The New Science of Retailing: How Analytics Are Transforming the Supply Chain and Improving Performance

by Marshall Fisher and Ananth Raman

Chapter Four: Flexible Supply Chains—How to Design for Greater Agility End to End

The logic for supply chain flexibility is compelling. Product sales are hard to predict—prelaunch forecasts of new products typically have a 50 percent to 100 percent error. So being able to respond quickly to satisfy this unexpected demand can have a huge impact on profitability. It also means that you can buy less initially, knowing you can chase winners. That, in turn, prevents margin-killing markdowns at the end of the season. Flexibility cures a merchant's two biggest headaches: having too little of the right products and too much of the wrong ones.

This chapter describes how to create a flexible supply chain. Many apparel and shoe retailers control their supply chains. Some grocers own factories to make private label goods. They can directly apply the ideas found here.

But what if you don't own any part of your supply chain? A big movement in retailing is greater coordination between retailers and suppliers. The grocery industry has formulated a concept called collaborative planning, forecasting, and replenishment (CPFR) that offers guidelines for cooperating to forecast demand and plan supply. Retailers in other industries can work with their suppliers to create the same sort of flexibility. We'll describe in this chapter how one retailer—Best Buy—did this with many of its suppliers, starting with Hewlett-Packard (HP).

A Mystery: Why Are There Such Big Differences in Lead Time Between Retailers?

In 1997, we began a study of thirty-two leading retailers to understand how they used data analytics to improve forecasting and supply chain flexibility. [1] Fourteen of the companies sold footwear and apparel or were department stores with heavy sales in footwear and apparel.

Table 4-1 shows their lead times, together with those of one other retailer we came to know after the study, Destination Maternity, a seller of maternity wear with a nearly 50 percent market share. Three of these retailers—Destination Maternity, World, and Zara—had such fast and efficient supply chains that, if necessary to avoid a stockout, they could replenish a hot-selling item within two to three weeks. By contrast, the other specialty retailers in the group had an average lead time of six months, and the department stores, a whopping eleven months.

We've studied World, Zara, and Destination Maternity to plumb their operations and understand how they've achieved such short lead times while other companies lagged. We have also pondered the equally interesting question of why many other retailers are so slow, given that they all have access to the same equipment and processes as these three lightening fast retailers. In this chapter, we describe what we have learned.

Table 4-1: Apparel retailer replenishment lead times

Retailer	Replenishment lead time
World. Kobe, Japan	2–3 weeks
Zara/Inditex. La Coruña, Spain	2–3 weeks
Destination Maternity. Philadelphia, PA, U.S.	2–3 weeks
U.S. specialty retailers	6 months
U.S. department stores	11 months

[1]See Marshall L. Fisher, Ananth Raman, and Anna Sheen McClelland, "Rocket Science Retailing Is Almost Here: Are You Ready?" *Harvard Business Review* , July–August 2000, 115–124.

Flexibility 101: Flexibility and Inflexibility at National Bicycle

The best way to understand the differences we observed in lead time between retailers is to study an inflexible supply chain to understand what makes it slow and compare it to a fast one to understand the enablers of speed. Fortunately, there's a company that operates both kinds, right next door to each other. National Bicycle, a subsidiary of the Japanese giant Matsushita Electric, produces Panasonic bicycles. [2]

It's one of the three big Japanese bike makers.

National has several product lines, including kid's bikes, low-cost bikes marketed to students and others seeking cheap transportation, and sports bikes marketed to more affluent recreational riders. We'll focus on sports bikes, which can command high margins but also face inventory risk because of annual new-model introductions.

The Inflexible Mass Production Supply Chain

Figure 4-1 shows National's mass production supply chain. At the first step, long titanium or chromium molybdenum steel tubes enter a cutting machine and exit as short lengths that will constitute a bicycle frame. These tubes are welded to form frames, which are then painted. Three parallel assembly lines, each attended by forty workers at separate stations, attach components like wheels, brakes, and gear shifters to the frames. After assembly, the bikes are boxed and sent to a distribution center on a conveyer. From the center, they're shipped to the warehouses of regional distributors called *hansha* and eventually to retailers. [3]

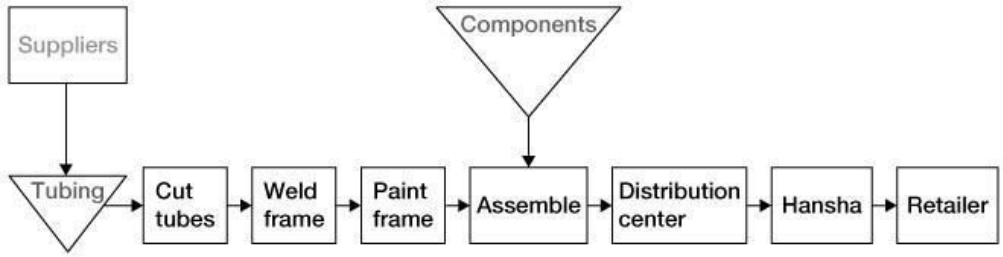

FIGURE 4-1: Mass production sports cycle supply chain

Each step in the process requires a time-consuming setup as National's workers switch from one model of bike to another. During welding, for example, the metal tubes are held in place by fixtures, which need to be adjusted for each different frame and size. Setup consumes thirty minutes for tube cutting, sixty minutes for welding, twenty-five minutes for painting, and five minutes for assembly, for a total of two hours. Because of the long prep times, the factory makes bikes in batches of fifty, one hundred, one hundred fifty, or more, depending on demand. National also uses batch production to enhance efficiency. Workers can complete bikes more rapidly as they do more of them and grow accustomed to each model.

