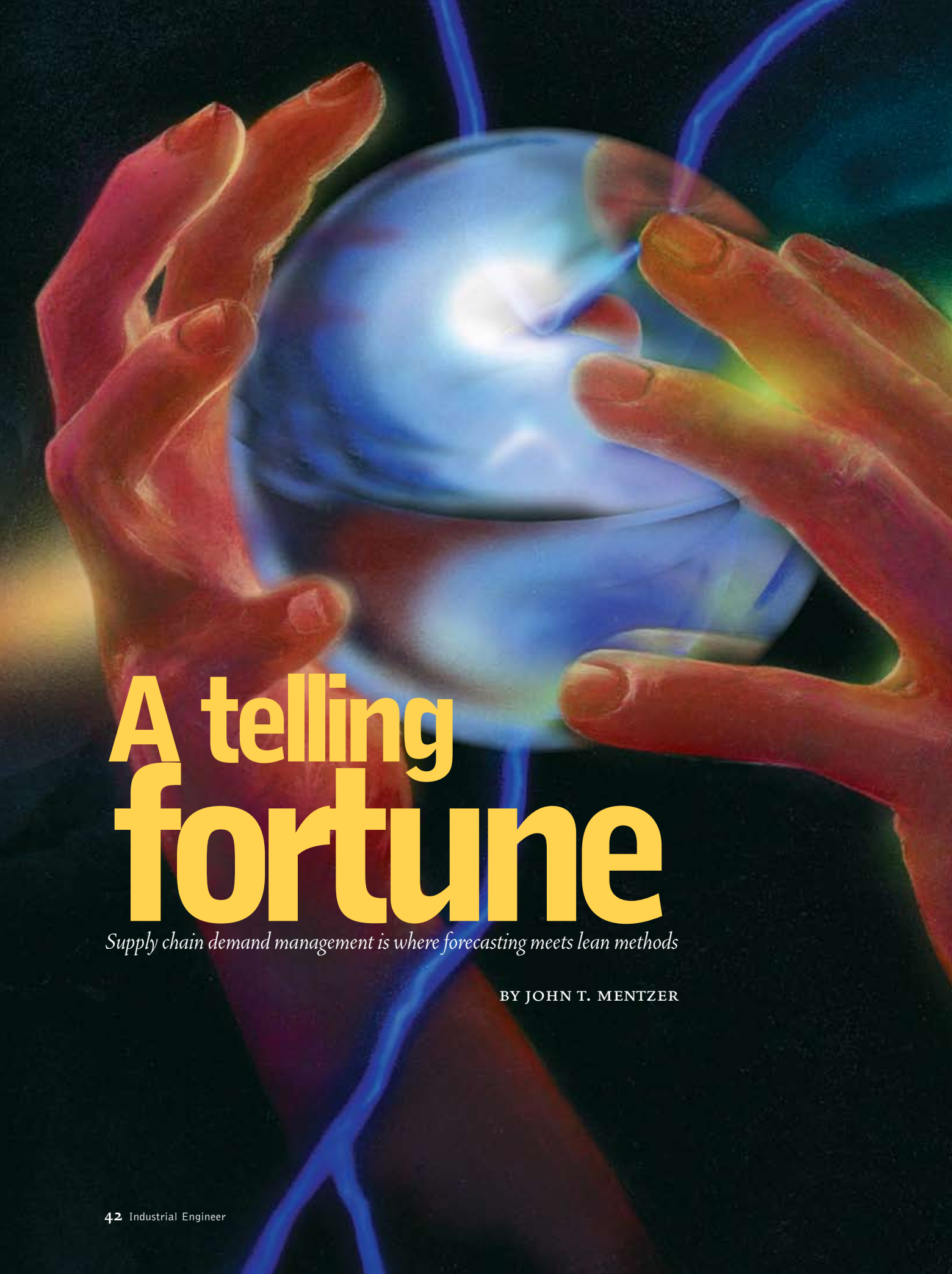


A telling fortune

Supply chain demand management is where forecasting meets lean methods

BY JOHN T. MENTZER

A company thought it had a forecasting problem. Many of its products were slow movers with spiking demand. It's a daunting forecasting problem when four units sell in one week, three the next, five the next, 10,000 the next, three the next, six the next, 20,000 the next, and so on. The spikes are seemingly unforecastable, cause huge supply chain disruptions, and make applying lean principles difficult or impossible.

