IS in Managing Business Operations: The Supply Chain

MANAGERIAL QUESTIONS

What is supply chain management?
What are the five components of supply chain management?
What is the goal of supply chain management?
How is supply chain software used?
What is the role of collaboration?
What is the relation to ERP?
What are the resistances to supply chain software?

INTRODUCTION

Businesses always dealt with their supply chain. That is, they bought raw materials, components, and supplies that they used to create their products or services and sold to a set of customers to whom they delivered their products. What is new is that the speed at which goods and services move through the supply chain increased considerably because improvements in computers and communications speeded the exchange of information.

Although a firm may see only its direct providers and its direct purchasers, as shown in Figure I, the sets of suppliers and customers are much more complex. For example, auto manufacturers obtain almost every component of a car from someone else, although most components are built to the manufacturer's specification. The so-called manufacturer in this case is really an assembler. The suppliers (of doors, batteries, mirrors, engines, and hundreds of other pieces) in turn assemble these pieces from components bought from their own suppliers and so on back to the people who dig raw material out of the ground. If the firm is a producer of consumer products, it may sell directly to end users (e.g., acting as a retailer via e-commerce) or the goods may go through a distribution chain that can involve multiple levels of distributors and resellers. For business-to-business transactions, the sales may be direct through a sales force, through intermediaries such as jobbers, or more and more over the Internet. In other words, the supply chain extends from your supplier's supplier to your customer's customer.

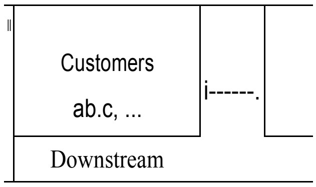

Figure I The supply chain as seen by the firm.

Note, too, that supply chain activities go on within the firm as goods are transferred among departments or from subsidiaries. ln manufacturing, these operations are the assembly, manufacturing, and packaging that produce the finished product. Each of the subassemblies must be available to create the next level of subassembly or the finished product

The supply chain is really a delicate mechanism that depends on everything working together at the same time. In real life, of course, everything doesn't always come together. A lot of the variables are random: the economy fluctuates; mergers and acquisitions happen upstream and downstream in the chain: suppliers and customers go in and out of business; natural and man-made disasters (e.g., hurricanes, strikes, blackouts) occur along the chain. However, decisions need to be made ahead of time, sometimes a considerable time ahead, on how many to produce and when to produce. Keeping a firm's supply chain going often seems more of an art than a science. Therefore, like an insurance policy, firms keep inventory (even with just-in-time delivery) lo protect against uncertainly. They also engage in supply chain planning (SCP) to make their estimates of the future better.

SUPPLY CHAIN[1]

As described by the Supply Chain Council, managing the supply chain includes five components:

J. Planning
2. Sourcing
3. Making
4. Delivering
5. Returning

1. Planning. Planning involves assessing what demand will be (i.e., forecasting), finding and contracting for sources of supply, and measuring how well the supply chain is running. Metrics are used to determine whether your supply chain is being run efficiently, how well cost. goals are being met, and the level of quality and value being delivered lo customers.

2. Sourcing. Sourcing refers to choosing suppliers that provide the needed goods and services. Pricing, delivery, and payment are considerations, as are quality and value.

3. Making. In this step, the product to be delivered to the customer is produced. The product may be a physical object (a car, a toy) or a service (insurance policy, money market account). To create a sellable product and make a profit, it is necessary to schedule its production, test it for quality, package .it, and prepare it for delivery. Measures include quality level, production output, and worker productivity.

4. *Delivering.* Delivery, also called logistics, refers to the activities that move the product to the customer. It involves coordinating shipments so they reach the customer on time, implementing warehousing strategies for storing products until they are ready to ship, selecting transportation carriers, and creating an invoicing system to get paid.

5. *Returning.* Because customers may return part or all of a shipment, either because it is deemed defective or an excess amount was ordered, a network for receiving returns and for supporting customers must be established. In addition, for expensive, complex products, support services (e.g., a help desk) are required. (See the Section on Returns, near the end of this chapter.)

SOFTWARE'S ROLE

Many software products are on the market to help improve supply chain operations. Unfortunately, although some software vendors claim to deal with the entire process, none do. The complexity of each of the five steps described in the previous section is such that dozens of tasks need to be performed. Specific software is available that deals with individual or groups of tasks, but these software packages are not integrated with one another. Integration (see Chapter 10) is a holy grail.

