
Making Supply Meet Demand in an Uncertain World

by Marshall L. Fisher, Janice H. Hammond,
Walter R. Obermeyer, and Ananth Raman



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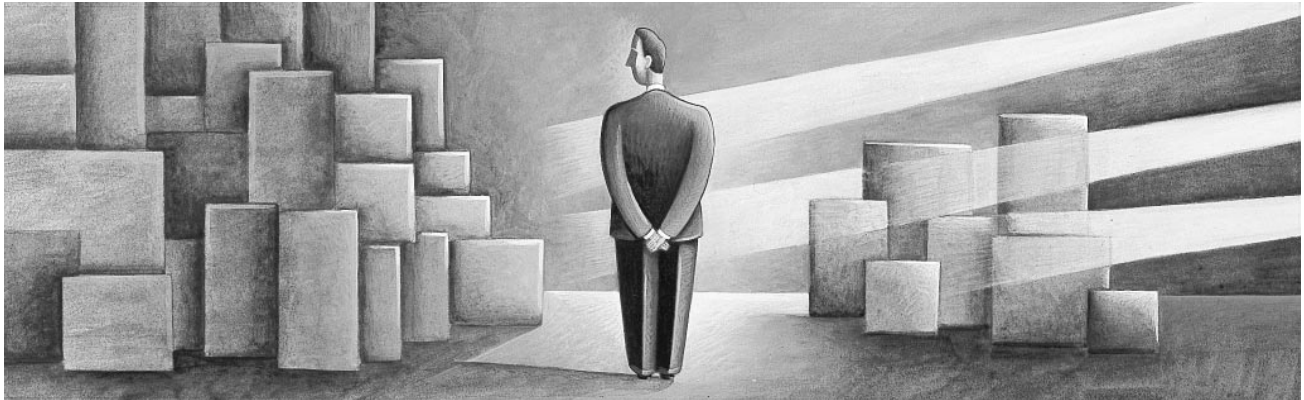
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MAKING SUPPLY MEET DEMAND



IN AN UNCERTAIN WORLD

by Marshall L. Fisher,
Janice H. Hammond, Walter R. Obermeyer, and Ananth Raman

Thanks to global competition, faster product development, and increasingly flexible manufacturing systems, an unprecedented number and variety of products are competing in markets ranging from apparel and toys to power tools and computers. Despite the benefits to consumers, this phenomenon is making it more difficult for manufacturers and retailers to predict which of their goods will sell and to plan production and orders accordingly.

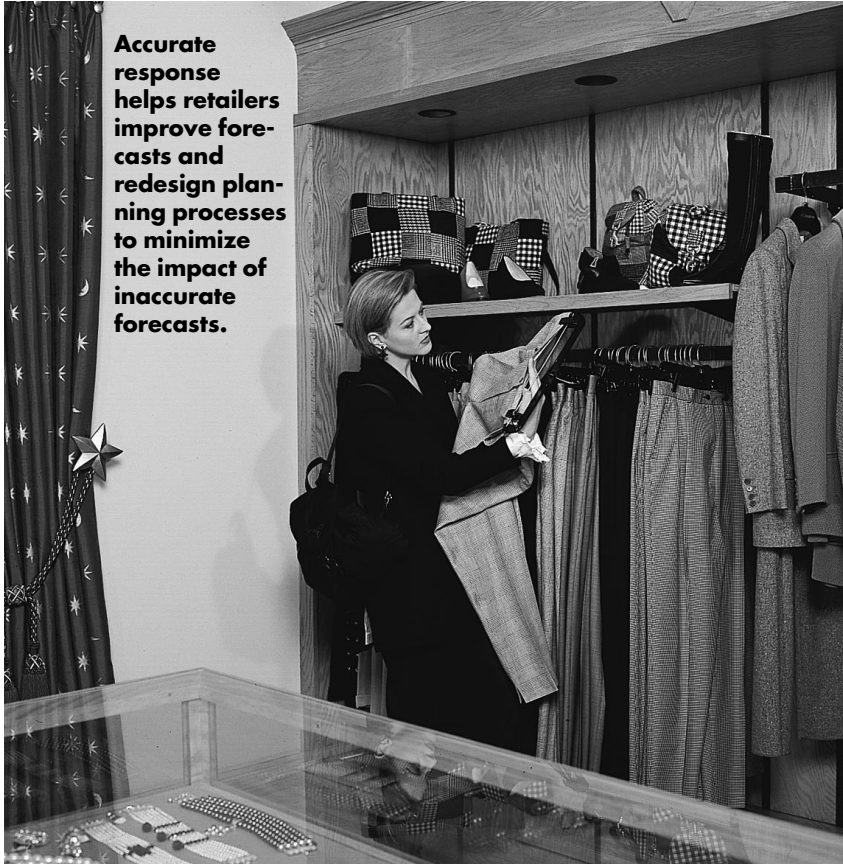
As a result, inaccurate forecasts are increasing, and along with them the costs of those errors. Manufacturers and retailers alike are ending up with more unwanted goods that must be marked down—perhaps even sold at a loss—even as they lose potential sales because other articles are no longer in stock. In industries with highly volatile demand, like fashion apparel, the costs of such “stockouts” and markdowns can actually exceed the total cost of manufacturing.¹

To address the problem of inaccurate forecasts, many managers have turned to one or another pop-

ular production-scheduling system. But quick-response programs, just-in-time (JIT) inventory systems, manufacturing resource planning, and the like are simply not up to the task. With a tool like manufacturing resource planning, for example, a manufacturer can rapidly change the production schedule stored in its computer when its original forecast and plan prove incorrect. Creating a new schedule doesn't help, though, if the supply chain has already been filled based on the old one.

