
The Triple-A Supply Chain

by Hau L. Lee

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The 21st Century Supply Chain

Managing the modern supply chain is a job that involves specialists in manufacturing, purchasing, and distribution, of course. But today it is also vital to the work of chief financial officers, chief information officers, operations and customer service executives, and certainly chief executives. Changes in supply chain management have been truly revolutionary, and the pace of progress shows no sign of moderating. In our increasingly interconnected and interdependent global economy, the process of delivering supplies and finished goods (and information and other business services) from one place to another is accomplished by means of mind-boggling technological innovations, clever new applications of old ideas, seemingly magical mathematics, powerful software, and old-fashioned concrete, steel, and muscle.

An end-to-end, top-to-bottom transformation of the twenty-first-century supply chain is shaping the agenda for senior managers now and will continue to do so for years to come. With this special series of articles, *Harvard Business Review* examines how corporations' strategies and structures are changing and how those changes are manifest in their supply chains.

The Articles

The Triple-A Supply Chain

by Hau L. Lee

October 2004

The best supply chains aren't just fast and cost-effective. They are also agile and adaptable, and they ensure that all their companies' interests stay aligned.

Reprint R0410F; OnPoint 8096

Leading a Supply Chain Turnaround

by Reuben E. Slone

October 2004

Five years ago, salespeople at Whirlpool said the company's supply chain staff were "sales disablers." Now, Whirlpool excels at getting the right product to the right place at the right time—while keeping inventory low. What made the difference?

Reprint R0410G

Aligning Incentives in Supply Chains

by V.G. Narayanan and Ananth Raman

November 2004

A supply chain stays tight only if every company in the chain has reasons to pull in the same direction.

Reprint R0411F; OnPoint 8363

Rapid-Fire Fulfillment

by Kasra Ferdows, Michael A. Lewis, and Jose A.D. Machuca

November 2004

Spanish clothier Zara turns the rules of supply chain management on their head. The result? A superresponsive network and profit margins that are the envy of the industry.

Reprint R0411G

Building Deep Supplier Relationships

by Jeffrey K. Liker and Thomas Y. Choi

December 2004

Two Japanese automakers have had stunning success building relationships with North American suppliers—often the same supplier companies that have had contentious dealings with Detroit's Big Three. What are Toyota and Honda doing right that their American counterparts are missing?

Reprint R0412G

We're in This Together

by Douglas M. Lambert and A. Michael Knemeyer

December 2004

If your latest supply chain partnership failed to live up to expectations, as so many do, it's probably because you never stated your expectations in the first place.

Reprint R0412H

The Triple-A Supply Chain

The Idea in Brief

The holy grails of supply chain management are high speed and low cost—or are they? Though necessary, they aren't sufficient to give companies a sustainable competitive advantage over rivals. Consider these disturbing statistics: Though U.S. supply chains became significantly faster and cheaper between 1980 and 2000, product markdowns owing to excess inventory jumped from 10% to 30% of total units sold—while customer satisfaction with product availability plummeted.

But some companies—Wal-Mart, Amazon.com, Dell Computer—have bucked these trends. How? Their supply chains aren't *just* fast and cost-effective. They're also:

- **Agile:** They respond quickly to sudden changes in supply or demand. They handle unexpected external disruptions smoothly and cost-efficiently. And they recover promptly from shocks such as natural disasters, epidemics, and computer viruses.
- **Adaptable:** They evolve over time as economic progress, political shifts, demographic trends, and technological advances reshape markets.
- **Aligned:** They align the interests of all participating firms in the supply chain with their own. As each player maximizes its own interests, it optimizes the chain's performance as well.

To achieve sustainable competitive advantage, your supply chain needs *all three* of these qualities. Apply the following practices to create agility, adaptability, *and* alignment.

The Idea in Practice

AGILITY

Objective: Respond to short-term changes in demand or supply quickly.

Methods:

- Continuously provide supply chain partners with data on changes in supply and demand so they can respond promptly.
- Collaborate with suppliers and customers to redesign processes, components, and products in ways that give you a head start over rivals.
- Finish products only when you have accurate information on customer preferences.
- Keep a small inventory of inexpensive, non-bulky product components to prevent manufacturing delays.

ADAPTABILITY

Objective: Adjust supply chain design to accommodate market changes.

Methods:

- Track economic changes, especially in developing countries.
- Use intermediaries to find reliable vendors in unfamiliar parts of the world.
- Create flexibility by ensuring that different products use the same components and production processes.
- Create different supply chains for different product lines, to optimize capabilities for each. For example, with highly customized, low-volume products, use vendors close to your main markets. For standard, high-volume products, commission contract manufacturers in low-cost countries.

ALIGNMENT

Objectives: Establish incentives for supply chain partners to improve performance of the entire chain.

Methods:

- Provide all partners with equal access to forecasts, sales data, and plans.
- Clarify partners' roles and responsibilities to avoid conflict.
- Redefine partnership terms to share risks, costs, and rewards for improving supply chain performance.
- Align incentives so that players maximize overall chain performance while also maximizing their returns from the partnership.

► Example:

Convenience-store chain Seven-Eleven Japan (SEJ) builds supply chain **agility** by using real-time systems to detect changes in customer preferences and track sales and customer data at every store. Satellite connections link stores with distribution centers, suppliers, and logistics providers. SEJ reallocates inventory among stores and reconfigures store shelves three times daily to cater to different customer groups at different hours.