The bike sales season begins in early spring. Retailers aim to have new models on display by March 1, so National begins planning its new line the preceding July. It builds samples and exhibits them in September and then finalizes designs in late November or early December. That gives it enough time to make bikes and ship them to retailers by March 1. Due to paperwork, it can easily take a week from the time a retailer places an order until it reaches the factory. If the bikes to fill the order are in inventory—the ten hansha, the factory, and retailers each carry about one month's worth of finished goods—they are shipped via truck from National to the hansha and then to the retailer. That takes seven to ten days.

If ordered bikes are not in stock, the time needed to produce more can drag out because of the minimum batch size of fifty bikes. Each bike requires an hour of direct labor. At one hour per bike plus a total of two hours for the setups, the time to produce a batch of fifty bikes is fifty-two hours. Add that to the order processing time of a week and a week to ten days for transport, and the lead time stretches to at least a month. The actual lead time can easily be even longer. A retailer typically orders several different bikes requiring several batches and thus several weeks to produce. Moreover, National has nine thousand retailers, so orders back up. And it won't produce a batch of fifty to satisfy an order for a single bike. It waits until other retailers have ordered enough of that model to justify another batch. This further stretches the lead time. A retailer can wait months for replenishment during the sales season, a delay that often results in stockouts and lost sales.

National works hard at projecting the popularity of each year's models. But random events and fickle consumers thwart accurate prediction, so each year popular models frequently sell out, while less popular models go unsold. When the season ends, everyone in the supply chain has bikes that have to be marked down. Thus National suffers from lost sales due to having too few of its best sellers and markdown losses due to too many duds.

Flexibility Arrives at National Bicycle

In 1987, in an effort to increase sales and reduce inventory risk on its sports bikes, National introduced the customization process depicted in figure 4-2. When customers visit Panasonic dealerships, they can still buy bikes from the stores' stock, and the mass production factory still supplies these bikes. But customers can also order custom-made bikes from a greatly expanded selection of frame sizes, colors, and components—more than 2 million combinations in all. National offers seventy color patterns and eighteen frame sizes for its custom bikes, compared with one or two colors and two frame sizes for a typical stock bike. What's more, the retailer can tailor the fit of each custom bike by taking a series of measurements in his shop, using a special measuring stand developed by National. The stand—in effect, an adjustable bike without wheels—lets the customer try out the size and comfort of a proposed custom frame.

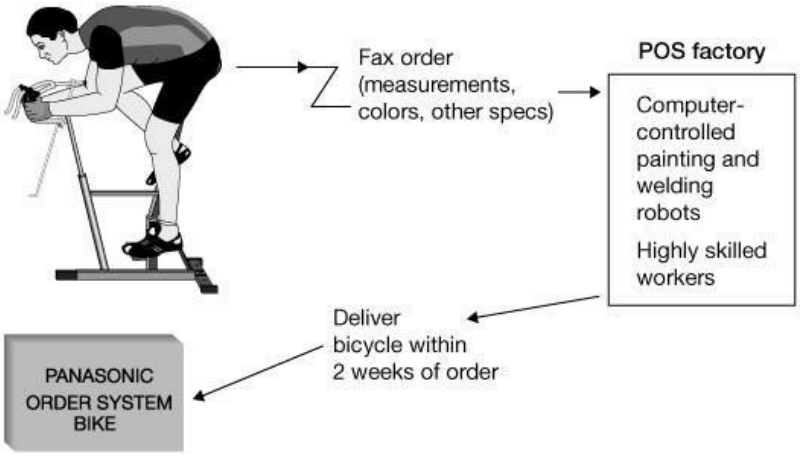

FIGURE 4-2: The Panasonic Order System (POS)

Once a customer has chosen his ideal bike, his order is sent to the factory (by fax in 1987, now over the Internet), and two weeks later he receives a bike custom built to his exact specifications.

By 1991, helped by this customization process, National had increased its share of the sports bike segment in Japan from 5 percent to 29 percent and was meeting a two-week delivery goal 99.99 percent of the time. Customers bought two-thirds of Panasonic road bikes and one-fifth of its mountain bikes via the custom process, and annual sales exceeded fourteen thousand bikes. National also received lots of media attention. Its process was one of the first examples of *mass customization* —that is, production of customized goods with nearly the efficiency of mass production. National built a new factory to make the custom bikes. It's housed in a small structure next to the company's larger mass production plant and uses computer-controlled welding robots together with highly skilled workers. Table 4-2 compares the performance of the old and the new factories.

Table 4-2: Comparison of POS and mass production factories

	Mass production	POS
Frame sizes	2	18
Color options	1–2	70
Batch size	50 or more	1
Lead time	Several months	2 weeks
Labor content	1 hour	2 hours
Control protocol	Push	Pull

Creating a Flexible Process

In our experience, flexibility requires four capabilities.

1. Efficient production of small quantities (This capability is crucial to taking advantage of a short lead time; a two-week lead time won't do you much good if your minimum batch size is a six-month supply.)
2. The ability to offer a wealth of product versions
3. Accommodation of variation in aggregate demand volume
4. A short lead time

Let's examine how National created each of these four capabilities

Efficient Production of Small Quantities

National achieved the ultimate in efficient small-quantity product: a lot size of one. In other words, each single bike is built individually. To enable single-lot production, National artfully blended technology and skilled workers to reduce the two-hour setup time in the mass production process to less than a minute. The longest setup time was the hour needed to

adjust the equipment that held the tubes in place while welders connected them to create each frame. To reduce this time, National resurrected some old frame-building equipment that it had slated for the scrap heap. It then attached servomotors, controlled by a computer, to the old equipment. [4] After a worker cut tubes to the right length, he'd drop them into slots in a flexible device and scan a bar code that identified the bike. The servomotors would then adjust the fixtures to the appropriate dimensions for that frame, which was then welded by robots. This reduced setup time from an hour to a mere twenty seconds.

Robots also inspect frames for dimensional accuracy and apply base coats of paint. Craftsmen apply the finish painting manually, and a single worker assembles each bike, which eliminates the need for batch production that was required for the forty-worker assembly line used in the mass production factory.

