Supply Chain Systems: Are You Ready?

James B. Ayers and David M. Malmberg

Managers of complex, or even not-so complex, supply chains must push constantly for improvement. The obstacles to improvement are many. Quite a few initiatives fall short of objectives, or just fail outright. This is particularly true of complicated, big-ticket systems investments. The authors have found that effectively implementing new supply chain systems requires two "enablers." The first enabler is a supportive organization and mindset. The second is what they call the "demand-driven" supply chain.

Answering a question such as that posed in the title is difficult. To do so, one needs to understand common barriers to supply chain improvement. This discussion describes the barriers and how we reached our conclusion that organization and process enablers must accompany the supply chain system implementation. The most common reason for failure of improvement efforts comes not from the technology but from weaknesses in necessary enablers.

Supply chain complexity

Complexity is a primary reason why supply chain improvement is such a daunting task. Sources of complexity include complicated networks, logistics bottlenecks, short product life cycles, demand uncertainty, supplier reliability or lack thereof, and other factors. Complexity has also promoted the rise of sophisticated computer applications and other solutions. It is not necessarily true that complexity should be combatted with more complexity. In many cases, the promise of these approaches is real. In others, it is naïve to think a single system application or other approach will be sufficient. In most cases, the answer lies somewhere in between.

Exhibit 1 depicts a supply chain for a manufactured product. We call it the "simple model" because it is widely used to depict supply chains. Many readers may have seen such an illustration in presentations and sales literature. In the simple model, subtier suppliers support direct suppliers. Our company, shown by the large circle, makes products it sells to distributors. Distributors, in turn, sell to retailers. Retailers serve the mass market.

By putting one's own company at the center of this universe, some will refer to the supply chain when considering incoming material. The demand chain comprises downstream operations to distribution and sales channels. This viewpoint is self-centered. It emphasizes, perhaps unrealistically, the company's own importance in the overall supply chain. It also overlooks the impact of competitors and multiple pathways, or channels, to a wide range of end users.

While the simple model is useful for illustration, there is a danger that an unknowing executive may conclude the world actually operates this way. The reality is

Jim Ayers and Dave Malmberg *are principals with CGR Management Consultants. They can be reached at (310) 822-6720 and (310) 798-2929, respectively.*

Exhibit 1. ***The Simple Model***

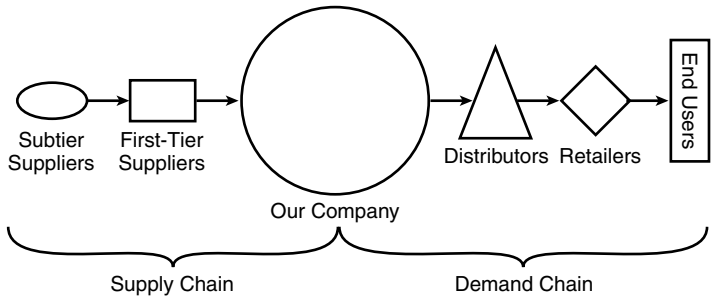
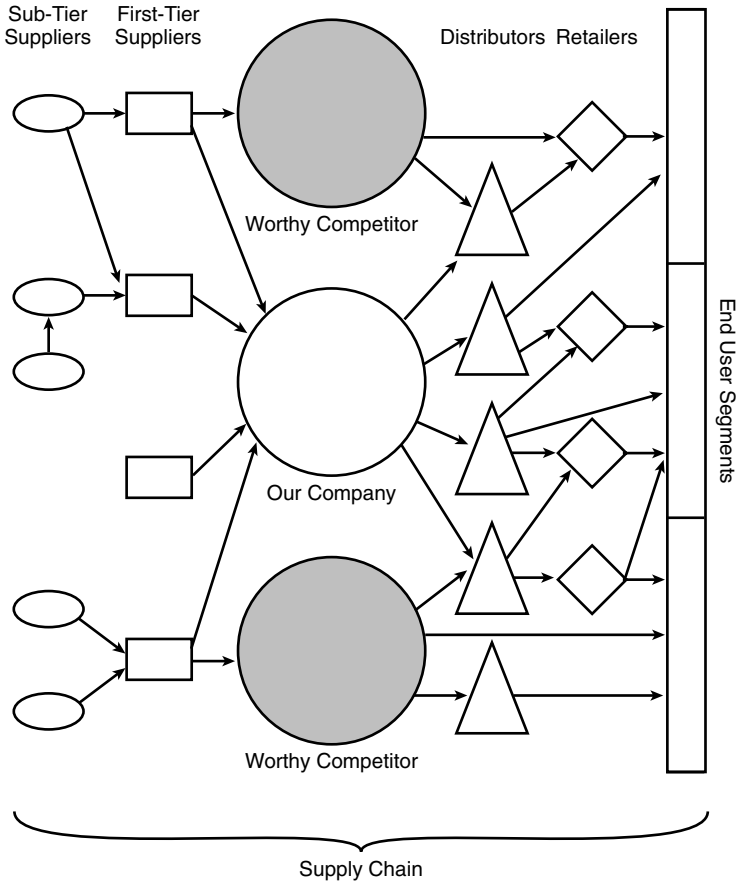