In thinking about supply chain software, it is convenient to divide it into

- software that supports planning and
- software that helps execute the steps after planning.

Planning Software

Supply chain planning is intertwined with the methods of management science. Much of t~e planning software imbeds advanced mathematical algorithms designed to reduce inventory and improve both the efficiency and the flow through the supply chain. Being mathematical, these methods can only provide good answers if the input data from customers (e.g., present and future orders, sales by the customer to its clients, inventory on hand) and from within the organization (e.g., production, warehouse, and delivery capacity still available to commit) are current and accurate. The key parameter is demand, because if the demand estimate is right, the rest of the results will usually be right. If not, you can overproduce or underproduce, hire too many or hire too few, and make other errors. Demand forecasting turns out to be the most complex and the most likely to be wrong in quantity in the planning process.

Execution Software

Execution software automates supply chain operations. The idea is to complete steps more quickly so that the delay between the receipt of an order and its delivery to the customer is shortened. Some execution software is quite simple. For example, by sharing your estimates of demand with your suppliers, your suppliers can organize their production to meet your production needs. In theory, all that is needed is to decide which information to share, sending it regularly to suppliers, and receiving data from suppliers on their performance and their capacity. As discussed later in this chapter, coordination with suppliers is not an easy task.

WHY INSTALL SUPPLY CHAIN SOFTWARE?

Supply chain software makes it possible to gain visibility about demand. Interchanging supply chain information up and down the supply chain became easier as the Internet grew in speed and capacity, telecommunications networks expanded, and communications costs went down. In theory, supply chain software can connect the firm with its suppliers and customers in a large, optimized network. In practice, information is exchanged in only a few industries (e.g., automobiles, high technology, supermarkets, and drugstores) and even then not among all firms.
When they share demand estimates:

- suppliers don't have to guess how much material or how many subassemblies to order for meeting a particular client's needs,
- manufacturers reduce the inventory they need to keep to meet .sudden or unexpected demand, and
- Retailers are not out of stock of specific items in a store because the manufacturer's production falls behind the store's demand.

COOPERATION

A part of the problem is getting firms to collaborate. Most firms trust no one' and therefore prefer not to give anyone information about their plans. Thus, while it is technically relatively easy to share information, the culture (both in the United States and in most other countries) is not to do so, even though sharing information helps everyone. As a result, inventories all up and down the supply chain expand to guard against contingencies.

Cooperation is easier if a large firm insists on it as a condition for doing business with it. Two classic examples, Wal-Mart and Cisco Systems, are described in Sidebars 1 and 2.

SIDEBAR I Wal-Mart

Wal-Mart is, by some accounts, the gorilla of retailing. Specializing at the low cost end of the retail market, it insists on large volumes of information from suppliers who want to do business with it. They do so even with large suppliers. For example, Proctor & Gamble is connected to Wal-Mart distribution centers and, via satellite uplinks, can tell when a single unit of theirs passes through a scanner at a store. When a distribution center drops below a preset level of inventory, Wal-Mart sends an alert to Proctor & Gamble to ship more products.

The nearly real-time information (see the discussion of business activity monitoring in Chapter 8) helps Proctor & Gamble to coordinate its production and shipments with Wal-Mart's demand. In effect, Proctor & Gamble is managing Wal-Mart's inventory. The claim is that Proctor & Gamble is able to reduce its own inventory because of better knowledge of Wal-Mart's demand. Through this process, Wal-Mart, of course, shifted a large portion of its own inventory management and physical inventory costs to its suppliers.

' Some firms stamp everything company confidential. It is said that if you wrote force = mass times acceleration (Newton's law), some firms would consider it private information.

SIDEBAR 2 Cisco Systems

Cisco Systems Inc. creates network hardware for connecting to the Internet, to corporate intranets, and to extranets (see Chapter 3). By linking its own network to its suppliers, contract manufacturers, and distributors, Cisco created a just-in-time supply chain. When an order is received for a network router, for example, messages are sent to contract manufacturers (e.g., of circuit boards, final assembly) and to distributors of standard components (e.g., power supplies). That is, these firms in Cisco's supply chain receive advance warning of what demands are corning because they are logged on to Cisco's intranet and linked to Cisco's manufacturing execution system.