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Accurate response helps retailers improve forecasts and redesign planning processes to minimize the impact of inaccurate forecasts.



Similarly, quick response and JIT address only part of the overall picture. A manufacturer might hope to be fast enough to produce in direct response to demand, virtually eliminating the need for a forecast. But in many industries, sales of volatile products tend to occur in a concentrated season, which means that a manufacturer would need an unjustifiably large capacity to be able to make goods in response to actual demand. Using quick response or JIT also may not be feasible if a company is dependent on an unresponsive supplier for key components. For example, Dell Computer Corporation developed the capability to assemble personal computers quickly in response to customers' orders but found that ability constrained by component suppliers' long lead times.

We think that manufacturers and retailers alike can greatly reduce the cost of forecasting errors by embracing *accurate response*, a new approach to the entire forecasting, planning, and production process. We believe that companies can improve their forecasts and simultaneously redesign their planning processes to minimize the impact of inaccurate forecasts. Accurate response provides a way to do both. It entails figuring out what forecasters can and cannot predict well, and then making the supply chain fast and flexible so that managers can

postpone decisions about their most unpredictable items until they have some market signals, such as early-season sales results, to help correctly match supply with demand.

This approach incorporates two basic elements that other forecasting and scheduling systems either totally or partially lack. First, it takes into account missed sales opportunities. Forecasting errors result in too little or too much inventory. Accurate response measures the costs per unit of stockouts and markdowns, and factors them into the planning process. Most companies do not even measure how many sales they have lost, let alone consider those costs when they commit to production.

Second, accurate response distinguishes those products for which demand is relatively predictable from those for which demand is relatively unpredictable. It does this by using a blend of his-

torical data and expert judgment.

Those two elements help companies rethink and overhaul not only every important aspect of their supply chains—including the configuration of their supplier networks, schedules for producing and delivering unfinished materials, transportation, and the number and location of warehouses—but also the designs of their products. Armed with the knowledge of which products have predictable demand and which do not, they can then take different approaches to manufacturing each class of product. Those in the relatively predictable category should be made the furthest in advance in order to reserve greater manufacturing capacity for making unpredictable items closer to the selling season. Such a strategy enables companies to make smaller quantities of the unpredictable products in advance, see how well the different goods fare early in the selling period, and then use that information to determine which products to make more of.

Accurate response thus enables companies to use the power of flexible manufacturing and shorter cycle times much more effectively. And the capability to do a better job of matching supply and demand produces savings that drop straight to the bottom line. One supplier in the fashion-ski-apparel business, Aspen, Colorado-based Sport Obermeyer,

Ltd., has slashed its mismatch costs in half by using accurate response.

By dramatically reducing mismatch costs, this approach also gives companies the option of taking a further action: lowering prices. Currently, suppliers, distributors, and retailers alike build mismatch costs into their prices. In other words, they try to make consumers pay more to cover the cost of inaccurate forecasts.

Clearly, companies that make or sell products with long lifetimes and steady sales do not need to make such changes to their forecasting and planning systems. Forecasts for those products are likely to be consistently close to the mark, and in any case, the long lifetimes of such products greatly reduce the cost of any forecast inaccuracy. But for companies that deal with products that are new or highly seasonal, or have short lifetimes, the accurate response approach is essential. Any manufacturer whose capacity is constrained during peak production periods can benefit from making better use of its off-peak capacity. And any retailer that has difficulty predicting demand can likewise benefit by learning which products to order in bulk before the selling season and which to order in increments during the season.

The Growing Need to Face Demand Uncertainty

A few companies are already using some of the techniques incorporated in accurate response. The Timberland Company, the fast-growing New Hampshire-based shoe manufacturer, for example, has developed a sophisticated production-planning system linked to a sales-tracking system that updates demand forecasts. Those systems, along with efforts to reduce lead times in obtaining leather from tanners, have enabled the company to reduce stockout and markdown costs significantly.

