By Kate Vitasek and Karl Manrodt, Ph.D.

Supply-Demand Alignment — One SKU at a Time

More and more, success in today's marketplace depends on solving the complicated supply-demand mismatch problem.

Most supply managers are familiar with the constant pressures of trying to align supply and demand — the constant challenge of minimizing stockouts while also minimizing inventory levels. The problem is further complicated when demand for each individual product can vary widely.

Solving the problem requires a careful matching of supply and production capacity with demand. Few organizations have developed a complete demand profile to base a manufacturing and distribution strategy that best suits their products. Instead, the use of enterprise resource planning (ERP) systems has encouraged organizations to implement make-to-stock practices.

Using the Two-Prong Approach of Volume and Alignment

ERP systems make it easy for organizations to drive their entire shop floor operations by simply loading in a forecast or putting orders into their manufacturing production schedule (MPS). The challenge? Forecast accuracy averages rarely exceed 70 percent in most industries. While the goal is to make the right products at the right time, using the forecast as a build plan for an MRP system inevitably leads to too little inventory, too much inventory or stockouts that result in costly write-offs. However, organizations have overcome these challenges by using two principles:

1. Volume-variability demand profiling
2. Manufacturing and distribution alignment

Volume-variability demand profiling. By using volume and variability, organizations that have a complete profile of products' demand can match supply to demand more effectively. Volume and variability have been used to assist in operational planning and execution since the early 1960s; techniques are widely taught in operations management and logistics classes. However, aside from safety-stock planning, organizations rarely consider both the volume and variability of demand in their planning and execution processes. Instead, they typically adopt a "one size fits all" methodology for manufacturing and distribution. SKUs with erratic demand often are treated the same as those units with predictable patterns.

In volume-based analysis, products are segmented into different classes or "buckets" depending on the volume of demand. For example, fast-moving, popular items are typically classified as "A" items, while slower-moving products are characterized as "C" items. A general rule is that "A" items account for 80 percent of the overall demand volume, "B" items account for 15 percent and "C" items account for the last 5 percent.

What is missing from this analysis is the dimension of variability. Is demand relatively constant, or is there a wide range of variability associated with that particular SKU? Considering the volume being shipped, most "A" items experience less variation than the other two product groups. Lower-volume SKUs usually experience more variable demand. Some items, however, have low volume with low variability or high volume with high variability. Augmenting the traditional Pareto classification to include variability allows stratification that enhances demand profiling.

In a volume-variability demand profile, each SKU is classified by both its volume (based on unit volume or dollar volume) and its variability (measured by standard deviation or normal standard deviation). The box on page 11 shows an example of a volume and variability profile. Each dot on the chart indicates where a particular SKU falls in terms of its volume and variability. Some of the SKUs have a relatively low weekly volume with a fairly normal distribution of variability. A few of the products show a high weekly volume pattern with relatively low variability (X). Two items (Y) experience both high degrees of variability and high levels of weekly volume. These are the items that can cause a great deal of disruption in manufacturing and distribution processes. Typically, supply managers either hold larger quantities of inventory to handle the variation in demand or attempt to manufacture the products in a shortened time window.

Through this volume-variability analysis, organizations can classify products into four main categories based on their volume-variability demand profile, as shown in the box on page 11. These four categories are:

"A" SKUs: represent high-volume products with predictable demand. These products are usually the organization's bread and butter. Scheduling of these items is fairly straightforward, as the overall volume is predictable.

"B" SKUs: represent products with medium volume and low to medium variability. These are typically average products. They are not organizations' top sellers, but sales are still steady and consistent.

"C" SKUs: traditionally have been the source of frustration for production. These low-volume products typically slow down production due to time-consuming changeovers and therefore can minimize throughput optimization. Increased production volumes mean more inventory and associated costs. Although "C" items

Kate Vitasek *is managing partner for Supply Chain Visions, Bellevue, Washington, and* ***Karl Manrodt, Ph.D.****, is assistant professor in the department of information systems and logistics at Georgia Southern University, Statesboro, Georgia. To contact the authors or sources mentioned in this article, please send an e-mail to* ***author@ism.ws****.*

represent only a small amount of volume, they usually have the poorest service levels. The reason: they're often pushed aside to make room for high-volume products that drive production capacity, revenue and fill rates.

"D" SKUs: experience medium to high volume and have the most potential to impact overall customer service negatively. Promotions used to spur demand may result in a single order that can exceed the current level of inventory, leaving the organization in an out-of-stock position for the rest of its customers.

Demand profiling by both volume and variability can help organizations more effectively manage products in each of these SKU categories. By examining volume and variability, the supply manager can begin to understand the impact of a particular SKU on operations. Thus, by understanding the nature and associated variability of demand, organizations can better optimize their operations to meet the real needs of the marketplace.