Exhibit 2. ***The Likely Reality***



more like Exhibit 2, which we call the "likely reality." In this version, pathways are complex for both incoming and outgoing sides. Segments displace the mass market of customers, with each making its own demands for product configuration and delivery options. Because end users are indifferent to supply and demand distinctions by individual links, they view the whole operation as a supply chain.

The reality that supply chains are seldom simple means many are not amenable to certain types of initiatives. For example, a common thrust is to shift supply chains from build-to-forecast to build-to-order models. While Dell is known for building its computers to order, this model may not be possible in other supply chains. For example, an ongoing debate rages over whether it will work in U.S. automobile markets. It might also be true that particular segments are amenable while others are not. Any supply chain improvement effort should assess amenability. Later in this article, we provide a methodology for this task.

Lots of systems; lots of claims

Another barrier to supply chain improvement, particularly as it applies to technology solutions, is the proliferation of products in the software space. To longtime observers, the assertions of these purveyors are quite familiar. A prominent example is inventory reduction claims. Claimed reductions in the 30 to 50 percent range could easily have been transported from the heydays of just in time, total quality management, kaizen events, or early MRP systems to the present era.

The authors believe most supply chain improvement efforts have the potential to yield significant savings. But one must be cautioned that a big-budget system is unlikely to produce the savings by itself. The accompanying disciplines, processes, and organization must also be in place to achieve the benefits.

An example of the problems that can be encountered when these key ingredients are not in place is the experience of Nike. They made a $400 million dollar expenditure to implement i2's demand and supply planning system. Nike chairman and CEO Philip Knight blamed most of the company's February 28, 2001, quarterly profit shortfall on implementing the i2 system where they "experienced complications which resulted in product shortages and excesses as well as late deliveries."[1]

Not everyone is going to spend $400 million for a planning system. However, the smaller company may have to make bets of the same relative size just to stay competitive. Few can afford to fail when the stakes are so high.

Different chains; different approaches

The customer base is not monolithic. Earlier, we observed that product end users fall into segments. Exhibit 2 illustrated this, showing three end-user segments on the right. This is likely to be true for both business and consumer markets. For example, many companies have a few large business customers that buy half or more of their products. The other half may be fragmented, with no customer representing a significant share. Such a case may call for separate supply chains, and accompanying systems, to accommodate each large company. One or two supply chain designs might serve the fragmented customers.

An example of the impact of segmentation on the supply chain is forecasting. Large customers may supply their own forecasts or be willing to share point-of-sale data. For these customers, elaborate forecasting systems beyond basic order/forecast collaboration will do little to improve decision making. On the other hand, more sophisticated approaches for forecasting may improve service to the fragmented market.

Parochial approaches

Perhaps the largest barrier to supply chain change is the need to move outside company walls to organize and implement the strategy. This, to many, is an unnatural act. The arm's-length relationship with suppliers and customers is alive and well in most organizations. Collaboration is a dirty word. Even if it is accepted on an intellectual level, it requires changing ingrained habits to make collaboration work.

