

# supply chain strategy

A newsletter from the MIT Center for Transportation & Logistics

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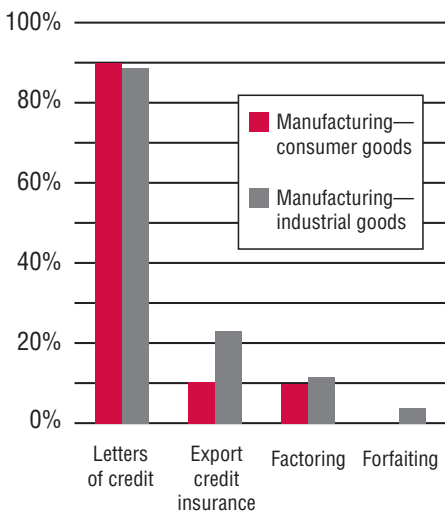
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(Source: IOMA 2009 Import-Export & Global Supply Chain survey)

## Lenovo's Borderless Supply Chain Team

**M**ANY COMPANIES CLAIM TO BE GLOBAL but, in reality, have set up shop in multiple countries without changing the home-market culture that still dominates the organization. A truly global enterprise thinks globally.

Computer maker Lenovo is building a global company by removing the national silos that prevent the organization from developing a world view of its markets. Supply chain is leading the way, an obvious candidate for such a transformation given the discipline's international pedigree.

The company's decentralized supply chain team is scattered across various countries but is managed as a unit. Also, it operates under a business management system designed specifically for a global commercial environment. The team's head, senior vice president, global supply chain, Gerry Smith, acknowledged that "I still have my Western moments," but his supply chain organization is developing a global mentality that he believes is an important competitive strength.

### Crossing the Threshold

The fact that Lenovo does not have a world headquarters says much about the organization's corporate culture. The absence of a head office does not, in itself, guarantee that an enterprise really has a global identity, but it does remove many of the nationalistic tendencies that resist globalization.

To a large degree, the company has to overcome national stereotyping by virtue of its history. The organization was formed in 2005 when Lenovo Group, one of China's leading computer makers, acquired IBM's PC division, the American computing icon. Melding the East-West corporate and national cultures together was crucial to the success of the new enterprise. "We talk about diversity in the United States or Europe, but it is completely different when you throw in this integration between a U.S. and Chinese company," said Smith.

Today Lenovo has operations hubs in China, the United States, and France, a marketing hub in India, and major research centers in Japan, China, and the United States. The company employs more than 23,000 people.

Smith's supply chain team members come from different work and cultural backgrounds. There is a logistics head in the United Kingdom, a chief of staff and a strategist in the United States, a chief procurement officer and a manufacturing

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## Lenovo's Borderless Supply Chain Team (continued)

manager in China, and various other managers in Slovakia, Mexico, and Brazil. Smith, an American, lives in Singapore.

"I can literally run my team from anywhere in the world," he said. But getting to this point has required a lot of change on various fronts. There is still some way to go, but the national and departmental divisions that individuals usually affiliate with, as well as associations with other company cultures, are disappearing. "In my mind, that is testimony that we have crossed the barrier and are now one team," he said.

Here are some of the challenges that Smith and his team have tackled to achieve greater unity of purpose across company and national cultures.

### *Multifaceted Management Style*

For Smith, a notable personal challenge has been to adapt the way he manages to a decentralized, multicultural work environment. "My style of leadership has changed tremendously," he said.

He has had to learn how to tune his communications approach to the cultures that shape his team. "I will still throw a fast-ball if I have to, but it's the way I approach it," he explained. For instance, losing face publicly is a major issue for Chinese members of the team, so making a point forcefully may require some work behind the scenes first. But team members from Western cultures who are used to a more direct approach might interpret this as not being tough enough to the point of favoritism.

It is important to make sure that individuals are aware of the need for different managerial nuances. "Over time, people have recognized that I use different styles depending on which team member is involved," Smith said. "But I am consistent," he emphasized.

A valuable source of feedback is the 360-degree review, a method for assessing individual performances that requires subordinates and peers to anonymously fill out questionnaires about an employee. In Smith's opinion, "it's important for any company that wants to be global to have a very strong 360-degree feedback mechanism." In his case, the process has identified instances where the message he thought he'd conveyed to employees was not in fact interpreted in that way, "because they were looking through a different set of glasses." Smith has used feedback such as this to hone his management style.

### *Bridge Cultural Divides*

Smith has spent a lot of time building trust and integrity across his team through bridging exercises such as workshops.

An example is an East-meets-West workshop where the team spent an entire day focusing on various national differences. Led by Lenovo's vice president of diversity, the session covered the historical backgrounds of members from Eastern and Western countries, different geographies, geopolitical and religious experiences, and educational backgrounds. The session was something of a turning point, said Smith, in that it helped team members understand how and why their work approaches differ.

### *Create Communications Channels*

Clear and regular communications is crucially important to the efficiency of any functional team, particularly when it straddles multiple countries and cultures.