Ability to Offer a Wealth of Product Versions

Once the setup time for a bike variant is reduced to less than a minute, it is feasible to offer an essentially unlimited variety of bikes. There was, however, one barrier to variety that needed to be overcome. In the mass production process, forty line workers contributed to the hour of work needed to build a bike, so each worker did (and needed to remember)

1.5 minutes of work. In contrast, workers in the custom factory must do the entire 120 minutes of work required for a single bike, and each bike that they assemble is unique. To make this situation workable, National employs its best workers in the custom factory and uses video terminals to provide instruction on the most complex tasks.

Accommodation of Variation in Aggregate Demand Volume

The demand for custom bikes fluctuates greatly over the year, with low demand in the winter and high demand in spring and summer. National accommodates this variation by setting factory capacity to the maximum weekly demand rate and then using the custom factory to make high-end made-to-stock bikes during the winter when demand for custom bikes is too low to fill factory capacity. Producing time-sensitive made-to-order products and less time-sensitive made-to-inventory products in the same factory allows the entire capacity of the factory to be devoted to the time-sensitive product if needed, while the less time-sensitive production can be scheduled when needed to keep the factory operating at high utilization. Of course, this requires that both types of products can be produced in the same factory, which was the case for National because the custom bikes were simply made-to-inventory bikes configured to a customer order. Hence an "order" to produce a lot of made-to-inventory bikes looked no different from an order from a customer.

Short Lead Time

Recall that lead time includes periods for (1) information processing (the time for order entry), (2) actual production, (3) batching, (4) waiting, and (5) transportation. Consider how each of these changed in the custom factory. Because the retailer transmits an order directly to the factory it eliminates all of the time lost in order processing and the handoffs from the retailer to the hansha, to the sales office, and finally to the factory. Once the factory receives the order, entering it takes just a day.

Actual production time is an hour longer in the custom factory because custom frames require more work. But thanks to its ability to handle batch sizes of one, the custom factory eliminates time wasted while waiting for a batch of orders to accrue. Yet it also has enough capacity to meet demand in the busiest week of the year, so it prevents orders from backing up. Delivery by truck takes only two days. If needed, National will resort to airfreight, even occasionally taxi, to deliver the bikes.

Though welding and assembly of a custom bike take only two hours, National set its delivery promise at two weeks to account for the fact that customers place about 30 percent of orders on Saturday and Sunday, when the factory doesn't operate. It takes the factory until midweek to work through the weekend's backlog. On top of that, parts shortages can delay assembly. National keeps inventory of all of the components required to build its bikes and has an average in-stock level of 99.4 percent. This sounds high, but a bike requires seventeen different components. While any given component is in stock 99.4 percent of the time, the chance that all seventeen are in stock at the same time is .994 raised to the power of seventeen, or 90.3 percent. Thus parts stockouts delay about 10 percent of the bikes. When this happens, National can usually get an emergency delivery of a component within a week and still fulfill its two-week promise. Failing this, it substitutes, with the customer's permission, more expensive parts than the ones that the customer ordered.

National considered setting a one-week lead time but settled on two, thinking that it was better to fulfill a two-week promise 99.95 percent of the time than to meet a one-week promise 90 percent of the time. National usually meets its promise of a two-week turnaround on orders with time to spare, but when it does miss its two-week guarantee, it refunds the

customization fee.

The Supply Chain Decouple Point (aka the Push/Pull Boundary)

These capabilities allow the custom supply chain to operate under a control protocol called *pull* , in which the factory makes production decisions in response to customer orders or recent sales. By contrast, the mass production supply chain operates under *push* control, with National making decisions based on long-range demand forecasts and with production occurring long before sales.

In reality, even in pull supply chains, if you move far enough upstream, processes require push control. Consider furniture making. Building tables and sofas in response to customer orders makes sense, but no one would suggest growing trees in response to orders, or even harvesting and sawing them in response to orders. Likewise, in the auto industry, Toyota's famous just-in-time inventory controls exemplify the pull approach. But no one would suggest mining iron ore just in time to produce a car.

The point where a supply chain switches from push to pull is called the push/pull boundary or the *decouple point* , because at the boundary there is usually sufficient inventory to decouple the upstream push processes from the downstream pull processes. Where to position the decouple point is one of the most important supply chain decisions a company makes. Poor supply chain performance can often be traced to an ill-positioned decouple point.

Figure 4-3 shows the supply chain and the decouple point for National's custom factory. It's positioned right before tube cutting. National keeps inventory of uncut tubing and components and replenishes this inventory based on a forecast of demand; that is, it uses push control up to this point. The pull process starts with cutting the tubes for a specific frame and ends with delivery to the customer. National offers 14 bike models, each in 18 sizes, resulting in 252 versions (14 × 18). Each frame can be painted in one of 70 color patterns, resulting in 17,640 (252 × 70) possible painted frames. The addition of components results in over 2 million distinct configurations. Of course, with annual demand of about 14,000 units, National annually produces only a small fraction of these options, and probably no two of the 14,000 bikes will be the same.

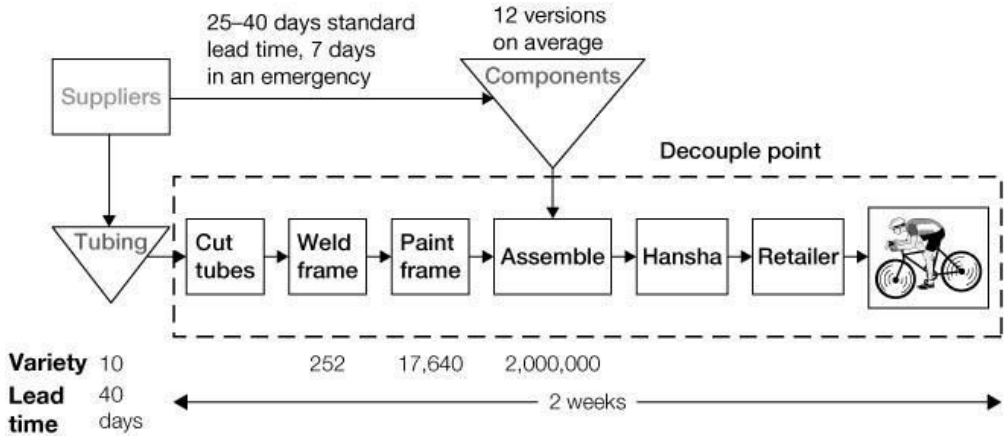

FIGURE 4-3: The POS decouple point is upstream of the point of differentiation

Its choice of decouple point works because National need only stock a small number of uncut tubes and components, and it can predict demand for them. What's more, it can perform all steps in the pull period within two weeks, a wait that customers accept because they get a much wider selection.

