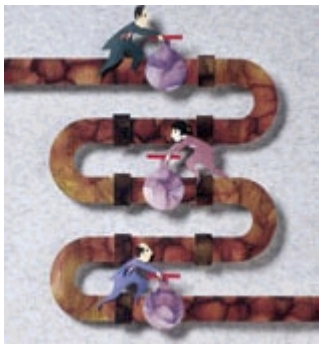
From the pages of Supply Chain Management Review

# After Supply Chains, Think Demand Pipelines

FRED HEWITT -- 5/1/2001



**It's time for a new perspective that extends beyond the traditional supply chain limitations. After all, supply is typically driven by forecasts, hardly the most reliable of indicators. And chains are only as strong as their weakest link. We need to think of materials flow as a pipeline that can be regulated at strategic control points based on actual consumption. We're ready for demand pipeline management.**

During the 1990s, many companies fundamentally revised their approach to managing the flow of materials into, through, and out of their manufacturing operations. At the same time, they began establishing new forms of relationships with their customers and their suppliers. These developments signaled the advent of supply chain management (SCM). Within a few years, SCM became widely acknowledged as a much more effective operational process than the highly fragmented approaches of previous decades.

Examples abound of companies that improved both their balance sheets and operating profits by implementing SCM strategies. Xerox, for example, reported that between 1990 and 1995, its supply chain reengineering efforts simultaneously cut inventories by $650 million, reduced annual operating expenses by $150 million, and significantly improved the success rate in meeting customer-requested dates for product delivery.

At Hewlett-Packard, the "DaVinci" supply chain integration project between 1993 and 1999 has been compared with the transformation that takes place when a caterpillar turns itself into a butterfly—and with equally dramatic results. Business partners and end customers now find Hewlett-Packard much easier to do business with and much more responsive. HP's internal processes have been simplified and have become less error prone. Supply chain management is, in fact, the most successful example of cross-functional business process management, a theory that surfaced in the early 1990s. Business process management principles can be applied both within and between companies. Within a single enterprise, the performance improvement comes from better coordination of previously fragmented and discordant business practices in sales, warehousing, production, and so forth. Extend supply chain integration beyond the boundaries of an individual company, integrating processes and removing delays and redundancies among supply chain partners, and the results are even more impressive.

***The ability to capture consumer demand is one thing;*** *the ability to physically respond to that demand in a timely manner is quite another.*

Chrysler's collaborative initiatives with its suppliers, for example, have been equated with the formation of an "American Keiretsu"—a reference to the Japanese management notion of a "family" of affiliated companies. Although more skeptical observers have suggested that manufacturers have used such inter-company initiatives merely to force their suppliers to hold increased inventories, others have maintained that when integration is applied equitably, suppliers as well as buyers can gain. Chrysler itself claims that its new relationships have led to lower production costs, improved quality, and shorter product development cycles.

In 1990, the U.K. government together with the Confederation of British Industry (CBI) established Partnership Sourcing Ltd. (PSL), a not-for-profit company chartered to promote inter-company collaboration as a primary driver of increased operating efficiency throughout the national economy. A subsequent survey carried out for PSL by management consultants Arthur D. Little indicated that 90 percent of respondents with partnership experience rated the approach a success. The top three benefits cited were reduced cost, increased quality of products and services, and the ability to take advantage of the partner's expertise.

**The Power—and Limitations—of the Supply Chain Metaphor**

With the success of these initiatives, the supply chain metaphor has become embedded in management thinking. The visual image of a "chain" of people both within and between companies cooperating to pass materials from point of origin to point of need is powerful and readily understood. Unheard of before the 1990s, "vice-president of supply chain management" is a common job title today. Both academic and practitioner journals now are dedicated to the theme of supply chain management, numerous textbooks have been written on the subject, and university degree programs abound.

But is it possible that the metaphor is becoming outdated, potentially restrictive of further improvements, and therefore counterproductive? Should we really be thinking of chains? After all, "chains" have their limitations. The strength of a chain is determined by its weakest link. The slowest transfer point—not the fastest one—determines the speed of movement along a chain. In one sense, being "chained" to others is the same as being restricted by them. And why focus on supply? Isn't this at odds with that other great mantra of the 1990s, customer obsession? Shouldn't demand take preference over supply in our thinking? And is cooperation, fashionable as it may be, really as effective as good old-fashioned single-point control of materials flows?

