What is the right supply chain for your product?

by Marshall L. Fisher

The success of many supply chains depends entirely on the ability to adopt a framework that will create an effective supply chain strategy. A strategy that will co-exist with technologies is needed to offset the dismal performances of many supply chains. A prerequisite to the creation of a strategy is the ability to determine the nature of the demand for the products a company supplies, either functional or innovative, since each pattern requires a different kind of supply chain. A matrix representing four possible combinations of products and priorities is created from which an effective supply chain strategy is based, either efficient or responsive.

A simple framework can help you figure out the answer.

Never has so much technology and brainpower been applied to improving supply chain performance. Point-of-sale scanners allow companies to capture the customer's voice. Electronic data interchange lets all stages of the supply chain hear that voice and react to it by using flexible manufacturing, automated warehousing, and rapid, logistics. And new concepts such as quick response, efficient consumer response, accurate response mass customization, lean manufacturing, and agile manufacturing offer models for applying the new technology to improve performance.

Nonetheless, the performance of many supply chains has never been worse. In some cases, costs have risen to unprecedented levels because of adversarial relations between supply chain partners as well as dysfunctional industry practices such as an overreliance on price promotions. One recent study of the U.S. food industry estimated that poor coordination among supply chain partners was wasting $30 billion annually. Supply chains in many other industries suffer from an excess of some products and a shortage of others owing to an inability to predict demand. One department store chain that regularly had to resort to markdowns to clear unwanted merchandise found in exit interviews that one-quarter of its customers had left its stores empty-handed because the specific items they had wanted to buy were out of stock.

Why haven't the new ideas and technologies led to improved performance? Because managers lack a framework for deciding which ones are best for their particular company's situation. From my ten years of research and consulting on supply chain issues in industries as diverse as food, fashion apparel, and automobiles, I have been able to devise such a framework. It helps managers understand the nature of the demand for their products and devise the supply chain that can best satisfy that demand.

The first step in devising an effective supply-chain strategy is therefore to consider the nature of the demand for the products one's company supplies. Many aspects are important -- for example, product life cycle, demand predictability, product variety, and market standards for lead times and service (the percentage of demand filled from in-stock goods). But I have found that if one classifies products on the basis of theIr demand patterns, they fall into one of two categories: they are either primarily functional or primarily innovative. And each category requires a distinctly different kind of supply chain. The root cause of the problems plaguing many supply chains is a mismatch between the type of product and the type of supply chain.

Is Your Product Functional or Innovative?

Functional products include the staples that people buy in a wide range of retail outlets, such as grocery stores and gas stations. Because such products satisfy basic needs, which don't change much over time, they have stable, predictable demand and long life cycles. But their stability invites competition, which often leads to low profit margins.

To avoid low margins, many companies introduce innovations in fashion or technology to give customers an additional reason to buy their offerings. Fashion apparel and personal computers are obvious examples, but we also see successful product innovation where we least expect it. For instance, in the traditionally functional category of food, companies such as Ben & Jerry's, Mrs. Fields, and Starbucks Coffee Company have tried to gain an edge with designer flavors and innovative concepts. Century Products, a leading manufacturer of children's car seats, is another company that brought innovation to a functional product. Until the early 1990s, Century sold its seats as functional items. Then it introduced a wide variety of brightly colored fabrics and designed a new seat that would move in a crash to absorb energy and protect

What is the right supply chain for your product?

the child sitting in it. Called Smart Move, the design was so innovative that the seat could not be sold until government product-safety standards mandating that car seats not move in a crash had been changed.

Although innovation can enable a company to achieve higher profit margins, the very newness of innovative products makes demand for them unpredictable. In addition, their life cycle is short -- usually just a few months -- because as imitators erode the competitive advantage that innovative products enjoy, companies are forced to introduce a steady stream of newer innovations. The short life cycles and the great variety typical of these products further increase unpredictability.

