Demand-Driven Supply Chain Implementation

JIM AYERS is a principal with CGR Management Consultants (Los Angeles, CA; Phone: (310) 822-6720; E-mail: jimayers@cgrmc.com; www.ayers-consulting.com). He consults to companies globally on supply-chain management, including strategy and tactics. He has written five books on the subject, including the "Handbook of Supply Chain Management," and numerous articles, many of which are available on his website. Ayers is a member of the Council of Supply Chain Management Professionals, the Society of Manufacturing Engineers, the Project Management Institute, and the Institute of Management Consultants (IMC), where he became a certified management consultant. He has a BS in engineering from the U.S. Naval Academy and MBA and MS industrial engineering degrees from Stanford Univ.

How can my company take advantage of the flexibility and profitability of a demand-driven (vs. forecast-driven) approach to supply chain management (SCM)?

Many process industry companies lag in exploiting advances in supply chain management (SCM). Day to day, these companies may rely on forecasts for production decisions, creating complicated paperwork quagmires that obscure accountability for product availability and cost effective production. They may also use ill-suited systems and production-planning techniques from discrete product industries, as well as ignore supply-chain operations as sources of competitive advantage. This article points out the disadvantages of forecast-driven SCM practices and then describes how to implement demand-driven SCM techniques that increase flexibility and improve profitability. The terms used when discussing SCM are included in Table 1.

The Theory of Constraints (TOC) developed by Eliyahu M. Goldratt defines three basic product types using the letters V, A and T:

- V-type structures are common in the chemical and phar-

Table 1. Supply chain vocabulary.

3C alternative to chain decisions. materials requirements planning (MRP)	The three Cs are capacity, commonality, and consumption. 3C uses demand rather than forecasts to make supply
Bullwhip effect	Wide swings in upstream supply-chain production despite narrow movements in final demand.
Competitive advantage	A supply-chain feature that improves market share, profits or both (e.g., becoming demand-driven rather than forecast-driven).
Constraint	An element that limits a supply chain from achieving higher levels of performance as measured by physical capacity, customer demand or its ability to generate cash. Such a constraint determines supply-chain capacity.
Cycle-time	The minimum time it would take to produce a product in a supply chain. Cycle-time is determined by process constraints.
Demand-driven	The use of end-user consumption to make supply-chain decisions. The alternative to demand-driven is forecast-driven. The degree to which a supply chain is either forecast- or demand-driven is measurable as a percentage of decisions that are demand-driven rather than forecast-driven. Common terms are "push" for forecast-driven, and "pull" for demand-driven.
Formulation	A formulation in this context is the base product, usually composed of a few ingredients, that is sold in many different forms. This is common for V- and T-type products. See V-A-T.
Lead-time	A market property driven by competitive forces. Includes all delays inherent in the supply chain. If the lead-time is shorter than cycle-time, inventory must be built to forecasts. Reducing lead-time produces competitive advantage.
Lean	A set of tools and methodologies originating in the Toyota Production System (TPS). These include kanban, setup reduction, cellular manufacturing, just-in-time production, and control of defects in manufacturing.
Postponement	A strategy that shifts a decision on product configuration closer to the end-user. Such strategies support transforming a supply chain from forecast-driven to demand-driven. The strategies can involve modular product designs with high levels of commonality, as well as restructuring the supply chain.
Six Sigma	A philosophy of improving process capabilities to the point that these processes produce very few defects (3.4/million chances).
Streamlining	For a supply chain, includes cutting unprofitable products, discontinuing business with redundant and/or poor-performing suppliers, and reducing echelons in the chain, a process called disintermediation.
Supply chain	The company and its trading partners from the end-user back to the suppliers of components or ingredients. This includes both the upstream supplier-side and downstream distribution-side of one's company.
Synchronization	This term describes even flow through the supply chain. Trading partners in such a supply chain produce products at the same or close to the same rate set by actual end-user demand.
V-A-T	Product structures that require different types of supply chain. V-type products have a few raw materials or components that are used to produce a variety of end products. A-type structures have many components that go into a single delivered product. T-type structures retain their identity until the point of sale, where they can be transformed into multiple variations.
Velocity	Velocity is the percent of time a product is moving. Supply-chain improvement seeks to increase velocity. Many supply chains have low velocities, in the 1–2% range.
Visibility improvement	Methods include information technologies, such as point-of-sale data sharing for retail operations, and tracking techniques, such as barcodes and radio frequency identification (RFID).

maceutical industries, where a single compound or formulation provides a base for a variety of products that differ in form (liquid, tablets, gels, lotions, etc.), dosage, size or quantity and packaging.

• A-type structures have many components that go into a single delivered product unit (*e.g.,* aircraft). While this form is uncommon in chemical industry products, it does exist in standardized processing-plant components that can be configured to finished plants.

• T-type products maintain their configuration through the supply chain, but serve a variety of applications. Process gases have this characteristic. So do paint colors that can be blended at the point of sale to match standard colors or color chips brought in by customers.