This company manufactures numerous lighting products. One of its slow movers with spikes is ballasts — little transformers that take electrical energy and convert it into an energy beam that passes through a fluorescent bulb. Without a ballast, fluorescent bulbs do not work.

One source of independent demand is do-it-yourself consumers who replace ballasts in their homes when they wear out. We now have a slow mover that sells one at a time as a replacement for ballasts already in use. As this independent demand affects the ordering policies of various home supply stores in the company's supply chain, we get the fairly smooth, slow-moving component of derived demand that the company experiences.

There is another source of independent demand for ballasts. The owners of a large office building decide to retrofit all the ballasts in their building. This is a return-on-investment decision since old ballasts use more electricity to light a fluorescent bulb than new ballasts would. Therefore, at some point, the cost of replacing ballasts can be justified on the basis of the electricity savings. The office building in question has 10,000 ballasts. When the building owner decides to retrofit the ballasts in the building (which is generally in connection with other renovations), an electrical contractor does the job, working with the other contractors involved in the renovation to decide when to start the ballast retrofitting part of the overall project — usually weeks if not months in the future.

Unfortunately, the electrical contractor does not tell the ballast manufacturer about the independent demand for 10,000 ballasts until the week before the ballasts are needed. Since it typically takes the manufacturer three weeks to fill an order of this size, the company incurs costs that are typical of non-lean operations: Higher supply chain costs associated with expediting a large order occur, and the company makes far less (if any) money on this large order.

By recognizing that the demand affecting the manufacturer was derived demand (derived from the contractor's ordering policies), not independent demand, the company shifted its emphasis from forecasting the spikes in independent demand to demand planning for the derived demand. The result was a new demand planning policy in this supply chain. The manufacturer now offers contractors a 3 percent price discount on any orders in excess of 10,000 that are placed with the manufacturer five or more weeks before they are needed. This is a considerable savings for contractors (each ballast may cost more than $20) and resulted in increased sales for the manufacturer.

More important, the manufacturer turned the unplanned large spikes into demand that could be planned weeks before needed, allowing the application of lean principles. Under the new demand planning system, the company knows about orders that take three weeks to fill five weeks in advance. This means instead of expedited production, overtime, higher procurement costs, and expensive production outsourcing, the manufacturer can produce products to fill the order any time during the five-week window, usually in slack production times. This smoothing out of the production scheduling system saves the manufacturer millions of dollars every year and increases its market share among contractors. This application of lean principles to spiky demand would not have been possible without the realization that the demand the company was trying to forecast consisted of both derived and dependent demand — both of which could be planned.

Much like this example, supply chain demand management is about much more than just forecasting. In fact, it is about more than just sales forecasting. It is about three management activities in any supply chain: demand management, demand planning, and sales forecasting management.

Demand management

The role of sales forecasting changes depending on a company's position in the supply chain. Any supply chain has only one point of **independent demand** or the amount of product demanded (by time and location) by the end-use customer of the supply chain. Whether this end-use customer is a consumer shopping in a retail store or online or a business buying products to conduct its operations, these end-use customers determine the true demand for the product that flows through the supply chain.

The company in the supply chain that directly serves the end-use customer experiences this independent demand. All subsequent companies in the supply chain experience a

demand that is tempered by the inventory levels and the order fulfillment and purchasing policies of other companies in the supply chain. This second type of supply chain demand is called **derived demand** because it is not the independent demand of the end-use customer but a demand that is derived from what other companies in the supply chain do to meet their demand from their immediate customers (the company or end-use consumer that orders from them).