Lenovo's supply chain team has put a great deal of effort into establishing regular telephone meetings across time zones. Each team member was asked how best to achieve 24/7 coverage while respecting all important national

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- » An international organization is not necessarily a global one, in the sense that operating in numerous countries does not automatically imbue an enterprise with a global culture.
- » At computer manufacturer Lenovo, the supply chain team is at the forefront of efforts to develop a truly global enterprise. Special workshops, skills programs, and a changed management style are among the methods being used.

holidays and Friday office hours. The conferences tend to be aligned with Singapore, Asia, and the U.S. East Coast zones, explained Smith.

In-person meetings are still important, and these are organized five or six times a year. Individuals might get together for a week of staff meetings and team-building exercises. In addition, “I rotate operational reviews across the functional areas and the rest of the leadership team sits in,” Smith said. The idea is to make sure that each individual has a thorough understanding of the roles and responsibilities of other members of the team.

Still, even with the most comprehensive support system in place, some people are simply not suited to working internationally. “To be honest, I have changed a lot of people over time, because we have found that some people are more flexible and capable in a global environment. We have a strong team now,” said Smith.

### ***Manage the Business Globally***

Lenovo has a global business management system that is geared to the demands of a decentralized organization with worldwide operations.

The system is built around five key performance indicators (KPIs) that Smith put in place three years ago when he joined the company. The first is predictable delivery times for customers. Second is structural supply cost—what Smith refers to as “the end-to-end cost or cost per box.” It encompasses logistics, manufacturing, overhead, and excess materials write-offs. The third KPI is materials costs. Smith sets targets in this category on a quarterly, not annually, for closer monitoring. Cost comparisons are made with competitors by a benchmarking group that Smith moved out of supply chain and into the business unit to make it more independent. The final two KPIs are quality and cash conversion cycle. From an end-to-end supply chain perspective, “I truly own all the processes from order-to-cash,” said Smith, and his unit has achieved significant improvements in all key areas.

The KPIs are reviewed weekly, and Smith attends these reviews. For a senior supply chain vice president, that’s paying

a lot of attention to detail, but he believes this is the way “you have to coach and mentor and push your team.” The good news is that he has to intervene less in these meetings, he said.

### ***Develop International Skills Sets***

National biases cloud the global outlook in many companies, something that Smith has worked to overcome in his team. A typical example is the belief that good managers for specific functions such as procurement can only be found in certain countries. “You can find talent anywhere in the world. You just have to develop it and coach it,” said Smith. Lenovo has an internal university that uses people from functions such as procurement, manufacturing, and logistics to help train supply chain employees. Smith believes that the steps Lenovo has taken in developing a global enterprise give it an edge when recruiting people. “You are on the ground floor of cultural and global integration,” he pointed out.

Still, recruiting and retaining good people is not easy, particularly individuals who also possess leadership skills. He has put much effort into hiring the best and brightest in all key areas of his business.

Internal specialists—called subject matter experts, or SMEs—are brought in to help plug skills gaps when they arise and provide a teaching and mentoring resource. For example, when Smith was ramping up production at the company’s facility in Monterrey, Mexico, a number of lean six sigma SMEs from the United States and manufacturing experts from China were temporarily assigned to the plant. “We will assign SMEs where there is a problem, and they can be from various backgrounds and have various skills,” he explained.

### ***Set the Right Structure***

A challenge for globally dispersed enterprises is deciding what organizational structure is best suited to this business model.

Smith opted for a dual structure where the key supply chain functions—procurement, manufacturing, and logistics—are centralized to drive efficiencies and best practices. There are also two “geography leaders,” who are responsible for the end-to-end supply chain in their assigned regions.

The geography leaders make end-to-end decisions; the job of the functional leaders is to put pressure on them to make sure that they are making best-practice decisions, explained Smith. “I am purposely creating a healthy tension that is maintaining best practices,” said Smith. At the same time, he is encouraging these managers to make decisions rather than having to constantly refer to him. “I don’t want all

## Lenovo's Borderless Supply Chain Team (continued)

the decisions to flow up to me. I want to lead, to provide the right direction," he said. "These guys are experts; they truly have the background and experience to be geography leaders and functional leaders."

### Shedding Stereotypes

Smith believes that the global culture Lenovo is developing is one of its most important assets in an increasingly

globalized business environment. Moreover, "it has been one of my most valuable experiences as an executive," he said.

Supply chains now routinely span national boundaries, but many companies have yet to overcome the nationalistic attitudes and perceptions that prevent them from becoming truly global enterprises. "I see raw intellectual horsepower as consistent across the world. You can find smart people in any culture," Smith said. ♦

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## Financing That Bypasses the Credit Crunch

### Credit alternatives for your supply chain

**P**ASSING COSTS ON TO SUPPLIERS HAS BECOME A MUCH RISKIER strategy since the credit crisis hit, and some companies are moving toward the other extreme by using their own credit rating to ease suppliers' financial difficulties. Banks are happy to accommodate this approach because it opens up new business opportunities for them.

The new approaches to supply chain finance not only benefit trading partners in the current economic climate, but such programs also could become a permanent feature of global supply chains, particularly as companies continue to expand into developing markets.