SEJ's **adaptability** is legendary. Within six hours after the 1995 Kobe earthquake, SEJ overcame highway gridlock by mobilizing helicopters and motorcycles to deliver 64,000 rice balls to its stores in the beleaguered city.

SEJ fosters **alignment** by making partners' incentives and disincentives clear. For example, when carriers fail to deliver on time, they pay a penalty. But SEJ also helps carriers save money by forgoing the typical time-consuming requirement that store managers verify all contents of each delivery truck.

The best supply chains aren't just fast and cost-effective. They are also agile and adaptable, and they ensure that all their companies' interests stay aligned.

The Triple-A Supply Chain

by Hau L. Lee

During the past decade and a half, I've studied from the inside more than 60 leading companies that focused on building and rebuilding supply chains to deliver goods and services to consumers as quickly and inexpensively as possible. Those firms invested in state-of-the-art technologies, and when that proved to be inadequate, they hired top-notch talent to boost supply chain performance. Many companies also teamed up to streamline processes, lay down technical standards, and invest in infrastructure they could share. For instance, in the early 1990s, American apparel companies started a Quick Response initiative, grocery companies in Europe and the United States touted a program called Efficient Consumer Response, and the U.S. food service industry embarked on an Efficient Foodservice Response program.

All those companies and initiatives persistently aimed at greater speed and cost-effectiveness—the popular grails of supply chain management. Of course, companies' quests changed with the industrial cycle: When business was

booming, executives concentrated on maximizing speed, and when the economy headed south, firms desperately tried to minimize supply costs.

As time went by, however, I observed one fundamental problem that most companies and experts seemed to ignore: *Ceteris paribus*, companies whose supply chains became more efficient and cost-effective didn't gain a sustainable advantage over their rivals. In fact, the performance of those supply chains steadily deteriorated. For instance, despite the increased efficiency of many companies' supply chains, the percentage of products that were marked down in the United States rose from less than 10% in 1980 to more than 30% in 2000, and surveys show that consumer satisfaction with product availability fell sharply during the same period.

Evidently, it isn't by becoming more efficient that the supply chains of Wal-Mart, Dell, and Amazon have given those companies an edge over their competitors. According to my research, top-performing supply

chains possess three very different qualities. First, great supply chains are agile. They react speedily to sudden changes in demand or supply. Second, they adapt over time as market structures and strategies evolve. Third, they align the interests of all the firms in the supply network so that companies optimize the chain's performance when they maximize their interests. Only supply chains that are agile, adaptable, and aligned provide companies with sustainable competitive advantage.

The Perils of Efficiency

Why haven't efficient supply chains been able to deliver the goods? For several reasons. High-speed, low-cost supply chains are unable to respond to unexpected changes in demand or supply. Many companies have centralized manufacturing and distribution facilities to generate scale economies, and they deliver only container loads of products to customers to minimize transportation time, freight costs, and the number of deliveries. When demand for a particular brand, pack size, or assortment rises without warning, these organizations are unable to react even if they have the items in stock. According to two studies I helped conduct in the 1990s, the required merchandise was often already in factory stockyards, packed and ready to ship, but it couldn't be moved until each container was full. That "best" practice delayed shipments by a week or more, forcing stocked-out stores to turn away consumers. No wonder then that, according to another recent research report, when companies announce product promotions, stock outs rise to 15%, on average, even when executives have primed supply chains to handle demand fluctuations.

When manufacturers eventually deliver additional merchandise, it results in excess inventory because most distributors don't need a container load to satisfy the increased demand. To get rid of the stockpile, companies mark down those products sooner than they had planned to. That's partly why department stores sell as much as a third of their merchandise at discounted prices. Those markdowns not only reduce companies' profits but also erode brand equity and anger loyal customers who bought the items at full price in the recent past (sound familiar?).

Companies' obsession with speed and costs also causes supply chains to break down during

the launch of new products. Some years ago, I studied a well-known consumer electronics firm that decided not to create a buffer stock before launching an innovative new product. It wanted to keep inventory costs low, particularly since it hadn't been able to generate an accurate demand forecast. When demand rose soon after the gizmo's launch and fell sharply thereafter, the company pressured vendors to boost production and then to slash output. When demand shot up again a few weeks later, executives enthusiastically told vendors to step up production once more. Five days later, supplies of the new product dried up as if someone had turned off a tap.

The shocked electronics giant discovered that vendors had been so busy ramping production up and down that they hadn't found time to fix bugs in both the components' manufacturing and the product's assembly processes. When the suppliers tried to boost output a second time, product defects rose to unacceptable levels, and some vendors, including the main assembler, had to shut down production lines for more than a week. By the time the suppliers could fix the glitches and restart production, the innovation was all but dead. If the electronics company had given suppliers a steady, higher-than-needed manufacturing schedule until both the line and demand had stabilized, it would have initially had higher inventory costs, but the product would still be around.

Efficient supply chains often become uncompetitive because they don't adapt to changes in the structures of markets. Consider Lucent's Electronic Switching Systems division, which set up a fast and cost-effective supply chain in the late 1980s by centralizing component procurement, assembly and testing, and order fulfillment in Oklahoma City. The supply chain worked brilliantly as long as most of the demand for digital switches emanated from the Americas and as long as Lucent's vendors were mostly in the United States. However, in the 1990s, when Asia became the world's fastest-growing market, Lucent's response times increased because it hadn't set up a plant in the Far East. Furthermore, the company couldn't customize switches or carry out modifications because of the amount of time and money it took the supply chain to do those things across continents.