Manufacturing and distribution alignment. A 2003 benchmarking study by management consultants PRTM reveals that 74 percent of all organizations rely on make-to-stock production, using forecasts to drive volume. Such a make-to-stock strategy, however, is not optimal for variable products, which have low levels of forecast accuracy. Stockouts and inventory write-offs frequently occur when variable products are produced in a make-to-stock environment. Organizations should use a mix of manufacturing and distribution strategies based on a volume and variability demand profile.

This means selecting the most efficient techniques for the demand profile to drive high service levels and to minimize inventory. The following manufacturing and distribution strategies based on the product's volume-variability demand profile may be appropriate:

- For "A" SKUs, consider manufacturing strategies such as assembly lines, make-to-stock (component inventory on hand) and factory level loading. Ideal distribution replenishment strategies may include fill from stock (finished goods inventory on hand) and rate-based planning to trigger manufacturing replenishment.
- For "B" SKUs, consider assembly lines or cellular manufacturing and build-to-order from kanbans (component inventory on hand). Distribution replenishment strategies could include fill from stock (finished good inventory on hand, if there's a long manufacturing leadtime); kanban/JIT replenishment from manufacturing, if shorter leadtimes are available, or kanban planning to trigger manufacturing replenishment.
- For "C" SKUs, consider cellular manufacturing, make-to-order (no component inventory on hand) and on-demand manufacturing (if available). Distribution replenishment strategies may include no finished goods inventory on hand (i.e., fulfill from manufacturing via make-to-order).
- For "D" SKUs, consider assembly lines and make-to-order. Distribution replenishment strategies could include finished goods inventory on hand for maximum order quantity projections only or giving longer leadtimes for orders exceeding order quantities.

It is important to note that an SKU's classification by volume and variability is not fixed and should be modified as conditions change. For example, marketing may plan a promotion on a particular product; knowing this in advance, the supply manager can reclassify the SKU into a more optimal production category (e.g., "A" to "D"). If market intelligence shows sales of a product are not materializing, the item can be reclassified (e.g., "A" to "B") and placed into a kanban-type planning model.

The Benefits of Manufacturing and Distribution Alignment

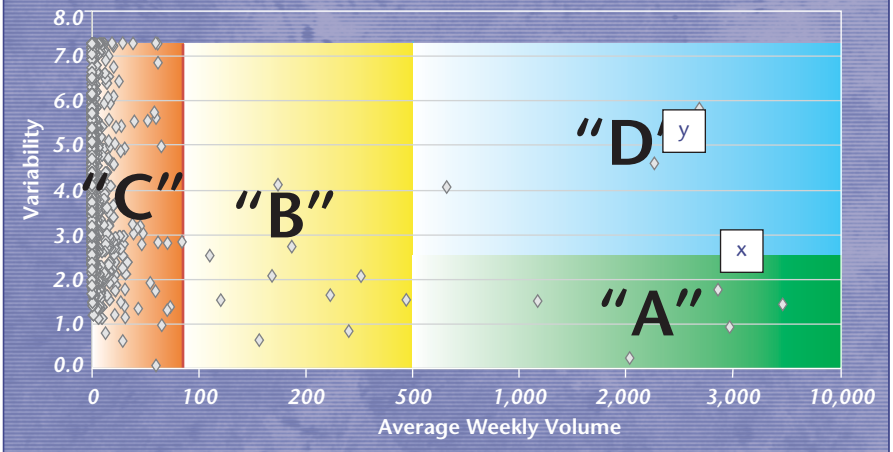
The approach outlined here offers three main benefits. First, by selecting manufacturing and distribution methods based on volume and variability, organizations can improve operational efficiencies by optimizing service levels while keeping inventories to a minimum. Service level expectations can be managed by communicating leadtime and other exceptions on the order form. Organizations can use statistical analyses combining volume and variability to set safety-stock levels that most efficiently meet customer service goals.

Second, by classifying SKUs by demand profile, organizations identify the ones that should be built to order on a fast turnaround because the risk of holding inventory is great. With this approach, organizations select their business models and inventory levels based on real customer demand instead of forecasted demand (as occurs when organizations use an across-the-board MTS strategy). Only in the case of high volume/low variability SKUs is an organization "betting" with finished goods inventory in anticipation of demand. When the demand materializes, the organization is prepared to satisfy customer requirements at optimal cost.

Third, this approach allows the organization to mitigate reliance on, and risk associated with, forecasts. Forecasts are traditionally used for planning; when they are used to release orders in anticipation of demand, stock is built prior to known demand. The longer the time period between order release and sale, the greater the opportunity for misallocating capacity for a given product. Under a combined volume-variability approach, the forecast is just one data element in the planning process, in contrast to the fixed data set for a build plan.

Implementing the right operational strategy, however, depends heavily on understanding products' demand — including the variability of that demand. With this insight, the organization can adopt manufacturing and distribution strategies to achieve the win-win situation of improved customer service fill rates and reduced inventory positions. ism

Box 1 – Volume-Variability Demand Profile



Note: Variability can be classified as Standard Deviation or Normal Standard Deviation.