Once an ordered item is assembled by a subcontractor,

- Cisco receives a bar code identification.
- Cisco checks the assembly's compliance with its customer's order, and
- the unit is connected to a centralized facility for automated quality control testing.

At that point. Cisco provides the customer name and the shipping instructions to its contractor.

The foregoing process is used for items that are custom-built in response to orders. For some products, whose demand is steady, parts are built to forecasts and, if necessary, stored in warehouses.

Ideally, for custom orders, Cisco needs no inventory and hence no warehouses. Furthermore, no paper invoices (remember it is all done over the Internet) are required among members of its supply chain. If events don't happen according to plan, management by exception kicks in.

The system was set up under the assumption that demand would continue to increase. It didn't in the economic downturn of 2001 to 2003. Cisco and its supply chain partners wound up producing more units than needed and creating warehouses of unsold products. At that point, supply chain planning had to be revised to cope with the situation.

MANUFACTURING

An enormous amount of software and hardware is available to improve both engineering and manufacturing operations in a firm. These two functions are the 'make' part of the supply chain.

Overview

Factory automation, long a dream of futurists, is coming closer and closer to reality. The idea goes back to the early twentieth century. For example, the Czech play RUR (the name is a crossword puzzle favorite) opened in 1920. It told the tale of Rossum's Universal Robots. Today, lights out factories and lights out computer centers are in the early stages of implementation. Many of these operations are part-time, such as plastic factories stamping out products on third shift. Information systems are central to making this change happen.

The reality for most companies is much less than full automation. We are at the stage of computer-aided design (CAD) and computer-aided manufacturing (CAM), where many functions previously performed by hand are automated. For example, in engineering, computer-aided design is standard.

CAD

The first CAD systems in the late 1960s were typically limited to producing drawings similar to hand-drafted drawings. Since then, CAD systems grew to include

- Reuse of existing design components and automatic generation of standard components of the design.
- Validation/verification of designs against specifications and design rules.
- Simulation of designs without building a physical prototype.
- Automated design of assemblies of parts and subassemblies.
- Creation of manufacturing drawings, and bill of materials.
- Output of design drawings directly to manufacturing facilities.

Realizing these benefits requires recognizing that CAD is not a universal solution. CAD will not automate all routine design tasks. It will not generally provide a three-dimensional rendering that can be viewed from all angles, with detailed cross sections, and used to create CAM data sets or solid models. The design process is still far from paperless.

CAM

Computer-aided manufacturing uses computers to communicate work instructions directly to manufacturing machinery. The technology evolved from numerically controlled machines. Today a single computer can control banks of robotic milling machines, lathes, welding machines, and other tools, moving the product from machine to machine as each step in the manufacturing process is completed. Such systems allow easy, fast reprogramming of the machines from the computer, permitting quick implementation of design changes. As we will see below, these capabilities make customized and just-in-time manufacturing possible. The most sophisticated CAM systems, often integrated with CAD systems, can manage tasks such as parts ordering, scheduling, and tool replacement. Analysis of CAM systems indicates three critical success factors:

- a technology champion who is effective,
- systems integration (see Chapter I 0), and
- Cross-functional steering and implementation teams.

Just-in- Time Manufacturing[3]

Just-in-time (JIT) manufacturing, done right, is a means for increasing the return on investment by reducing the amount of inventory needed. JIT differs from traditional manufacturing in that it takes a different approach to work flow. In traditional manufacturing, production planners schedule production of a batch, that is, a fixed number of units of a given product. The key parameter is the "economic lot size," determined by trading off the cost of setup[4] and the cost of inventory. A large amount of in-process inventory (and hence cost) is created to make sure that raw materials and subassemblies are available as needed.

In just-in-time manufacturing, individual products are built from beginning to end and traditional inventory is largely eliminated. However, in just-in-time manufacturing not having materials or parts available at the time they are needed stops the entire production line. Therefore, to make

Just-in-time work, you need to store data on where each piece of material and part is located and to make sure that parts and components arrive at the place where they are needed at the correct time.

Conversion to just-in-time means keeping accurate track of raw material and in-process inventory, including materials issued and component scrap. The goal is to keep raw material and inprocess inventory as low as possible while avoiding frequent setups.