Lucent's troubles deepened when vendors

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shifted manufacturing facilities from the United States to Asia to take advantage of the lower labor costs there. “We had to fly components from Asia to Oklahoma City and fly them back again to Asia as finished products. That was costly and time consuming,” Lucent’s then head of manufacturing told me. With tongue firmly in cheek, he added, “Neither components nor products earned frequent-flyer miles.” When Lucent redesigned its supply chain in 1996 by setting up joint ventures in Taiwan and China to manufacture digital switches, it did manage to gain ground in Asia.

In this and many other cases, the conclusion would be the same: Supply chain efficiency is necessary, but it isn’t enough to ensure that firms will do better than their rivals. Only those companies that build agile, adaptable, and aligned supply chains get ahead of the competition, as I pointed out earlier. In this article, I’ll expand on each of those qualities and explain how companies can build them into supply chains without having to make trade-offs. In fact, I’ll show that any two of these dimensions alone aren’t enough. Only companies that build all three into supply chains become better faster than their rivals. I’ll conclude by describing how Seven-Eleven Japan has become one of the world’s most profitable retailers by building a truly “triple-A” supply chain.

Fostering Agility

Great companies create supply chains that re-

spond to sudden and unexpected changes in markets. Agility is critical, because in most industries, both demand and supply fluctuate more rapidly and widely than they used to. Most supply chains cope by playing speed against costs, but agile ones respond both quickly and cost-efficiently.

Most companies continue to focus on the speed and costs of their supply chains without realizing that they pay a big price for disregarding agility. (See the sidebar “The Importance of Being Agile.”) In the 1990s, whenever Intel unveiled new microprocessors, Compaq took more time than its rivals to launch the next generation of PCs because of a long design cycle. The company lost mind share because it could never count early adopters, who create the buzz around high-tech products, among its consumers. Worse, it was unable to compete on price. Because its products stayed in the pipeline for a long time, the company had a large inventory of raw materials. That meant Compaq didn’t reap much benefit when component prices fell, and it couldn’t cut PC prices as much as its rivals were able to. When vendors announced changes in engineering specifications, Compaq incurred more reworking costs than other manufacturers because of its larger work-in-progress inventory. The lack of an agile supply chain caused Compaq to lose PC market share throughout the decade.

By contrast, smart companies use agile supply chains to differentiate themselves from rivals. For instance, H&M, Mango, and Zara

Building the Triple-A Supply Chain

Agility

Objectives:

Respond to short-term changes in demand or supply quickly; handle external disruptions smoothly.

Methods:

- Promote flow of information with suppliers and customers.
- Develop collaborative relationships with suppliers.
- Design for postponement.
- Build inventory buffers by maintaining a stockpile of inexpensive but key components.
- Have a dependable logistics system or partner.
- Draw up contingency plans and develop crisis management teams.

Adaptability

Objectives:

Adjust supply chain’s design to meet structural shifts in markets; modify supply network to strategies, products, and technologies.

Methods:

- Monitor economies all over the world to spot new supply bases and markets.
- Use intermediaries to develop fresh suppliers and logistics infrastructure.
- Evaluate needs of ultimate consumers—not just immediate customers.
- Create flexible product designs.
- Determine where companies’ products stand in terms of technology cycles and product life cycles.

Alignment

Objective:

Create incentives for better performance.

Methods:

- Exchange information and knowledge freely with vendors and customers.
- Lay down roles, tasks, and responsibilities clearly for suppliers and customers.
- Equitably share risks, costs, and gains of improvement initiatives.

have become Europe's most profitable apparel brands by building agility into every link of their supply chains. At one end of their product pipelines, the three companies have created agile design processes. As soon as designers spot possible trends, they create sketches and order fabrics. That gives them a head start over competitors because fabric suppliers require the longest lead times. However, the companies finalize designs and manufacture garments only after they get reliable data from stores. That allows them to make products that meet consumer tastes and reduces the number of items they must sell at a discount. At the other end of the pipeline, all three companies have superefficient distribution centers. They use state-of-the-art sorting and material-handling technologies to ensure that distribution doesn't become a bottleneck when they must respond to demand fluctuations. H&M, Mango, and Zara have all grown at more than 20% annually since 1990, and their double-digit net profit margins are the envy of the industry.

Agility has become more critical in the past few years because sudden shocks to supply

chains have become frequent. The terrorist attack in New York in 2001, the dockworkers' strike in California in 2002, and the SARS epidemic in Asia in 2003, for instance, disrupted many companies' supply chains. While the threat from natural disasters, terrorism, wars, epidemics, and computer viruses has intensified in recent years, partly because supply lines now traverse the globe, my research shows that most supply chains are incapable of coping with emergencies. Only three years have passed since 9/11, but U.S. companies have all but forgotten the importance of drawing up contingency plans for times of crisis.