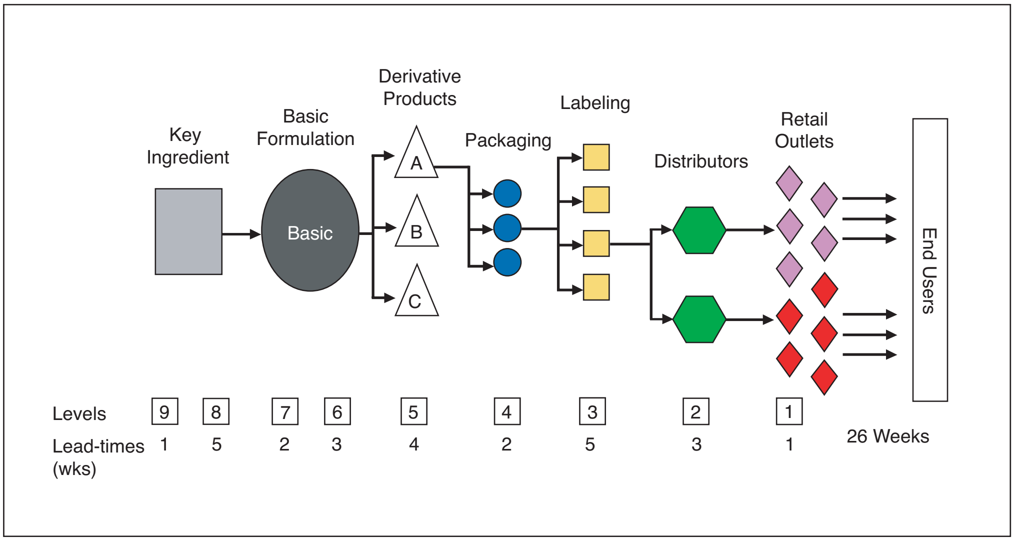

Figure 1. A conventional supply-chain management scenario.

Figure 1 shows a V-type product and is based on an example from the pharmaceutical industry. It shows the flow of product through nine supply-chain levels from a "key ingredient" to the "end-user." As the product moves through the supply chain, it gets transformed into derivative products with different packaging and labeling configurations. It is then sold to country distributors who, in turn, supply retail outlets in their respective countries.

This particular formulation is sold in about 100 versions at the packaging level, denoted as Level 4 in Figure 1. Company management uses rolling monthly forecasts at this level to plan supply-chain production and inventory levels. Each forecast looks ahead for 24 months, requiring sales managers to produce over 2,000 forecasts every month. At some point, such busy work is fruitless, particularly if the forecasts are pretty much irrelevant in production and inventory decision-making.

Figure 1 captures the complexity that negates forecast effectiveness. Each level requires a decision. This is where a planner or an automated production system using business rules decides to make more product or replenish inventories. For example, the retailers (Level 1) replenish store stocks from distributors when shelves run low. Likewise, the distributor (Level 2) must replenish from the labeling operation. Further up the chain, the manufacturer preparing the formulation must decide when to produce using raw materials (Level 6) and when to reorder raw materials (Level 7).

The bottom of Figure 1 shows lead-times for each level in the supply chain. With lead-times in the markets for these products surpassing six months, the reaction at the start of the chain (Level 9) is far removed from the actual sale of the product at Level 1. This leads to inventory accumulation and heightened risk that the right products aren't available when customers want them.

Note that no company boundaries are identified for the operations in Figure 1. In fact, they can vary from product to product. For example, the distributor could be in the same organization as the retailers; likewise, packaging (Level 4) and labeling (Level 3) can be in the manufacturing company or at a stocking distributor. Having a distributor perform these tasks is an example of postponement, a strategy for delaying a commitment to a final configuration until the product has moved closer to the customer.

The demand-driven supply chain

The fact that supply chains operate this way has frustrated executives to the point of executing a plan for improvement. Money is tied up in inventory. Competitors capture sales when product is out of stock and operations aren't efficient. Often, there are wide swings in production, particularly at Levels 6–9, even though end-user demand varies little. This is called the bullwhip effect. There are a number of reasons why such conditions exist. Here are a few:

Barriers. There are barriers between functions, particularly sales and operations, where collaboration is needed between the source and the users of forecasts.

Training. Production planners are trained to use methods that depend on forecasts and lead-times. These processes are often embedded in enterprise resource planning (ERP) systems.

Lack of knowledge. Many companies don't have the know-how to reform their processes and decision-making methods.

Inability to collaborate. Solving problems among trading partners is difficult. A multicompany consensus must exist or a strong trading partner must enforce new rules on others.