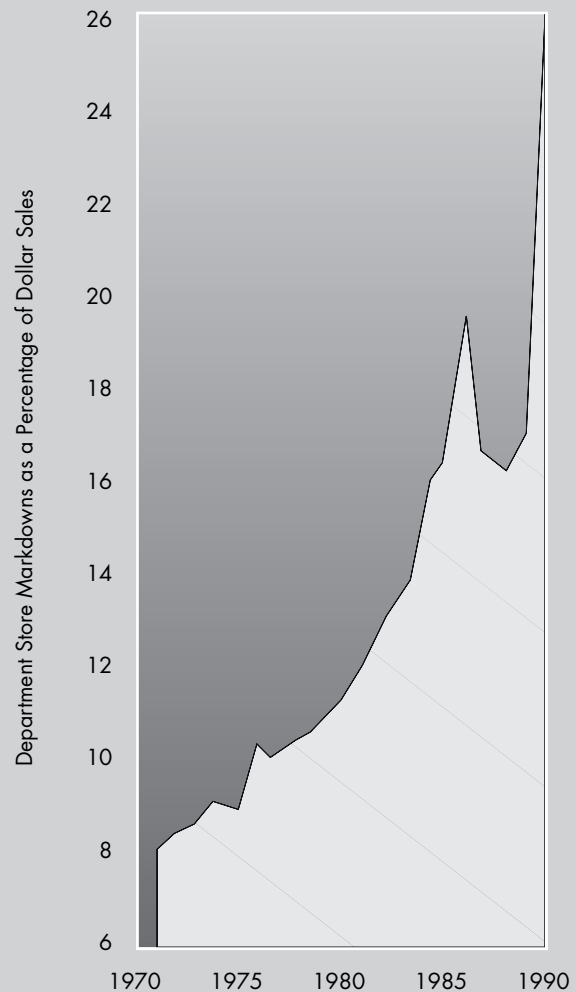
L.L. Bean, the Maine outdoor-sporting-goods company, has started to use its understanding of uncertainty to drive its inventory-planning decisions. As a direct marketer, Bean finds it easy to capture stockout data. Having discovered that forecasts for its continuing line of "never out" products are much more accurate than those for its new products, Bean estimates demand uncertainty differently for each category and then uses those estimates in making product-supply decisions.

But most companies still treat the world as if it were predictable. They base production planning on forecasts of demand made far in advance of the selling season to provide ample time for efficient production and distribution. And when that ap-

proach results in shortages of some products, and in pipelines filled with obsolete components and finished goods because anticipated hot sellers have bombed, it is generally seen as a forecasting problem. Everyone unfairly blames the forecasters.

The real problem, though, is that most companies do a poor job of incorporating demand uncertainty into their production-planning processes. They are aware of demand uncertainty when they create a forecast—witness the widespread reliance on safety stocks—but they design their planning processes as if that initial forecast truly represented reality. They do this for two reasons. First, it's complicated to factor multiple demand scenarios into

Skyrocketing Markdowns in the Retail Industry



Source: Financial and Operating Results of Department and Specialty Stores, National Retail Federation

planning; most companies simply don't know how to do it. Second, the dramatic increase in demand unpredictability is fairly recent, so most companies haven't yet changed their planning systems to adapt to it. The result, as shown by the sharp increase in department store markdowns in the past two decades, has been catastrophic. (See the graph "Skyrocketing Markdowns in the Retail Industry.")

All this is somewhat ironic given the advances during the past 15 years that have ostensibly made

Most organizations do a poor job of incorporating demand uncertainty into their production-planning processes.

it easier to identify and supply ever-smaller market niches. Point-of-sale scanners have provided a flood of data on consumers' buying patterns. And by reducing the cost of making smaller quantities of products, flexible manufacturing has enabled companies to make a much wider variety of goods—all with the goal of giving customers exactly what they want. Even industries that traditionally have not been considered fashion driven have been affected. The number of new-product introductions in the U.S. food industry, for example, has exploded in recent years, from 2,000 in 1980 to 18,000 in 1991.

But frequent introductions of new products have two side effects that most companies are not prepared to address. For one, they reduce the average lifetime of products; more of them are either at the beginning of their life (when prediction is tough because there is no demand history) or at the end of their life (when keeping inventory is expensive because the products will soon become obsolete). For another, as products proliferate, demand is divided over a growing number of stock-keeping units (SKUs). Even if manufacturers and retailers can forecast aggregate demand figures with some certainty, it is becoming increasingly difficult to predict how that demand will be distributed among the many SKUs they sell. To visualize this effect, compare the relative difficulty of predicting who will win a baseball game (the aggregate result) with the difficulty of predicting who will score more runs in each inning (the result at an SKU level).

Consider the problems General Motors' Cadillac division faced after redesigning its Seville and Eldorado models. Based on initial demand forecasts for its 1992 line, General Motors allocated half the capacity of its Detroit-Hamtramck plant to those two models; the remaining capacity was slated to produce Buicks and Oldsmobiles. However, demand for the Sevilles and Eldorados quickly exceeded supply: GM's underproduction of the two models led to the loss of thousands of potential customers.

Scrambling to meet the growing demand, GM changed its allocation and devoted 86% of the plant's capacity to the Cadillac models. Eventually, the company allocated all of the plant's production capacity to the Seville and Eldorado. But the damage had already been done.

In the computer industry, which is contending with considerable product proliferation, short product life cycles, and a limited history of specific customer demand, undersupply and oversupply problems are endemic. And in retailing, consolidation in many segments has given the surviving businesses much more power over suppliers—power they have not been shy about using to reduce their own vulnerability to an unpredictable market. Kmart, for example, told a number of its toy suppliers last July that it would in effect buy products from them on a consignment basis: the toy manufacturers were expected to send products to Kmart distribution centers based on Kmart's orders, but Kmart would not actually purchase the products unless and until they were sent from the distribution center to a Kmart store. Products not selling up to expecta-

Consolidation in retailing has given the surviving businesses more power over suppliers.

tions would be returned from the distribution center to the manufacturer.