It may seem strange to lump technology and fashion together, but both types of innovation depend for their success on consumers changing some aspect of their values or lifestyle. For example, the market success of the IBM Thinkpad hinged in part on a novel cursor control in the middle of the keyboard that required users to interact with the keyboard in an unfamiliar way. The new design was so controversial within IBM that managers had difficulty believing the enthusiastic reaction to the cursor control in early focus groups. As a result, the company underestimated demand -- a problem that contributed to the Thinkpad's being in short supply for more than a year.

With their high profit margins and volatile demand, innovative products require a fundamentally different supply chain than stable, low-margin functional products do. To understand the difference, one should recognize that a supply chain performs two distinct types of functions: a physical function and a market mediation function. A supply chain's physical function is readily apparent and includes converting raw materials into parts, components, and eventually finished goods, and transporting all of them from one point in the supply chain to the next. Less visible but equally important is market mediation, whose purpose is ensuring that the variety of products reaching the marketplace matches what consumers want to buy.

Each of the two functions incurs distinct costs. Physical costs are the costs of production, transportation, and inventory storage. Market mediation costs arise when supply exceeds demand and a product has to be marked down and sold at a loss or when supply falls short of demand, resulting in lost sales opportunities and dissatisfied customers.

The predictable demand of functional products makes market mediation easy because a nearly perfect match between supply and demand can be achieved. Companies that make such products are thus free to focus almost exclusively on minimizing physical costs -- a crucial goal, given the price sensitivity of most functional products. To that end, companies usually create a schedule for assembling finished goods for at least the next month and commit themselves to abide by it. Freezing the schedule in this way allows companies to employ manufacturing-resource-planning software, which orchestrates the ordering, production, and delivery of supplies, thereby enabling the entire supply chain to minimize inventory and maximize production efficiency. In this instance, the important flow of information is the one that occurs within the chain as suppliers, manufacturers, and retailers coordinate their activities in order to meet predictable demand at the lowest cost.

That approach is exactly the wrong one for innovative products. The uncertain market reaction to innovation increases the risk of shortages or excess supplies. High profit margins and the importance of early sales in establishing market share for new products increase the cost of shortages. And short product life cycles increase the risk of obsolescence and the cost of excess supplies. Hence market mediation costs predominate for these products, and they, not physical costs, should be managers' primary focus.

Most important in this environment is to read early sales numbers or other market signals and to react quickly, during the new product's short life cycle. In this instance, the crucial flow of information occurs not only within the chain but also from the marketplace to the chain. The critical decisions to be made about inventory and capacity are not about minimizing costs but about where in the chain to position inventory and available production capacity in order to hedge against uncertain demand. And suppliers should be chosen for their speed and flexibility, not for their low cost.

Sport Obermeyer and Campbell Soup Company illustrate the two environments and how the resulting goals and initiatives differ. Sport Obermeyer is a major supplier of fashion skiwear. Each year, 95% of its products are completely new designs for which demand forecasts often err by as much as 200%. And because the retail season is only a few months long, the company has little time to react if it misguesses the market.

What is the right supply chain for your product?

In contrast, only 5% of Campbell's products are new each year. Sales of existing products, most of which have been on the market for years, are highly predictable, allowing Campbell to achieve a nearly perfect service level by satisfying more than 98% of demand immediately from stocks of finished goods. And even the few new products are easy to manage. They have a replenishment lead time of one month and a minimum market life cycle of six months. When Campbell introduces a product, it deploys enough stock to cover the most optimistic forecast for demand in the first month. If the product takes off, more can be supplied before stocks run out. If it flops, the six-month, worst-case life cycle affords plenty of time to sell off the excess stocks.

How do goals and initiatives differ in the two environments? Campbell's already high service level leaves little room for improvement in market mediation costs. Hence, when the company launched a supply chain program in 1991 called continuous replenishment, the goal was physical efficiency. And it achieved that goal: the inventory turns of participating retailers doubled. In contrast Sport Obermeyer's uncertain demand leads to high market mediation costs in the form of losses on styles that don't sell and missed sales opportunities due to the "stockouts" that occur when demand for particular items outstrips inventories. The company's supply chain efforts have been directed at reducing those costs through increased speed and flexibility.