The bottom line for supply chain is that you are more likely to get a call from treasury or accounts payable about which suppliers should be offered these finance programs. Take a financial supply chain program created by auto parts company Advanced Auto Parts (AAP), which involves a group of its strategic suppliers and a cross-functional team that includes treasury, accounts payable, IT, and merchandizing.

### Shaped by the Market

Headquartered in Roanoke, Va., AAP is a leading after-market retailer of auto parts with more than 3,400 stores and 2008 revenue of \$5 billion, explained Navdeep Gupta, director, treasury. Gupta described his company's financial supply chain programs at the Unlocking Liquidity: How to Effectively Implement Supply Chain Financing webinar this July, organized by Business Finance.

AAP's two core market segments are do-it-yourself (DIY) auto servicing and repair and the professional installer market known as do-it-for-me. There are three key players in

these segments: parts manufacturers, retailers, and customers.

In credit rating terms, there is a significant gap between the manufacturers—there are a large number of them, and many are relatively small—and retailers. The retailers are fewer in number, and they tend to be bigger; the market share of the top three in the DIY segment is more than 60 percent. As a result, retailers tend to enjoy a higher credit rating than manufacturers, which means a higher cost of funds for these latter players.

Certain market characteristics shape the supply chain for auto parts. For example, customers place more value on product availability and quality than they do on price, said Gupta. Also, there is not much interchangeability between parts; when a customer requests a specific part, the chances are that there are no substitutes should it be unavailable. One of AAP's strategic goals is "availability excellence," which basically means ensuring that product is available in the right place at the right time. However, as Gupta pointed out, in the retail channel, this can easily translate into maintaining large volumes of inventory on hand.

### Looking Outside the Box

Historically, AAP has a DIO (days inventory outstanding, or how many days it takes to sell all the inventory) of around 220 days, and its average payment terms for suppliers is 120 days. The 100-day gap between the two values puts immense pressure on working capital, explained Gupta. The treasury and merchandising teams were tasked with the challenge of narrowing the gap.

However, given that product availability is critical to the business, there is less leeway to tackle the inventory half of the equation than the payment terms element. But here too there are constraints. The teams realized that tightening vendors' payment terms is actually a zero-sum game because these enterprises would have to pay more for their funds and would pass this cost increase on to AAP. If the suppliers are unable to defray the extra cost in this way, service levels can suffer, undermining AAP's strategic goals.

The teams looked at solutions outside traditional areas such as more stringent supplier payment terms and identified supply chain financing options as worth pursuing. These options enable a company such as AAP to modify payment terms and improve working capital flows without putting undue financial pressure on suppliers.

These solutions "in effect strengthen the supply chain, because you are able to give the liquidity support to the supplier and therefore forge a stronger relationship with the supplier as well as possibly gain from pricing advantages," Gupta

said. The incentive for suppliers is a lower cost of borrowing since these costs are tied to AAP's credit rating and not necessarily their own.

## New Routes to Finance

AAP uses Deutsche Bank (DB), a bank that provides financial supply chain solutions, to help manage the program. Supplier finance is part of a suite of products that DB offers in this area and is growing rapidly, according to Jonathan Richman, managing director and global product head, Trade and Financial Supply Chain. "The credit crisis has made it a priority to use financial supply chain as a means to generate liquidity across the supply chain for both what we call the anchor client, which is the major corporate that sits in the middle, as well as its trading partners, its suppliers, and buyers," Richman said.

Traditional ways to finance trade and manage transactional risk—most notably letters of credit—have become less viable in the current economic climate. Alternatives such as the suite of products that DB offers are helping to fill the void and provide "a reasonably good substitute for the letter of credit with a lot less administration and cost for all the parties involved," said Richman.

Although most of world trade is transacted on open account, the letter of credit is used to pay exporters in many international trade transactions. A recent survey of exporters and importers by IOMA indicates the popularity of the payment mechanism even in these credit-starved times.

IOMA's *2009 Import-Export & Global Supply Chain* survey polled import and export and global supply chain managers in companies ranging from organizations with less than 100 to more than 1,000 employees, in May and June of this year. Of the 79 respondents, 90 percent in consumer goods and 88.5 percent in industrial manufacturing companies indicated that the letter of credit is the tool they use to ensure payment for export sales (see cover chart).

The key to the alternative payment mechanism offered by financial institutions such as DB is the strength of the anchor party involved, the enterprise that is at the center of the transactions. Also crucial is the relationship between this core player and its trading partners.

The process as described by Richman is fairly straightforward. The seller ships the ordered goods and invoices the buyer. The buyer sends an approved payment file to the bank. The approved invoices are visible to the supplier, which chooses all or some of them to discount for immediate payment from the bank (invoice discounting is basically the provision of

## PAYMENTS NETWORK LAUNCHED

Two financial institutions, Visa Inc. and U.S. Bancorp, have joined forces to offer an electronic supply chain payments service for businesses. The joint venture offers a business-to-business (B2B) network called Syncada that enables corporations and governments to process and track invoices, make and receive payments around the world, and have payables or receivables financed through local and global financial institutions.