A new perspective is needed that extends beyond the intrinsic limitations of the supply chain paradigm. We believe that perspective is embodied in a concept called demand pipeline management (DPM). To fully understand the advantages of DPM, we need to address three basic questions:

1. Which should drive materials movements—supply or demand?
2. Should point-to-point (chain-like) movement be the goal, or would continuous flows of materials (as in pipelines) be better?
3. Should coordination remain as the preferred management approach, or would a more direct form of control be more effective?

**Supply or Demand?**

Without being overtly acknowledged as such, many of the recent developments in supply chain management represent a move toward allowing demand, in the form of actual downstream consumption, to drive upstream supply actions. This is true both for business-to-consumer and for business-to-business transactions. Leading companies are using true point-of-consumption information to trigger replenishment actions back through multi-company supply processes with enormous improvements in inventory and service levels. In effect, demand chains are replacing supply chains.

Efficient consumer response (ECR) offers an early example of demand chain orientation. Pioneered by Procter & Gamble (P&G) in the early 1990s, the ECR project encompassed a wide range of initiatives but at its heart lay the continuous replenishment program (CRP). Through the CRP, companies could tap into point-of-consumption data and drive a fast replenishment process based on actual retail store sales data. Significantly, P&G not only adapted its own production processes to synchronize supply with demand but also worked with its suppliers to integrate their upstream activities into the replenishment process. This demand chain pioneer also cooperated with its motor carriers to develop and implement more frequent delivery schedules appropriate to the new approach.

It is not surprising that early implementations of demand-driven ECR focused on fast-moving consumer goods (FMCGs). The adoption of point-of-sale (POS) information technology, the Universal Product Code (UPC), the associated bar-coding systems, and electronic data interchange (EDI) standards—combined with the relatively simple manufacturing processes involved in producing most FMCGs—make implementing demand-driven replenishment relatively easy in this sector. Inventory velocity has been long recognized as the key driver of success in FMCG retailing. It is common for companies to sell goods to consumers out of consignment stocks or from stocks for which the supplier's payment date has not been reached by the time of retail sale. In this business model, success or failure depends, more than anything else, on stock turns driving positive cash flows. Stagnant inventory and obsolescence are the sector's two deadly sins. Not surprisingly, therefore, ECR-like demand-based replenishment techniques have now spread widely within the retail sector.

Further upstream, demand-driven replenishment has become commonplace at several points within manufacturing operations. A simple factory floor Kanban system is a classic example of demand's pulling inventory to the point of use. At an inter-company level, usage-driven just-in-time (JIT) deliveries apply the same principle. Leroy Zimdars, director of supply chain management at Harley-Davidson, has identified "trigger inventory replenishment systems" as a key component of the company's streamlined manufacturing operation. Zimdars has explained that "rather than push, we pull inventory into the plant, where items are actually re-ordered at the point of use on the shop floor based on a signal sent from our computer to the supplier." Harley-Davidson credits JIT with lowering costs and improving quality without sacrificing supply flexibility.

The Dell business model for direct delivery of personal computers is another classic example of a demand-driven process. In this model, the sales order calls down existing stock items held by various suppliers. The essence of the business approach is that it uses consumer demand to trigger the materials flows. As Michael Dell has explained: "We tell our suppliers exactly what our daily production requirements are. So it's not, 'Well, every two weeks deliver 5,000 to this warehouse, and we'll put them on the shelf.' It's, 'Tomorrow morning we need 8,562, and deliver them to door number seven by 7 a.m.'"1 One or two steps beyond direct delivery lies mass customization. Here individual customer orders, rather than aggregated demand, are used to drive supply. Build-to-order techniques, traditionally reserved for high-priced, low-volume items such as ships and airframes, are applied to the production of lower-priced, more common items. One early and frequently quoted example is the customization of bicycles by the Japanese manufacturer National Bicycle Industrial Company (NBIC), a subsidiary of Matsushita. In 1987, the president of NBIC noticed that an Osaka department store had built a successful business by delivering high-quality custom-made dresses to customers within two weeks of receiving their orders. By using a radically revised ordering process and changing its manufacturing assembly operations, NBIC also moved to a two-week order fulfillment cycle. Remarkably, it accomplished this while providing customers with what was mathematically a range of eight million product variants. The techniques of mass customization now have been extended to many products, including customized Barbie dolls and customized pet foods.

