An Executive White Paper

The Inventory Optimization Maturity Curve

*Mapping an IO Journey for Today’s Supply Chain Teams*
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Executive Overview

Over the last dozen years Inventory Optimization (IO) has assumed a crucial supply chain role. It’s bottom-line benefits have proven to rival established activities such as network design, transportation optimization, advanced planning and scheduling, and sales and operations planning.

The business challenge is the same today as ever—hold the least amount of inventory while meeting customer service requirements—but the methods have evolved.

While components such as re-order point formulas, safety stock calculations and economic order quantities are just as relevant now as they were in the 80’s and 90’s, the inventory optimization discipline today exhibits a never-before-possible sophistication. Its activities range from simple inventory management techniques all the way to advanced multi-echelon optimization, from tactical deployment of safety stocks for SKU’s to strategic use of inventory analytics to drive an integrated S&OP process.

As their IO efforts and understanding become progressively more mature, companies traverse a common sequence of stages. Experience shows that all companies fit somewhere along this universal spectrum of IO sophistication and expertise. An organization must first understand where it sits on the IO maturity curve in order to pursue a journey toward superior competitiveness and outstanding profitability.

This paper provides a quick guided tour of the evolutionary steps companies traverse as they progress up the inventory optimization maturity curve.
Leadership is the most crucial driver for continually climbing the IO maturity curve.

People, Process and Technology

Before focusing on the IO technology curve, consider the “people” and “process” components of inventory optimization.

Planners, buyers, and inventory managers may have differing levels of understanding and sophistication regarding inventory optimization. The team should ask itself questions such as:

- Does our organization have a solid understanding of inventory practices?
- How well do we understand the mathematical relationship between inventory, service level and lead times?
- Do we understand the concept of uncertainty in inventory planning?

From a process perspective, expect to develop new business processes as you climb the curve:

- Moving from rules of thumb to statistical methods requires different inputs and different outputs to drive greater precision.
- Planning across multiple inventory storage points, or echelons, may be a new concept to be added to your comprehensive process.
- Inventory optimization across a global network requires a process to collect the input and provide output back into existing business processes.

You are here: Conduct a “people and process” review. Look for knowledge that is already present in the organization and consider adding a trained resource to support IO initiatives. Also, make sure that executives budget for the process changes and organizational modifications required.

Where to next: Now let’s explore the four stages of the IO technology maturity curve.
Companies fall within a spectrum of sophistication and expertise, clustered around several levels of maturity.

The IO Technology Maturity Curve

Ask a number of supply chain teams what Inventory Optimization means and you’ll get a wide range of answers. Many years’ experience working with leading companies in dozens of industries has revealed a universal IO maturity curve that every organization traverses. It starts with a single SKU in a single location, builds to optimizing inventory across a single site, and so on until the team ultimately creates a multi-echelon inventory optimization model that drives strategy to reach business goals.

The journey can be divided into four major phases or stages (see Figure 1.). Your company’s current inventory optimization practices fall somewhere on this curve.

Figure 1. The Inventory Optimization Maturity Curve
Stage 1: Single Item/Location

At its simplest level, managers generally start to apply science to inventory with a single item, single location safety stock calculation that defines how much inventory should be held for an item to cover demand, lead times and ordering frequency for a given level of service.

In addition to this, rules of thumb may exist, such as “hold 20 days of inventory for all ‘A’ items.” Most supply chain practitioners start their inventory journey here, either through the use of spreadsheets or using simple safety stock modeling capabilities available through their existing ERP system.

You are here: If this describes your situation, there is good news: you have a big opportunity, and right away there are simple “low hanging fruit” actions you can take that will deliver impressive results.

Where to next: For you, the path to lowering inventory cost and raising service level performance may start with applying advanced optimization to a single node (plant, DC), or product line.
In many cases the optimal targets recommended are less than the existing targets, but in others the recommendation may be higher, giving you greater precision over inventory investments.

Stage 2: Single Site (a.k.a. Single Tier)

The next level in the maturity curve is optimizing the inventory at a site (or, in multi-echelon terms, a tier) within the supply chain. At this maturity, the organization uses science to set a statistical safety stock systematically for all item locations as part of a tactical planning process. Some include more advanced considerations like supply and demand uncertainty and time phasing of the safety stock.