Without a doubt, agile supply chains recover quickly from sudden setbacks. In September 1999, an earthquake in Taiwan delayed shipments of computer components to the United States by weeks and, in some cases, by months. Most PC manufacturers, such as Compaq, Apple, and Gateway, couldn't deliver products to customers on time and incurred their wrath. One exception was Dell, which changed the prices of PC configurations overnight. That allowed the company to steer consumer demand away from hardware built with components that weren't available toward machines that didn't use those parts. Dell could do that because it got data on the earthquake damage early, sized up the extent of vendors' problems quickly, and implemented the plans it had drawn up to cope with such eventualities immediately. Not surprisingly, Dell gained market share in the earthquake's aftermath.

Nokia and Ericsson provided a study in contrasts when in March 2000, a Philips facility in Albuquerque, New Mexico, went up in flames. The plant made radio frequency (RF) chips, key components for mobile telephones, for both Scandinavian companies. When the fire damaged the plant, Nokia's managers quickly carried out design changes so that other companies could manufacture similar RF chips and contacted backup sources. Two suppliers, one in Japan and another in the United States, asked for just five days' lead time to respond to Nokia. Ericsson, meanwhile, had been weeding out backup suppliers because it wanted to trim costs. It didn't have a plan B in place and was unable to find new chip suppliers. Not only did Ericsson have to scale back production for months after the fire, but it also had to delay the launch of a major new product. The bottom

The Importance of Being Agile

Most companies overlook the idea that supply chains should be agile. That's understandable; adaptability and alignment are more novel concepts than agility is. However, even if your supply chain is both adaptable and aligned, it's dangerous to disregard agility.

In 1995, Hewlett-Packard teamed up with Canon to design and launch ink-jet printers. At the outset, the American company aligned its interests with those of its Japanese partner. While HP took on the responsibility of producing printed circuit boards (or "formatters"), Canon agreed to manufacture engines for the LaserJet series. That was an equitable division of responsibilities, and the two R&D teams learned to work together closely. After launching the LaserJet, HP and Canon quickly adapted the supply network to the product's markets. HP used its manufacturing facilities in Idaho and Italy to support the LaserJet, and

Canon used plants in West Virginia and Tokyo.

But HP and Canon failed to anticipate one problem. To keep costs down, Canon agreed to alter the number of engines it produced, but only if HP communicated changes well in advance—say, six or more months before printers entered the market. However, HP could estimate demand accurately only three or fewer months before printers hit the market. At that stage, Canon could modify its manufacturing schedule by just a few percentage points. As a result, the supply chain couldn't cope with sudden fluctuations in demand. So when there was an unexpected drop in demand for the LaserJet III toward the end of its life cycle, HP was stuck with a huge and expensive surplus of printer engines: the infamous LaserJet mountain. Having an adaptable and aligned supply chain didn't help HP overcome its lack of agility.

line: Nokia stole market share from Ericsson because it had a more agile supply chain.

Companies can build agility into supply chains by adhering to six rules of thumb:

- Provide data on changes in supply and demand to partners continuously so they can respond quickly. For instance, Cisco recently created an e-hub, which connects suppliers and the company via the Internet. This allows all the firms to have the same demand and supply data at the same time, to spot changes in demand or supply problems immediately, and to respond in a concerted fashion. Ensuring that there are no information delays is the first step in creating an agile supply chain.

- Develop collaborative relationships with suppliers and customers so that companies work together to design or redesign processes, components, and products as well as to prepare backup plans. For instance, Taiwan Semiconductor Manufacturing Company (TSMC), the world's largest semiconductor foundry, gives suppliers and customers proprietary tools, data, and models so they can execute design and engineering changes quickly and accurately.

- Design products so that they share common parts and processes initially and differ substantially only by the end of the production process. I call this strategy "postponement." (See the 1997 HBR article I coauthored with Edward Feitzinger, "Mass Customization at Hewlett-Packard: The Power of Postponement.") This is often the best way to respond quickly to demand fluctuations because it allows firms to finish products only when they have accurate information on consumer preferences. Xilinx, the world's largest maker of programmable logic chips, has perfected the art of postponement. Customers can program the company's integrated circuits via the Internet for different applications after purchasing the basic product. Xilinx rarely runs into inventory problems as a result.

- Keep a small inventory of inexpensive, nonbulky components that are often the cause of bottlenecks. For example, apparel manufacturers H&M, Mango, and Zara maintain supplies of accessories such as decorative buttons, zippers, hooks, and snaps so that they can finish clothes even if supply chains break down.

- Build a dependable logistics system that can enable your company to regroup quickly in response to unexpected needs. Companies don't need to invest in logistics systems them-

selves to reap this benefit; they can strike alliances with third-party logistics providers.

- Put together a team that knows how to invoke backup plans. Of course, that's only possible only if companies have trained managers and prepared contingency plans to tackle crises, as Dell and Nokia demonstrated.

Adapting Your Supply Chain

Great companies don't stick to the same supply networks when markets or strategies change. Rather, such organizations keep adapting their supply chains so they can adjust to changing needs. Adaptation can be tough, but it's critical in developing a supply chain that delivers a sustainable advantage.

Most companies don't realize that in addition to unexpected changes in supply and demand, supply chains also face near-permanent changes in markets. Those structural shifts usually occur because of economic progress, political and social change, demographic trends, and technological advances. Unless companies adapt their supply chains, they won't stay competitive for very long. Lucent twice woke up

Adaptation of the Fittest

Many executives ask me, with a twinkle in their eye, if companies must really keep adapting supply chains. Companies may find it tough to accept the idea that they have to keep changing, but they really have no choice.

