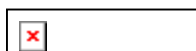


Forecasting, Demand Management, and Capacity Planning

Charles C. Poirier

A root problem in supply chain management is the unavoidable uncertainty in predicting future demand. This condition manifests itself in the unreliable sales forecasts that form the heart of many inventory management and planning systems. Contributing to this nebulous nature of predicting the future is the distortion of past facts as the usual communication platforms, which include telephone, mail, fax, some EDI processing, and a bit of e-commerce, are often rife with mistakes, errors and manual overrides. What typically goes into the upstream side of the chain is quite different from what is needed at the downstream side. In the early levels of the supply chain evolution, this complication leads to allowances being made for forecast error, additional buffers to inventories to cover contingencies, changed schedules, and heroic efforts to respond to special customer conditions. Manual processes and overrides work but are extremely cost intensive and inefficient. The results are higher administrative costs, excess inventory and/or poor customer service levels, as well as higher costs of goods sold because of the instability in planning and scheduling systems. Leaders do not accept this situation and expend the time and effort to eliminate the problems and introduce new processes and systems that bring greater accuracy and efficiency to the steps involved in entering, planning, and fulfilling orders.



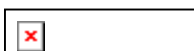
A Framework Guides Execution

Exhibit 1 – Modeling Supply Chain Transformation

Process	Functions	Advanced Capability
Demand Management Forecasting, Planning and Order Management	<ul style="list-style-type: none"> • Sales forecasting • Order processing • SKU consolidation • Replenishment 	<ul style="list-style-type: none"> • Consumption trigger • Higher turns • High forecast accuracy • Low forecast bias
Capacity Planning and Inventory Management	<ul style="list-style-type: none"> • Supply capability • Core competence • Cycle time consistency • Inventory, buffers 	<ul style="list-style-type: none"> • Flexible response • Lower variability • Constraint elimination

Exhibit 1 illustrates the typical process steps involved in demand management, capacity planning and inventory management. Note that the processing begins with sales forecasting and other functions that must be improved before moving to advanced capability, as the firm is able to increase that accuracy and build a more responsive supply chain system. As the focus transfers to demand management, the firm pays attention to the weaknesses in sales forecasting and begins to establish better methods and procedures for order entry; order planning and order management, and supply planning. The number of items or SKUs offered is typically reduced to those on which the firm can make a profit or those needed to have an acceptable market offering.

Processing is oriented around how to replenish those items using optimized conditions. In the advanced levels, consumption triggers this replenishment, often through an active, online network that transfers cash register data to planning systems, a key element in a true “pull” system. Higher turns in the most profitable items are experienced because of high forecast



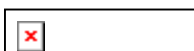
accuracy and a low bias in the forecast, which helps the firm avoid having too much or too little inventory to meet actual demand.

With a better handle on what is happening with internal order processing, attention moves to capacity planning – to match what can be produced with what is being demanded, essentially balancing the supply chain with the demand chain. Here the issue of inventory management is faced, not as a means of foisting inventories upstream in the supply chain to willing suppliers, but as a way to reduce the need for the extraneous inventories in the supply chain system and to utilize capacity to the most effective degree possible. The results are a matching of just-in-time deliveries with actual manufacturing needs, and reduction of the buffer stocks by virtue of knowing what is truly being taken out of the system at the customer end of the chain.

Supply capability is reviewed in the advanced levels with respect to the core competencies of the firm and its value chain partners and decisions made on which partner should perform which process steps. In the most advanced levels, flexible systems of response are created. There is much lower variability in the network as all parties are working together through an online extranet to review instantly what is occurring and where changes must be made. Constraints in the system will be eliminated or under control as the end-to-end partners have linked their ERP systems and have visibility into what is occurring across the full network.

Forecasting is the Achilles' Heel

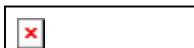
Throughout this progression, supply chain efficiency is inexorably linked with a better understanding of exactly what is being demanded of the system. All of the process steps



mentioned are affected by what is needed, when and where. And forecast error often becomes the scapegoat for lack of an efficient response. Since forecasting is an inexact science, forecasts will always be inaccurate. The challenge becomes careful management of this inaccuracy and balancing the incremental cost of producing higher accuracy versus the gains in service, processing costs and inventories that accrue from additional accuracy.

Over the years, companies have spent considerable time and effort working with their historical data to project incoming orders, often sending approximations of what they believe to be current demand to planning. For those who persevere, mathematical models and algorithms are applied to match the educated guesses with actual data trends to keep the forecasts synchronized with what is actually taking place in the market. Combining history with the present, adjustments are made that should bring a closer congruence between what the firm thinks should occur and what really takes place. The most common mistakes interfering with the development and deployment of a successful forecasting system include:

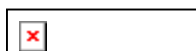
- Lack of an on-going and rigorous process of forecast error measurement.
Advanced firms have automated on-going processes that measure forecast accuracy using meaningful and accepted definitions
- Lack of organizational acceptance of the need for accurate forecasts.
- Lack of clear organizational ownership of the forecasts that are generated.
Without an obvious responsibility, everyone can run for cover and use weak forecasting as an excuse for all the poor processing and extra inventories.