Syncada combines Visa's commercial payment services with U.S. Bank's PowerTrack, an automated B2B e-invoicing, payment processing, and trade finance network. The venture allows financial institutions of all sizes to offer their commercial clients standardized B2B invoice processing, financing, and payment services across a variety of payment types and local currencies. Financial institutions can also build transaction and credit-based treasury management business by offering the network's services to buyer and supplier clients.

The founding organizations claim that Syncada lowers costs, provides a more accurate accounting of spending by category, improves the management of working capital and global cash needs, and gives access to financing through a global network of financial institutions.

Syncada has begun operations and initially serves U.S. Bank and its legacy client base from the PowerTrack network. Syncada will be headquartered in Minneapolis with operations in Chicago, Memphis, Tenn., Toronto, Mumbai, and Brussels. The network's day-to-day operations are led by its independent management team.

## Financing That Bypasses the Credit Crunch (continued)

financing against the security of receivables). “The bank then debits the buyer’s account for final repayment on due date, which is often a date that’s extended from the previous payment terms,” explained Richman. The process can also begin at the purchase order stage for preshipment finance programs.

Each of the parties involved benefits in some way. The buyer is able to extend payment terms and reduce its reliance on letters of credit; it can also build in other benefits such as price reductions. The supplier has access to an alternative source of affordable finance and less uncertainty in that the payment cycle is clearly set out. The bank gets the new business. The gains are particularly large where there is a big difference between the buyer’s cost of funds and the supplier’s cost of funds, said Richman.

From APP’s perspective, supply chain financing programs such as these improve working capital with extended payment terms without jeopardizing the viability of participant suppliers. The supply chain is strengthened “because you are able to give the liquidity support to the supplier and therefore forge a stronger relationship,” Gupta said.

### Assessing the Options

Although corporate finance specialists drive these programs to a large extent, APP’s treasury department does not own the supply chain financing process the company has put in place, said Gupta. A cross-functional team was set up to evaluate financial service providers and supplier participants.

The team reflects the different objectives of the departments involved. Finance’s main concern might be unlocking working capital and cash trapped in the supply chain; procurement’s focus could have more to do with extending payment terms and reducing the cost of goods sold.

When assessing solution providers, standardize your requirements as far as possible so you can compare the different options quickly, he advised. Key criteria include the funding amounts and costs involved with each solution, the level of support afforded to bringing suppliers on board, and the IT costs associated with both implementing and supporting respective programs.

A similar evaluation was carried out to decide which suppliers should be given the opportunity to join the program. Current and projected purchase volumes were important criteria, and “we looked at the gap between the current days inventory on hand and the current inventory terms that we had with the vendor,” explained Gupta. These comparisons were set against the possible improvements in days’ payable outstanding. “The way you do this is to try to understand

#### [Key Takeaways]

- » It’s no secret that the credit crisis is squeezing suppliers, but a silver lining is that alternative sources of finance that benefit both buyer and seller in the supply chain are emerging.
- » Auto parts company Advanced Auto Parts turned to Deutsche Bank to provide such an alternative, and the result is a program that yields benefits for AAP and its strategic suppliers.

the supplier’s expected cost of capital and what the new cost would be versus their current cost of funding,” Gupta said.

The merchandising team did a strategic evaluation of each supplier chosen as a candidate for participation. The aim, said Gupta, was to balance the portfolio of suppliers from a working capital perspective as well as in terms of their strategic importance to APP.

From the bank’s perspective, a number of factors are crucial to the success of these programs. Over the last year or so, financial supply chain solutions have been “one of the easier products to sell, but it is one of the more difficult to implement,” said Richman. These solutions are still in the early development stages, particularly when compared to long-established trade finance vehicles such as letters of credit. He suggested a number of factors that are common to successful implementations he has seen:

- Set clear working capital goals. Ideally, senior management, sometimes C-level executives, should set these goals, which are disseminated to various departments within the organization.
- Prioritize participant suppliers. Proactively engage suppliers to make sure that the process to bring them on board is appropriate, particularly in terms of the level of support they need.
- Internal departments should be well-coordinated. Accounts payable, treasury, procurement, and IT are all key players.

### Demand Outstrips Supply

The push to find alternative sources of supply chain finance has been under way at APP for about two years. But the effort gained momentum in the last six months or so, at a time when credit has become significantly scarcer, explained Gupta.

The company’s top 15 to 20 strategic suppliers are participating, but “we have more demand for this program than we have supply in terms of the funding,” he said. There are plans to increase the availability as conditions allow. “This program is really attractive to our vendors,” Gupta said. ♦

# Grounding Cloud Computing in Supply Chain

## A sunny outlook for cloud apps

**I T MIGHT SOUND LIKE A LOFTY IDEA BUT THE BASIC CONCEPT** of cloud computing is not complicated: The latest software and hardware you need to run your supply chain is available on tap so that your usage varies with demand and the technology is always up-to-date.

But even the best ideas often wait in the wings until their time arrives, and it looks as if the stage is set for cloud technology. A combination of changing attitudes toward information sharing, a growing need for operational agility, and the availability of cheap and abundant computing power makes cloud computing a compelling alternative to traditional technology models.

In the August 2009 issue of SCS, we looked at a specific application of the technology (see “Orthera’s Cloud-Enabled Supply Chain”). In this second article, we take a broader look at what cloud computing brings to the supply chain management table both now and in the near future.