Many organizations also show inconsistent faces to supply chain partners. For example, the engineering departments in the

partner companies may communicate freely and openly. Procurement departments, on the other hand, where the dollars that change hands are negotiated, are constantly warring over price and terms with suppliers. In other cases, top management talks "best value" in selecting its suppliers while in-the-trenches buyers pick the lowest prices.

Another barrier in many organizations is the lack of supply chain leadership. Department managers hold onto the links they have within their function, but overall coordination is left to a single organization such as procurement or sales, and that department often has limited experience and inappropriate measures of performance. Some attempt to address this problem by renaming an executive to a title such as "supply chain vice president." But the reality is that no substantive change will come as a result of this action.

One size fits all solutions

The strongest advocates for a supply chain solution are the salespeople whose livelihoods depend on meeting their sales target. Too often, according to the solution package sales representative, there is no problem that his or her product will not solve. In addition, the promoter can often maintain that the prospect's competitor is using the solution. No one wants to be left behind.

The busy buyer, needing a solution of some kind, accepts the persuasively delivered message. These managers have their own problems to solve, and the proposed solution buys time and makes the assertion that "we're doing something." The day of reckoning can be far off, especially if the incoming system is complex and takes a long time to implement.

Unfortunately, there is no quick solution for this problem. "Buyer beware" is as true with major systems purchases as it is with any other product. The framework we describe later, however, should aid a frank self-assessment of one's own preparedness to make such a major decision.

The opportunities

For those who persevere, the rewards of a well-done change effort take many shapes. Doing new things adds a spark to the organization. For many, change is fun. Being out in front of the competitive pack adds confidence in the future of the company and job security for employees in a fast-changing world.

Supply chain change offers monetary rewards in two forms. The most visible is savings in operating expense, working capital, and assets. These bottom-line benefits enrich owners, employees, and shareholders. A subtler, but certainly no less significant, benefit is the improvement in competitive position. The company that takes the needs of individual customer segments into account is more likely to gain more business from those segments.

With this in mind, let us explore how an organization can improve its chances of reaching its objectives.

Four stages of readiness

We spoke earlier of the enablers for successful information technology implementation. These are what we call the *supply chain organization* and the *demand-driven supply chain*. Exhibit 3 is a four-stage model showing how enablers support the introduction of information technology to the supply chain. If the enabling elements are in place for implementing change at any stage, the effort is likely to be successful.

On the other hand, if there is a mismatch at any stage, the program is at risk. In other words, if a Stage 4 technology is imposed on a Stage 1 organization, it is likely to fail. And this is a fundamental reason for many failures.

The following sections describe the Exhibit 3 classifications in more detail.

Exhibit 3. *Enablers of Supply Chain Improvement*

	Stages of Supply Chain Evolution			
	1	**2**	**3**	**4**
	Infrastructure	**Cost Reduction**	**Collaboration**	**Strategic Contribution**
Supply Chain Organization	Capability building Execution of basic tasks	Root cause analysis Item stratification "Optimal" buys	Intercompany improvement programs Financial sharing arrangements	Customer-focused organization structures along supply chain Supply chain level steering committees
Demand-Driven Supply Chain	Supplier reduction Negotiations Mostly forecast driven; backorder and simple service level indicators	Quality systems Outsourcing Supplier ratings Lead-time reduction (cells, small batches) Modest JIT/pull arrangements; 25 % of demand-driven potential	Design changes Postponement strategies Information exchange (inventories, forecasts, demand) 50 % application of demand-driven potential	Segment strategies New product involvement 80–90% implementation of demand-driven potential
Supply Chain Systems	Basic capabilities (e.g., bills of material) Data timeliness and accuracy Paper-based or rudimentary computer procurement systems	Mature technology deployment (ERP, EDI, forecasting tools) Stratified forecasting and inventory practices	Web-based technology for information exchange Partner system integration	Increased use of customized transaction and planning tools integrated with supply chain operations
Stage Challenges	People, skills, discipline, time	Systems support, knowledge Inertia, unwillingness to change supply chain partners and their roles	Procurement paradigms, willingness and/or ability to be creative	Barriers between operations, engineering, and marketing functions Difficulties in coordination Amenability of the supply chain to such collaboration Weak links in chain

The organization

The supply chain organization — its structure, its roles, and its processes — is the first enabler. The people in the organization will implement and maintain the information technology. If they are ill-prepared, the result is predictable. Note we use the term *supply chain* organization here. This is likely to include what are traditionally separate departments like procurement, engineering, operations, and distribution functions.