The derived demand for one company is often the dependent demand of their customers. **Dependent demand** is the demand for the component parts that go into a product. Often called bill-of-materials or BOM forecasting, this demand is usually dependent on the demand for the product in which it is a component. The exception is when different amounts of a component part go into different versions of the product: This is a special kind of forecasting called statistical BOM forecasting. For example, the manufacturer of a large telecommunications switch may have 50 different component parts that can go into each switch, with the number of each component included varying from zero to five, depending on the customer order. The independent demand of customers for the switch and the independent demand of customers for various switch configurations (and their resulting BOM), must be forecast to determine the dependent demand for each component part.

It is important to note that only one company in any given supply chain is directly impacted by independent demand — demand that may be extremely variable and unpredictable, which makes forecasting and lean management difficult. The rest are impacted by derived or dependent demand — demand that can be planned and is therefore more amenable to lean principles.

Recognizing the differences between independent, dependent, and derived demand, recognizing which type of demand affects a company, and developing techniques, systems, and processes to deal with that company's type of demand can have a profound impact on supply chain costs and customer service levels.

Derived vs. independent demand

Figure 1 depicts a traditional supply chain with a retailer serving the end-use customer, a wholesaler supplying the retailer, a manufacturer supplying the wholesaler, and a supplier providing raw materials to the manufacturer. The source of independent demand for this supply chain is 1,000 units for the planning period. However, the retailer does not know this with certainty (as is typically the case). In fact, the retailer has a reasonably good forecasting process and forecasts end-use customer demand to be 1,000 units for the planning period. Since the forecast has typically experienced +/- 10 percent error in the past, the retailer places an order to its supplier (the wholesaler) for 1,100 units (1,000 units for expected demand and 100 units for safety stock to meet expected forecasting error). Notice that in this simple example of a typical, unmanaged supply chain that the demand the wholesaler experiences is 1,100 units, not 1,000.

The wholesaler, in turn, forecasts the demand impacting the wholesaler at 1,100 units. The wholesaler is not forecasting end-use customer independent demand but is inadvertently forecasting retailer-derived demand. Again, the wholesaler