### Dial for Software

Boston-based research firm AMR Research defines cloud computing as “an emerging access and business model for software and hardware that makes computing more like a telephone service.” Customers buy access to externally hosted hardware and software services via the Internet, thereby avoiding costly one-time purchases of the technology that commit them to endless updates. The name “cloud computing” comes from the notion that these services are located in the network “cloud.”

These services include software-as-a-service, platform-as-a-service, and infrastructure-as-a-service variants. Examples cited by AMR are Salesforce CRM, Microsoft Azure, and Amazon EC2. AMR lists some distinguishing characteristics shared by these offerings:

- Customers need only a PC and access to the Internet; no servers are required;
- Customers generally don’t need to install software though they sometimes need special software to connect to a cloud service;
- Customers can scale their use of services up and down dynamically through a self-service interface and are billed accordingly;
- Cloud service providers do all maintenance, upgrades, and capacity management for the hardware and software

underlying their services; customers are promised good performance, reliability, and scalability, regardless of how great their needs; and

- Cloud hardware and software are often shared across different customers, but customers are guaranteed isolation from other customers sharing their part of the cloud.

“I don’t think there is anything magical about the cloud,” said Ian Finley, AMR’s vice president of research. When the technology was emerging, people were still looking to the business world for computing innovations. Attitudes have changed, and today “we look to the consumer market to figure out what is new in technology,” he said. Having become adept at navigating around social networking sites such as Facebook and Twitter, people now expect similar opportunities in their work environments, a major attitudinal shift that is paving the way for cloud computing.

Companies are also less anxious about losing control over important functional areas by relying on externally hosted services for computing power, believes Rafael Gonzalez Caloni, executive vice president, marketing, at retail solutions provider Predictix LLC. Headquartered in Atlanta, Predictix claims to offer the first and only software-as-a-service suite for planning, allocation, assortment and space optimization, pricing, promotions, forecasting, and replenishment. “The conversation has shifted quite dramatically over the last year,” he said. The example set by relatively mature cloud applications such as Salesforce.com has helped to allay these fears, Caloni believes.

The economic downturn is also playing a part. For example, large retailers that are used to signing big checks for enterprise software systems are looking to trim costs. Cloud solutions that do not require sizeable up-front investments represent an attractive option.

### The Provider Challenge

Still cloud technology requires service providers to make some radical changes in the way they operate. Under the traditional enterprise model, “the whole game is winning the deal,” Caloni said. Once the client has signed the check, it is effectively locked into lucrative maintenance and update agreements. In the cloud environment, where customers turn on the technology spigot only as needed, providers are obliged to provide upgrades automatically and their clients are less committed to staying with them.

## Grounding Cloud Computing in Supply Chain (continued)

“But that’s not a bad thing,” argued Caloni. The problem with the traditional model is that once the vendor has collected the big licensing check from the customer, “every quarter you have to go out and find new business; you are starting from zero.” The cloud model offers a steadier income stream and “because our incentives are aligned, we have to deliver value.” That will hopefully cement the relationship between the technology buyer and seller.

An important element of this service ethic is making sure that the client has the latest technology. As Finley pointed out, a problem with conventional software model is that as the technology advances, customers that made hefty investments early find it more difficult to afford the more sophisticated product. In effect, they financed the early technology, and the new customers benefit from the initial investments. In the cloud model, new technology is available to customers old and new because it is not a one-off purchase but part of a pay-as-you-go service package.

The cloud approach also delivers technology faster—an important benefit in these increasingly uncertain markets. Amar Singh, CEO of supply chain software provider Amitive Inc., described his experience of selling traditional software products. “It took a year to sell the deal, three years to deploy because the whole company had to go through with it, and every company complained because it was too expensive.”

This May his San Mateo, Calif.-based company unveiled what it claims to be the industry’s first supply chain management solution delivered in the cloud, called Amitive Unity 5.0. The company recently deployed three different customers, explained Singh, a \$15 billion truck manufacturer, a \$5 billion maker of steel containers, and a \$100 million retail supplier. “They were all live in less than 60 days,” he said.

This is particularly important in an increasingly volatile business environment. To illustrate the point, Singh recalled the experience of a large sports apparel manufacturer that had spent four years and millions of dollars on supply chain software. The technology was geared to individual product lines. The various systems were in place and running satisfactorily when one of the company’s main retailer customers decided that it would order by category and not by product. The manufacturer had to change its relatively new systems to accommodate category-based decisions. “The constantly changing environment is a problem, so you have to have a lot of flexibility,” said Singh.

## Making the Change

How can companies that have invested heavily in traditional supply chain software transition to cloud-based

solutions? Even if they find the cloud alternative extremely compelling, simply dumping millions of dollars worth of existing technology is hardly an option.

AMR has been tracking the market for some time, and companies “tend to experiment with things that are not too dangerous,” said Finley. In other words, applications that will only cause limited damage if the conversion to cloud does not pan out. That might include a piece of procurement spend that will not injure the entire business should it underperform. Also companies are “picking off new areas” for their forays into cloud, Finley said. A new joint venture or a system that is due for replacement are possible candidates. After all, “let’s not sugarcoat this: You still have to train people; you still have to move data and integrate,” he said. But at least the onus is on the vendor to ensure that the cloud technology performs and, crucially, continues to perform.