Designing a supply chain organization is an art. What can and should be included from the list of traditional functions will vary from case to case. The supply chain organization can also be an entity on an organization chart

or a permanent or semipermanent team. There can be multiple supply chain organizations if there is a need for multiple supply chains.

From Exhibit 3, we see that a Stage 1 supply chain organization is focused on basic tasks. The Stage 1 company is likely to have strong, functional departments responsible for supply chain activities. It is unlikely that the Stage 1 organization can take on anything too sophisticated. It is crawling, not running. Stage 1 is typical of many organizations in start-up companies, high-technology growth companies whose success has been tied to product innovation, organizations without much competition, or mature companies that have not had to change.

An organization at Stage 2 will undertake internally focused initiatives. These include efforts to improve incoming material quality, reduce suppliers, and adapt mature technologies to supply chain management. There is more cross-talk between departments because initiatives require the cooperation of more than one department.

To reach Stage 3, the supply chain organization must look outside the company. Some companies, such as Detroit automakers, are able to decree to their supplier base. In these cases, Stage 3 collaboration is dictatorial in nature. For most companies, the power balance between trading partners is more matched; thus, collaboration is on an equal or nearly equal footing. At Stage 3, organizations are changing their roles in the supply chain. For example, some distributors may perform light assembly or some suppliers may sell integrated modules rather than components.

At Stage 4, the chain is ready for the cutting edge in innovation. A Stage 4 company recognizes customer segments and responds with tailored solutions for each important segment. It may also decide it cannot serve some segments and pares back its business. At Stage 4, there are now governance mechanisms, such as a steering committee, at the supply chain level. The steering committee includes high-level executives from supply chain organizations. They set direction and approve initiatives focused on mutual benefit. Transaction and financial information is widely shared at Stage 4.

The demand-driven supply chain

Earlier we observed that many companies are trying to shift from a build-to-forecast to a build-to-order discipline. We refer to supply chains where this has been achieved as "demand-driven" supply chains. The demand-driven supply chain is one that derives the information for production and inventory decisions from actual, real-time demand, not forecasts — even if the forecasts use past demand as a basis.

The property of being demand-driven is one of degree. Being *0 percent* demand-driven means all production/inventory decisions are based on forecasts — even if those forecasts are themselves based on actual demand. So all product available for sale to the end user is there by virtue of a forecast. Being 0 percent demand-driven may be the case in fashion goods. The designer may not know how buyers will react to a new design. Trends, past experience, and "gut" may be only basis for the deciding how much to produce.

A *100 percent* demand-driven supply chain is one in which the order is received before production begins. The commercial aircraft industry comes close to this model. In most cases, no production occurs until the order is received.

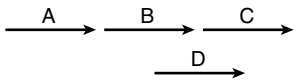
A fast-food example illustrates an in-between case. The Subway sandwich shop or local taco stand forecasts its needs by day. These needs take the form of the ingredients — from sliced turkey to refried beans — required to make its products. These ingredients are then configured to customer order into sandwiches or tacos. The fast-food outlets are likely to be served daily by a food distributor, so they can replenish their stock at the end of the day based on actual demand. The shop keeps its forecast error exposure low by using

Exhibit 4. *Lead-Time and Cycle-Time*

For the purposes here, we use the term *lead-time* as the time elapsed between the identification of the need for the product and the time at which it is delivered. Lead-time is associated with a product or service delivered by the supply chain. It is "imposed" on the supply chain by the competitive environment and geographic and physical constraints. Customer expectations, supply chain innovations, and competitive pressure are the drivers.

Cycle-time is a property of processes along the supply chain. The minimum theoretical cycle-time for a product's supply chain is the sum of individual process cycle-times. The cycle-time for a process also has two components: value adding and idle. Value adding is time the process actually works on the product; idle is dead time waiting in queues or experiencing other delays. Many cycle-times are less than 5 percent value adding and more than 95 percent idle.