Inventory

The idea in the supply chain is to make sure that goods are available when needed. For physical goods, that results in inventory-goods kept in reserve to meet demand when it occurs. Inventory, of course, incurs cost. It ties up capital, storage space (which costs money), and requires a good data system to keep track of what is currently in stock and what is scheduled to arrive.

The movement to just-in-time inventory as part of just-in-time manufacturing, that is, the attempt to minimize inventory so that supplies are obtained only at the moment they are needed, also acts as a device to push the storage of inventory up the supply chain.' For example, the auto manufacturer who plans to assemble 500 units of a given model tomorrow seeks to have its suppliers bring the exact number of components needed for the 500 cars to the factory floor in the early morning or, better still, at the very moment each car is assembled.' In practice, the goal can be approached but not reached because some spare parts must be available in case of a defect or to rectify a mistake in assembly.

Inventory shows up in two ways: in-process and finished. In-process inventory refers to goods that are stored between stages of production or service. For example, consider the service of creating an insurance policy. The sales information (input) comes in from the insurance agents. Sales pile up (inventory) at the receiving desk. From there they are routed to individual actuaries and/or risk assessors who determine whether the policy should be written or not and, if written, should it be at the price sold by the agent or at a higher or lower price. The actuaries usually have a stack of policies to act on in their in-box (in-process inventory). As they complete individual policies, the actuaries route them to a production department whose clerks create the needed forms and send them out. Of course, there is an inventory of policies waiting to be sent out by each of the clerks.

Reducing inventory is an example of where improving the supply chain pays off. A company aims to minimize its inventory. To do so, it must produce products as close to when it is demanded as possible. Two kinds of losses can be incurred:

1. Not producing enough goods to meet demand. The penalty comes from lost sales and profits.
2. Producing more goods than are demanded. The penalty is the cost of storing (or even destroying) excess goods.

One of the fundamental formulas learned in operations management courses in business schools is the idea of an optimum lot size, that is, the number of units to produce at a time and the frequency between starting successive production batches. The idea is to balance off the two kinds of losses.

The classic example involved hiring airline stewardesses.[7] Stewardesses were trained in classes. How big should a class be (the lot size in inventory theory) and how often should a new class be

[5] Just-in-time manufacturing, invented at Toyota in Japan where space for keeping inventory was at a premium, was originally devised to reduce the amount of inventory on hand.

"Your author observed an example of the unintended consequences of just-in-time inventory in Tokyo. Arriving around 11 P.M. because of a flight delay, he found the freeways crowded with giant trucks creating traffic jams as bad as rush hour.

'Today, stewardesses are called flight attendants and are no longer limited to female employees started (time between setups)? Recognize that there is a lead time (from the time a class starts to the time it graduates) before newly trained stewardesses become available. Recognize too that there are two kinds of losses: (I) salaries to stewardesses who graduated but are waiting to be assigned to flights (excess inventory) and (2) airplanes that can't fly because too few stewardesses are available" (loss of sales). Clearly, the latter is more expensive.

ROLE OF ERP

The role of ERP (Chapter 4) is different for supply chain planning and for supply chain execution software.

Supply Chain Planning

Enterprise requirement planning systems, which gather information from throughout the company, contain large amounts of information that are used as inputs in supply chain management planning. For a firm with an ERP system in place, it can be of great help because the system assembles needed up-to-date planning information in one place and, conversely, the planning information serves as input to the ERP system. To be useful for supply chain planning, an existing ERP system must be compatible with the supply chain software selected.

The conventional wisdom is that if a firm plans to install both ERP and supply chain planning, it should install ERP first. Part of the reason is that the ERP installation forces the firm to regularize its data. As discussed in Chapter 4, ERP is expensive and difficult to install. Therefore, if supply chain is a major problem and funds are tight, it may prove appropriate to install the supply chain software separately. However, while it is possible, it is quite difficult to create a supply chain planning system from legacy systems because information is needed quickly and reliably from many places. To do so requires great skill in integration with legacy systems (Chapter 10).

Supply Chain Execution

Execution systems don't need as much information as planning systems. Therefore, it is easier to install such systems without ERP in place. However, even in this case, it is advantageous to create compatible ERP, supply chain planning, and supply chain execution capabilities so that orders, payments, delivery, and manufacturing status are available together.