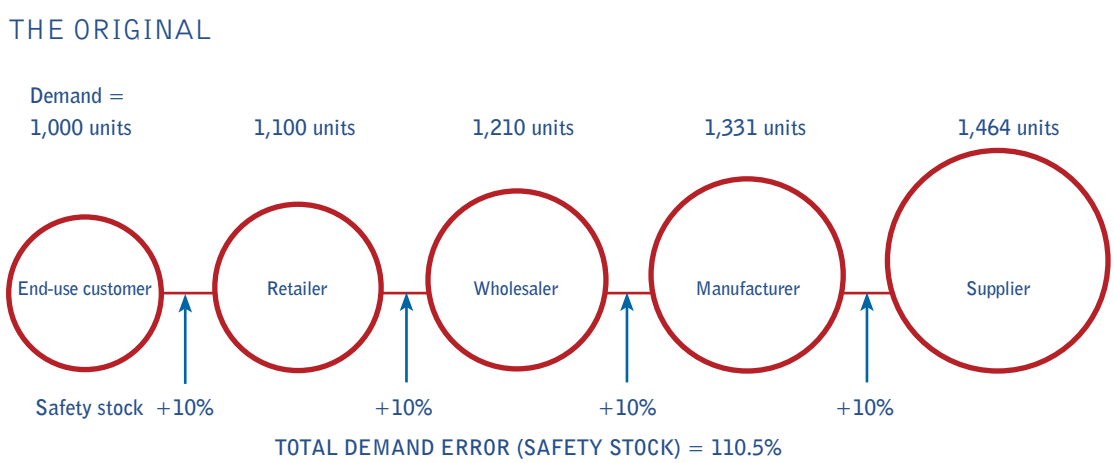
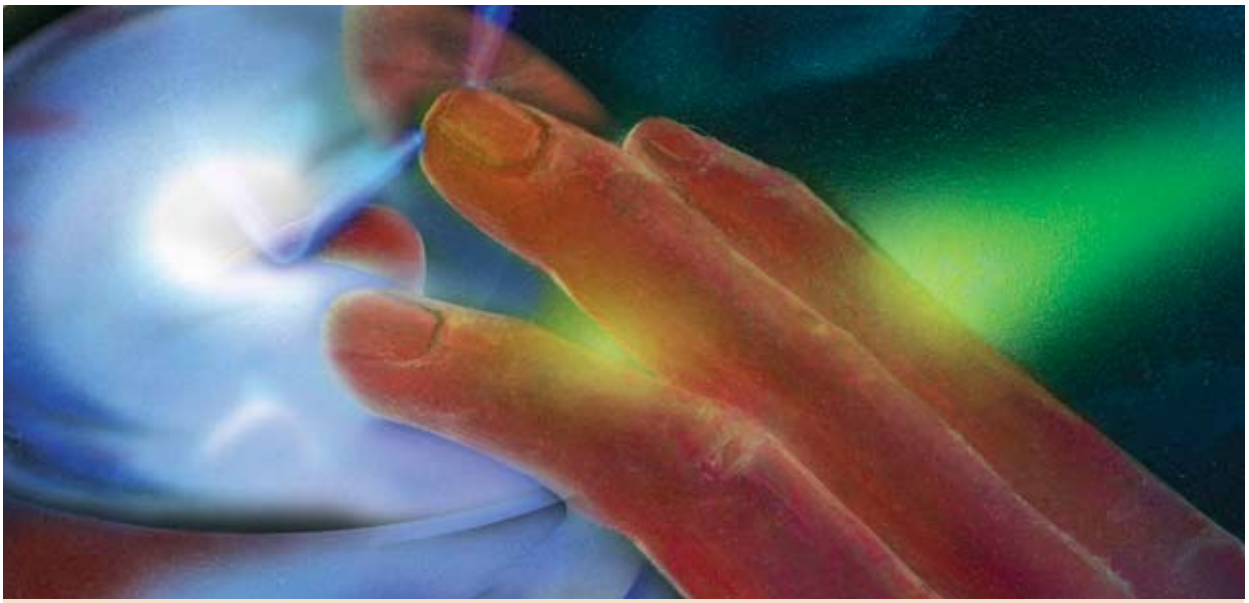


Figure 1. Demand error adds up across a traditional supply chain.



BENCHMARKED OUTLOOK

In February, *The Journal of Business Forecasting* released its fourth annual benchmarking report based on comments from the Institute of Business Forecasting's conference attendees, two-thirds of whom work for companies with more than $500 million in revenue. The highlights from the report include the following:

- Of the forecasting models companies are using, the most prevalent were various time-series models (68 percent). Of the time series modelers, 61 percent use averages or simple trending, 22 percent said cause-and-effect models were their mainstay, and 12 percent indicated judgment with little historical data as the predominant model.
- Respondents said forecasting reported to disparate areas in their companies: 38 percent said forecasting is part of a supply chain-related group, 26 percent said forecasting reported to operations/manufacturing, and 12 percent said it reported into the logistics group.
- Most companies (46 percent) indicated that they operate on a one-year forecasting model, 22 percent reported operating on a greater-than-12-month horizon, and 17 percent indicated forecasting one quarter ahead.
- Fifty-two percent of respondents lock production schedules one month out, 13 percent lock them two months out, and 19 percent lock them three months out.
- Twenty-six percent of the companies are involved in collaborative planning, forecasting, and replenishing — mostly consumer goods companies.

Source: SupplyChainDigest, *www.scdigest.com*

believes forecasting error to be approximately +/- 10 percent, so the wholesaler orders 1,100 plus 10 percent (1,210 units) from the manufacturer. If the manufacturer and the supplier both assume the same +/- 10 percent forecasting error, then they will each add 10 percent to their orders to their suppliers. We are assuming for the sake of simplicity that there is no BOM. If there were, the logic would still hold, but the illustration would become unnecessarily complicated.