Caloni agreed that the decision to convert to cloud often revolves around relatively old supply chain technology. “In essence, companies have reopened the discussion about what they are going to do, say, planning and replen-

## FIRST STEPS

Cloud computing is attracting more interest from leading supply chain software solutions providers. “On demand is getting more important in all areas of software, not just supply chain,” said Stefan Theis, vice president of solutions management for supply chain, SAP. “We have some solutions on the market, and we are looking at it and evaluating products in several areas.”

Collaboration is one area where the technology offers tremendous potential, he believes. In extensive networks where trading partner relationships are very dynamic, “cloud computing makes a lot of sense to give you more access to more partners to exchange information without a huge investment in technology,” said Theis.

The automotive industry offers a good example of the potential. In this industry, supply chains can involve thousands of suppliers, including small companies with limited computing capacity. The power of cloud-enabled networks to provide standardized electronic data securely to large communities of users is particularly important. “I see this increasing dramatically. We will see many more solutions in the future,” Theis said.

But even a vendor as large as SAP is approaching cloud applications with caution. “First it starts with the requirement of the customer,” Theis said; for example the buyer might be under pressure to cut IT costs or to get quicker access to data. SAP is looking at how its solutions can be hosted. “This is a new model for SAP to provide software, and we have to get experience and the right investment,” said Theis.

- » Cloud computing offers supply chain managers the ability to only pay for the computing power they actually need when they need it.
- » Worries that the technology takes too much control away from users are fading, and applications are gaining in sophistication.

ishment,” he said. Two persuasive arguments for choosing the software-as-a-service model are that it “gives the ability to scale computing power on demand much more cost-effectively, and by extension, we can offer applications that have a very high performance at a very compelling price,” he said.

The “secret sauce” for Amitive is that customers do not have to re-engineer their business processes to adopt cloud technology, said Singh. This is a drawback with traditional software, where vendors make the case for forcing clients to make radical changes in processes by claiming that the replacements are best practices. “Our (cloud) architecture has no predefined data structure,” Singh said. “Imagine walking in with an Excel spreadsheet that is blank.”

With this level of flexibility, “technically we can cover any supply chain process,” although that depends on which areas Amitive chooses to compete in, said Singh. Also, certain processes, such as indirect procurement, are fairly standard and do not need a high degree of tailoring. “But in my experience, the problem with supply chain as an industry is that every

company does their processes differently. That consistency is not there,” he said.

## Future Growth

As part of its ongoing research into the cloud computing market over the last two to three years, AMR has been asking companies across different application segments whether they are interested in buying alternatives to existing solutions such as software-as-a-service offerings. “The numbers have gone from 20 percent to 35 percent, depending on the application,” said Finley, an indication that cloud technology is gaining ground.

The new technology is an enticing prospect for small vendors because it offers a departure from traditional models. In fact, “venture capitalists have been pushing companies to software-as-a-service over the last few years, so lots of little companies have converted to it because that’s the only way they can get funding,” Finley said. Now that the market is maturing, look for the top vendors to become more aggressive in this space over the next few years (see sidebar).

Cloud computing applications are becoming more sophisticated, said Caloni. Predictix is now tackling complex enterprise-class problems for Tier 1 retailers. Particularly exciting is the potential for bringing new solutions to niche supply chain problems that were “not on the table in the traditional model because that is an all-or-nothing, monolithic license model,” he said. ♦



## [RE]SEARCHING FOR ANSWERS

# Bringing Disruptions Into the Classroom

Seeing is believing when planning for supply chain disruptions

**M**AKING A CASE FOR INVESTING IN SUPPLY CHAIN risk-mitigation measures is often difficult because you are preparing for something that might never happen and has no obvious payback. When a disruption happens, the returns from good preparation become painfully obvious, but waiting for disaster to strike to make your case is hardly a sensible approach.

The next best thing is a simulation that shows both quantitatively and qualitatively what will happen to your supply chain and, crucially, customer service, should a disruption interrupt product flows. This is what researchers at the MIT Center for Transportation & Logistics (MIT CTL) hope to achieve with a supply network model they are developing.

## Advantage in Adversity

As supply chains have grown in reach and complexity, they have become more susceptible to all manner of disruption. But there is an upside to this increase in scale: You can use it to make the supply chain more resilient.

Savvy supply chain managers deploy the resources of large-scale supply chains to provide backup capabilities and redundancies. Making the supply chain more risk-resistant in this way can significantly reduce the impact of disruptions.

The challenge is deciding where to make the right investments and how best to allocate the resources you have at your disposal. This can be particularly tricky when preparing for

## Bringing Disruptions Into the Classroom (continued)

service interruptions that ripple through your network and affect facilities and products that are a long way down the line.

Simulations of these situations can show you where the supply chain needs to be reinforced and what the outcomes are of different investments in mitigation measures. In addition, a simulation that allows you to “see” how a disruption pans out is a powerful training tool.