Between the deliver-to-order and mass customization approaches lies a continuum of order fulfillment techniques such as finish-to-order and customer-applied customization kits. All of these approaches use actual demand to drive supply. In fact, during the last decade, the basic approach of allowing actual orders rather than predicted sales to drive supply has been applied at multiple points along the chain. When the customer requires immediate product availability, the ECR response is appropriate. However, when there's a lag between customer order and required delivery date, as in the case of more complex items such as production machinery, the more appropriate response is to build to order or finish to order. The basic idea is to drive supply off demand and move the actual orders as far upstream as possible, while still retaining the capability to meet the customer's required availability date.

In all of these cases, real demand data, pushed back upstream as far as possible, can be used to dampen what has become known as the "bullwhip effect" of inventory creation. Reducing delays and uncertainty by providing actual demand data upstream to points where inventory "pools" are deemed necessary results in pools that are shallower than those subjected to the bullwhip effect. That means the total chain can operate with less inventory. In fact, recent research at MIT indicates that information visibility and collaboration offer savings of between 40 and 70 percent in inventory costs for the total chain.

There are undoubtedly industrial sectors in which the norm is still to let supply drive demand. One recent study, for example, indicates that most European auto manufacturers' production schedules are still geared to volumes and variants that buyers are expected to want three months out. The same research shows that although acres of finished vehicles exist, customers have less than a 10-percent chance of getting a vehicle that matches their exact preferences. The customer is much more likely to receive a discount for unavailable features or to receive unrequested features free. In effect, demand is manipulated to match supply.

Even in this complex industry, however, the automakers are striving to create a process that will enable production of truly customized automobiles within acceptable order fulfillment times. Among several initiatives under way, the U.K. Science Research Council is sponsoring the International Car Distribution Program (ICDP), a three-year research effort involving manufacturers, component and sub-systems suppliers, and dealers. The program's aim is to assess the feasibility of producing and delivering truly customized cars within three days of order acceptance. Although technically possible (given that the average automobile requires only 16 hours of actual assembly time), the issue is whether the total order fulfillment process can respond to the three-day requirement without excessive inventories in the upstream "pools."

In summary, a growing number of initiatives clearly show that, with appropriately designed production and logistics systems, companies can often use actual demand (direct pull) instead of forecast-based supply to drive materials flows at multiple points in the materials chain. And in an age when responsiveness and flexibility are key differentiators, it's clear that demand-driven operational processes will continue to gain ground over supply-driven ones in an ever-widening range of industries. Put another way, demand chain thinking will progressively replace supply chain thinking.

**Chains or Pipelines?**

Today's consumers expect far more than previous generations did in terms of instant and universal product availability. If we can have a vast variety of ready-to-eat foods delivered to our homes in a few minutes, why do we need to travel long distances and wait longer for other items? Immediate worldwide communications and the ease of instantly ordering a wide array of products to suit our individual needs have created an expectation that the products themselves should also be available wherever and whenever we want them.

What is becoming clear, however, is that the ability to capture consumer demand is one thing; the ability to physically respond to that demand in a timely manner is quite another. Increasingly, companies will seek to gain competitive advantage by providing their products in a

more timely and more affordable manner than their competitors can.

***As companies rethink their business models,*** *they must also rethink their supply chain relationships.*

The world of "real-time everything" has changed not only our expectations but also the economic formulae upon which successful business models are based.

Manufacturing and distribution processes are under extreme pressure to respond faster and faster to customer orders. Yet in today's highly competitive business environment, the traditional option of holding "just in case" finished goods to satisfy demand is rarely affordable. One of the primary lessons of the 1990s is that inventory carries costs far beyond the purchase price of the goods held. When allowance is made for handling costs, stocktaking costs, obsolescence write-downs, and the like, the cost of holding inventories is often three or more times the actual cost of the goods. Cash tied up in inventory also implies lost investment opportunities. As Peter Drucker has succinctly put it, inventory of any kind, but particularly finished-goods inventory, is not an asset; it is a sunk cost. Every echelon and every stock location adds significantly to operating costs.

Caught between enhanced customer expectations and ever-greater attention to affordability, suppliers must find ways of minimizing the number of inventory locations as well as the amount of stock held at each. Thus, shortening logistics leadtimes has become a major imperative in demand chain design. In fact, the objective must be to attain as near as possible a pipeline-like continuous flow of materials through a minimum number of inventory pools. "Pass the parcel" is no longer an acceptable logistical response. "Move it and use it" is today's mantra.

Recognizing the need to redesign both materials flows and information flows early in its ECR project, Procter & Gamble implemented a cross-docking/flow-through distribution program alongside the continuous replenishment program. The objective was to develop a cost-effective process for enabling frequent deliveries to multiple destinations from multiple sources. Coordinated transport networks that facilitated cross docking and avoided static inventory were key to achieving this objective.