Although the distinctions between functional and innovative products and between physical efficiency and responsiveness to the market seem obvious once stated, I have found that many companies founder on this issue. That is probably because products that are physically the same can be either functional or innovative. For example, personal computers, cars, apparel, ice cream, coffee, cookies, and children's car seats all can be offered as a basic functional product or in an innovative form.

It's easy for a company, through its product strategy, to gravitate from the functional to the innovative sphere without realizing that anything has changed. Then its managers start to notice that service has mysteriously declined and inventories of unsold products have gone up. When this happens, they look longingly at competitors that haven't changed their product strategy and therefore have low inventories and high service. They even may steal away the vice president of logistics from one of those companies, reasoning, If we hire their logistics guy, we'll have low inventory and high service, too. The new vice president invariably designs an agenda for improvement based on his or her old environment: cut inventories, pressure marketing to be accountable for its forecasts and to freeze them well into the future to remove uncertainty, and establish a rigid just-in-time delivery schedule with suppliers. The worst thing that could happen is that he or she actually succeeds in implementing that agenda, because it's totally inappropriate for the company's now unpredictable environment.

Devising the Ideal Supply-Chain Strategy

For companies to be sure that they are taking the right approach, they first must determine whether their products are functional or innovative. Most managers I've encountered already have a sense of which products have predictable and which have unpredictable demand: the unpredictable products are the ones generating all the supply headaches. For managers who aren't sure or who would like to confirm their intuition, I offer guidelines for classifying products based on what Nave found to be typical for each category. (See the table "Functional Versus Innovative Products: Differences in Demand.") The next step is for managers to decide whether their company's supply chain is physically efficient or responsive to the market. (See the table "Physically Efficient Versus Market-Responsive Supply Chains.")

Functional Versus Innovative Products: Differences in Demand

	Functional (Predictable Demand)	Innovative (Unpredictable Demand)
Aspects of Demand		
Product life cycle	**more than 2 years**	**3 months to 1 year**
Contribution margin(*)	**5% to 20%**	**20% to 60%**
Product variety	**low (10 to 20 variants per**	**high (often millions of variable**

What is the right supply chain for your product?

	category)	per category)
Average margin of error in the forecast at the time production is committed	10%	40% to 100%
Average stockout rate	1% to 2%	10% to 40%
Average forced end-of-season markdown as percentage of full price	0%	10% to 25%
Lead time required for made-to-order products	6 months to 1 year	1 day to 2 weeks

(*) The contribution margin equals price minus variable cost divided by price and is expressed as a percentage

Physically Efficient Versus Market-Responsive Supply Chains

	Physically Efficient Process	Market-Responsive Process
Primary purpose	supply predictable demand efficiently at the lowest possible cost	respond quickly to unpredictable demand in order to minimize stockouts, forced markdown, and absolete inventory
Manufacturing focus	maintain high average utilization rate	deploy excess buffer capacity
Inventory strategy	generate high turns and minimize inventory throughout the chain	deploy significant buffer stocks of parts or finished goods
Lead-time focus	shorten lead time for cost and quality	invest aggressively in ways to reduce lead time
Approach to choosing supplies	select primary for cost and quality	select primary for in ways to reduce lead time
Product-design strategy	maximize performance and minimize cost	use modular design in order to post-pone product differentiation for as long as possible

Having determined the nature of their products and their supply chain's priorities, managers can employ a matrix to formulate the ideal supply-chain strategy. The four cells of the matrix represent the four possible combinations of products and priorities. (See the exhibit "Matching Supply Chains with Products.") By using the matrix to plot the nature of the demand for each of their product families and its supply chain priorities, managers can discover whether the process the company uses for supplying products is well matched to the product type: an efficient process for functional products and a responsive process for innovative products. Companies that have either an innovative product with an efficient supply

What is the right supply chain for your product?

chain (upper right-hand cell) or a functional product with a responsive supply chain (lower left-hand cell) tend to be the ones with problems.