National Bicycle's experience illustrates the challenge of giving customers what they want when they want it. No single step in the process ensures success. Rather, a manufacturer must simultaneously design the product, with all of its needed variation, and the supply chain, especially the decouple point. To pick the right point, you want to have low variety upstream but high variety downstream. A wealth of choices makes the customer willing to wait for a made-to-order product, while efficient processes downstream from the decouple point ensure that they don't wait too long.

How Other Companies Decouple Their Supply Chains

Many companies have used the concept of supply chain decoupling to enable flexibility. The most famous example may be Dell. It cannot predict demand for specific computers, but it has the ability to assemble an ordered computer in three minutes from components whose demand it can predict. This allows it to employ push control, buffered by a modest

amount of component inventory.

Similarly, Hitachi Global Storage Technologies found that demand at the SKU level was totally unpredictable, but that all SKUs were minor variations on a few generic base products, which are very predictable. So it builds the predictable base products to forecast, under push control, and then quickly modifies them as needed to fill customer orders.

Hewlett-Packard, in contrast, needs many printer model types to supply different countries' needs for, say, power supplies and local-language instruction manuals. It copes with this by stocking a generic printer and inserting, just before shipping, a country-specific localization kit, containing the needed power supply and manual. [5]

McDonald's has embraced efficient customization, too. In the mid-1990s, it found that it was tailoring 40 percent of its orders in response to customer requests like "No pickles, please." Because it made its sandwiches in advance, dealing with this simple request required considerable time and was making McDonald's "fast" food increasingly slow. The chain's solution was its "Made for You" process, in which restaurants precooked protein components such as hamburger patties and chicken to inventory and then assembled sandwiches in response to customer orders. [6] In essence, McDonald's decoupled the process at the component level, just as Dell does with its computers.

Finally, let's not ignore the role of product design in decoupling a supply chain. Sport Obermeyer, a designer and maker of skiwear, found that custom-dyed zippers created its longest lead times. Its designers had traditionally matched zipper and parka colors, but they decided that a black zipper looked fine in most cases. It provided an accent contrast color to the parka and dramatically reduced the lead time for sourcing this key component. [7]

The Cost of Flexibility—Does Mass Customization Pay?

Flexibility comes at a cost. When National introduced customization, building a bike required three hours of labor, compared with one hour for the traditional mass production process. Factory workers managed to reduce this to two hours via many small process improvements that they suggested. (The Japanese name for this sort of continuous process improvement is *kaizen* .) But the extra hour of labor per bike still adds 10,000 yen to each bike's cost. This is offset by a customization fee charged to customers—ranging from 7,000 to 15,000 yen, depending on the number of colors on the bike—that more than offsets the extra cost. Just as important, customization eliminates unsold inventory, which previously had to be marked down at the end of the season.

In the early 1900s, Henry Ford made an opposite change, converting from craft to mass production by introduction of an assembly line. He thus reduced the labor content of a car from 12.5 to 1.5 hours. [8]

The 2- or 3-to-1 labor penalty for customization at National Bicycle is less than the more than 8-to-1 differential of craft versus mass in Ford's factory, presumably due to the use of flexible technology in the National Bicycle custom process. But basically, the physical characteristics of production haven't changed much since Ford's day. Mass production continues to have a significant productivity advantage over custom work. What has changed since Ford's day is consumer taste and pliability. Ford's clientele would accept, in the automaker's famous words, any color as long as it was black in exchange for a low-priced Model T. National Bicycle's customers, in contrast, are willing to pay a surcharge to get whichever color they fancy. [9]

[2]This discussion is based on Marshall Fisher, "National Bicycle Industrial Co" (unpublished case), the Teaching Note for this case, and "Japan's New Personalized Production," *Fortune* , October 22, 1990.

[3]A *hansha* (for "sales company") is a distributor more or less peculiar to Japan that is incorporated as an independent company but that is completely captive to a particular manufacturer. National Bicycle used ten hansha that had been established by Matsushita Electric and were run by ex-managers of Matsushita. The hansha carried only Panasonic bicycles that they bought from National Bicycle and resold to retailers in exclusive territories.

[4]A servomotor has an output shaft that can be set to a specific angular position based on a signal from a computer. Servos are used in a wide range of applications, from remote-controlled planes to robots.

[5]L. Kopczak and H. Lee, "Hewlett-Packard Company DeskJet Printer Supply Chain (A)," Case GS3A (Stanford, CA: Stanford Graduate School of Business, May 2001).

[6]Dana Canedy, "McDonald's Burger War Salvo: Is 'Made for You' the Way Folks Want to Have It?" *New York Times* ,

June 20, 1998.

[7]For additional details, see Marshall Fisher et al., “Making Supply Meet Demand in an Uncertain World,” *Harvard Business Review* , May–June 1994.

[8]G. N. Georgano, *Cars: Early and Vintage, 1886–1930* (London: Grange-Universal, 1985).

[9]One might also argue that labor costs have become a smaller portion of total costs and hence maximizing labor efficiency is less crucial.