Black & Decker Corporation lost tens of millions of dollars in sales in less than one year because of increased retailer demands, notes Al Strumar, the company's former vice president of advanced manufacturing technology. In the power tool industry, stiff competition has meant an increased variety of products and a need for faster delivery. Also, to some extent, power tools have become fashion

items that compete with ties and compact discs for Father's Day and Christmas gift purchases. As a result, a few years ago, some of Black & Decker's largest retailer customers began pushing the company to deliver smaller orders more frequently—on a just-in-time basis. Those customers also established a policy of canceling any order that could not be shipped 100% complete and on time. Black & Decker couldn't meet those exacting requirements using its traditional planning methods. Top managers' attention has subsequently turned to making plants fast and flexible so that the company can respond to rapid changes in market preferences.

How Accurate Response Developed at Sport Obermeyer

Any company that chooses to implement accurate response should obviously tailor the approach to its own situation. But the case of Sport Obermeyer provides a good example of how it can be done. In fact, the insights that emerged from our analysis of Sport Obermeyer formed the foundation for the accurate response approach.

In the fashion skiwear business, demand is heavily dependent on a variety of factors that are difficult to predict—weather, fashion trends, the economy—and the peak of the retail selling season is only two months long. Even so, Sport Obermeyer has been able to eliminate almost entirely the cost of producing skiwear that customers don't want and of not producing skiwear that they do want by using accurate response. The company estimates that by implementing this approach, it has increased its profits by between 50% and 100% over the last three years.

Founded in 1950 by German-born aeronautical engineer and ski instructor Klaus Obermeyer, Sport Obermeyer is a leading supplier in the U.S. fashion-ski-apparel market. Its products are manufactured by a joint venture in the Far East and by independent manufacturers located in the Far East, Europe, the Caribbean, and the United States. With sales of approximately \$30 million in 1992, Sport Obermeyer had a commanding 45% share of the children's market and an 11% share of the adult market.

Nearly all of Sport Obermeyer's products are newly designed each year to include changes in style, fabric, and color. And until the mid-1980s, the company's design-and-sales cycle was relatively straightforward: design the product, make samples, and show samples to retailers in March; place production orders with suppliers in March and April after receiving retail orders; receive goods at Sport Obermeyer's distribution center in September and October; and then ship them immediately to retail outlets. That approach worked well for more than 30 years: production commitments were based on firm orders, and fall delivery provided ample time for efficient manufacturing.

In the mid-1980s, however, several factors rendered the approach obsolete. First, as Sport Obermeyer's sales volume grew, the company began to hit manufacturing constraints during the peak skiwear-production period. It was unable to book sufficient production with high-quality-skiwear manufacturers during the critical summer months to allow all of its volume to be produced after it had received firm retail orders. As a result, it began booking production the previous November, or about a year before the goods would be sold, based on speculation about what retailers would order.

Second, the pressure to reduce manufacturing costs and increase variety compelled Sport Ober-



For companies that deal with new or seasonal products, the accurate response approach is essential.

meyer to develop a more complex supply chain. (Today a parka sold in the United States might be sewn in China from fabrics and findings—zippers, snaps, buckles, and thread—sourced from Japan, South Korea, and Germany.) Such a supply chain supported increased variety and improved production efficiency but greatly increased lead times. Finally, and most important, Sport Obermeyer successfully launched a line of children's fashion skiwear. Dealers began demanding earlier delivery, because a substantial portion of sales in the booming children's category had begun to take place in August, during the back-to-school season.

Was there a way to tell which forecasts were likely to be accurate before seeing orders?

To contend with lengthening supply chains, limited supplier capacity, and retailers' demands for early delivery, Sport Obermeyer undertook a variety of quick-response initiatives to shorten lead times. First, the company slashed the time it took to process orders and compute raw-material requirements by introducing computerized systems to support those activities. Second, because lead times for obtaining raw materials proved difficult to shorten, the company began to anticipate what materials it would require and pre-position them in a warehouse in the Far East. With materials in hand, Sport Obermeyer was able to begin manufac-

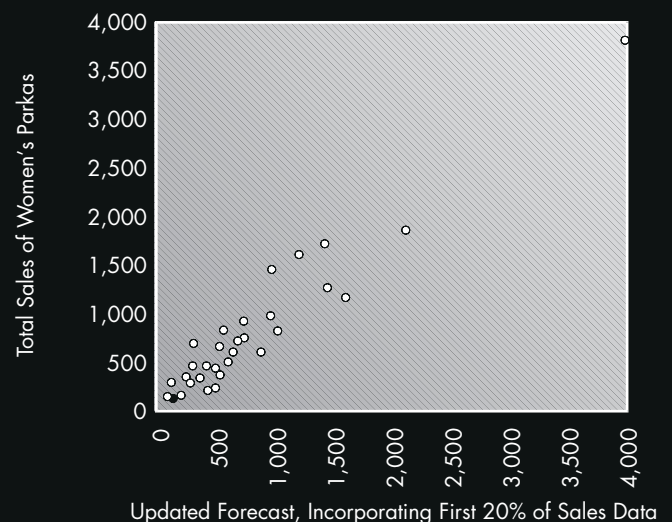
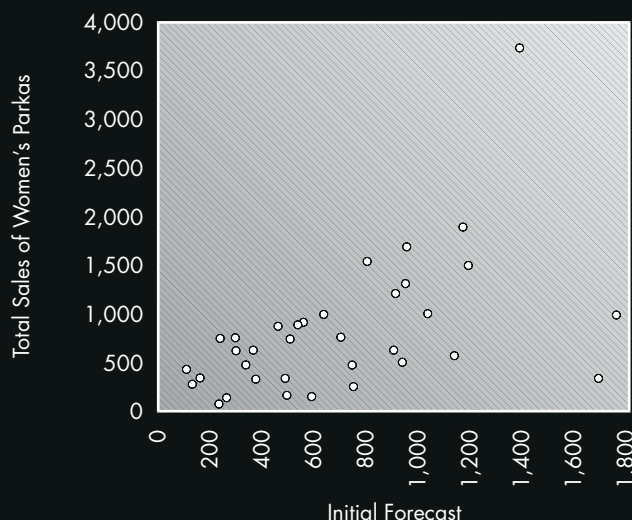
turing as soon as it received orders. Third, as delivery due dates approached, the company turned to air freight to expedite delivery from the Far East to its Denver distribution center. By 1990, those changes had reduced delivery lead times by more than one month.