A product requires four processes in its manufacture; these are A, B, C, and D. A, B, and C are on the critical path. D is not. Each process has its own cycle time, shown by the length of the arrow. The cycle-time has two components: the adding value cycle-time and the idle cycle-time.



A and B have over half their cycle-time devoted to value-added activity, which is a good thing. For C and D, a majority of time is idle, creating the potential for unneeded inventory and lengthy lead time. Removing idle-time from C should the shorten the lead-time. Removing idle-time from D should have no effect on lead-time.

Shortening cycle-time requires removing both idle and value-added time. Often, the idle-time can be addressed through simplification of procedures and reducing batch sizes, measures compatible with flow manufacturing. Technology solutions, like better machine tools or other automation, may reduce value-added cycle-time.

common components and having frequent deliveries.

Each product-market combination at an individual company will have some potential to be demand-driven. The drugstore can replenish fast-moving Crest toothpaste frequently, based on actual demand. On the other hand, they may buy a year's supply of shaving mugs, perhaps only five or six, at one time. Indeed, the aggressive competitor will try to set the standard for being demand-driven. Dell has exploited the build-to-order model to achieve the highest profits in the personal computer industry.

We believe organizations undertaking supply chain change should methodically assess their potential to be demand-driven. This takes into account the practical reality that not every industry is like the commercial aircraft industry. There are limits to each company's ability to achieve the build-to-order model. But many companies operate far below their potential to be demand-driven. To raise their demand-driven levels, they need to undertake a systematic effort that has three elements.[2]

- *Shortening process lead-time.* Overall lead-time is composed of individual cycle-times for multiple processes. This step involves shortening the cycle-time at each step in the critical path processes from the point of purchase to the start of production for the entire supply chain. These processes include both physical value-adding manufacturing/processing steps as well as information exchanges. Refer to Exhibit 4 for an illustration.
- *Adopting flow model economics.* Flow model economics encompass low-cost ways to vary mix and volume. Lean manufacturing is a discipline that has the same goals as flow economics. Examples include "single minute exchange of dies" in manufacturing and mixing different products on production lines. Batch picking for multiple customers in a warehouse would represent a nonmanufacturing example. A flow model will synchronize supply chain steps and increase the overall supply chain ability to respond to changes.
- *Replacing forecasts with demand.* This step requires efficient sharing of information up and down the chain. An ideal is for all partners to have access to the level of real-time sales as well as the business rules to react.

Exhibit 5. *Typical Demand-Driven Supply Chain Assessment*

1: Level	2: Entities	3: Step	4: Decision(s) required	5: Frequency	6: Basis of decision	7: Responsibility	8: Forecast or demand-driven
1	Retail chain	Order: Store-level replenishment	Refill stock to target levels	Daily	Point-of-sale system data	Automatic. Set by chain replenishment system.	Demand-driven
2		Order: Chain distribution center replenishment	Reorder predetermined batch quantity	Weekly	Reorder point set in system by line item	Automated system. Buyer reviews by exception.	Demand-driven
3	Distributor	Order: Manufacturer warehouse replenishment	Order predetermined batch quantity	Bi-weekly	Reorder point and forecast	Demand manager using forecast. Review by exception.	Forecast
4	Manufacturer	Produce: Manufacturer	To make or not to make a batch on fixed schedule	Monthly	Orders from warehouse	Factory production planner Manufacturing manager	Forecast
5		Order: Manufacturer raw material	Order predetermined batch quantity	Quarterly	Sales forecast	Commodity manager/buyer Sales department	Forecast
6	Manufacturer's supplier	Order: Supplier warehouse replenishment	Batch size based on forecast	Quarterly	Manufacturer forecast	Commodity planner	Forecast
7		Produce: Supplier	Batch size based on forecast	Quarterly	Sales forecast and production plan	Factory production planner Manufacturing manager	Forecast
8		Order: Supplier material replenishment	Batch size based on forecast	Quarterly	Sales forecast	Commodity manager	Forecast

An example illustrates this improvement process.

