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## **The Future of Supply Chain Management**

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# The Future of Supply Chain Management

A new approach  
essential to survival  
in the 21st century

By Penny Guyer

Supply chain strategies and management have, of course, always been a vital part of any manufacturer's or distributor's profit picture. Despite this obvious fact, until recently they were generally left to an ad hoc method of planning and execution. Coordination and long-range planning were rarely part of the landscape for managers in warehousing and shipping. There was certainly no full-fledged academic approach to logistics management.

That is hardly the case today. There now exist full-scale programs at major universities for studying logistics and supply chain management. Although these programs have existed for awhile, it is really only with the explosive growth of the Internet that these formal study opportunities have attracted companies' attention.

One of the nation's leading programs is the Center for Transportation Studies (CTS) Massachusetts Institute of Technology (MIT). CTS recently held its annual Affiliates Day Event in Louisville, Kentucky, hosted by UPS. One of the featured speakers was David Simchi-Levi, a professor of Engineering Systems at MIT, who discussed the trends in e-commerce and supply chain management.

Professor Simchi-Levi is prominent in the field of logistics and supply chain management. He has co-authored a prize-winning book, *Designing and Managing the Supply Chain*, on the subject and teaches these topics at the undergraduate, graduate and the executive levels. Simchi-Levi is also a technology entrepreneur and is founder and chairman of LogicTools Inc. ([www.logic-tools.com](http://www.logic-tools.com)), a software development company focusing on tools for logistics and supply chain management. LogicTools' software, LogicNet, a decision support system that facilitates strategic planning for distribution systems, was featured in the April 2000 issue of *Parcel* in the article "Designing Perfect Distribution Channels."

During the fall of 2000, once-mighty dot-coms were dropping faster than the leaves. Most of the demises were a result of the disenchantment of investors — and they had a good reason: the companies were simply not making money. Why not? Primarily because the companies' supply chains were not functioning well, resulting in ongoing operating losses as well as many dissatisfied customers.

It is becoming clear to those in Internet-based commerce as well as the traditional brick-and mortar businesses that a brand new approach to supply chain management is essential to survival in the 21st century. The following is a conversation with David Simchi-Levi on his view of the future of supply chain management.



An interview with  
David Simchi-Levi

### **Let's start with the basics. What is your definition of "supply chain management?"**

Supply chain management is efficient integration of suppliers, factories, warehouses and stores, so that merchandise is produced in the right quantities and distributed to the right location at the right time, so as to minimize total system cost while satisfying service requirements.

The primary objective is to reduce total costs - not just inventory or transportation costs. In an efficient supply chain strategy, the firm will, for instance, increase transportation costs but will be able to reduce total costs by reducing inventory costs. This implies the firm needs to integrate all areas: purchasing, manufacturing, warehousing and customers. In order to do this, you have to overcome their conflicting objectives.

### **Conflicting objectives?**

Suppliers typically want manufacturers to commit themselves to purchasing large quantities in stable volume requirements with flexible delivery times.

Of course, manufacturers like buying in large quantities, since this implies all sorts of volume and transportation discounts, as well as the ability to implement long production runs that reduce production costs. Unfortunately, manufacturers also need flexibility so that if customer demand is that much higher than anticipated, they can receive more raw materials from the suppliers. But, on the other hand, if customer demand is much smaller than anticipated, the manufacturer wants the ability to return inventory. Hence, the suppliers' objectives are in direct conflict with the manufacturers' desires for flexibility.

Note that the manufacturers' objective of implementing long production runs typically implies large inventory, which conflicts with the warehouses' objectives. In fact, warehouse managers wish to keep their inventories low, but with quick replenishment capabilities. These goals, of course, increase transportation costs but greatly reduce inventory costs.

And finally, the customers want the best of all worlds: they want a short order lead time — instant gratification. They want their suppliers to have large stocks on hand with a huge variety of products ready to ship immediately. And naturally, they want low prices.