[ILLUSTRATION OMITTED]

For understandable reasons, it is rare for companies to be in the lower left-hand cell. Most companies that introduce functional products realize that they need efficient chains to supply them. If the products remain functional over time, the companies typically have the good sense to stick with efficient chains. But, for reasons I will explore shortly, companies often find themselves in the upper right-hand cell. The reason a position in this cell doesn't make sense is simple: for any company with innovative products, the rewards from investments in improving supply chain responsiveness are usually much greater than the rewards from investments in improving the chain's efficiency. For every dollar such a company invests in increasing its supply chain's responsiveness, it usually will reap a decrease of more than a dollar in the cost of stockouts and forced markdowns on excess inventory that result from mismatches between supply and demand. Consider a typical innovative product with a contribution margin of 40% and an average stockout rate of 25%.(1) The lost contribution to profit and overhead resulting from stockouts alone is huge: 40% X 25% = 10% of sales-an amount that usually exceeds profits before taxes.

Consequently, the economic gain from reducing stockouts and excess inventory is so great that intelligent investments in supply chain responsiveness will always pay for themselves -- a fact that progressive companies have discovered. Compaq, for example, decided to continue producing certain high-variety, short-life-cycle circuits in-house rather than outsource them to a low-cost Asian country, because local production gave the company increased flexibility and shorter lead times. World Company, a leading Japanese apparel manufacturer, produces its basic styles in low-cost Chinese plants but keeps production of high-fashion styles in Japan, where the advantage of being able to respond quickly to emerging fashion trends more than offsets the disadvantage of high labor costs.

That logic doesn't apply to functional products. A contribution margin of 10% and an average stockout rate of 1% mean lost contribution to profit and overhead of only .1% of sales -- a negligible cost that doesn't warrant the significant investments required to improve responsiveness.

Getting Out of the Upper Right-Hand Cell

The rate of new-product introductions has skyrocketed in many industries, fueled both by an increase in the number of competitors and by the efforts of existing competitors to protect or increase profit margins. As a result, many companies have turned or tried to turn traditionally functional products into innovative products. But they have continued to focus on physical efficiency in the processes for supplying those products. This phenomenon explains why one finds so many broken supply chains -- or unresponsive chains trying to supply innovative products -- in industries such as automobiles, personal computers, and consumer packaged goods.

The automobile industry is one classic example. Several years ago, I was involved in a study to measure the impact that the variety of options available to consumers had on productivity at a Big Three auto plant. As the study began, I tried to understand variety from the customer's perspective by visiting a dealer near my home in the Philadelphia area and "shopping" for the car model produced in the plant we were to study. From sales literature provided by the dealer, I determined that when one took into account all the choices for color, interior features, drive-train configurations, and other options, the company was actually offering 20 million versions of the car. But because ordering a car with the desired options entailed an eight-week wait for delivery, more than 90% of customers bought their cars off the lot.

The dealer told me that he had 2 versions of the car model on his lot and that if neither matched my ideal specifications, he might be able to get my choice from another dealer in the Philadelphia area. When I got home, I checked the phone book and found ten dealers in the area. Assuming each of them also had 2 versions of the car in stock, I was choosing from a selection of at most 20 versions of a car that could be made in 20 million. In other words, the auto distribution channel is a kind of hourglass with the dealer at the neck. At the top of the glass, plants, which introduce innovations in color and technology every year, can provide an almost infinite variety of options. At the bottom, a multitude of customers with diverse tastes could benefit from that variety but are unable to because of dealers' practices at the neck of the glass.

The computer industry of 20 years ago shows that a company can supply an innovative product with an unresponsive

What is the right supply chain for your product?

process if the market allows it a long lead time for delivery. In my first job after college, I worked in an IBM sales office helping to market the System/360 mainframe. I was shocked to learn that IBM was then quoting a 14-month lead time for this hot new product. I asked how I could possibly tell a customer to wait that long. The answer was that if a customer really wanted a 360, it would wait, and that if I couldn't persuade it to wait, there must be something seriously lacking in my sales skills. That answer was actually correct: lead times of one to two years were then the norm. This meant that computer manufacturers had plenty of time to organize their supplies around physical efficiency.

Now PCs and workstations have replaced mainframes as the dominant technology, and the acceptable lead time has dropped to days. Yet because the industry has largely retained its emphasis on a physically efficient supply chain, most computer companies find themselves firmly positioned in the upper right-hand cell of the matrix.