As Figure 1 illustrates, even in a supply chain where forecasting error is only +/- 10 percent, simple failure to recognize the difference between independent demand (which needs to be forecast) and derived demand (which can be derived and planned in a lean environment) adds greatly to the safety stock carried in the supply chain. In fact, since each member of the supply chain only needed 1,000 units to meet the actual demand plus 100 units for the potential forecasting error, this particular supply chain is carrying 705 units too much of inventory — a 16 percent inventory overstock across the entire supply chain for the actual end-use customer demand. Inventory carried for total demand error (safety stock) in this supply chain is 1,105 units — 110.5 percent of actual end-use customer demand!

This example allows us to introduce the supply chain concept of **demand planning**, which is the coordinated flow of derived and dependent demand through companies in the supply chain. Demand planning is illustrated in the Figure

THE IMPROVED

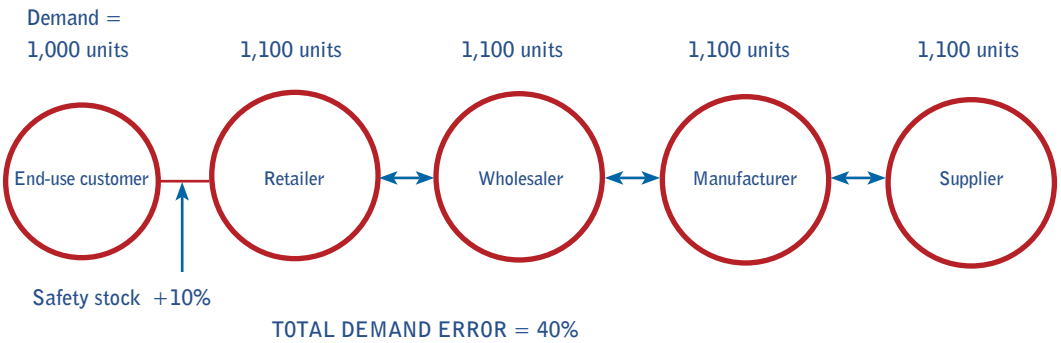


Figure 2. Demand error in a demand planning supply chain is controlled.

2 supply chain. End-use customer demand is the same as in Figure 1, and the retailer's faith in the forecast (+/- 10 percent) is unchanged. What has changed, however, is that the other companies in the supply chain are no longer attempting to forecast customer demand. Rather, each member of the supply chain receives point-of-sale demand information from the retailer, and the retailer's planned ordering is based on this demand. Combined with knowledge of the time-related lean management order flows through this supply chain, each company can plan its processes (including orders to suppliers). The result is that each member of the supply chain carries 1,100 units in inventory — a systemwide reduction in inventory of 13.81 percent from 5,105 units to 4,400 units.

More important, the inventory carried for forecasting error drops from 1,105 units to 400 units, for a reduction of total demand error inventory of 63.8 percent.

Notice, however, that the inventory reductions are not uniform across the supply chain. The supplier has a reduction in safety stock of 78.4 percent (from 464 units to 100 units), while the retailer experiences no reduction. In fact, the further up the supply chain, the greater the safety stock reduction. This illustrates a paradox of demand planning in any supply chain: The very companies that are most needed to implement supply chain demand planning have the least economic motivation to cooperate. This leads us to the concept of demand management.

Demand management is the creation across the supply chain and its markets of a coordinated flow of demand. Much is implied in this seemingly simple definition.

First, the traditional function of marketing is to create demand for various products but these demand-creating plans (such as promotional programs) are often not shared with other departments of the company, much less with other companies in the supply chain.