In addition, Sport Obermeyer succeeded in persuading some of its most important retailer customers to place their orders sooner, thereby providing the company with valuable early information on the likely popularity of individual styles. Starting in 1990, the company accomplished this by inviting about 25 of its largest retailer customers to

Aspen each February to give them a sneak preview of the new annual line and to solicit early orders. Every year since then, the orders resulting from this program, called Early Write, have accounted for about 20% of Sport Obermeyer's total sales.

Unfortunately, those efforts did not solve the problem of growing stockouts and markdowns. The company still had to base about half its production on demand forecasts, which was a big risk in the highly volatile fashion industry. Sport Obermeyer relied on an in-house "buying committee"—a group of company managers from a range of functional areas—to make a consensus forecast of the demand for each of the company's various products. But its track record was not particularly impressive. In the 1991-1992 season, for example, some women's parka styles outsold the original forecast by 200%, while sales of other styles amounted to less than 15% of the forecasted amount.

Improving Forecasts at Sport Obermeyer



Sport Obermeyer's managers weighed the alternatives. Could they improve forecasting? Could they further reduce manufacturing lead times? Wasn't there some way to take greater advantage of the information generated by the Early Write program? Could they induce more retailers to place their orders early?

It was at that point that the four of us formed a research team to consider those questions. The accurate response approach evolved as a result. We realized that the problem was rooted in Sport Obermeyer's inability to predict what people would buy. A decision to produce a parka is essentially a gamble that the parka will sell. To help Sport Obermeyer avoid the highest-risk gambles, we needed a way to determine which products were safest to make before Early Write and which should be postponed until after the sales information gathered from Early Write became available. Taking the buying committee's original forecast as a starting point, we noticed that although some forecasts were indeed off the mark, about half were quite accurate, differing by less than 10% from actual sales. (See the first graph in the exhibit "Improving Forecasts at Sport Obermeyer.") Was there a way to tell which forecasts were likely to be accurate before we saw actual orders?

To answer that question, we first examined the way the buying committee operated. The buying committee had traditionally provided a single consensus forecast for each style and color. We decided to ask each member of the committee to make an independent forecast for each style and color. At

the beginning, committee members found that request somewhat unsettling. They were used to a collegial environment; they had been accustomed to arriving at the consensus forecast by holding an extensive discussion. Under the new system, individuals were responsible for their own forecasts.

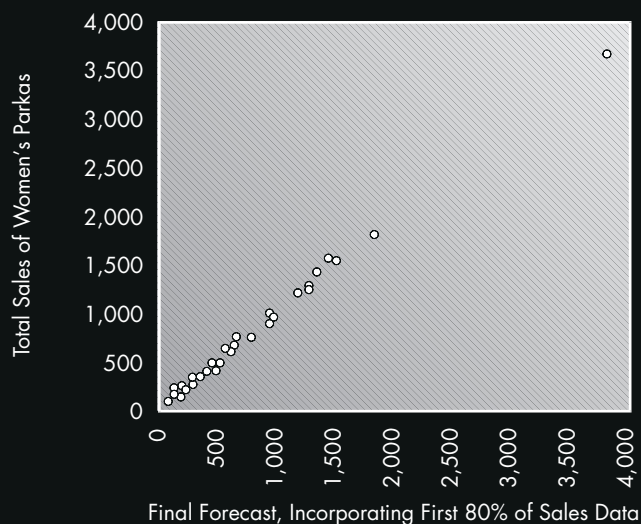
Dominant members of a group often unduly influence the outcome of a consensus forecast.

But the change proved invaluable for two reasons. First, consensus forecasts rarely represent a true consensus. Dominant members of a group, such as senior executives, often unduly influence the outcome of a team forecast; they could not do this if each person had to submit his or her own forecasts. Second, and more important, the new process provided a way to determine statistically the probable accuracy of the committee's forecasts for each style.

Indeed, an interesting discovery emerged from the independent-forecasting process. Although the average forecasts for two parka styles could be the same, the dispersion of individual forecasts for the two styles could differ greatly. For example, everyone's forecast for the Pandora parka was close to the average, but the forecasts for the Entice shell were all over the map. (See the table "How Sample Predictions Differ for Two Products.") It seemed plausible that the forecast for the Pandora was more likely to be right than the forecast for the Entice.