That mismatch has engendered a kind of schizophrenia in the way computer companies view their supply chains. They cling to measures of physical efficiency such as plant capacity utilization and inventory turns because those measures are familiar from their mainframe days. Yet the marketplace keeps pulling them toward measures of responsiveness such as product availability.

How does a company in the upper right-hand cell overcome its schizophrenia? Either by moving to the left on the matrix and making its products functional or by moving down the matrix and making its supply chain responsive. The correct direction depends on whether the product is sufficiently innovative to generate enough additional profit to cover the cost of making the supply chain responsive.

A sure sign that a company needs to move to the left is if it has a product line characterized by frequent introductions of new offerings, great variety, and low profit margins. Toothpaste is a good example. A few years ago, I was to give a presentation to a food industry group. I decided that a good way to demonstrate the dysfunctional level of variety that exists in many grocery categories would be to buy one of each type of toothpaste made by a particular manufacturer and present the collection to my audience. When I went to my local supermarket to buy my samples, I found that 28 varieties were available. A few months later, when I mentioned this discovery to a senior vice president of a competing manufacturer, he acknowledged that his company also had 28 types of toothpaste -- one to match each of the rival's offerings.

Does the world need 28 kinds of toothpaste from each manufacturer? Procter & Gamble, which has been simplifying many of its product lines and pricing, is coming to the conclusion that the answer is no. Toothpaste is a product category in which a move to the left -- from innovative to functional -- makes sense.

In other cases when a company has an unresponsive supply chain for innovative products, the right solution is to make some of the products functional and to create a responsive supply chain for the remaining innovative products. The automobile industry is a good example.

Many suggestions have been made for fixing the problems with the auto distribution channel I have described here, but they all miss the mark because they propose applying just one solution. This approach overlooks the fact that some cars, such as the Ford Fairmont, are inherently functional, while others, such as the BMW Z3 roadster (driven in the James Bond movie Golden Eye), are innovative. A lean, efficient distribution channel is exactly right for functional cars but totally inappropriate for innovative cars, which require inventory buffers to absorb uncertainty in demand. The most efficient place to put buffers is in parts, but doing so directly contradicts the just-in-time system that automakers have so vigorously adopted in the last decade. The just-in-time system has slashed parts inventories in plants (where holding inventory is relatively cheap) to a few hours, while stocks of cars at dealers (where holding inventory is expensive) have grown to around 90 days.

Efficient Supply of Functional Products

Cost reduction is familiar territory, and most companies have been at it for years. Nevertheless, there are some new twists to this old game. As companies have aggressively pursued cost cutting over the years, they have begun to reach the point of diminishing returns within their organization's own boundaries and now believe that better coordination across corporate boundaries -- with suppliers and distributors -- presents the greatest opportunities. Happily, the growing acceptance of this view has coincided with the emergence of electronic networks that facilitate closer coordination.

What is the right supply chain for your product?

Campbell Soup has shown how this new game should be played. In 1991, the company launched the continuous-replenishment program with its most progressive retailers. The program works as follows: Campbell establishes electronic data interchange (EDI) links with retailers. Every morning, retailers electronically inform the company of their demand for all Campbell products and of the level of inventories in their distribution centers. Campbell uses that information to forecast future demand and to determine which products require replenishment based on upper and lower inventory limits previously established with each retailer. Trucks leave the Campbell shipping plant that afternoon and arrive at the retailers' distribution centers with the required replenishments the same day. The program cut the inventories of four participating retailers from about four to two weeks of supply. The company achieved this improvement because it slashed the delivery lead time and because it knows the inventories of all retailers and hence can deploy supplies of each product where they are needed the most.