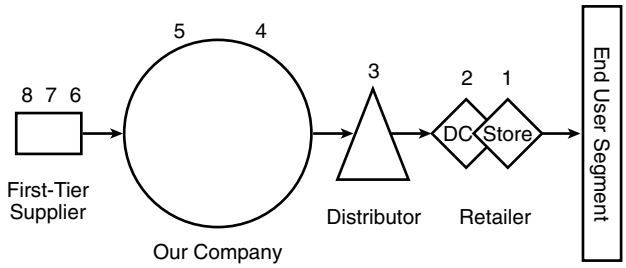
Demand-driven supply chain — case study

Exhibit 5 provides an example of a typical process appropriate for each major end-user segment. It charts decisions, shown as "levels," for ordering and making product as they occur in our example supply chain.

Exhibit 6 shows each level graphically with numbers beside the entity responsible for the decision. The numbers start with "1" at the interface between the retailer and the end user and work backward up the chain.

With this information, a company can quantify its supply chain's progress toward being demand-driven. A table similar to Exhibit 5 for any supply chain provides a valuable assessment of production/inventory related

Exhibit 6. ***Demand-Driven Supply Chain Case Study***



decisions and helps identify supply chain improvement opportunities.

Exhibit 5 shows how often the decisions to order replenishment material and produce product are made. The frequencies in column 5 are different for different entities in the chain. This is one reason for long lead-times and a major barrier to the demand-driven supply chain. If the manufacturer and the manufacturer's supplier are making quarterly decisions, it could mean it will take six months to respond to changes in end-user demand.

In our Exhibit 5 example, it is apparent that the retailer is not sharing actual sales information back through the chain. Only the first two levels are demand-driven; subsequent levels have no information to displace their forecasting. We could say that this supply chain is only *25 percent demand-driven* because only two out of eight levels are making ordering decision based on actual demand.

Two areas for collaboration look fruitful. One is to synchronize the supply chain by putting as many levels on the same schedule as possible. By doing so, as many levels as feasible are on the shortest possible frequency for replenishment and production. This requires the flow economics mentioned above that enables smaller production and delivery batches.

Sharing point-of-sale information, another collaboration opportunity, will also make more supply chains demand-driven. Of course, such data has to be filtered to remove the impact of one-time or other exceptional events. Returning to the four stages described in Exhibit 3, we would say that the supply chain in this case is Level 1 or 2 in terms of being demand-driven. This would assume that managers in the supply chain had assessed its potential to be demand-driven at the 80 to 100 percent level. This implies that most of the decisions along the chain would benefit by real-time demand information delivered in a timely fashion.

What you must do first

The chief lesson of this case and the concepts in the article is that supply chain partners can objectively assess their progress toward achieving world-class levels of supply chain management. They can then pick the right solutions for where they are at any particular time. This will save time, money, and frustration by not taking on more than they can chew. Here are steps worth undertaking as you reassess your supply chain's capability to deliver low-cost customer service and strategic advantage.

- *Know where you stand.* Assess how demand-driven your important supply chains are. Assess your organization's capability as well. Decide how capable the organization is in moving to higher stages of supply chain evolution.
- *Set your expectations.* Goal-setting is fundamental to any improvement effort. Too often, it is limited to financial returns — not the ability to reach them.

In the context of this article, we would use the stages in Exhibit 3 to set specific stage objectives for the organization and demand-driven supply chain.

- *Define your strategy and key tasks for moving to the next stage.* Successful implementation, using the concepts given here, must have three primary drivers: organizational readiness, demand-driven level for each important supply chain, and appropriate technology. This not only increases the chances of success, but also puts a premium on project management.
- *Coordinate your attack.* Although technology may be the driver for the effort, much will have to be done in the enabling areas first. Do not get it backwards by starting with the technology! ▲

Notes

1. "Nike Says Inventory Woes Will Be Fixed by 1H FY02," by Paula Stepankowsky, *Dow Jones News Service,* 02/26/2001, reporting on a conference call with Nike senior executives.
2. James B. Ayers described these approaches in the *Handbook of Supply Chain Management*, St. Lucie Press/APICS, 2001.

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