ROLE OF DATA WAREHOUSING

For firms with a large number of items in their supply chains, a data warehouse is a necessity both for planning and for execution. Wal-Mart, discussed in Sidebar 1 in this chapter, is an example. Its data warehouse in 2004 was 400 terabytes. It contains every transaction in every store, recorded within a few minutes of purchase. Data are available on new merchandise as it arrives and as it is put on the shelves. Thus, Wal-Mart is able to keep track of inventory available to sell, to plan orders, and (since they run on just-in-time deliveries) determine when goods should arrive at the stores. The data warehouse thus is the key to integrating their supply chain. Many firms also give access to selected parts of their data warehouse to their trading partners, both their suppliers and their customers.

'The problem can be ameliorated to some extent by using retired stewardesses who work part-time.

CHALLENGES TO IMPLE1\1ENTATION

The three major challenges in implementing supply chain software are

- Gaining trust from suppliers, partners, and customers.
- Overcoming resistance to change by employees.
- Going up the learning curve.

Trust

Almost all the other large-scale software systems described in this book operate completely internal to the firm. Supply chain software, however, requires the cooperation of other firms to make it successful. Not only will your own people need to change how they work, but so will almost every one of your trading partners. That's a tall order. While large firms, simply because of their size, can force changes by threatening to replace a partner (and actually doing so, if need be), most firms do not enjoy enough market clout to enforce a behavior change. A firm embarking on improving its supply chain activities must coax, wheedle, and entice each of its trading partners to change their ways. That's a culture change, and like all culture changes, it is hard to implement. As described in Sidebar l for Proctor & Gamble, supply chain changes can move the management of inventory to the supplier, something suppliers did not do in the past and which they do not necessarily feel able to do.

Resistance

Not only will partners be difficult to bring on board, your own employees will resist change as well. As discussed in Chapter 12 on people issues, people don't like to deal with new ideas in their work. Pre-computer supply chain operations involved long-term people-to-people contacts through phone, fax, and e-mail. People in the organization have tacit information (see Chapter 7, Knowledge Management) about likely sources in case of a crunch. Computer-based supply chain systems upset relationships and diminish individual importance. If the software doesn't perform as expected or runs into even minor problems, people return to their previous ways of solving a problem.

To overcome a lack of commitment within an enterprise and in the supply chain, it is important to provide specific, measurable goals for the effort and to make certain that the goals are clearly understood within the firm.

Learning Curve

When a commercial supply chain program is introduced, it behaves according to what the software vendor viewed as the standard way or the best practice for the purpose. Such programs do not include the company's practices and history. They follow the built-in algorithms and, as a result, seem dumb to the user. Thus, the initial forecasts often need to be modified.[9] Only after a while when a program is, in effect, trained does it develop the smarts that the vendor advertises.

'A classic tale, reported in CIO magazine, involved an auto industry supplier who received an unusually large order just after the software was installed. As a result, the program badly overestimated future demand because forecasts were based on this single order. Fortunately, a staff member who substituted his own estimate based on history caught the error.

A side effect is that initial errors reduce the trust in the program. People revert to working with their own data. Trust is only regained after the program becomes more accurate and when in-house expertise is merged into the system.

THER PROBLEMS ALONG THE SUPPLY CHAIN

Problems along the supply chain principally come from three sources:

- Uncertainties, particularly in demand. Decisions are made on the basis of a demand forecast, that is an estimate of what kinds of units and how many of each will be ordered and when they must be delivered.
- Difficulties in coordinating multiple activities, business partners, and internal units. That is, managing the nuts and bolts of the supply chain.
- Poor customer service, ranging from defective products to poor after-purchase support to early or late delivery.

As shown in Table 1, IT can help in reducing these sources of difficulty.

Demand Forecasting

Demand depends on competition, prices, weather (e.g., a warm or a cold winter), new technologies or fashions, the state of the economy, and much more. Modeling demand can be a tricky business. First, there is the bullwhip effect, discussed in Sidebar 3, that causes demand forecasts to escalate because of small errors made at various stages.