Similarly, in an attempt to achieve a more responsive and more continuous flow of materials, Dell has adopted a merge-in-transit approach to fulfilling some of its more complex orders. Supported by in-transit tracking technology based on wireless communications and global positioning systems, Dell breaks down these customer orders into their constituent sub-items. The flow of these sub-items then is regulated such that they come together en route to the customer, arriving as a completed product at the customer's designated delivery destination.

Indeed, much of the value-added proposition that FedEx, UPS, and other major carriers provide is their ability to leverage the benefits of cross docking and merge in transit. They also have progressively extended their range of services from the basic warehousing and point-to-point shipping offered in the past to full-service materials flow planning, tracking, and handling. The success in recent years of these and other logistics service providers reflects the increasing importance of end-to-end materials flow management.

Faced with the issue of minimizing both delivery times and finished-goods inventories when responding to country-specific orders for copiers, Xerox and others have adopted another continuous flow strategy—the "doggy bag" technique. First, the product is designed in such a way that the country-specific items such as LCD chips, labels, and manuals can be fitted at the latest possible stage in the production process. Second, the "doggy bag" containing these items is not matched with the basic product until after actual country-specific demand is known. Then, the doggy bag's contents are fitted either in transit or as part of the delivery and installation process at the customer's premises. Essentially the logistics time serves a dual purpose—keeping the goods moving while still completing the manufacturing process.

Overlapping in-transit time and assembly time in order to keep materials moving and reduce total order fulfillment time is not a new idea. Whaling "factory ships" have employed the basic technique for many years. What is new, however, is that variants of the techniques are now beginning to emerge in different industrial sectors. The approach minimizes delays in responding to orders by combining the distribution/manufacturing/assembling/finishing sub-processes into a single seamless mega-process. How long, one wonders, before "factory ships" of other types appear—perhaps applying the finishing touches to Xerox's configured products in the mid-Atlantic en route to Europe or tailoring clothes to individual specifications in the mid-Pacific?

Clearly, the challenge of responding to demand stimuli and heightened customer expectations puts great pressure on supply flexibility and responsiveness. At the same time, SCM initiatives have exposed the true costs of traditional build-for-stock approaches. The economics of supply are changing, and static inventories at any point in the pipeline are becoming less and less affordable.

In response, manufacturers and their suppliers are looking for fundamentally different operating processes to replace traditional point-to-point, multi-stop, hierarchical, inventory-intensive materials-handling processes. They are beginning to collaborate to develop synchronized response systems that emulate networks of pipelines rather than point-to-point chains. Along these virtual pipelines, they look to minimize the number of inventory pools needed to assure supply. Importantly, they are gearing the level of inventory in each pool as closely as possible to the actual outflow of material from that pool. The result is best thought of as a network of demand pipelines, rather than as links in a chain.

But how should these responsive materials flows be regulated? Is SCM-style partnership coordination

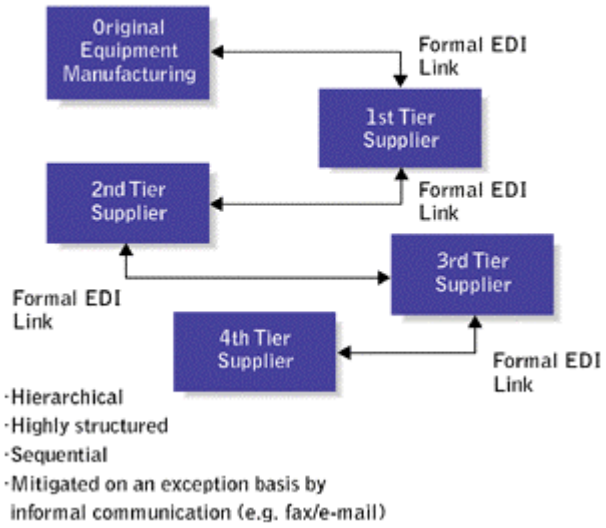
appropriate in designing and operating demand pipelines? Or will an alternate, more control-oriented approach be required?

**Coordination or Control?**

Under the traditional approach, supply chain integration requires adjacent members of the chain to coordinate their actions. This is achieved by passing "parcels" of information along the chain to stimulate a counterflow of "parcels" of replenishment materials. At the boundaries, EDI standards ensure information exchangeability. Typically, the production schedule of the final assembler drives a materials requirements planning (MRP) system or manufacturing resources planning (MRPII) system, which in turn generates orders to immediate first-tier suppliers. These suppliers, in turn, generate requirements on their suppliers, and so the requirements are cascaded down. Both the information exchanges and the resultant materials transfers follow structured paths that are essentially sequential and hierarchical, **as depicted in Exhibit 1**.