Just ask Lucent. In the mid-1990s, when the American telecommunications giant realized that it could make inroads in Asia only if had local manufacturing facilities, it overhauled its supply chain. Lucent set up plants in Taiwan and China, which allowed the company to customize switches as inexpensively and quickly as rivals Siemens and Alcatel could. To align the interests of parent and subsidiaries, Lucent executives stopped charging the Asian ventures inflated prices for modules that the company shipped from the United States. By the late 1990s, Lucent had recaptured market share in China, Taiwan, India, and Indonesia.

Unhappily, the story doesn't end

there, because Lucent stopped adapting its supply chain. The company didn't realize that many medium-sized manufacturers had developed the technology and expertise to produce components and subassemblies for digital switches and that because of economies of scale, they could do so at a fraction of the integrated manufacturers' costs. Realizing where the future lay, competitors aggressively outsourced the manufacture of switching systems. Because of the resulting cost savings, they were able to quote lower prices than Lucent. Meanwhile, Lucent was reluctant to outsource its manufacturing because it had invested in its own factories. Ultimately, however, Lucent had no option but to shut down its Taiwan factory in 2002 and create an outsourced supply chain. The company's adaptation came too late for Lucent to regain control of the global market, even though the supply chain was agile and aligned.

The best supply chains identify structural shifts, sometimes before they occur, by capturing the latest data, filtering out noise, and tracking key patterns.

late to industry shifts, first to the rise of the Asian market and later to the advantages of outsourced manufacturing. (See the sidebar “Adaptation of the Fittest.”) Lucent recovered the first time, but the second time around, the company lost its leadership of the global telecommunications market because it didn’t adapt quickly enough.

The best supply chains identify structural shifts, sometimes before they occur, by capturing the latest data, filtering out noise, and tracking key patterns. They then relocate facilities, change sources of supplies, and, if possible, outsource manufacturing. For instance, when Hewlett-Packard started making ink-jet printers in the 1980s, it set up both its R&D and manufacturing divisions in Vancouver, Washington. HP wanted the product development and production teams to work together because ink-jet technology was in its infancy, and the biggest printer market was in the United States. When demand grew in other parts of the world, HP set up manufacturing facilities in Spain and Singapore to cater to Europe and Asia. Although Vancouver remained the site where HP developed new printers, Singapore became the largest production facility because the company needed economies of scale to survive. By the mid-1990s, HP realized that printer-manufacturing technologies had matured and that it could outsource production to vendors completely. By doing so, HP was able to reduce costs and remain the leader in a highly competitive market.

Adaptation needn’t be just a defensive tactic. Companies that adapt supply chains when they modify strategies often succeed in launching new products or breaking into new markets. Three years ago, when Microsoft decided to enter the video game market, it chose to outsource hardware production to Singapore-based Flextronics. In early 2001, the vendor learned that the Xbox had to be in stores before December because Microsoft wanted to target Christmas shoppers. Flextronics reckoned that speed to market and technical support would be crucial for ensuring the product’s successful launch. So it decided to make the Xbox at facilities in Mexico and Hungary. The sites were relatively expensive, but they boasted engineers who could help Microsoft make design changes and modify engineering specs quickly. Mexico and Hungary were also close to the Xbox’s biggest

target markets, the United States and Europe. Microsoft was able to launch the product in record time and mounted a stiff challenge to market leader Sony’s PlayStation 2. Sony fought back by offering deep discounts on the product. Realizing that speed would not be as critical for medium-term survival as costs would be, Flextronics shifted the Xbox’s supply chain to China. The resulting cost savings allowed Microsoft to match Sony’s discounts and gave it a fighting chance. By 2003, the Xbox had wrested a 20% share of the video game market from PlayStation 2.

Smart companies tailor supply chains to the nature of markets for products. They usually end up with more than one supply chain, which can be expensive, but they also get the best manufacturing and distribution capabilities for each offering. For instance, Cisco caters to the demand for standard, high-volume networking products by commissioning contract manufacturers in low-cost countries such as China. For its wide variety of mid-value items, Cisco uses vendors in low-cost countries to build core products but customizes those products itself in major markets such as the United States and Europe. For highly customized, low-volume products, Cisco uses vendors close to main markets, such as Mexico for the United States and Eastern European countries for Europe. Despite the fact that it uses three different supply chains at the same time, the company is careful not to become less agile. Because it uses flexible designs and standardized processes, Cisco can switch the manufacture of products from one supply network to another when necessary.

Gap, too, uses a three-pronged strategy. It aims the Old Navy brand at cost-conscious consumers, the Gap line at trendy buyers, and the Banana Republic collection at consumers who want clothing of higher quality. Rather than using the same supply chain for all three brands, Gap set up Old Navy’s manufacturing and sourcing in China to ensure cost efficiency, Gap’s chain in Central America to guarantee speed and flexibility, and Banana Republic’s supply network in Italy to maintain quality. The company consequently incurs higher overheads, lower scale economies in purchasing and manufacturing, and larger transportation costs than it would if it used just one supply chain. However, since its brands cater to different consumer segments, Gap uses different

kinds of supply networks to maintain distinctive positions. The adaptation has worked. Many consumers don't realize that Gap owns all three brands, and the three chains serve as backups in case of emergency.