Table 1 IT SOLUTIONS TO SUPPLY CHAIN PROBLEMS

Supply chain problem	IT solution
Waiting times between chain segments are too Jong	Find reasons by using decision support software and/or groupware for collaboration
Non-value-added activities along the chain	Use supply chain management or simulation software
Slow delivery of paper documents	EDI, e-mail
Shipment errors, poor quality	Electronic verification, automation, quality alerts
Learn about delays after they occur	Shipment tracking systems, trend analysis
Excessive approvals	Work flow software, electronic approvals
Poor coordination, cooperation, and communication	Groupware, collaboration tools, e-mail
Parts obsolescence due to excessive time in warehouses	Tracking software, RFID[10]

''' RFID is an acronym for radio frequency identification. Units are equipped with microchips in a tag or label with stored data such as unit number and date built. Transmitters send inquiries to a physical area and each unit responds with its identification information. Privacy issues for RFID are discussed in Chapter 15.

SIDEBAR 3 *The Bullwhip Effect*

The bull whip effect is the name given to systemic problems that can arise in the supply chain where problems at one point can create problems at many others.

Originally found at Proctor & Gamble in its disposable diaper business, the bullwhip effect reflects the magnification of small errors into large ones. Specifically, Proctor & Gamble found that, while demand for its product at the retail level was relatively stable and hence predictable, the orders they received from their intermediaries, the distributors, fluctuated wildly. On investigation they found that poor demand forecasts, price fluctuations, and the batch size of orders were principal causes of the variations. The result was unnecessary inventories all along the supply chain because each firm was looking at its own interests, not the interests of the supply chain. Stockpiling against just-in-case scenarios occurred simultaneously at seven or more points, resulting in up to 100 days of inventory. The bullwhip effect can be overcome by sharing information between firms. As pointed out previously in this section (and in Chapter 7, Knowledge Management), corporate culture in the United States is ingrained against sharing. However, firms that do share, gain significant benefits.

Second, there is the issue of how the demand forecast is created. If the sales department makes it, there is a cultural tendency for salespeople to assume that only the best outcome will occur. Again, the forecast is badly overestimated. If a pessimistic manager who assumes the worst will happen makes the forecast, the forecast demand is much lower than the actual. A more neutral (and realistic) way to forecast is to run a computer model of the supply chain. Sidebar 4 describes this Methodology briefly.

Note: If you are unfamiliar with simulation under uncertainty, feel free to skip Sidebar 4. It requires somewhat more mathematical understanding than the other sections of this book.

WHAT IS THE PAYOFF FROM INFORMATION SYSTEMS IN THE SUPPLY CHAIN?

The major benefits achieved from a successful supply chain software installation include

- a shorter supply chain (implying fewer suppliers to deal with),
- lower costs,
- shortened cycle times,
- ability to build to demand,
- use of more science in meeting customer demand,
- reduced overstock, and
- Improved customer service.

SIDEBAR 4 *MODELING THE SUPPLY CHAIN*

Because of the uncertainties in the supply chain (e.g., in demand, in supplier performance, in manufacturing performance, in transportation, and in timing of customer payments) many firms use "stochastic risk analysis" based on simulation techniques. Stochastic is just a fancy word for saying uncertain. Simulation is the idea of creating a computer model that describes the phenomenon being studied. The idea is that you can run the computer program much, must faster than the real supply chain and that you can do so with much Jess expense. Thus, you can explore many more cases than by other means. Risk models fall into the class of simulation models in which randomness is represented by probability distributions.

A model allows you to create a simple generic framework that describes the supply chain. The framework is really a network with randomness in time and/or cost at many nodes and along many arcs. For example, you might consider the following uncertainties:

- Manufacturing: the time for process design, the capabilities of the resulting product design, the time to produce a component, and the quality of the product produced.
- Customer demand: the robustness of the economy, the stimulation of incentive programs.
- Customer delivery: time required to deliver the goods.
- Supplier performance: responsiveness of the supplier, cost of transportation

Figure 2 shows one distribution (a normal distribution) that an uncertainty may follow. You use your best estimate of what the distribution will look like for each uncertainty.

In a simulation, when an uncertainty is encountered, a single number is chosen from the probability distribution to represent what happens. For example, if the distribution of time for goods to reach you from a particular manufacturer is normally distributed as in Figure 2, you choose a value from that distribution.[11] By proceeding through the chain in this way, you create one possible outcome. But an individual outcome only has a small chance of occurring. Repeating this procedure many times allows you to obtain both the average and the standard deviation of the time from one end of the chain to the other. You can then do what-if analysis that allows you to see what proposed improvements in a node (e.g., time for a supplier to produce a component) or an arc (e.g., shipping time) can do to improve the average performance and the variability of your supply chain.