EXHIBIT 1

**Traditional Materials Flow**



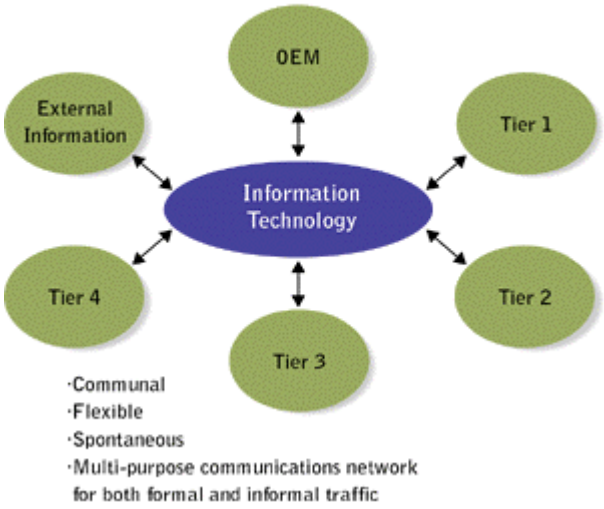

The situation, however, is changing quite significantly. Recent developments in information technology (IT) hold out the possibility of radically reengineering this traditional approach in two important ways.

1. The emergence of enterprise resource planning (ERP) systems, which use object-oriented databases and are implemented on a client server networked IT infrastructure, means that within a company, information from all points in the intra-company demand pipeline is available to all participants in the business process simultaneously. It also means that the range of information that can be exchanged with partner organizations can be increased.
2. With the arrival of the Internet, and in particular the adoption of extranets for commercial transaction processing, even information exchange between companies need no longer be sequential. Rather than wait to receive information from the next-higher-tier member of the chain, all participants can potentially exchange information simultaneously with all other participants along the pipeline. And simultaneous information access carries with it enhanced potential for simultaneous rather than sequential reaction, leading to previously unattainable levels of responsiveness.

**The new model that emerges from these IT capabilities is depicted in Exhibit 2.**

EXHIBIT 2

**New Information-Enabled Model**




But to attain these new levels of responsiveness, companies need to rethink not only information flows but also the roles, responsibilities, and authorities of the participants within the business process. As traditional concepts of hierarchy break down, a new form of collaboration may be required. Two potential ways of capturing this opportunity seem at first contradictory. First, responsibility for regulating the total pipeline flow of materials could be delegated to fewer points along the pipeline, in effect substituting control for coordination. Second, "lower tier" upstream participants could be given more responsibility and authority not only to respond to their adjacent downstream customer but also to monitor and react to what is happening even farther downstream. Ideally, this could extend to the end point of final consumption.

The shift in thinking from coordination to control is evident in Xerox's decision to create the position of customer supply assurance manager (CSAM). The CSAM's role reflects the belief that effectiveness and efficiency stem as much from integrated decision making as from integrated physical materials handling. Matching supply to demand in real time now is the responsibility of a professional, not a committee.

As implied in their job title, the primary task of CSAMs is to satisfy customer demand by assuring product availability. They are expected to do this efficiently in

terms of the use of human and materials resources. In assuming this responsibility, the CSAM interfaces with all points in the supply chain on a daily basis. A demand-driven data set, derived from the Xerox "production planning process" (P3), provides the factual background against which the pipeline members base future actions. In essence, it is the periodic snapshot of the state of play on a particular product. The CSAM acts as ringmaster, iteratively facilitating decisions that may range from changing production schedules to introducing or terminating sales promotions.

The role of the CSAM has experienced an interesting evolution since its introduction in 1995. Today a CSAM rarely needs to convene a formal weekly P3 meeting once a product has passed through its launch phase. Experience has shown that a process driven by valid, unmanipulated, timely data defuses disagreement and builds trust among pipeline members. This, in turn, allows the CSAM to become more proactive in decision making without curtailing the freedom of other participants to act in their own spheres of influence. The CSAM does not exert hard-line control over materials flows. Rather, the participants in the order fulfillment process act as members of a full demand-satisfaction community, not just as one link in a chain. The CSAM has become a de facto flow regulator.