MIT CTL hopes to provide such simulations using the model of a supply network it is developing. In addition to simulating the impact of disruptions on materials flows and customer service levels, the aim is to evaluate the pros and cons of different countermeasures. For example, the model could be used to analyze various approaches to storing extra inventory to protect against upstream disruptions or to test the deployment of plants or distribution centers to back up each other when a disruption hits.

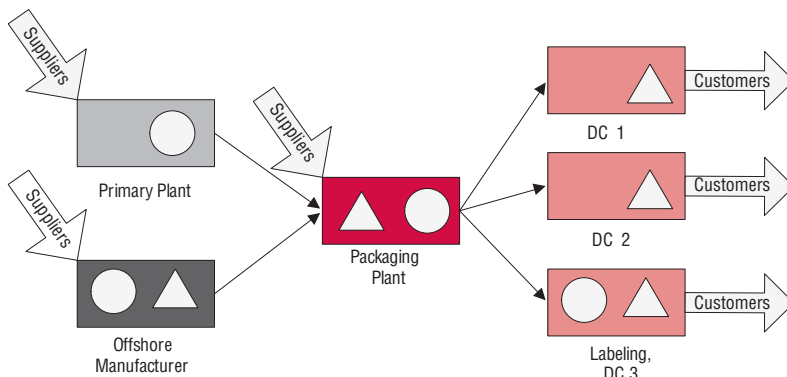
### Risk Simulator

The model was originally developed in collaboration with a large consumer packaged goods company that is an MIT CTL corporate partner. The company, a global manufacturer, selected an actual supply chain as the basis of the model (see diagram). Branching across the globe, the supply chain involves multiple products and multiple distribution centers (DCs).

The MIT CTL research team worked with the company’s operations and business continuity personnel to develop risk profiles for every node and arc in the supply chain. The profiles aggregate all the risks that a given location could conceivably face and map the frequencies and durations of these potential disruptions.

### Supply Chain Network for the Model

(Circles represent processes, and triangles represent inventory location)



### [Key Takeaways]

- » Companies can turn the scale and complexity of supply chains to their advantage by using the resources they control to bolster resiliency.
- » The trick is knowing what resources to deploy where; a simulator that shows how different strategies work would help managers to make these types of decisions.

These profiles were integrated into a discrete-event simulation of the entire network. The model measures on-time fulfillment of customer demand, or fill rate. Inputs to the model include capacity at the plants, inventory levels maintained throughout the network, and risk-mitigation tactics. For instance, it is possible to simulate a scenario where a DC is disrupted and other facilities respond to maintain service levels, albeit with more limited capacity and a delayed response.

The initial simulations identified a number of problem areas. Cross-network mitigation strategies, for example, were not well-documented. While business continuity plans performed well internally at every node in the supply chain, there was little or no documentation on how one node of the network could back up another. Yet, management’s perception was that multiple backup options not only existed in the network, but also could be quickly implemented. A key takeaway is that, in order for one facility to effectively back up another, organizations must develop clear support plans that can be implemented smoothly.

### Management Lessons

By using the simulator, operations managers can see how various disruptions play out in real time and then test the effectiveness of each strategy. They can also quantify the various outcomes to gain a better understanding of which management approaches tend to be the most cost-effective.

Here are some examples of lessons learned by users of the model:

#### *The Impact of Operations Status*

The simulations showed that fill rate and recovery after a disruption are highly affected by the operational state of the network when a disruption occurs. “Operational state” refers to the inventory levels and production capacities throughout the system. If the volume of inventory positioned downstream from a disruption is relatively low before the interruption, then the impact will be greater and the recovery time longer than if the inventory volumes

were high. Since inventory volumes might be lower than expected due to demand surges or production batches, this is a realistic concern.

The notable takeaway here is that if maintaining an adequate supply of inventory is an important risk-mitigation measure, fluctuations in inventory should be closely monitored so that the company can understand its vulnerability to service breakdowns. Additionally, when inventory target levels are set, both downstream risk and upstream risk must be taken into account. Downstream risk captures demand uncertainty and forecast error and is traditionally used for setting optimal inventory levels. However, upstream risk at the supplier or internal network locations is often neglected when planning for day-to-day operations.

For example, the analysis showed that if the company in the simulation has a target fill rate of 95 percent, then two weeks' worth of inventory is unlikely to be sufficient, since in 81 percent of the simulated weeks, the fill rate failed to meet that service level. However, three weeks of inventory met that service level all but 25 percent of the time, and four weeks of inventory met it all but 18 percent of the time. Thus, when fixing optimum inventory levels, managers need to decide how often the enterprise is willing to accept missing the target and how much money they want to invest in inventory on an ongoing basis.

### ***Impact of Mitigation Strategies***

The simulator can be used to test different backup plans, including the speed of response and percent capacity that various contingencies could offer.

During one sequence of simulations, a DC was disrupted and another DC was required to support the stricken facility at either 50 percent or 80 percent capacity one week following the breakdown. According to the results, over the course of the disruption, fill rates for the entire network were approximately 15 percent higher if the second DC could provide the 80 percent support capacity (around 90 percent overall, as opposed to 75 percent overall if they could only provide 50

percent capacity). The simulations show that there are clear benefits to be gained from such a backup strategy.