Sometimes it's difficult for companies to define the appropriate markets, especially when they are launching innovative new products. The trick is to remember that products embody different levels of technology. For instance, after records came cassettes and then CDs. Videotapes were followed by DVDs, and almost anything analog is now or will soon become digital. Also, every product is at a certain stage of its life cycle, whether it's at the infant, ramp-up, mature, or end-of-life stage. By mapping either or both of those characteristics to supply chain partners, manufacturing network, and distribution system, companies can develop optimal supply chains for every product or service they offer.

For example, Toyota was convinced that the market for the Prius, the hybrid car it launched in the United States in 2000, would be different from that of other models because it embodied new technologies and was in its infancy. The Japanese automobile maker had expertise in tracking U.S. trends and geographical preferences, but it felt that it would be difficult to predict consumer response to a hybrid car. Besides, the Prius might appeal to particular consumer segments, such as technophiles and conservationists, which Toyota didn't know much about. Convinced that the uncertainties were too great to allocate the Prius to dealers based on past trends, Toyota decided to keep inventory in central stockyards. Dealers took orders from consumers and communicated them via the Internet. Toyota shipped cars from stockyards, and dealers delivered them to buyers.

Although Toyota's transportation costs rose, it customized products to demand and managed inventory flawlessly. In 2002, for example, the number of Toyotas on the road in Northern California and the Southeast were 7% and 20%, respectively. However, Toyota sold 25% of its Prius output in Northern California and only 6% in the Southeast. Had Toyota not adapted its distribution system to the product, it would have faced stock outs in Northern California and been saddled with excess inventory in the Southeast, which may well have resulted in the product's failure.

Building an adaptable supply chain requires two key components: the ability to spot trends and the capability to change supply networks. To identify future patterns, it's necessary to follow some guidelines:

- Track economic changes, especially in developing countries, because as nations open up their economies to global competition, the costs, skills, and risks of global supply chain operations change. This liberalization results in the rise of specialized firms, and companies must periodically check to see if they can outsource more stages of operation. Before doing so, however, they must make sure that the infrastructure to link them with vendors and customers is in place. Global electronics vendors, such as Flextronics, Solectron, and Foxcom, have become adept at gathering data and adapting supply networks.

- Decipher the needs of your ultimate consumers—not just your immediate customers. Otherwise, you may fall victim to the “bullwhip effect,” which amplifies and distorts demand fluctuations. For years, semiconductor manufacturers responded to customer forecasts and created gluts in markets. But when they started tracking demand for chip-based products, the manufacturers overcame the problem. For instance, in 2003, there were neither big inventory buildups nor shortages of semiconductors.

At the same time, companies must retain the option to alter supply chains. To do that, they must do two things:

- They must develop new suppliers that complement existing ones. When smart firms work in relatively unknown parts of the world, they use intermediaries like Li & Fung, the Hong Kong-based supply chain architects, to find reliable vendors.

- They must ensure that product design teams are aware of the supply chain implications of their designs. Designers must also be familiar with the three design-for-supply principles: commonality, which ensures that products share components; postponement, which delays the step at which products become different; and standardization, which ensures that components and processes for different products are the same. These principles allow firms to execute engineering changes whenever they adapt supply chains.

Creating the Right Alignment

Great companies take care to align the inter-

ests of all the firms in their supply chain with their own. That's critical, because every firm—be it a supplier, an assembler, a distributor, or a retailer—tries to maximize only its own interests. (See the sidebar “The Confinement of Nonalignment.”) If any company's interests differ from those of the other organizations in the supply chain, its actions will not maximize the chain's performance.

Misaligned interests can cause havoc even if supply chain partners are divisions of the same company, as HP discovered. In the late 1980s, HP's integrated circuit (IC) division tried to carry as little inventory as possible, partly because that was one of its key success factors. Those low inventory levels often resulted in long lead times in the supply of ICs to HP's ink-jet printer division. Since the division couldn't afford to keep customers waiting, it created a large inventory of printers to cope with the lead times in supplies. Both divisions were content, but from HP's viewpoint, it would have been far less expensive to have a greater inventory of lower-cost ICs and fewer stocks of expensive printers. That didn't happen, simply because HP's supply chain didn't align the interests of the divisions with those of the company.

The Confinement of Nonalignment

It's not easy for executives to accept that different firms in the same supply chain can have different interests, or that interest nonalignment can lead to inventory problems as dire as those that may arise through a lack of agility or a lack of adaptability. But the story of Cisco's supply chain clinches the argument.

All through the 1990s, everyone regarded Cisco's supply chain as almost infallible. The company was among the first to make use of the Internet to communicate with suppliers and customers, automate work flows among trading partners, and use solutions such as remote product testing, which allowed suppliers to deliver quality results with a minimum of manual input. Cisco outsourced the manufacturing of most of its networking products and worked closely with contract manufacturers to select

the right locations to support its needs. If ever there were a supply chain that was agile and adaptable, Cisco's was it.

Why then did Cisco have to write off \$2.25 billion of inventory in 2001? There were several factors at play, but the main culprit was the misalignment of Cisco's interests with those of its contract manufacturers. The contractors accumulated a large amount of inventory for months without factoring in the demand for Cisco's products. Even when the growth of the U.S. economy slowed down, the contractors continued to produce and store inventory at the same pace. Finally, Cisco found it couldn't use most of the inventory of raw materials because demand had fallen sharply. The company had to sell the raw materials off as scrap.