Learning from Two Flexibility Champions: World and Zara

The discussion of National Bicycle has prepared us for a deeper look into two companies with which we began this chapter, World and Zara. [10] When we’re done with them, you’ll understand what they do to achieve flexibility.

World is headquartered in Kobe, Japan, called the country’s “fashion capital” because of the many apparel firms located there. A group of managers who left another apparel company, called Empire, started it. They chose “World” for their name because it underscored their ambition to be bigger than Empire. When we visited in 1998, the company had sales of more than $2 billion and more than five thousand stores. Its mantra was, “We make what’s selling rather than sell what we’ve made.” It can replenish a hot seller in two weeks, and in six weeks, it can design, produce, and stock new styles similar to a big seller.

Zara is located half a world away in La Coruña, a coastal city in the northwest corner of Spain. Zara’s founder, Amancio Ortega, began as an apparel maker in the 1960s and founded Zara, a retailer, in 1975 as a way to better understand the market for his wares. A decade later, he started Inditex, a parent company that sits atop Zara and several other retailers and suppliers that he’d also formed. Zara can replenish existing items in as little as two weeks and can design and produce new items in three weeks. It spends almost nothing on advertising and uses the savings to support the higher cost of producing in Spain, which enables the company to make what its customers want, not force on them what it has already made.

World’s and Zara’s supply chains are similar but not identical. Nearly all of World’s stores are in Japan, so it can colocate production with demand. Zara’s original stores were in Spain, but the company expanded into western Europe. It now sells in Europe, Latin America, the Middle East, and Asia. It replenishes all of its locations by air except for those in Mexico, which has more than 150 stores and its own distribution center.

Straightforward Steps to Flexibility

Many of the steps that World and Zara take to achieve their supply chain flexibility can be understood using the ideas developed in our analysis of National Bicycle. Both companies, for example, reserve production capacity far in advance and keep substantial inventory of undyed fabric. This is a logical decouple point because fabric production and factory capacity have long lead times, but demand for them is very predictable. To enable small-lot production, the companies employ skilled line workers, giving them flexibility to process smaller batches, and use efficient technologies such as laser cutting. Traditional fabric cutting requires a lot of labor, so manufacturers typically cut in layers of fifty or more sheets, which translates to a minimum batch size for a style and size of fifty or more. A computer-controlled laser can cut a single layer of fabric automatically, allowing a batch size of one and thus flexibility in responding to sales. Last, producing close to the market helps to reduce lead times, although the fact that Zara can quickly replenish its remote locations using airfreight shows that it’s not essential.

Some More Subtle Keys to Flexibility: Information and Empowerment

But if all it takes to be a World or a Zara is a laser cutter and an airplane, why aren’t more companies imitating them?

We had a chance to dig deeper when World’s CEO, Hidezo Terai, came to New York for the opening of a World store in SoHo. There, we arranged for him to meet with a group of Nine West senior executives with whom we were working. By U.S. standards, Nine West was no slouch in supply chain speed, achieving an eight-week lead time from factories in Brazil. After the usual introductions and small talk, a Nine West executive asked Terai to explain how World managed its two-week lead time.

After the translator posed the question, Terai answered for several minutes in Japanese. When he finished, the translator said, “Empowerment!” We were perplexed. Something had been lost in translation.

The Nine West executives pressed the point, saying they were eager to learn more about World's human resource management, too, but for the moment wanted to focus on the supply chain. Terai elaborated and, this time, so did his translator. Terai believed that most supply chain decisions required coordination between functions. Suppose, he said, you want to make more of a hot seller but can't get the buttons used in the original design. Your search for a substitute requires interaction between your design, purchasing, and factory staffs. Suppose that communication between these departments gets channeled through the departmental vice presidents, with the CEO weighing in to referee disputes. The season will end by the time you make a decision. To make quick decisions, Terai had created cross-functional teams that included operating personnel from design, buying, and production. The teams could make a wide range of decisions on production and design without consulting their bosses.

Both World and Zara empower their people in this way, and both expect them to respond quickly to changes in the market. World has separate merchandising teams for more than forty brands, creating an ability to spot emerging trends. Zara follows a similar approach, with narrowly focused teams of designers and product managers. These teams oversee the design, sourcing, and production of, say, women's sportswear. They're responsible for both the initial collection and in-season responses.

World introduces new designs into a factory using a process intended to eliminate production problems that might cause delays. Using measurements and patterns sent electronically to the factory from the corporate headquarters, members of the design production team make a sample garment and formulate detailed instructions to be used by line workers in producing the garment. The production designers can make design changes if, in making the samples, they encounter difficulties that they think could cause delays in the factory. A common change is to increase the allowance for a seam.

Responding quickly to sales data requires knowing not just what sold, as revealed in point-of-sale (POS) data, but also what would have sold had it been offered. To find out what could have sold, Zara store associates query customers. If someone tries on a garment but doesn't buy it, they'll ask why. Maybe the collar on a blouse was too pointy or the stripes too wide. Whatever the reason, associates report their market intelligence every day to their managers, who funnel it to country managers and the product teams. Any retailer can get sales reports; that's in their POS data. What they don't have is the *nonsales* data that Zara's associates provide—they lack information on the customers who entered their stores but left empty-handed because they didn't find what they wanted.

While less aggressive than Zara in collecting nonsales data, World also gathers it via weekly handwritten reports from each store. It's also diligent in ensuring accurate store sales and inventory data and making this data immediately available. Each morning, design teams have access to online reports showing the previous day's sales by store SKU. World works hard to keep its store-SKU data accurate. In its distribution center, employees scan product bar codes when they're finished picking to ensure that they send the right goods to the stores. Salespeople log the merchandise into computers at the stores, thus backstopping the distribution center's accuracy. World also does monthly stock counts in each store using bar-code scanning and compares the results with its computer records. Its staffers routinely document an average store-SKU inventory error rate of less than 1 percent of the quantity stocked. Zara is less zealous in maintaining its data, believing that 95 percent accuracy is good enough, because it relies on its store associates to make visual stock inspections as part of the ordering process.