At the end of the 1992-1993 season, we were able to test our hypothesis that forecasts would tend to be more accurate when the buying committee's members had similar forecasts. The actual sales data showed that the variance in the individual forecasts was an almost perfect predictor of forecast accuracy. (For a detailed explanation of the forecasting process, see the insert "Coping with Demand Uncertainty at Sport Obermeyer.")

Sport Obermeyer now had a way to estimate which styles were accurately forecast. But it still had to deal with those styles that had unpredictable demand. We made the critical—and startling—discovery that even though retailer demand is unpredictable enough to make accurate forecasting impossible, the overall buying patterns of Sport Obermeyer's retailers were remarkably similar. For example, by updating the buying committee's forecasts using just the first 20% of orders, the accuracy



Coping with Demand Uncertainty at Sport Obermeyer

Longtime industry player Klaus Obermeyer characterizes the skiwear market as extremely fickle. What possible use could formal statistical methods have in such an unpredictable setting? You'd be surprised. The trick lies in realizing that although demand for each product can be highly uncertain, the distribution of demand follows a discernible pattern.

At Sport Obermeyer, we found that demand data followed a normal distribution, which is defined by its mean (average) and its standard deviation (a measure of the dispersion, or "width," of the distribution and hence of the level of demand uncertainty).

The graph "Probable Sales of the Pandora Parka" shows a forecast distribution based on the demand predictions of the buying committee. The area under the curve between two points is equal to or greater than the probability of demand falling between those points. (For example, the shaded area represents the probability that demand exceeds 1,285 units.) If Sport Obermeyer were to have only one opportunity to produce Pandora parkas, we would use this curve in the following manner to find the production quantity that maximizes expected profitability by balancing the risks of overproduction and underproduction.

For the Pandora parka, Sport Obermeyer earns \$14.50 in marginal profit for each unit sold and loses \$5.00 for each unit produced and not sold. The company should keep producing parkas as long as it expects the gain from each parka to exceed the loss. Expected profits are maximized by producing up to the point where the expected marginal gain from producing a parka is roughly equal to the expected marginal loss from producing that parka. For the Pandora, that occurs when the company produces 1,285 parkas, because the expected gain from producing the 1,285th parka is approximately equal to the expected loss from producing that parka. That is, the probability of selling the 1,285th parka (25.7%) multiplied by the profit if the company sells that parka (\$14.50) is roughly equal to the probability of not selling it (74.3%) multiplied by what the company loses if it makes it and cannot sell it (\$5.00).

This analysis illustrates two critical components of an accurate response program: assessing a probability distribution for demand, and estimating the costs of stockouts and markdowns. We have embedded this basic logic into a sophisticated algorithm that allows

us to generate multistage, risk-based production schedules.¹

To implement the approach described above, we had to estimate the mean and the standard deviation. For products with extensive historical demand data, those parameters can be estimated using statistical methods. However, with only a judgmental forecast available, we had to devise a different approach. We started by asking each member of Sport Obermeyer's buying committee to provide us with an individual forecast for each product.

We treated the average of the committee members' forecasts as the mean of the demand distribution. We estimated the standard deviation for each style to be twice the standard deviation of the buying committee's forecasts. We decided to scale by a factor of two

because the average standard deviation of actual forecasting errors in preceding seasons was twice that of the buying committee's forecasts.

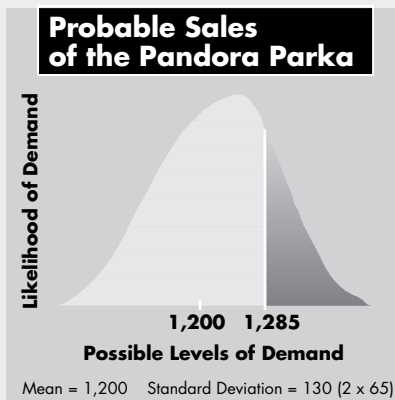
We believed that forecasts would tend to be more accurate for those styles for which the buying committee members had similar forecasts—that is, those whose forecasts had a low standard deviation. This hypothesis was confirmed with actual data from the 1992-1993 season. The close fit between actual and predicted forecasting errors gave us a solid basis for determining

which products were safe to produce before additional sales data became available and which were not. Using this information along with detailed data about minimum lot sizes and other production constraints, we formulated an appropriate risk-based production sequence for Sport Obermeyer.

Just as quick-response and just-in-time programs cannot realize their full potential without corresponding changes in planning systems, neither should those changes in analytical approach exist in isolation. Improvements in supply chain speed and flexibility are essential to achieving the full potential of an accurate response program.²

1. For a description of the model, see Marshall L. Fisher and Ananth Raman, "The Value of Quick Response for Supplying Fashion Products: Analysis and Application," Department of Operations and Information Management Working Paper No. 92-10-03, The Wharton School, University of Pennsylvania, 1992.