### ***Impact of Disruption Location***

When network disruptions occur in very close proximity to the customer, there is almost a one-to-one relationship between the duration of the interruption and the time that the customer "feels" a lower fill rate.

However, this is not the case with breakdowns upstream if capacity becomes an issue. Using the model, the researchers analyzed the fill rate over time for five replications of a six-week disruption at the primary plant. The only mitigation used in this case is the provision of downstream inventory; approximately six weeks' worth of total inventory is held at the packaging plant or the DCs for this scenario, and no backup production is available.

The analysis yielded a number of useful observations:

- Upstream disruptions may affect the customer long after the actual disruption itself is over. In every replication, the fill rate drops to 0 percent 10 weeks after the disruption begins, which is four weeks after it has ended.
- The negative effects of a disruption after it has taken place may exceed the impact of the disruption itself. The average number of weeks that the fill rate was less than 95 percent was  $10.2 \pm 0.55$ , while the disruption itself lasted only six weeks.

The availability of inventory downstream clearly helps in the immediate aftermath of a disruption, but eventually the material shortage is felt by the customer. Capacity constraints in the system (both at the primary plant itself and at the downstream packaging plant) can prolong the recovery time. Thus, the amount of inventory and location of a disruption in the supply chain are critically important factors to weigh when determining the ultimate impact on the customer.

### **New Tool**

MIT CTL is developing a risk management simulator based on the network model it created for a sponsor company, which can be used as a teaching tool. Although the simulator is based on a specific supply chain, the goal is to enable managers from any organization to learn about managing risk by simulating the outcomes of different mitigation strategies. ♦

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This article is based on a paper written by Dr. Amanda Schmitt, post-doctoral research associate at MIT CTL. She can be contacted at [aschmitt@mit.edu](mailto:aschmitt@mit.edu).

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[BACK PAGE]



By Ken Cottrill

## Supply Chain Technology on the Move

Companies get the mobility message

**L**AST MONTH, WE LOOKED AT HOW SOCIAL NETWORKS are shaping supply chains, but there is another consumer phenomenon we need to keep in the feedback loop when tracking the future of supply chain management: mobile communications.

Already the technology has profoundly affected supply chains in developing countries. In Asia and Latin America, for instance, it has enabled supply chain managers to leapfrog the inadequacies of land-based communications networks. Mobile devices help companies cover huge geographic areas in these countries. For example, managers at phonemaker Nokia use the devices to photograph shop displays in remote locations in India and keep tabs on inventory levels.

### Social Parallels

Like social networks, mobile technology for consumer markets continues to grow in scope and power. And as is the case with social networks, mobile markets in the consumer space are laying the groundwork for more advanced applications on the business side. Mobiles have become so ingrained in our daily lives—it's difficult to imagine a world without them—that using these devices in the workplace is second nature.

That makes it much easier to grow the technology in specific business areas, such as supply chain, because its use has become intuitive. And just as the technology gives social communications an immediacy that is almost addictive, its real-time capabilities can transform commercial operations.

Jim Hemmer, president and CEO of Jersey City, N.J.-based Antenna Software, the largest privately held mobile enterprise solutions provider in North America, believes that mobility in business “is as different to the existing IT infrastructure as laptops were to mainframes.” As the technology continues to make inroads into supply chain, new opportunities are opening up.

A simple story told by a company that is an Antenna customer illustrates the point. One of the company's retail customers got in touch to complain that a product delivery had not been made. The company apologized and checked the manifest, which was updated using mobile technology. It showed that the delivery had actually been made. The retailer realized that the problem was not a missed delivery but a sudden run

on the product at the store and was able to reorder instantly and replenish while demand was still high.

### Reaching for the Cloud

Tying mobility to cloud computing platforms is one avenue of development that offers huge potential (for more on cloud computing, see “Grounding Cloud Computing in Supply Chain”). As Hemmer pointed out, the technology has lots of moving parts and connection and integration issues and lends itself to applications in the cloud.

This is what Antenna has done for Coca-Cola Enterprises to connect thousands of Coke store merchandisers to operations managers. The merchandisers are able to update inventory and order information on the fly as they make their rounds between stores. They also feed information in real time to the company on store displays and sales trends, turning this mobile workforce into a powerful source of instant market intelligence.

Here the benefits are two-way. While the company gains from the information, by being able to submit such details electronically while its people are working, employees have less paperwork at the end of the day. That also offers workers an incentive to use the technology.

Coca-Cola is also using its newfound mobility to improve cash flow. When a driver makes a delivery, he or she updates the information system and triggers the invoice for the payment associated with that load. The streamlined invoicing procedure compresses the order-to-cash cycle from weeks to days.

An obvious advantage of real-time communications networks is that they facilitate collaboration between trading partners. Less obvious is the potential for collaboration on an informal level—the type of communication that is more akin to instant messaging, where work groups are able to quickly share information that helps them do a better job, noted Hemmer.

Again this echoes consumer applications of mobiles. When individuals are already intimately familiar with a technology in this way and have accepted the benefits, it becomes a must-use tool as opposed to just another gizmo handed down by management. ♦

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