Interpreting and responding to market signals can be even trickier than accurately tracking store SKUs. Many factors, including unexpected supply disruptions, can distort sales, undercutting their ability to reflect true demand. Miguel Diaz, CFO of Zara, likes to tell a story that points to the energy that his company devotes to understanding sales' zigzags. Before meeting with one of his buyers, he pored over a thick sales report for the products that the buyer oversaw. Diaz found one, out of hundreds listed, with an aberrant pattern. Its sales had been strong but had suddenly fallen. So he tested the buyer by asking him to explain what had happened. Nonchalantly, the buyer reached over to a rack of clothes, pulled out an item, and said, "You mean this one. We've had a transportation problem with the supplier, and that has interrupted supply to the stores, but I'm working on getting another truck and should have the problem solved later today." The staff at Zara understands the adage about success being 10 percent inspiration and 90 percent perspiration.

The effort that World devotes to forecasting and inventory planning similarly contributes to its supply chain flexibility. It consciously plans for quick reactions to the vicissitudes of market demand. It begins each of its thirteen-week seasons by developing an aggregate sales forecast for each category and each store based on prior category and store sales. To forecast the sales of individual items, World adopted and enhanced the Obermeyer committee forecast process that we described in chapter 3. [11] Before each season, its staff creates a store mock-up in the basement of its Tokyo office building, with next season's line displayed as it would be in a store. Several dozen store associates who have the same characteristics as World's target customers then spend a day in the store test-shopping next season's line. They try on garments, check out how they look on each other, and rate each SKU on a seven-point scale. They also rate fabrics and colors. World combines the rankings with its aggregate forecasts to create an item-level forecast. The company, for

example, knows that historically the top 10 percent ranked items account for 40 percent of sales. This fact can be used to create an item forecast from the aggregate forecast.

World buys and places in its stores half of the forecast demand for a style. On top of that, the factory and the fabric supplier each hold enough fabric to satisfy another 25 percent of demand. Thus the supply chain is primed to react to sales, with World, the factory, and the fabric supplier sharing the risk.

One thing distinguishes Zara and World. Zara produces in Spain to support sales across the globe, while World produces where its sells, in Japan. This suggests that while proximity to the market may be helpful to supply flexibility, it is not essential. What is important is a tight integration of design, merchandising, and production. Zara's planning *and* production facilities are in La Coruña. World's planning staff in Kobe is near to factories with which the company has close relationships. Both setups facilitate the integration of design, merchandising, and production.

[10]This section is based in part on the cases "Supply Chain Management at World, Ltd.," by Anna Sheen McClelland, Ananth Raman, and Marshall Fisher, Case 9-601-072 (Boston: Harvard Business School, 2001) and "Zara: IT for Fashion," by Andrew McAfee, Vincent Dessain, and Anders Sioman, Case 9-604-081 (Boston: Harvard Business School, 2007). The facts about World are accurate as of the time of the case.

[11]For additional details on the Obermeyer forecast process, see Marshall Fisher, Janice Hammond, Walter Obermeyer, and Ananth Raman, "Making Supply Meet Demand in an Uncertain World," *Harvard Business Review* , May–June 1994.

Partnering with Suppliers: The Path to Flexibility If You Don't Own Your Supply Chain

If you don't own your supply chain, you can still apply the ideas of this chapter by working in partnership with your suppliers. Best Buy exemplifies this approach. Soon after Kevin Freeland joined the company as senior vice president of inventory management in the mid-1990s, he launched a vendor collaboration that proved instrumental to its late-'90s turnaround. [12] Around 1997, Best Buy approached Compaq, then its largest computer vendor, but Compaq declined to work with the firm. Similarly, its number two vendor, IBM, turned it down. But number three, Hewlett-Packard, readily agreed to work on improving the supply chain. They called their effort Project Gemini, because, like the Gemini twins of Greek mythology, they believed that they were joined in battle against Dell.

One indicator of the project's success is how Best Buy and HP fared relative to their competitors. When the project was launched, Circuit City dominated consumer electronics, and Best Buy was flirting with closure. Today, their positions are reversed. Similarly, HP was a distant third in its business to Compaq and IBM. Since then, HP has acquired Compaq, and IBM has exited the personal computer business. Project Gemini was so successful that Best Buy subsequently extended it to all major vendors.

One exercise that Freeland engaged in with suppliers was lead-time mapping. He would gather everyone with supply chain responsibilities from a particular vendor, together with their counterparts from Best Buy, and have them write what they did on yellow sticky notes. He then drew a timeline on a whiteboard that began with the sourcing of the rawest of raw materials and stretched to the sale of the finished product in a Best Buy store. He'd next invite everyone to paste their stickies on the timeline where their activity happened.

Just through this simple process, he uncovered all sorts of inefficiencies. When he and his staff met with one of their Japanese computer vendors, for example, they found that Best Buy's people arrived Monday morning, looked at weekend sales, and sent an order to the vendor by noon. The vendor's personnel also arrived Monday morning, looked at orders received over the weekend, and set their weekly schedule, *also by noon* . And thus Best Buy's Monday orders would be put off for a week. In fact, Freeland and his team discovered delays like this all along the path from the factory to the store. At the end of the meeting, the most senior executive from the Japanese supplier present in the meeting handed Freeland his business card with a phone number written on the back. It turned out this was the fax number of the factory that made the products they had been discussing, and Freeland was asked to please fax directly to the factory the order they placed Monday at noon after reviewing weekend sales, thus taking many weeks of non-value-adding delay out of lead time.

[12]Freeland is currently chief operating officer, Advance Auto Parts.

Why Are Many Retailers So Inflexible?

The writer Leo Tolstoy observed in *Anna Karenina* that "happy families are all alike; every unhappy family is unhappy in its own way." Many ingredients create a happy family, and if all are present, bliss results. But if any are missing, misery rules. So it is, too, with flexible supply chains. Flexibility requires getting many things right. Miss one, and rigor mortis sets in.