Pursuing continuous replenishment made Campbell aware of the negative impact that the overuse of price promotions can have on physical efficiency. Every January, for example, there was a big spike in shipments of Chicken Noodle Soup because of deep discounts that Campbell was offering. Retailers responded to the price cut by stocking up, in some cases buying a year's supply -- a practice the industry calls forward buying. Nobody won on the deal. Retailers had to pay to carry the year's supply, and the shipment bulge added cost throughout the Campbell system. For example, chicken-boning plants had to go on overtime starting in October to meet the bulge. (See the graph "How Campbell's Price Promotions Disrupted Its Supply System.") Recognizing the problem, Campbell required its retail customers on the continuous-replenishment program to waive the option of forward buying at a discounted price. A retailer that promotes Campbell products in its stores by offering a discounted price to consumers has two options: it can pay Campbell an "everyday low price" equal to the average price that a retailer receiving the promotional deals would pay or it can receive a discount on orders resulting from genuine increases in sales to consumers.

[GRAPH OMITTED]

The Campbell example offers some valuable lessons. Because soup is a functional product with price-sensitive demand, Campbell was correct to pursue physical efficiency. Service -- or the in-stock availability of Campbell products at a retailer's distribution center -- did increase marginally, from 98.5% to 99.2%. But the big gain for the supply chain was in increased operating efficiency, through the reduction in retailers/ inventories. Most retailers figure that the cost of carrying the inventory of a given product for a year equals at least 25 % of what they paid for the product. A two-week inventory reduction represents a cost savings equal to nearly 1% of sales. Since the average retailer's profits equal about 2% of sales, this savings is enough to increase profits by 50%.

Because the retailer makes more money on Campbell products delivered through continuous replenishment, it has an incentive to carry a broader line of them and to give them more shelf space. For that reason, Campbell found that after it had introduced the program, sales of its products grew twice as fast through participating retailers as they did through other retailers. Understandably, supermarket chains love programs such as Campbell's. Wegmans Food Markets, with stores in upstate New York, has even augmented its accounting system so that it can measure and reward suppliers whose products cost the least to stock and sell.

There is also an important principle about the supply of functional products lurking in the "everyday low price" feature of Campbell's program. Consumers of functional products offer companies predictable demand in exchange for a good product and a reasonable price. The challenge is to avoid actions that would destroy the inherent simplicity of this relationship. Many companies go astray because they get hooked on overusing price promotions. They start by using price incentives to pull demand forward in time to meet a quarterly revenue target. But pulling demand forward helps only once. The next quarter, a company has to pull demand forward again just to fill the hole created by the first incentive. The result is an addiction to incentives that turns simple, predictable demand into a chaotic series of spikes that only add to cost.

Finally, the Campbell story illustrates a different way for supply chain partners to interact in the pursuit of higher profits. Functional products such as groceries are usually highly price-sensitive, and negotiations along the supply chain can be fierce. If a company can get its supplier to cut its price by a penny and its customer to accept a one-cent price increase, those concessions can have a huge impact on the company's profits. In this competitive model of supply chain relations, costs in the chain are assumed to be fixed, and the manufacturer and the retailer compete through price negotiations for a bigger share of the fixed profit pie. In contrast, Campbell's continuous-replenishment program embodies a model in which

What is the right supply chain for your product?

the manufacturer and the retailer cooperate to cut costs throughout the chain, thereby increasing the size of the pie.

The cooperative model can be powerful, but it does have pitfalls. Too often, companies reason that there never can be too many ways to make money, and they decide to play the cooperative and competitive games at the same time. But that tactic doesn't work, because the two approaches require diametrically different behavior. For example, consider information sharing. If you are my supplier and we are negotiating over price, the last thing you want to do is fully share with me information about your costs. But that is what we both must do if we want to reduce supply chain costs by assigning each task to whichever of us can perform it most cheaply.

Responsive Supply of Innovative Products

Uncertainty about demand is intrinsic to innovative products. As a result, figuring out how to cope with it is the primary challenge in creating a responsive supply process for such products. I have seen companies use four tools to cope with uncertainty in demand. To fashion a responsive supply process, managers need to understand each of them and then blend them in a recipe that's right for their company's particular situation.

