inventory Exposure metrics, a company has two basic choices:

- Compress the Time-Investment Curve for products
- Increase the lead-time quoted to customers

Compressing the Time-Investment Curve for products is simply a matter of taking time out of the supply chain. To shrink the time for value-added steps, companies should look at the touch time (i.e., the actual time where value is being added to the product) versus the lead-time. For most high-tech products, the lead-time is hundreds of times larger than the touch-time. The difference is made up of waiting times and transit times. The portion of lead-time that is consumed by non-value-added steps is tied to how effectively issues like batch sizes, set-up times, constraint management, and product flow are managed. To shrink the lead-time for components, companies need to take the time to understand the manufacturing steps for the components. By discovering how parts flow and where they are differentiated, companies can look for opportunities to reduce lead-times using a combination of strategies, including postponement, strategic buffers at low-cost points, increased information velocity, and reduced supplier manufacturing time.

The other option is to adjust the product lead-times companies quote to their customers. Most companies set lead-times without a real dialogue about the trade-offs concerning inventory exposure and the impact on financial performance. Clearly, there are some products where companies must have stock available or risk losing the customer. In most companies, there are also products that are older or less important or where the competitive environment is less threatening. In those cases, it makes sense to look at increasing the lead-time and sharing the uncovered inventory risk with the customer.

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As outsourcing increases and supply chains grow more complex, traditional manufacturing is giving way to virtual enterprises that comprise a coordinated, yet decentralized network of interconnected players. At the same time, customers are demanding greater flexibility and faster response to constantly changing demands. In this environment, companies need strategies for supply chain agility and risk management supported by tools that provide immediate, global visibility into the impact of potential changes they wish to make.

Response Management is highly useful in this regard. By providing end-to-end supply chain visibility to market dynamics, Response Management solutions make it easier for companies to identify which problems deserve top priority for resolution. The ability to conduct multiple "what-if" scenarios using live, accurate data helps companies rapidly analyze how proposed inventory management changes will impact all areas of their business.

For example, a company can quickly see how reducing lead-time on a certain product component in order to compress the Time-Investment Curve would affect liability, then compare those results to the impact of many other potential lead-time reduction alternatives. Real-time collaboration supports decentralized decision-making by key participants, so OEMs, CMs, suppliers, and others can act quickly in a way that aligns with the organization's key objectives. These capabilities empower companies to effectively analyze risk and manage inventory liabilities by ensuring that the best decisions are made at the point of change—not just by OEMs, but across the entire supply chain.

To reach new levels of performance, companies need to approach inventory in a different way. Instead of waiting for the problem to show up at the receiving dock and then reacting, it is important to explore the dynamics that cause inventory and address the root issues. While there are other factors that cause inventory, the fundamental framework that sets up inventory risk can be measured using the Inventory Worry Gap and the other Inventory Exposure metrics. By using tools like Response Management, companies can make intelligent, rapid decisions about the best actions. The combination of reduced exposure and nimble response will lower the amount of money at risk in the supply chain at any point in time. By decreasing the risk, companies starve the mechanism that feeds inventory levels, and will be taking proactive steps to reduce inventory.

John Holton is a principal at Symphony Consulting, Inc., a supply chain consulting company located in Sunnyvale, California. Symphony's workshop,"How to Balance Inventory Exposure and Supply Flexibility," offers solutions, tools, and methodologies that allow OEMs, CMs, EMS providers, and component suppliers to successfully address the challenges of demand fluctuations without extra inventory.

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