Flexibility Is Hard to Value and Thus People Tend to Assume It Has Zero Value

As you design or tweak your supply chain, you have to make many decisions in which you weigh a slow and cheap alternative against a faster, more expensive one. Low costs are easy to see and measure, while flexibility enabled by speed isn't. Guess which factor usually gets the bigger weight? As a result, most supply chains are biased toward the slow and cheap. Even when one staffer or department wants to do the right thing, someone else will complain about the cost, forgetting that lost sales could dwarf the additional outlays.

Consider this tale from the senior vice president of merchandising for a major women's shoe retailer. She had a hot seller but was running out and wanted to buy another five thousand pairs. Her Hong Kong sourcing agent said it would take four months for the additional supply to arrive. By then, the season would have ended, and the chance to sell a fashion item like shoes would be gone. The vice president knew that actual production only took a week. If she had the shoes airfreighted, she could have them in stores within two weeks. She reasoned that if these shoes were hot for her, they were hot for other retailers too, and that the reason for the four-month lead time was that she had to wait in line behind other orders. Thinking it might move her to the front of the line, she told the agent to offer to pay the supplier $1 more per pair to fill her order within a week. Then she'd pony up for airfreight so she could receive the shoes in two weeks. This shoe sold for $80 and normally cost $30, so an additional $1 production cost and $4 for airfreight would only reduce the margin from $50 to $45.

The manufacturer agreed, and the vice president went to her CFO to get what she thought would be perfunctory approval. To her surprise, he rejected the deal, refusing to budge on the margin. This seems nonsensical—which is bigger, after all, $50 times 0 or $45 times 5,000? But it's too often how retailers think. They obsess over a few points of margin and refuse to pay for speed, which could reduce their margin percentage but would increase their total earnings.

The Trust Needed for Flexibility May Be Missing

Trust, or rather the lack of it, can erode supply chain flexibility just as quickly as rigid financial calculations do. Reacting quickly sometimes requires that your supply chain partners take risks on your behalf. If you seek short-term advantages at their expense, they won't be willing to put themselves out for you in the future.

An executive vice president of manufacturing for a women's sportswear apparel retailer, for example, told us of an initiative that he launched, with the encouragement of his company's buyers, to enable a better response to hot sellers. The company replaced its traditional point forecast of demand with high and low forecasts. The manufacturing department then made enough finished goods to meet the low forecast and bought enough extra fabric to cover the high forecast. The year that the vice president introduced this program, sales surged, and most of the extra fabric ended up as finished goods that the retailer sold. Not surprisingly, the buyers were thrilled.

The next season, sales slumped, leaving lots of extra fabric. When the manufacturing vice president asked the buyers to help cover the cost of the leftovers, the uniform response was, "No way! You bought it, not us." Needless to say, the vice president wasn't willing to do any speculative buying in the future.

This story clarifies the difficulty of World's program of having suppliers hold fabric. The suppliers wouldn't agree to it unless World strove to design new items that could absorb leftover fabric and helped its suppliers in other ways, such as ensuring a long-term relationship and significant sales.

A Virtuous Cycle: Reading and Reacting to Early Signals

An unwillingness to invest in accurate forecasting can lead to inflexibility, too. After all, to make what's selling, you have to not only know what's selling but also see it promptly. This kind of knowledge doesn't just come from the right software. You have to train your frontline staff to do their part in collecting solid sales data. Otherwise, you won't be able to distinguish between real trends and temporary blips.

To understand the importance of solid data in making these distinctions, consider our experience in working with American Pacific Enterprises (APE), a maker of quilts and comforters. We helped to create a market test for one of its products, which one of its leading retail accounts would conduct in its stores. Two of the test stores were in Chicago, where APE's CEO, Greg Block, happened to have had a long layover while traveling. He decided to visit the stores to see how the test was going. At the first store, when he introduced himself, the manager gushed about the new product. She'd displayed it prominently, and it was selling briskly. He left thrilled and headed to the next store. He was eager for another enthusiastic response. This time, the store manager looked perplexed and said that she didn't think she'd received his product. She checked the back room and found it in a corner, waiting to be logged in as received.

After this experience, we encouraged the retailer's supply chain vice president to display test merchandise uniformly. His

wry response: “We can ask, but we can’t control.”

This story illustrates how hard it can be to get accurate feedback from the sales floor and shows why Zara puts so much energy into working with its sales staff to gather daily market intelligence.

What we’ve often seen with retailers is a vicious cycle: long lead times discourage making the effort to accurately read sales, and the inability to read sales becomes a reason for not bothering to reduce lead time. Thus *retailers fail to plan to react* . They buy exactly what they have forecast will sell, and any reaction is just a scramble to chase a hot seller. Smart reaction, in contrast, requires preparation, just like an audible play in football. That preparation includes all of the activities that we have covered in this chapter, such as prepositioning fabric and production capacity and buying less inventory up front because you know you’ll be able to get more if you need it.

How Much Flexibility Do You Need?

Creating a flexible supply chain requires a big commitment of effort over a long time, so it’s reasonable to ask whether the payoff is worth the cost and toil. In seeking an answer, consider the record of World and Zara.

When World was publically traded, its stock price appreciation significantly outperformed its Japanese competitors. Similarly, Zara’s financial success over the last few years has been stellar. Figure 4-4 shows the stock price performance of Inditex, its parent, compared with Limited Brands and Gap Inc.

What’s more, Zara recently reported gross margins of a remarkable 57 percent. Compare this with the typical specialty apparel retailer, where gross margins might start at 60 percent to 70 percent but, after end-of-season markdowns, end up at 40 percent. The higher initial margin reflects the lower cost of sourcing from cheaper suppliers, but the severe margin erosion from markdowns happens because cheaper suppliers are farther away and slower. By contrast, Zara starts with a lower gross margin because of more expensive local production but marks down less merchandise and ends the season with a gross margin not much lower than its initial margin.