Second, the role of demand management is often to decrease demand. This may sound counterintuitive, but demand often exists for company products at a level management cannot realistically or profitably fulfill. Demand management implies an assessment of the profit contribution of various products and customers, all with capacity constraints in mind (including the capacity of all components in the BOM), emphasizing demand for the profitable ones and decreasing demand for the unprofitable ones by lessening marketing efforts. This is consistent with the lean principle of pull demand; it implies that the pull is lessened where capacity is constrained and strengthened where capacity exists.

Third, as mentioned earlier, considerable supply chain savings can result from demand planning, but the rewards are not always consistent with the need to obtain collaboration from all companies in the supply chain. Thus, an aspect of demand management is supply chain relationship management, which is the management of relationships with supply chain partners to match performance with measurements and rewards so that all companies in the supply chain are fairly rewarded for overall supply success (measured as cost reduction and increased customer satisfaction).

Therefore, considerable supply chain savings can occur from applying lean principles to demand planning (derived and dependent demand), but this also depends on successful management of the sales forecasting process for independent demand.

Sales forecasting management

Sales forecasting management is about recognizing that although its organizational function is typically called sales forecasting, we are really trying to forecast demand: We want to know what our customers demand so we can plan to achieve sales at or near that level. Sales forecasting involves the use of various qualitative and quantitative techniques in the context of corporate information systems to meet the needs of different users of the sales forecasts and to manage this process.

A **sales forecast** is a projection into the future of expected demand given a stated set of environmental conditions. This should be distinguished from an **operational plan**, which is a set of specified managerial actions to meet or exceed the sales forecast. Examples of operational plans include production plans, procurement plans, and logistics plans. Both the sales forecast and the operational plans should be distinguished from sales targets, which are sales goals that are established to provide motivation for sales and marketing personnel.

Notice that our definition of a sales forecast does not specify the technique (quantitative or qualitative), does not specify who develops the forecast, and does not include managerial plans. The reason is that many companies confuse the functions of forecasting, planning, and target setting. Operational plans for the level of sales to be achieved should be based on the forecast of demand, but the two management functions should be kept separate. Similarly, target setting should be done with a realistic assessment of expected future demand in mind, and this assessment comes from the sales forecast. In other words, the functions of planning and target setting should be informed by forecasts of demand but should not be confused with sales forecasting.

These definitions imply different performance measures for sales forecasts than for operational plans. Since the purpose of sales forecasting is to make projections of demand given a set of specified environmental assumptions, one of the key measures of sales forecasting performance is accuracy of the forecast and one of the key methods to explain variances in accuracy is how the environment varied from the one defined. This explanation is not intended to excuse forecast inaccuracy but to help us understand the business environment and forecast more accurately in the future.

In contrast, the goal of operational plans is not accuracy but to meet forecasted demand effectively and efficiently. In addition, while forecasts are meant to be accurate, targets are meant to be met or exceeded. Many companies make the mistake of confusing the sales forecast, where the objective is accuracy, with the sales target, where the objective is to meet or exceed the goal. Companies should never confuse sales forecasting with the firm's motivational strategy.

Managerial implications

Much has been written in the past several years about the benefits of a supply chain orientation. Tremendous benefits can be gained by all members of supply chains when information is made available across organizational boundaries, plans are coordinated, and benefits are shared by all parties. Such benefits require relationship building between and within companies in the supply chain that support this information flow and coordination.

But what many companies have failed to realize is that coordination of supply chains is not possible without an adequate understanding of demand. Not only must future demand be understood, which is the critical role sales forecasting plays, but it must be managed. Such demand management must include active and committed participation from the demand side of the enterprise — sales and marketing. In many organizations, there is a huge cultural divide between the demand and the supply sides of the business. Neither side understands the problems and constraints experienced by the other, and reward and incentive systems often encourage this cultural divide. To realize the benefits that are possible from managing demand in a supply chain (including the application of lean principles), communication among the enterprise must be open, coordination in the form of sales and operations planning processes must be implemented, and a culture of collaboration must be established. The benefits from supply chain management and lean management will not be realized unless demand management is also a priority.

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