Lack of alignment causes the failure of many supply chain practices. For example, several high-tech companies, including Flextronics, Solectron, Cisco, and 3Com, have set up supplier hubs close to their assembly plants. Vendors maintain just enough stock at the hubs to support manufacturers' needs, and they replenish the hubs without waiting for orders. Such vendor-managed inventory (VMI) systems allow suppliers to track the consumption of components, reduce transportation costs, and, since vendors can use the same hub to support several manufacturers, derive scale benefits. When VMI offers so many advantages, why hasn't it always reduced costs?

The problem starts with the fact that suppliers own components until they physically enter the manufacturers' assembly plants and therefore bear the costs of inventories for longer periods than they used to. Many suppliers are small and medium-sized companies that must borrow money to finance inventories at higher interest rates than large manufacturers pay. Thus, manufacturers have reduced costs by shifting the ownership of inventories to vendors, but supply chains bear higher costs because vendors' costs have risen. In fact, some VMI systems have generated friction because manufacturers have refused to share costs with vendors.

One way companies align their partners' interests with their own is by redefining the terms of their relationships so that firms share risks, costs, and rewards equitably. For instance, the world's largest printer, RR Donnelley (which prints this magazine) recognized in the late 1990s that its supply chain performance relied heavily on paper-and-ink suppliers. If the quality and reliability of supplies improved, the company could reduce waste and make deliveries to customers on time. Like many other firms, RR Donnelley encouraged suppliers to come up with suggestions for improving processes and products. To align their interests with its own, however, the company also offered to split any resulting savings with suppliers. Not surprisingly, supplier-initiated improvements have helped enhance RR Donnelley's supply chain ever since.

Sometimes the process of alignment involves the use of intermediaries. In the case of VMI, for instance, some financial institutions now buy components from suppliers at hubs and sell them to manufacturers. Everyone ben-

efits because the intermediaries' financing costs are lower than the vendors' costs. Although such an arrangement requires trust and commitment on the part of suppliers, financial intermediaries, and manufacturers, it is a powerful way to align the interests of companies in supply chains.

Automaker Saturn's service parts supply chain, one of the best in the industry, is a great example of incentive alignment that has led to outstanding results. Instead of causing heartburn, the system works well because Saturn aligned the interests of everyone in the chain—especially consumers.

Saturn has relieved car dealers of the burden of managing service parts inventories. The company uses a central system to make stocking and replenishment decisions for dealers, who have the right to accept, reject, or modify the company's suggestions. Saturn doesn't just monitor its performance in delivering service parts to dealers, even though that is the company's only responsibility. Instead, Saturn holds its managers and the dealers jointly accountable for the quality of service the vehicle owners experience. For example, the company tracks the off-the-shelf availability of parts at the dealers as the relevant metric. Saturn also measures its Service Parts Operation (SPO) division on the profits that dealers make from service parts as well as on the number of emergency orders that dealers place. That's because when a dealer doesn't have a part, Saturn transfers it from another dealer and bears the shipping costs. The SPO division can't overstock dealers because Saturn shares the costs of excess inventory with them. If no one buys a particular part from a dealer for nine months, Saturn will buy it back as obsolete inventory.

That kind of alignment produces two results. First, everyone in the chain has the same objective: to deliver the best service to consumers. While the off-the-shelf availability of service parts in the automobile industry ranges from 70% to 80%, service part availability at Saturn's dealers is 92.5%. After taking transfers from other retailers into account, the same-day availability of spare parts is actually 94%. Second, the right to decide about inventory replenishment rests with Saturn, which is in the best position to make those decisions. The company shares the risks of stock outs or overstocks with dealers, so it has an interest in making the best possible decisions. Fittingly,

the inventory turnover (a measure of how efficient inventory management is, calculated by dividing the annual cost of inventory sold by the average inventory) of spare parts at Saturn's dealers is seven times a year while it is only between one and five times a year for other automobile companies' dealers.

Like Saturn, clever companies create alignment in supply chains in several ways. They start with the alignment of information, so that all the companies in a supply chain have equal access to forecasts, sales data, and plans. Next they align identities; in other words, the manufacturer must define the roles and responsibilities of each partner so that there is no scope for conflict. Then companies must align incentives, so that when companies try to maximize returns, they also maximize the supply chain's performance. To ensure that happens, companies must try to predict the possible behavior of supply chain partners in the light of their current incentives. Companies often perform such analyses to predict what competitors would do if they raised prices or entered a new segment; they need to do the same with their supply chain partners. Then they must redesign incentives so partners act in ways that are closer to what's best for the entire supply chain.

Seven-Eleven Japan's Three Aces

Seven-Eleven Japan (SEJ) is an example of how a company that builds its supply chain on agility, adaptability, and alignment stays ahead of its rivals. The \$21 billion convenience store chain has remarkably low stock out rates and in 2004 had an inventory turnover of 55. With gross profit margins of 30%, SEJ is also one of the most profitable retailers in the world. Just how has the 9,000-store retailer managed to sustain performance for more than a decade?