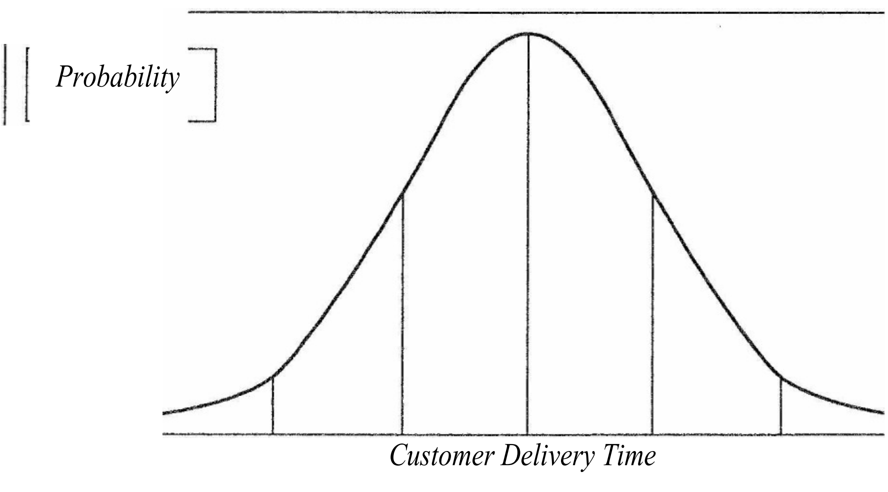

Figure 2 Normal distribution: One representation of uncertainty in a supply chain.

SIDEBAR 5 *EXAMPLES OF SUCCESS*[12]

Toy maker Mattel, who makes the Barbie doll among other products, uses supply chain optimization software in managing its seven distribution centers, seven factories, and other facilities around the world. In planning, it was able to move from monthly cycles to weekly ones and to align its production to reduce over-production and, at the same time, meet customer demand on time. At the distribution end, it concentrated on moving product by installing a transportation management system that reduced less-than-truckload shipments and improved its shipping network.

Atari, a video game manufacturer, uses cooperative forecasting. It links its Oracle ERP system with the sales planning system to formulate weekly demand forecasts by SKU (stock keeping unit) and store. It obtains input data from customers such as Target and Best and feeds its analysis of the data to its suppliers who produce its games. Specific orders come in electronically via EDI and go through an order management system. When an order is shipped, the system sends an advance shipping notice and an invoice.

A McKinsey & Company study" concluded from a study of 63 high-tech companies that a firm can't and won't improve the flow of goods and information unless:

- the supply chain software is coupled with improvements in a company's most important supply chain processes,
- it improves training,
- provides clear accountability, and
- sets more realistic goals.

The difference between a successful installation and an unsuccessful one is a supply chain that is in good shape.

McKinsey & Company found that firms that didn't adopt any supply chain technologies fared better than low-performing adopters. This finding is in keeping with the idea that management must address flawed supply chain processes and practices before technology implementation can do any good. Simply throwing software at the problem won't help. It will, in fact, make things worse. It also reinforces the idea, discussed earlier, that it is wise to put ERP in place before undertaking supply change management. The ERP installation requires updating the firm's business processes so they are compatible across the firm. The McKinsey & Company study emphasizes the simple truth that implementing supply chain management technologies without a corresponding business process change makes you worse off than before. As expected, firms that adopted the supply chain technologies after improving their processes did better than the non-adopters and the low-performing adopters.

In summary, the McKinsey & Company survey found, as would be expected, that

- successful implementation occurs if broken processes are fixed first,
- rollout is incremental with repeated success rather than an all-at-once approach,
- what is promised is delivered,

- training emphasizes improvement in decision making by using the technology, and
- a credible incentive program is instituted for adopters.

RETURNS

Returns are the last stage of the supply chain. They happen all the time. An individual receives a faulty unit (e.g., a lemon) or accepts the money back guarantee offered. A clothing store returns merchandise at the end of the season. A company upgrades its PCs to flat screens or replaces its portables with new ones that are wireless. In each case, the old merchandise must go somewhere. Usually it winds up being returned to the source. That is, returns create a supply chain in reverse.[14] Rather than pushing merchandise down the supply chain to the customer, the customer is pushing finished merchandise up the chain. The source firm's objective is to recover unsold or defective product and then resell it or send it to a liquidation outlet or a recycling center. The income derived from salvage offsets some of the losses on the returns.