Bose Corp.'s development of JIT II is another clear example of wide-ranging authority's being delegated to a single individual. In this approach, one person is authorized to perform multiple product design, procurement, and order-satisfaction roles. Supplier representatives are located in-house within the Bose customer's design and procurement team. These "in-plants" are empowered to place orders with their own company on behalf of Bose. Performing the materials planning, purchasing, and supplying as an integrated activity has reduced the complexity of the process. With the in-plant approach, a two-step, one-person process replaces a four-step, four-person process. This has led to major reductions in cycle times and overhead costs, **as depicted in Exhibit 3**.

Bose now uses JIT II both with suppliers, who have in-plants on Bose's premises, and with customers, who have Bose employees stationed at their plants. JIT II is now a registered service mark with courses run by Bose and by licensees. The approach is proving highly effective in sectors as varied as steel making and grocery retailing. Progressively building a trust-based relationship has allowed Bose and its partners to take their coordinating processes beyond those typically found in supply chain management partnerships. As with the Xerox CSAMs, the Bose approach uses a combination of information visibility and professional staff vested with a high level of delegated authority based on high levels of trust. The result: JIT II has enabled Bose to greatly enhance the responsiveness and effectiveness of materials flows down the demand pipeline.

In all of this, the human aspects of change management are often much more challenging than the technical ones. But if the new information technologies' potential is to be captured, the roles, responsibilities, and therefore the relationships of the pipeline partners must change. The Xerox and Bose examples show that some companies are willing to move to levels of delegated control that go well beyond traditional customer-supplier relationships. Operational control of materials flows is placed in the hands of a few key players. Working within agreed frameworks and parameters, these individuals can engage proactively in demand-driven order fulfillment, thus taking demand pipeline performance to new levels of efficiency. Such "delegated control" techniques may, in fact, become an essential prerequisite to success in the networked world of e-business.

EXHIBIT 3

**How Bose Has Reduced Pipeline Complexity**

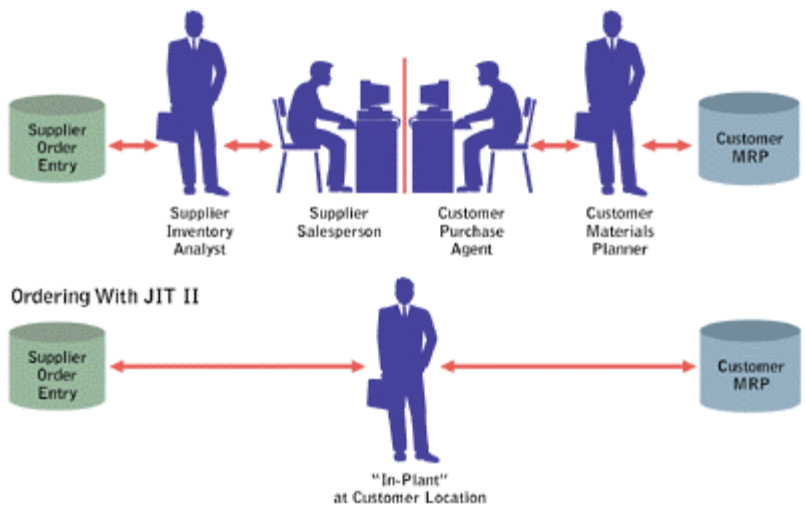


EXHIBIT 4

**How Do You Measure Up Against the Demand Pipeline Template?**

**Supply or Demand?**

- Do all your order fulfillment processes respond to real demand?
- How far are you pushing actual sales data upstream?
- Are you avoiding the "bullwhip effect"?

**Can you/do you/should you:**

- Customize to order before dispatch?
- Provide customer-fitted customization kits?

**Can you/do you:**

- Build to order?
- Configure to order?
- Finish to order?

**Chains or Pipelines?**

- Are you operating virtual pipelines, or do you accept the traditional point-to-point materials chains?

**Can you/do you/should you:**

- Deliver direct to customers?
- Use cross-docking and merge-in-transit techniques?
- Use finish-in-transit techniques?
- Does your inventory flow, or do you have multiple points of inventory "pools"?
- Do you make maximum use of automatic replenishment triggers and min/max controls to keep inventory moving with minimum delay?

**Coordination or Control?**

- Are you ready to collaborate in a non-hierarchical business relationship as part of a multi-company demand satisfaction community?
- Are you willing to establish control parameters within which the community's demand pipeline network may be operated?
- Would you be willing to assume a trust-based control role on behalf of the community as a whole?
- Are you willing to delegate such a role to others within the community if they are best suited to perform that role?