Each of these areas has a laudable goal. What's needed, however, is integration; the objective must be to reduce total cost and increase service levels. In that process, the firm may have to increase inventory or transportation costs. However, by integrating supply, manufacturing and logistics activities and by strategically optimizing the performance of each, overall costs can be reduced. This is exactly why many companies are engaged in strategic partnering and alliances with both customers and suppliers. These strategies allow supply chain partners to deal with conflicting objectives and efficiently integrate the supply chain.

### **In your presentation, you mentioned "the bullwhip effect" as a result of non-integration of supply chain links. Can you explain?**

The bullwhip effect is a term coined by Procter and Gamble to describe a problem they observed in the supply chain for Pampers, its disposable diapers. Babies use a pretty steady number of diapers daily. (Editor's note: unless the father decides to feed a six-month-old an eight-ounce bottle of prune juice, as in the case of the editor's daughter). But the orders placed by retailers to distributors showed a good deal of variability. The orders from

the distributors to the suppliers were even wider in their swings. The farther up the supply stream you go, the wider the swings in order quantities. In the end, Procter and Gamble's manufacturing plants were receiving orders that were far out of proportion to customer demand.

The bullwhip effect stems from a number of sources. First, traditional inventory management techniques practiced at each level of the supply chain lead to the bullwhip effect. This is due to the need of each level in the supply chain to forecast demand. An important characteristic of all forecasts is that the more data we receive the more we modify the forecast and therefore the inventory policy, leading to an increase in variability. Second, volume discounts, transportation discounts and promotional activities tend to destroy the structure of customer demand, forcing retailers to order less frequently than customer demand, and therefore increase variability in the supply chain. Finally, the longer the lead-time in the supply chain the larger the increase in variability.

Obviously, the bullwhip effect has important consequences. As variability in the supply chain increases, inventory levels must increase, or alternatively, service levels decrease. In addition, the increase in variability makes it very difficult for warehouses and manufacturing plants to manage resources effectively. That is, it is not clear whether resources should be managed based on peak demand or average demand. Either way, cost is going to increase. For instance, if transportation capacity is managed based on average demand, during peak demand the firm will need extra capacity, which come at a premium.

### **But you see e-business as the means of changing that?**

Yes. E-business can eliminate the bullwhip effect, thus reducing costs and increasing profits but also increasing service levels and flexibility. Here, I am focusing on providing each stage of the supply chain with complete information on customer demand, so-called "supply chain visibility." Supply chain visibility can reduce the bullwhip effect: if customer demand information is shared among supply chain partners, each stage of the supply chain can use actual customer demand to create more accurate forecasts, rather than relying on orders received from the previous stage, which can vary more than customer demand.

### **Is e-business just another term for Internet commerce?**

No, e-business is far more than e-commerce. E-commerce is defined as the ability to perform transactions electronically. Thus, e-commerce is a part of e-business. E-business, on the other hand, is the process of redefining a business model using the Internet to improve the extended enterprise performance. Thus, the focus in e-business is on using the Web to improve intra-organizational, B2B and B2C processes and transactions.

### **So, you see e-business changing the supply chain?**

Definitely. In fact, e-business suggests a shift from the traditional "push" supply chain strategy to a new supply chain model called "push/pull" strategy.

A push system is a traditional supply chain where production and distribution are based on forecasts. The problem with that is that "forecasts are always wrong." You can be close but never precisely on the mark. It is difficult to predict customer demand and therefore difficult to match supply and demand. And the farther out the forecast, the less accurate it is. Thus, a push system is very susceptible to the bullwhip effect.

In the early days of the Internet and the dot-com companies, many believed that the Internet suggested a completely different supply chain strategy, a pull system. In a pull strategy, customer, rather than forecast, demand drives production and distribution. That is, in just a pure pull system, the firm does not hold any inventory and only produces to order. These systems are intuitively very attractive since they allow the firm to eliminate inventory, reduce the bullwhip effect, increase service levels, etc.

Unfortunately, it is very difficult to implement a pull supply chain strategy if there are long lead times in the supply chain. Similarly, a pull strategy does not take advantage of economies of scale, since production and distribution are in response to specific customer demand, and therefore batch production or fully loaded trucks are hard to achieve.