The optimal safety stock levels calculated by an IO solution usually vary dramatically from simpler targets generated using existing rules of thumb.

The example shown in Figure 2 shows optimized inventory levels for every SKU/location in the tier. The optimal target inventory (Optimized Safety Stock DOS) is calculated based on demand uncertainty, supply uncertainty, lead time, and required service level.

In many cases the optimal targets recommended are less than the existing targets — this is where the inventory reductions come from. Some targets are actually increased to address service level misses. This approach provides a reduction in inventory and an increase in service levels at the same time.

You are here: At this level of maturity the science is more advanced. This is the point at which operationally focused ERP systems start to struggle.

Where to next: Once the senior management team is sufficiently aware that the benefits of single-site IO are significant, it’s time to break out of the silos and model your supply chain end-to-end for global inventory optimization.
Many supply chains manage their inventory locally to the tier, but typically each tier (or echelon) is only concerned with its own inventory. For instance, managers may optimize Finished Goods inventory at a warehouse without considering if that’s the best place to hold the inventory in the first place. In this case there is usually double buffering for the same uncertainty and no real idea of how inventory decisions in one tier impact the overall cost and service of the supply chain.

This is where the practice of Multi-echelon Inventory Optimization (MEIO) creates a major opportunity for the company. From its academic roots over a decade ago, the Operations Research science at the core of MEIO is well understood, peer reviewed and proven in real-world global deployments. The application of this research to thousands of real-world supply chains has produced easy-to-use software solutions that identify the causes of excess inventory and calculate the least-cost allocation of buffers across complex global networks.

**Modeling the End-to-End Supply Chain**

MEIO models the supply chain from raw materials through work in process and out into the distribution channels to the customer. Inventory optimization science is applied at each tier (at an item or SKU/location granularity), taking into account demand uncertainty, supply uncertainty, and constraints for the stage.

Next, the system propagates uncertainty up and down the chain. Algorithms calculate the optimal inventory at a tier, while factoring in interdependencies with other nodes in the network, including the actual lead times and service level relationships between nodes.

The model must “understand” how cost is accumulated through the supply chain. In order to position inventory most effectively, pooling and postponement points are identified for inventory before additional cost is accumulated. MEIO calculates the optimal mix and quantity of each SKU/location at each site as well as where in the overall supply chain to position that inventory for effect.
Buffering stock at the finished goods stage holds inventory at its most expensive, most differentiated, least flexible state.

The lowest-cost solution that supports the company’s service goals is typically not to “sprinkle inventory everywhere,” nor is it best to position all inventory buffers at the finished goods stage (figure A below), a “strategy” that guarantees inventory will be held at its most expensive, most differentiated, least flexible state.

A multi-echelon analysis takes advantage of pooling opportunities, and positions buffers at the most cost effective points at earlier stages, for instance, semi-finished work-in-process and strategic raw material at the vendor (figure B).

Improving the level of service each upstream tier provides to its downstream “customers” reduces the amount of safety stock required throughout the supply chain. By understanding all the dynamics of uncertainty, time, and cost, MEIO positions inventory for greatest service with the leanest overall investment.

Figure 3A. Inventory buffered at the Finished Goods stage
Mastering demand volatility is the number one priority for most supply chains, and as the organization becomes more demand-driven, the supply chain responds to customer needs much faster. The tendency to overstock during periods of falling demand and under-build when demand recovers can be minimized by MEIO’s holistic inventory policy recommendations. Inventory policies created using demand histories and probability distributions prevents fluctuations in the demand signal from provoking over-reactive decisions and exaggerated “bullwhip” expansions of safety stock buffers.

MEIO positions inventory for greatest service with the leanest investment.

Finished Goods - Driven Safety Stock

You are here: Companies at this level are optimizing inventory policies as well as tactical targets to achieve higher service levels while freeing up working capital trapped in excess inventory. This level of IO maturity requires advanced dynamic programming using non-linear mathematics that cannot be performed using ERP, traditional inventory planning, Warehouse Management systems, or spreadsheets.

Where to next: The stage is set for making MEIO a core competency of the organization and a driver of strategic business planning.
MEIO upgrades the supply chain to a new, previously unavailable tradeoff between inventory and service level.