The company has designed its supply chain to respond to quick changes in demand—not to focus on fast or cheap deliveries. It has invested in real-time systems to detect changes in customer preference and tracks data on sales and consumers (gender and age) at every store. Well before the Internet era began, SEJ used satellite connections and ISDN lines to link all its stores with distribution centers, suppliers, and logistics providers. The data allow the supply chain to detect fluctuations in demand between stores, to alert suppliers to potential shifts in requirements, to help reallo-

The message to Seven-Eleven Japan's partners is clear: Make the company successful, and share the rewards. Fail to deliver on time, and pay a penalty.

cate inventory among stores, and to ensure that the company restocks at the right time. SEJ schedules deliveries to each store within a ten-minute margin. If a truck is late by more than 30 minutes, the carrier has to pay a penalty equal to the gross margin of the products carried to the store. Employees reconfigure store shelves at least three times daily so that storefronts cater to different consumer segments and demands at different hours.

SEJ has adapted its supply chain to its strategy over time. Some years ago, the company decided to concentrate stores in key locations instead of building outlets all over the country. But doing so increased the possibility of traffic congestion every time the company replenished stores. The problem became more acute when SEJ decided to resupply stores three or more times a day. To minimize delays due to traffic snarls, the company adapted its distribution system. It asked its suppliers from the same region to consolidate shipments in a single truck instead of using several of them. That minimized the number of trucks going to its distribution centers, which is where SEJ cross-docks products for delivery to stores. The company has also expanded the kinds of vehicles it uses from trucks to motorcycles, boats, and even helicopters. The effectiveness of the company's logistics system is legendary. Less than six hours after the Kobe earthquake on January 17, 1995, when relief trucks were crawling at two miles per hour on the highways, SEJ used seven helicopters and 125 motorcycles to deliver 64,000 rice balls to the city.

Fundamental to the supply chain's operation is the close alignment between Seven-Eleven Japan's interests and those of its partners. The incentives and disincentives are clear: Make Seven-Eleven Japan successful, and share the rewards. Fail to deliver on time, and pay a penalty. That may seem harsh, but the company balances the equation by trusting its partners. For instance, when carriers deliver products to stores, no one verifies the truck's

contents. That allows carriers to save time and money, since drivers don't have to wait after dropping off merchandise.

When Seven-Eleven Japan spots business opportunities, it works with suppliers to develop products and shares revenues with them. For instance, two years ago, SEJ created an e-commerce company, 7dream.com, with six partners. The new organization allows consumers to order products online or through kiosks at SEJ stores and pick up the merchandise at any Seven-Eleven. The partners benefit from SEJ's logistics network, which delivers products to stores efficiently, as well as from the convenient location of stores. By encouraging partners to set up multimedia kiosks to produce games, tickets, or CDs in its shops, Seven-Eleven Japan has become a manufacturing outlet for partners. The company could not have aligned the interests of its partners more closely with those of its own.

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When I describe the triple-A supply chain to companies, most of them immediately assume it will require more technology and investment. Nothing could be further from the truth. Most firms already have the infrastructure in place to create triple-A supply chains. What they need is a fresh attitude and a new culture to get their supply chains to deliver triple-A performance. Companies must give up the efficiency mind-set, which is counterproductive; be prepared to keep changing networks; and, instead of looking out for their interests alone, take responsibility for the entire chain. This can be challenging for companies because there are no technologies that can do those things; only managers can make them happen.

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The Triple-A Supply Chain

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Fast, Global, and Entrepreneurial: Supply Chain Management, Hong Kong Style

by Joan Magretta

Harvard Business Review

October 2002

Product no. 2020

Li & Fung, the Hong Kong-based multinational trading company, embodies supply chain agility, adaptability, and alignment. Instead of owning factories, it partners with a worldwide network of thousands of independent suppliers—filling customers' orders by selecting the best partners for each part of the job. It thus adds value at every link in the supply chain. At the front end, it provides design, engineering, and production-planning services. In the middle stages, it organizes raw-material and component sourcing. At the back end, it offers quality control, testing, and logistics services. Li & Fung's basic operating units consist of small, entrepreneurial divisions serving just one large customer or several smaller but similar ones. The company creates or collapses divisions as markets change.

Supply Chain Challenges: Building Relationships

by Scott Beth, David N. Burt, William Copacino, Chris Gopal, Hau L. Lee, Robert Porter Lynch, Sandra Morris, and Julia Kirby

Harvard Business Review

July 2003

Product no. R0307E

In this article, a panel of experts—practitioners from Intel, Intuit, and Unisys; leading academics; and consultants—maintain that relationships have become more important than technology in supply chain management. New opportunities and challenges arising from globalization are requiring companies to establish partnerships with new types of suppliers and to break down internal barriers to cross-functional collaboration. By focusing on relationships, leading supply chain performers

are reaping tremendous gains in all variables affecting shareholder value—such as cost, customer service, asset productivity, and revenue generation. Through these means, leaders are widening the gap between themselves and their rivals—in almost every industry.

Leading a Supply Chain Turnaround by Reuben E. Slone

Harvard Business Review

October 2004

Product no. R0410G

This article provides another example of a company that has built agility, adaptability, and alignment in its supply chain. Less than five years ago, salespeople at Whirlpool were in the habit of referring to their supply chain organization as the "sales disablers." Now, the company excels at getting product to the right place at the right time—while also managing to keep inventories low. What made the difference? As Reuben Slone of Whirlpool explains, he and his colleagues devised the right supply chain strategy, sold the plan internally, and executed it relentlessly. Slone not only describes how to develop world-class supply chain capabilities; he offers valuable advice for leaders in any turnaround situation.

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