In some cases, the product itself implies a reverse supply chain. A disposable camera, for example, is recycled with fresh film and resold. Manufacturers of laser printers encourage people to return their spent toner cartridge units back to the manufacturer. Recycling is being encouraged for more and more products.

Unfortunately, it is not possible simply to operate the supply chain in reverse. Forward supply chain management processes reduce transaction and transportation costs by minimizing the number of transactions in the system. For example, goods are shipped in standardized lot sizes (e.g., cases) for cost effective performance. In the reverse direction, moving unsold goods, say, from a store shelf, rarely results in standard lot sizes. That creates new problems in receiving, material handling, and stocking. Additional handling costs are incurred as individual items move to different locations in a warehouse. The computer must be able to account for small, irregular quantities.

Another technique at the retail level is to sell slow moving products at a discount either through markdowns or closeouts or outlet malls. Unfortunately, such tactics can send false signals into supply chain planning. A classic example is Volvo, whose dealers found that few people wanted their cars in green. When the dealers cut prices to move the cars, the factory took it as a signal that green Volvos were selling and started producing them in even greater quantities.

The conclusion is that reverse supply chains must be established separately from forward chains. They may take the form of third parties that act as accumulators of goods into standard lot sizes that are then shipped to the warehouse or to a plant that remanufactures the product. In either case, the goods are then treated as new product.

Computer software and infrastructure for reverse supply chains is still in its infancy. It is a business opportunity.

THE SUPPLY CHAIN MARKET

What you can do to improve the supply chain changes continually as new software comes on the market and additional supply chain functions are automated. The electronic supply chain is being credited with better customer service, more support from suppliers, and shorter production cycles.

Firms believe that they are creating ever greater levels of customer, supplier, and partner integration. To do so, however, involves challenges:

- Security
- Privacy
- Competition

Clearly, with hundreds of suppliers and customers, many of whom are small, a firm is not able to extend its supply chain end-to-end. A trade magazine, *Information Week,* [15] surveyed the 500 most innovative U.S. firms and found that a typical company in that cohort coordinated its supply chain in 2003 with 39% of its suppliers, 36% of its business partners, and 35% of its customers. These numbers are averages and vary by industry. At the high end is the automotive industry where the three numbers are 61%, 56%, and 54%, respectively. In some industries close connections are maintained with suppliers only.

Information Week found that companies provided different access to their suppliers depending on the application. The values ranged from 58% down to 35%. In rank order the applications were: order management, inventory, accounts payable, receivable status, product development specification, and production schedules.

Major Firms in the Supply Chain Market

Major vendors in the supply chain market include Manugistics and 12 which specialize in the area, and large software vendors such as SAP, Oracle, and IBM who offer supply chain software as well as ERP and other major systems. Table 2 lists the firms included in one supply chain management stock index.[16]

ANSWERS TO MANAGERIAL QUESTIONS

What is supply chain management?

Supply chain management refers to the use of the computer and analytic techniques to reduce the cost and improve the speed with which a firm obtains materials, components, and supplies for its products and services and is able to move those products to its customers.

What are the five components of supply chain management?

Supply chain management includes (l) planning to make it all happen, (2) sourcing to find the best (usually lowest cost, quickest response) vendors, (3) making the product or service, (4) delivering output, and (5) dealing with returns.

What is the goal of supply chain management?

Supply chain software allows firms to gain visibility about supplies and demand over time. As a result, they can reduce inventory, smooth out production and labor, and avoid being out of stock when a demand occurs.

How is supply chain software used?

Supply chain software is used to support planning and to help execute the supply chain steps after planning. *What is the role of collaboration?*

To make the supply chain work effectively, both providers of input and consumers of output need to work together. Thus, for a given firm, vendors who sell to the firm work better if they have access to anticipated needs and clients can plan better if they can obtain accurate forecasts of what outputs will be available.

What is the relation to ERP?

Although ERP is not required, it usually makes it easier to manage the supply chain because an ERP system provides much of the data needed for managing the supply chain.

What are the resistances to installing supply chain software?

The resistance to supply chain software is similar to that for other innovations. People don't like to learn new things, and fear their job will be displaced.

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