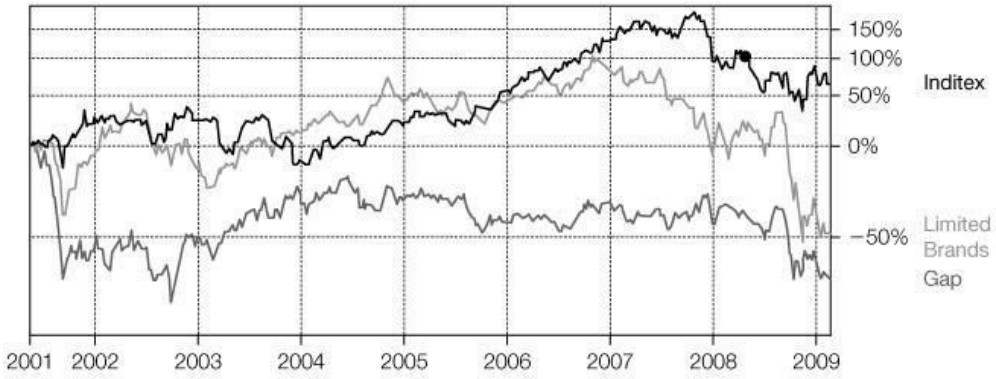

FIGURE 4-4: Stock price for comparison of Inditex with Limited Brands and Gap

World and Zara show that flexibility works, but we don’t think this constitutes a proof of the business case; too many factors affect a company’s performance to chalk up success to any one ingredient. A more appropriate question for a particular retailer is, What is the right level of flexibility for your situation?

Balancing Accurate Forecasts, Flexibility, and Inventory

Retailers have three tactics at their disposal for matching supply with demand: accurate forecasting, supply flexibility, and inventory stockpiling.

Accurate forecasting, where it’s possible, creates the most cost-effective supply chain. If you can forecast demand accurately far enough in advance, you can enable mass production under push control. A company rarely can do this for all of its products, but every firm has some aspects of its business that are predictable (usually total volume), some components that are common to a large number of products, and some products with strong, stable demand. This enables push planning. You might, for example, farm out production to low-cost countries like China, which are remote from the market.

There are many ways to increase forecast accuracy. Retailers, when they see how fickle consumers are, try to stick a little longer with established products or to emphasize basics over innovative offerings. Basics usually earn lower margins, but

many retailers have created highly profitable businesses by selling them. These retailers can operate well with a less flexible supply chain, because basic merchandise tends to have more stable and predictable demand.

Retailers can also increase forecast accuracy through advertising that attempts to sell what they've made. Gap stands out as a company that has had success with basic product positioning and a "sell what we make" approach, which its executives call "standing for something."

Once the potential for accurate forecasting has been exhausted, supply flexibility comes next, using the techniques described in this chapter. Stockpiling inventory, because it's the most expensive tactic of the three, should be used only after you've pushed accurate forecasting and supply flexibility to their limits.

Unfortunately, for all too many retailers, stocking inventory is the beginning point for matching supply with demand, rather than the residual after working diligently on forecasting and flexibility. They combine a rigid supply chain with low forecast accuracy, and the only way they can maintain reasonable in-stock rates is by carrying excessive inventory. They get their comeuppance at the end of the season, when they must clear all of that inventory with markdowns, which hurts profits and can erode a store's brand image. Department stores often use this approach.

If a retailer has enough market power, it can get its suppliers to share some or all of the cost of markdowns. Some department stores have managed to do this. But muscling people with your market power can go both ways. Nike has used its market power to force retailers to place noncancelable orders for shoes several months in advance of the season. Needless to say, these sorts of tactics don't build long-term loyalty.

Smart retailers, in contrast, make supply chain flexibility a cornerstone of their strategy. And most of them find it prudent to use a blend of inexpensive, slow suppliers and fast, expensive ones. Zara, for example, manufactures its most unpredictable items locally, in Spain, Portugal, and Morocco, and produces its more predictable products in Turkey and Asia, where the lead time can be as long as four months.

Destination Maternity, the maternity wear designer and retailer in Philadelphia, excels at this approach. It sells through two subsidiary retail chains—A Pea in the Pod and Motherhood Maternity—as well as through department stores such as Kohl's.

The husband-and-wife team of Dan and Rebecca Matthias founded Destination Maternity. Both Dan and Rebecca trained and worked as engineers before starting the company, and they've used their engineering skills to fine-tune their company's supply chain. As with World and Zara, their lodestar is to design and produce in response to sales, and their lead times for design and sourcing resemble World's and Zara's. Destination Maternity has three categories of suppliers, ranging from quick and costly ones (two-week lead time, produced in Philadelphia) to slow and cheap ones (four-month lead time, produced in China). It achieves an intermediate lead time and cost by sourcing from Latin America. To keep store inventory fresh, it does multiple deliveries per week of fast-selling garments and weekly pickups of products that aren't selling, so they can be transferred to other stores.

Destination Maternity's approach shows not only the benefits of flexibility but also when it pays to invest in the most flexible, responsive supply chain. Maximum flexibility makes sense for high-margin products with unpredictable demand. The high margin makes a high level of product availability profitable, and the unpredictable demand makes this hard to achieve without a flexible supply chain.

If your supply chain isn't as flexible as World's, Zara's, and Destination Maternity's, you're leaving money on the table—lots of it. Product sales are hard to predict. Some items will sell dramatically better than predicted; others worse. Being able to respond quickly to unexpected surges in demand thus can have a huge impact on your profitability. It means that you can buy less initially, knowing you can chase your winners, and it means fewer markdowns at the end of the season. For a retailer, supply chain flexibility cures your two biggest headaches—having too few of the right products and too many of the wrong ones—and thus brings greater profits.