These advantages and disadvantages of push and pull supply chains have led companies to look for a new supply chain strategy that takes advantage of the best of both worlds; enter a hybrid of the two systems, that is, push/pull supply chain systems.

#### How does that work?

Consider a PC manufacturer. Typically, a PC manufacturer builds to stock and thus makes all production and distribution decisions based on forecast. This is a typical push system. In a push/pull strategy, the manufacturer will build to order. This implies that component inventory is managed based on forecast, but the final assembly is made in response to a specific customer request. So, the push part is part of the manufacturer's supply chain prior to assembly, while the pull part is the part of the supply chain that starts with assembly and is based on actual customer demand. Dell Computers is an excellent example of the impact the push/pull system has on supply chain performance.

The book industry is a good example of the evolution of supply chain strategies from push to pull and then to push/pull. Barnes and Noble, for example, has a typical push supply chain. When Amazon.com started about four years ago, its supply chain was a pure pull system — with no warehouses and no stock. Actually, Ingram Books filled orders to meet customer demand. But this arrangement simply did not work well. Today, Amazon.com has seven warehouses around the country where it stocks most of the titles it sells. Thus, inventory at the warehouses is managed based on a push strategy (based on forecast) while demand is satisfied based on individual request, a pull strategy.

The online grocery industry is another excellent example. When Peapod was founded 11 years ago, the idea was to establish a pure pull strategy with no inventory and no facilities. When a customer ordered groceries, Peapod would pick up the products at a nearby supermarket. Unfortunately, stock-out rates at the supermarkets were very high. In the last few years, Peapod changed its business model to a push/pull strategy, adding a number of warehouses; stockout rates are now less than 2%. Of course, in this industry there are other challenges, especially reducing transportation costs. The problem is that no online grocer has the geographic density of customers that will allow them to control transportation costs and therefore compete with traditional supermarkets.

**So, this sounds as though online distributors need to have an infrastructure of, yes, good old warehouses and distribution centers around the country or world.**

Precisely. In that respect, brick-and-mortar to click-and-mortar companies (those that have added an Internet shopping to their

services) have a huge advantage over the pure Internet companies. They already have distribution and warehousing infrastructure in place. Wal-Mart, K-Mart, Target and Barnes and Noble, as a few examples, have all established virtual retail stores, serviced by their existing warehousing and distribution structures.

As a result of going online, click-and-mortars have now changed their approaches to stocking their various warehouses. High-volume products or products for which the demand can be matched with supply, are stocked locally in the stores, while low-volume products are stocked centrally for online purchasing.

#### Can brick-and-mortar companies take advantage of the Internet in other ways?

Yes. One important strategy used by retailers and suppliers is called collaborative planning, forecasting and replenishment (CPFR). CPFR is a process in which supply chain partners coordinate plans to better match supply and demand. This strategy was first developed and implemented successfully by Wal-Mart in collaboration with Warner-Lambert in early 1995. The CPFR process, as implemented by these companies, requires buyers and sellers to:

1. Establish a front-end agreement and a joint business plan (collaborative planning).
2. Create a sales forecast, identify and resolve exceptions (collaborative forecasting).
3. Create an order forecast (collaborative replenishment).

#### How do these new supply chain strategies affect the parcel industry?

The new developments in supply chain strategies mean good news for the parcel industry. Both the pull and the push/pull system rely heavily on individual parcel shipments rather than bulk shipments. This is especially true in the B2C area where a new term has been coined: e-fulfillment.

Another impact of e-fulfillment on the parcel industry is the significant increase in reverse logistics. Indeed, in the B2C arena, e-fulfillment typically means that the supplier needs to handle many returns, each of which consists of a small shipment. Parcel shipping is already set up to handle these returns, a major issue in B2C and in B2B commerce.

E-fulfillment logistics requires short lead times, global dispersion and the ability to reverse the flow easily from B2C to C2B. Only parcel shipping can do all that. Thus, the future looks promising for the parcel shipping industry. This will be especially true for those carriers and consolidators who work to modify their own systems in order to integrate them with their customers' supply chains.

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