2. For a description of such supply chain changes, see Janice H. Hammond, "Quick Response in Retail/Manufacturing Channels," in *Globalization, Technology, and Competition: The Fusion of Computers and Telecommunications in the 1990s*, ed. Stephen P. Bradley, Jerry A. Hausman, and Richard L. Nolan (Boston: Harvard Business School Press, 1993), p. 185.



of forecasts improved dramatically. Naturally, as more orders were obtained, the forecast accuracy continued to improve. (See the second and third graphs of the exhibit "Improving Forecasts at Sport Obermeyer.") The challenge then became to devise a production-planning approach that would recognize and take advantage of that information.

The key to doing this was realizing that the production capacity Sport Obermeyer uses to make ski parkas actually changes in character as the season progresses. Early in the season, when the company has no orders, that capacity is nonreactive, in the sense that production decisions are based solely on predictions rather than on a reaction to actual market demand. As orders begin to filter in, starting with those generated by the Early Write program, that capacity becomes reactive. Now Sport Obermeyer can base production decisions on the signals it is receiving from the marketplace and on its more accurate forecasts.

It is important to fill nonreactive capacity with those styles for which demand forecasts are most likely to be accurate, so the precious reactive capacity can be devoted to making as many of the unpredictable styles as possible. This strategy, which we call *risk-based production sequencing*, allows Sport Obermeyer to be as responsive to the market as possible in the areas where the payoffs are the greatest.

Production planning at Sport Obermeyer is actually more complicated than we have presented; we have streamlined the process here to provide a general explanation of how accurate response works. In addition, we have omitted several case-specific factors. For example, in reality, the company must meet production minimums for each style. Also, for styles that have high enough sales levels relative to the minimums, it can use multiple production runs. That is, a style can be manufactured in two increments—the first using nonreactive capacity based on a portion of the predicted sales, the second reactively, based on information derived from actual sales. Further, the styles' different costs affect their riskiness: other things being equal, more costly styles carry greater financial risk.

We developed a complex computerized mathematical model to create an optimal production schedule that takes all these factors into account. The model identifies those products that should be produced nonreactively together with their optimal production levels. Then, after updating the initial forecast with early demand information, it determines the appropriate reactive production schedule. We implemented the model's recommendations and compared its decisions with past practice: using the model's recommendations reduced costs by about 2% of sales. Because profits in this industry average 3% of sales, the improvement increased profits by two-thirds.

The model can also be used to evaluate the cost impact of physical changes to the supply chain. For example, we used the model together with historical sales data from the 1992-1993 season to estimate how much stockout and markdown costs would drop as we increased the available amount of reactive capacity—that is, capacity committed in reaction to actual early demand information.

For Sport Obermeyer's women's parkas, stockout and markdown costs would be 10.2% of sales if none of the parkas could be produced reactively—that is, if all production commitments had to be made before any orders were received. At the other extreme, those costs would drop to 1.8% if all the parkas could be produced reactively—if all production commitments could be placed after a certain portion of orders came in. (See the graph "An Ability to React Lowers Costs.")

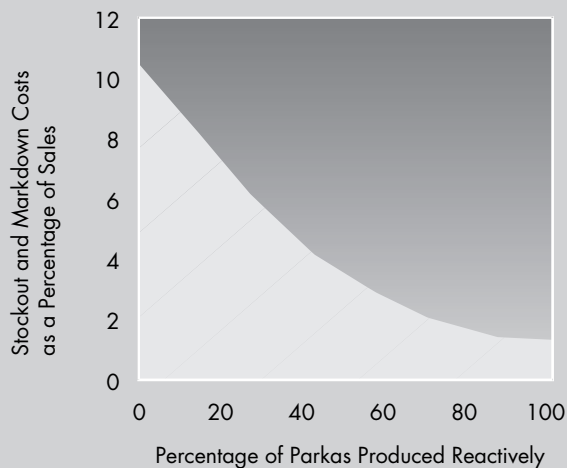
It is rarely possible to defer all production until after early demand information has been obtained; the important conclusion is that even a small amount of reactive capacity can have a dramatic impact on cost. In Sport Obermeyer's case, producing only 30% of the season's volume reactively provides nearly half of the potential cost reduction.

Guided by the model, Sport Obermeyer continued to make numerous refinements to its supply chain and product-redesign process, which collectively had a significant impact. Supply chain changes focused on keeping raw materials and factory-production capacity undifferentiated as long

How Sample Predictions Differ for Two Products

Committee Members	Carolyn	Laura	Tom	Keny	Wally	Wendy	Average	Standard Deviation
Number of Pandora Parkas	1,200	1,150	1,250	1,300	1,100	1,200	1,200	65
Number of Entice Shells	1,500	700	1,200	300	2,075	1,425	1,200	572

An Ability to React Lowers Costs



as possible. For example, in addition to warehousing raw materials, the company began to book factory capacity for the peak production periods well in advance but did not specify the exact styles to be manufactured until a later date. Sport Obermeyer assumed the risk of supplying the correct raw materials to the factories. In exchange, the factories allowed production commitments to be made later.

In addition to making supply chain changes, Sport Obermeyer has merged its design and production departments into one merchandising department and is thus broadening its strategy to encompass more production concerns. For example, the company has redesigned its parka line to reduce dramatically the variety of zippers used. Whereas it previously tended to match the color of both the zipper and its tape to the color of the garment, the company now uses black zippers in several lines as a fashion element introducing color contrast to the style. In this way, Sport Obermeyer has reduced the number of zippers it requires more than fivefold. This change has been particularly valuable because of lengthy lead times caused by limited supply sources for high-quality zippers; the absence of a zipper of a certain length and color could hold up production of an entire style for months.