Although it may sound obvious, the first step for many companies is simply to accept that uncertainty is inherent in innovative products. Companies that grew up in an oligopoly with less competition, more docile customers, and weaker retailers find it difficult to accept the high levels of demand uncertainty that exist today in many markets. They have a tendency to declare a high level of forecast errors unacceptable, and they virtually command their people to think hard enough and long enough to achieve accuracy in their forecasts. But these companies can't remove uncertainty by decree. When it comes to innovative products, uncertainty must be accepted as good. If the demand for a product were predictable, that product probably would not be sufficiently innovative to command high profit margins. The fact is that risk and return are linked, and the highest profit margins usually go with the highest risk in demand.

Once a company has accepted the uncertainty of demand, it can employ three coordinated strategies to manage that uncertainty. It can continue to strive to reduce uncertainty -- for example, by finding sources of new data that can serve as leading indicators or by having different products share common components as much as possible so that the demand for components becomes more predictable. It can avoid uncertainty by cutting lead times and increasing the supply chain's flexibility so that it can produce to order or at least manufacture the product at a time closer to when demand materializes and can be accurately forecast. Finally, once uncertainty has been reduced or avoided as much as possible, it can hedge against the remaining residual uncertainty with buffers of inventory or excess capacity. The experiences of National Bicycle, a subsidiary of Matsushita Electric, and of Sport Obermeyer illustrate the different ways in which these three strategies can be blended to create a responsive supply chain.

National Bicycle prospered for decades as a small but successful division. But by the mid-1980s, it was in trouble. Bicycles in Japan were functional products bought mainly as an inexpensive means of transportation, and sales were flat. Bicycles had become a commodity sold on the basis of low price, and Japan's high labor costs left National Bicycle unable to compete with inexpensive bikes fro Taiwan and Korea.

In 1986, in an attempt to salvage the situation, Matsushita appointed as president of National an executive from another division who had no experience in bicycles. The new president, Makoto Komoto, saw that the division had many strengths: technical expertise in manufacturing and computers, a highly skilled workforce, a strong brand name (Panasonic), and a network of 9,000 dealers. Komoto also noticed that National Bicycle had an innovative product segment that enjoyed high profit margins: sports bicycles that affluent customers bought purely for recreation. He concluded that National's only hope was to focus on that segment and use the division's strengths to develop a responsive chain that could supply sports bikes while avoiding the high risk of overproduction that resulted from their short life cycle and uncertain demand.

According to Komoto's vision, a customer would visit a Panasonic dealership and choose a bike from a selection of 2 million options for combining size, color, and components, using a special measuring I stand to find the exact size of the frame that he or she needed. The order would be faxed to the factory, where computer-controlled welding equipment and skilled workers would make the bike and deliver it to the customer within two weeks.

Komoto's radical vision became a reality in 1987. By 1991, fueled by this innovation, National Bicycle had increased its

What is the right supply chain for your product?

share of the sports bicycle market in Japan from 5% to 29%. It was meeting the two-week lead time 99.99% of the time and was in the black.

National Bicycle's success is a good example of a responsive supply chain achieved through avoiding uncertainty. National has little idea what customers will order when they walk into a retail shop, but that doesn't matter: its produce-to-order system allows it to match supply with demand as it happens. By radically increasing the number of choices from a few types of bikes to 2 million, it can induce the customer to sacrifice immediate availability and wait two weeks for a bicycle.

National's program is part of a new movement called mass customization: building the ability to customize a large volume of products and deliver them at close to mass-production prices. Many other companies have found that they, too, can benefit from this strategy. For example, Lutron Electronics of Coopersburg, Pennsylvania, became the world leader in dimmer switches and other lighting controls by giving customers an essentially unlimited choice of technical and fashion features. Says Michael W. Pessina, Lutron's vice president of manufacturing operations, "With our diverse product line, customer demand can be impossible to predict. Yet by configuring product, at the time of order, we can offer customers tremendous variety and fill orders very quickly without having to stock a huge amount of inventory."

Mass customization is not without its challenges. For example, what does National Bicycle do with its plant during the winter, when no one is buying bikes? It builds an inventory of high-end sports bicycles. In addition, mass customization is not necessarily cheap. National's custom production requires three times more labor than assembly-line mass production of bikes. Interestingly, one of the main reasons why Henry Ford in the early 1900s moved in the opposite direction -- from craft to mass production -- was to slash labor costs, which he succeeded in doing by a factor of three. So what has changed to make custom production viable now? Affluent consumers are willing to pay for high-margin, innovative products; and those products require a different, more expensive, but more responsive production process than the functional Model T did.