Various tools have been developed to overcome these obstacles. These include "lean," which calls for shorter lead-times along the chain, the aforementioned TOC that addresses bottlenecks, and Six Sigma to drive out process

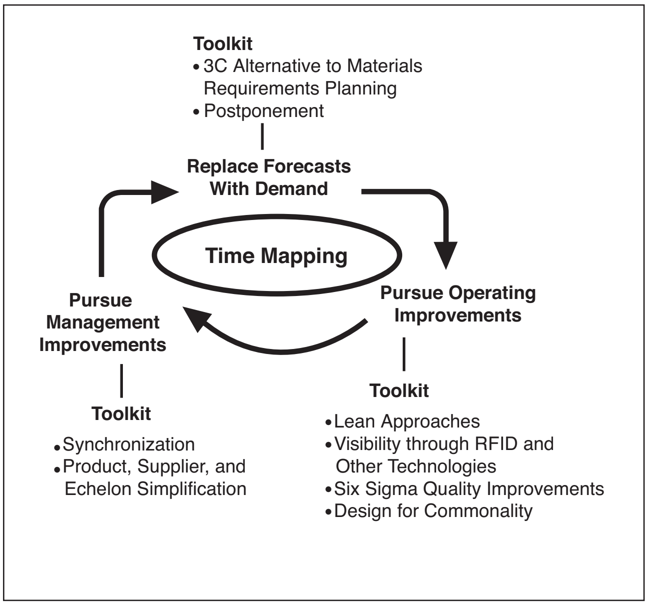

Figure 2. Achieving the demand-driven supply chain.

variation. These tools lead to the path of the demand-driven supply chain. Often, they are applied for other reasons, like short-term inventory and cost reduction. The process will look like that in Figure 2 — a continuous process that will take time to complete, but will yield early returns. At the core of the process is time mapping, a careful documentation of lead-times throughout the supply chain.

For chemical, pharmaceutical, and other V- and T-type product industries, the 3C alternative to materials requirements planning (MRP) deserves particular attention. This is by virtue of the commonality (one of the Cs) inherent in industry product structures and the difficulty of forecasting with accuracy. The other Cs are consumption and capacity. Consumption comes from the 3C demand-driven feature called the Consumption Center, where end-user consumption drives decisions along the chain. Signals from these centers trigger replenishment orders from upstream sources. In Figure 1, only retailers and distributors have visibility over actual end-user demand. If they base their decisions on demand, 22% of the supply chain would be demand-driven. With consumption centers further up the chain, replenishment will be by demand, rather than by forecast, thereby further increasing the percentage of decisions that are demand-driven.

Capacity sets the replenishment rules used by 3C. This is how much to replenish when the signal is given. These replenishments are at fixed intervals called the time between pulls. By setting the rule based on capacity, there can never — at least theoretically — be an out-of-stock condition.

The data in Table 2 will be used to illustrate how to derive a replenishment rule for manufacturing. The table depicts how much basic formulation (from here on noted as Basic) is required for each unit of derivative product —

Table 2. Order for replenishment.

	Product A	Product B	Product C	Target for Basic
Basic formulation required	4 units	10 units	2 units	4,000*
Capacity/wk	1,000	50	500	(*= 4 units x 1,000)

4 units for A, 10 units for B, and 2 units for C. Conventional practice would have us forecasting all the end items from each of these (A, B and C) to decide how much of each to produce.

3C takes a simpler approach to replenish Basic inventory. This will be based on the frequency at which Basic will be produced, which is weekly in our example. The 3C's capacity feature requires us to determine how much Basic could ever be consumed in a week. This capacity would assume that the most intensive user of Basic is 100% of product demand. In this case, it would be Product A. If nothing but Product A were sold, 4,000 units of Basic would be required. For Product B, this figure is 500 units, and for Product C, it is 1,000 units. This assumption is conservative, since it is likely that Products B and C will also be sold during any week.

In this example, the business rule is that Basic replenishment should be sufficient to reach the target inventory of 4,000 units. If downstream demand has consumed 1,500 units of Basic in the past week, then 1,500 units would be ordered. No rule could be simpler. We've simplified the situation somewhat to explain the replenishment rules of 3C. Note that the 3C method builds in reserve stock of Basic to populate the chain with initial inventory and to compensate for lead time in producing Basic.

One justifiable reaction might be that targeting so conservatively will result in excess Basic. The reality is that Basic will be consumed as it is produced so that actual inventory levels will never reach 4,000 units. Also, the 3C methodology allows for cutting target inventory since the 100% assumption is highly unlikely. The "capacity/wk" is the actual or forecast maximum sales rate of all the products that use Basic, provided the supply-chain capacity is not limited by physical constraints.

Call to action

Evolution to the demand-driven supply chain can start with any supply-chain trading partner. One way for the V- or T-type product chain is to start implementing the 3C alternative along the chain. It doesn't have to start at the end-user and work its way back. Installing 3C rules will lead to other revelations. For example, a large lead-time inventory buffer at a consumption center should prompt us to reduce that lead time through TOC, lean or Six Sigma techniques.

A seller of V-type process equipment should use 3C to stock the modules. This helps to ensure turnarounds of days rather than months for equipment orders.