Sport Obermeyer is also encouraging designers to use the same kinds of raw materials in their patterns. For example, whereas each designer previously might have selected a different shade of red for a particular article of clothing, resulting in the

company's having to work with five or six different shades, now the designers settle on two or three shades for any given design cycle. Sport Obermeyer has discovered that customers generally don't notice minute differences in color; they pay much more attention to a garment's overall appearance, quality of construction, and special features.

Achieving Accurate Response

When managers set out to assess the cost of stockouts and markdowns to see whether or not an accurate response program is warranted, they may be in for a surprise. The typical company lacks such information – mainly because tracking sales lost as a result of stockouts is difficult. But assessing lost sales is well worth the effort; even rudimentary estimates can be useful. For example, consider a product that sells evenly throughout a ten-week period. If supplies of that product run out at the end of the eighth week, it is logical to assume that the manufacturer and retailer could have sold 25% more than they had available.

Companies also can change their order-entry systems to capture orders that can't be filled because of insufficient inventory. Sport Obermeyer realized that orders during the retail selling season for products that were out of stock and hence could not be filled were not being entered into the computer. After it changed its system, it found that information invaluable for both improving forecasts and measuring the cost of insufficient inventory.

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Some organizations have made ingenious changes that allow them to improve their estimates of how many sales they have lost because of stockouts. Dillard Department Stores' new policy regarding customer requests provides a good example. When a store is out of an article requested by a customer, the company will mail that item to the customer at no extra charge from another Dillard store. Dillard's original intent was solely to improve customer service and increase sales. However, the company has reaped an important side benefit. It now has a better understanding of true demand at each store, which allows it to do a better job of estimating lost sales and forecasting demand.

An important component of an accurate response program is to streamline the supply chain to reduce production and distribution lead times. Clearly, a reduction in cycle time offers the potential to reduce the cost of stockouts and markdowns by allowing production decisions to be deferred until more information and better forecasts become available. Yet realizing that potential also requires changes in forecasting and production planning.

Accurate response requires two changes in forecasting. The first is to be more resourceful in using demand indicators to improve forecasts. The second is to institute a system for tracking forecasting errors.

Sales data early in the season are an obvious source of information that can be used to revise and improve forecasts. But they are only one kind of indicator. If a company is imaginative, it can usually find or even create better ones. Take the case of National Bicycle, a subsidiary of Matsushita that manufactures bicycles in Japan under the Panasonic and National brand names.

Several years ago, National Bicycle found that sports bikes—ten-speed and mountain bikes—had become fashion items sold in part on the basis of bright, intricate color patterns that changed every year. National's inability to predict which color patterns would be hot each year was causing it to overproduce some colors and underproduce others, generating huge losses. To circumvent the forecasting problem, the company created a custom-order system by which customers were measured for their ideal frame dimensions and invited to choose their favorite color pattern from a wide selection. Their ideal bike was then created in the company's remarkably flexible plant in Kashiwara and delivered to their door two weeks later.

The program has become so popular that nearly half of National's sports bikes are now custom ordered. But surprisingly, the system also benefits the rest of National's operation. The company has found that the most popular colors for its custom-ordered bikes are an excellent indicator of which colors will be hot across the board for that season. It now uses that information to guide planning for its mass-produced bikes, which has greatly reduced losses due to overproduction and underproduction.

As an organization begins to improve its forecasts, it must also systematically track its errors. Most operations managers have an opinion of the accuracy of forecasts in their company, but too often that opinion takes the form of grousing about

the latest blunder made by the marketing department. "They forecast we'd sell 2 million cans of mint-flavored dog food, so we made 2 million cans and now we have a 28-year supply sitting in our warehouse." Clearly, a more systematic approach is needed. Companies should note when a forecast was made, on what information it was based, and its level of detail (for example, was it on the aggregate or the SKU level?), and they should later compare it with actual demand.

For an existing product with at least one season of demand history, it may be possible to use past

Companies should use demand indicators to improve forecasts and institute a system for tracking forecasting errors.

forecasting errors to predict future forecasting accuracy. Otherwise, we recommend the approach employed by Sport Obermeyer: convene a panel of experts to make independent forecasts, and use the variance in their predictions to measure the accuracy of the forecasts.

Using risk-based production sequencing requires plants to be flexible enough to switch between various seasonal products and to have access to required materials and components when they are needed. Achieving optimal flexibility may entail changes in equipment or require limiting risk-based production sequencing to product families that run on the same equipment. Ensuring access to the right supplies requires extensive discussions with suppliers to find a way to meet both parties' needs. For example, the suppliers' need for early commitment might be satisfied if the company specifies only the total volume requirements early. The company's need for flexibility might be satisfied if the suppliers allow it to postpone specifying the mix of supplies it needs until market trends become clear.

Finally, for all decisions about supply chain changes and production planning, it is important to adopt a framework rooted in a probabilistic model of demand. Contrary to what many believe, market uncertainty is a manageable risk.

Reference

1. This assertion is based in part on the study by Robert M. Frazier "Quick Response in Soft Lines," *Discount Merchandiser*, January 1986, p. 40.

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