Sport Obermeyer, which is based in Aspen, Colorado, designs and manufactures fashion skiwear and distributes it through 800 specialty retailers located throughout the United States. Because 95% of its products are new each year, it constantly faces the challenges and risks of demand uncertainty: stockouts of hot styles during the selling season and leftover inventory of "dogs" at the end of the season. In 1991, the company's vice president, Walter R. Obermeyer, launched a project to attack those problems by blending the three strategies of reducing, avoiding, and hedging against uncertainty. To reduce uncertainty, Sport Obermeyer solicited early orders from important customers: the company invited its 25 largest retailers to Aspen each February to evaluate its new line. Sport Obermeyer found that the early orders from this handful of retailers permitted it to forecast national demand for all its products with a margin of error of just 10%.

Although it was helpful to get this information several months before Sport Obermeyer was required to ship its products in September, it didn't solve the company's problem, because long lead times forced it to commit itself to products well before February. Obermeyer concluded that each day shaved off the lead time would save the company $25,000 because that was the amount it spent each day at the end of September shipping products by air from plants in Asia to have them in stores by early October -- the start of the retail season. Once that figure was announced to employees, they found all kinds of ways to shorten the lead time. For example, the person who had dutifully used standard mail service to get design information to the production manager in Hong Kong realized that the $25 express-mail charge was a bargain compared with the $25,000 per day in added costs resulting from longer lead times caused by mail delays. Through such efforts, Sport Obermeyer was able to avoid uncertainty on half of its production by committing that production after early orders had been received in February.

Nevertheless, the company still had to commit half of the production early in the season, when demand was uncertain. Which styles should it make then? It would stand to reason that they should be the styles for which Sport Obermeyer had the most confidence in its forecasts. But how could it tell which those were? Then the company noticed something interesting. Obermeyer had asked each of the six members of a committee responsible for forecasting to construct a forecast for all products, and he used the average of the six forecasts as the company's forecast. After one year of trying this method, the company found that when the six individual forecasts agreed, the average was accurate, and when they disagreed, the average was inaccurate. This discovery gave Sport Obermeyer a means of selecting the styles to make early. Using this information as well as data on the cost of overproduction and underproduction, it developed a model for hedging against the risk of both problems. The model tells the company exactly how much of each style to make early in

What is the right supply chain for your product?

the production season (which begins nearly a year before the retail season) and how much to make in February, after early orders are received.

Sport Obermeyer's approach, which has been called accurate response, has cut the cost of both overproduction and underproduction in half -- enough to increase profits by 60%. And retailers love the fact that the system results in more than 99% product availability: they have ranked Sport Obermeyer number one in the industry for service. (See "Making Supply Meet Demand in an Uncertain World," by Marshall L. Fisher, Janice H. Hammond, Walter R. Obermeyer, and Ananth Raman, HBR May-June 1994.)

Companies such as Sport Obermeyer, National Bicycle, and Campbell Soup, however, are still the exceptions. Managers at many companies continue to lament that although they know their supply chains are riddled with waste and generate great dissatisfaction among customers, they don't know what to do about the problem. The root cause could very well be a misalignment of their supply and product strategies. Realigning the two is hardly easy. Bet the reward -- a remarkable competitive advantage that generates high growth in sales and profits -- makes the effort worth it.

(1.) The contribution margin equals price minus variable cost divided by price and is expressed as a percentage. This type of profit margin measures increases in profits produced by the incremental sales that result from fewer stockouts. Consequently, it is a good way to track improvements in inventory management.

Marshall L. Fisher is the Stephen J. Heyman Professor of Operations and Information Management and co-director of the Fishman-Davidson Center for Service and Operations Management at the University of Pennsylvania's Wharton School in Philadelphia. His current research focuses on how to manage the supply of products with hard-to-predict demand.