Stage 4: Strategic MEIO

Managing and optimizing inventory across the network delivers valuable strategic information, such as an analytical understanding of the causes of inventory, the ability to target improvement initiatives and maximize working capital performance.

When you can quantify how much of your inventory is caused by factors like vendor uncertainty, demand uncertainty, lot sizes, replenishment cycles, and so forth, it is possible to target strategic improvements more effectively. When the board of directors mandates a 10% reduction in inventory, the supply chain team can tell them which inventory can and should be reduced with the least potential risk, and identify real opportunities for strategic improvements that will lift the performance of the entire supply chain.

Efficient Frontier

A mathematical graph of the trade-off between inventory cost and corresponding service level is known as an efficient frontier.

Inventory Optimization generally allows organizations to lower inventory at the same level of service, raise the level of service for the existing inventory investment, or some combination of the two.

MEIO lets the supply chain team evolve to a completely new curve—a new and previously unavailable relationship between inventory and service level. This is the positive feedback loop—the “virtuous cycle” that drives continuous improvement.

Figure 4. The Efficient Frontier charts the trade-off between inventory cost and service level.
**Multidimensional analyses that would take days or weeks to perform using conventional methods can be completed in minutes.**

**What If Analysis**

The multi-echelon inventory model can be used to predict and analyze the impact of changes. A multi-dimensional analysis can explore What-If scenarios such as “What inventory investment would be required over a range of service levels and a range of demand variability?”

What is the lowest cost solution if we vary the demand uncertainty by a factor of 2 or 3 across a possible service level range from 95% to 99%?

This multidimensional analysis would take days or weeks to perform using conventional methods (if you could complete it at all). The MEIO system, which has modeled the end-to-end supply chain, can do this type of analysis in minutes. Any number of scenarios can be explored in a very short period of time.

**You are here:** At this level, MEIO is deployed across all business units and supply chains, used as a trusted business process company-wide. Optimized inventory levels are viewed as an input to the Sales and Operations Planning process, rather than as an output.

**Where to next:** Once MEIO becomes a core competency, all stakeholders gain one shared model of the supply chain. Data-driven business decisions can be made that foster continuous improvement and lasting competitive advantage. Increased agility empowers better decisions and powerful scenario analysis provides strategic clarity and confidence.
Summary

Inventory Optimization delivers three major benefits:

1. IO creates the optimal balance between service levels and inventory investment.
2. IO shows you the causes and types of inventory in your supply chain.
3. The inventory model lets you explore new ways to strategically improve the competitiveness of your supply chain.

When it comes to inventory optimization, companies fall within a spectrum of sophistication and expertise, clustered around several stages of maturity:

- **Optimizing a single item/location**
  Most teams start their inventory journey here either through spreadsheets or using the simple safety stock modeling capabilities of the ERP system. Because following rules of thumb always “leaves money on the table,” simple actions at this stage can deliver immediate value.

- **Single site optimization**
  Scientifically set a statistical safety stock for all item locations as part of a tactical planning process. This approach provides a reduction in inventory and an increase in service levels at the same time.

- **MEIO for end-to-end supply chain**
  Model the supply chain from raw materials through work in process and distribution channels to the customer. IO science is applied at across tiers, taking into account demand uncertainty, supply uncertainty, and constraints.

- **Strategic MEIO as core competency**
  Understanding the causes of inventory and hypothesizing and pre-testing alternative inventory strategies across the network delivers valuable strategic advantage and changes the supply chain’s efficient frontier.

The journey toward inventory optimization best practices delivers benefits at every step of the maturity curve, and drives a continuous improvement regime for inventory savings, working capital availability, and service level excellence. This is one curve it’s worth being in front of!
About Logility

With more than 1,250 customers worldwide, Logility is a leading provider of collaborative, best-of-breed supply chain solutions that help small, medium, large and Fortune 1000 companies realize substantial bottom-line results in record time.

Logility Voyager Solutions™ is a complete supply chain management solution that features a performance monitoring architecture and provides supply chain visibility; demand, inventory and replenishment planning; sales and operations planning (S&OP); supply and inventory optimization; manufacturing planning and scheduling; transportation planning and management; and warehouse management.

For more information about Logility, call 1-800-762-5207 or visit www.logility.com.