- Lack of clear rewards and incentives for forecast accuracy. Tying forecasts to sales quotas for example can produce some very bad results as salespeople lowball forecasts to ensure they beat their sales targets.
- Failure to understand the underlying patterns and the reasons for variances.
- Failure to involve senior executives in the forecasting process.

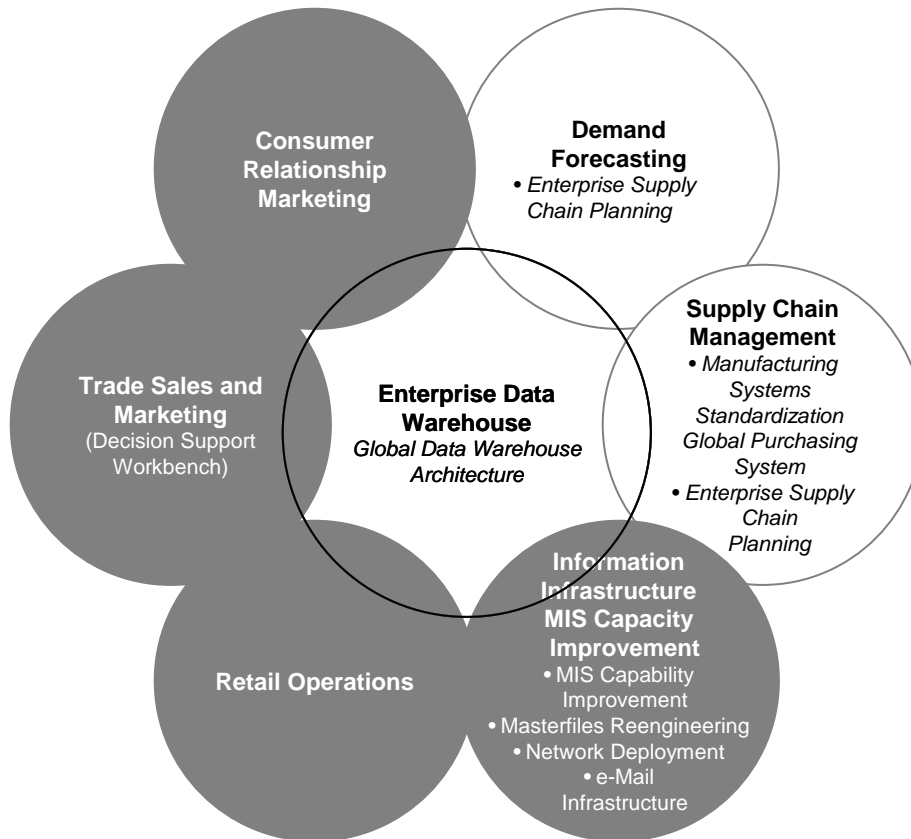
Finding solutions to these impediments and eliminating what becomes the Achilles' heel of supply chain management requires a rigorous effort to improve sales forecast accuracy. That starts with the realization that most sales forecasts are based on history, adjusted by sales predictions, and only occasionally matched with current consumption. This past information is further adjusted for current market conditions, seasonal alterations, special conditions, market changes, unforeseen events and expected changes in buying and supplying arrangements.

Better forecasting starts with asking the right people the right questions. The particular problems occur, not just around determining the direction of demand, but with the magnitude of the demand in a particular time frame. Forecasters can generally react well directionally. They tend to fail in knowing how much is needed for an adequate response, typically predicting higher sales than actual, and they tend to be slow in stemming the tide of extra inventory. One solution requires the balancing of forecasts by averaging multiple inputs – from sales, marketing and operations. Rules-based forecasting is another technique, which takes the judgment of the best experts, codifies their conclusions and uses this data to drive a mathematical model, resulting in a much more accurate forecast than one produced through data extrapolation.

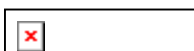


Forecast Accuracy Can Be Improved

Exhibit 2 – Forecasting is a Key Component of Information Strategy



The effort expands with a realization that forecasting is a key component affecting information strategy across a firm and its network partners. In exhibit 2, we see that information flows between many components of a business, all of which derive data from the forecasting process. Demand forecasting is directly linked with supply chain management and the enterprise data warehouse. It also links with consumer relationship marketing, trade sales and marketing, retail operations and the information infrastructure, and is used for virtually all planning steps and financial analysis. One simple improvement hint starts with understanding that better



incoming forecasts for those customers generating 75 to 80 percent of the business will drive improved decisions throughout the entire organization.

With this understanding, the firm moves to its flow charts and determines how the incoming forecast information affects processing. That means the analysis moves from forecasting to inventory planning, deployment planning, production scheduling and purchase planning. The idea is to seek an integrated system, so the flow chart must include how withdrawals are made from what is in current inventory, including work-in-process, material at co-packers or sub-assembly operations, product in transit, and materials and product on-hand with suppliers and customers. In short, all of the linkages need to be identified so you can ask where it is working and where it is broken. It usually results in an understanding of where the firm begins to guess at what is needed, what to make, and what must be added to inventory to cover uncertainty.

Forecasting is a Circular Process

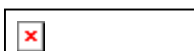
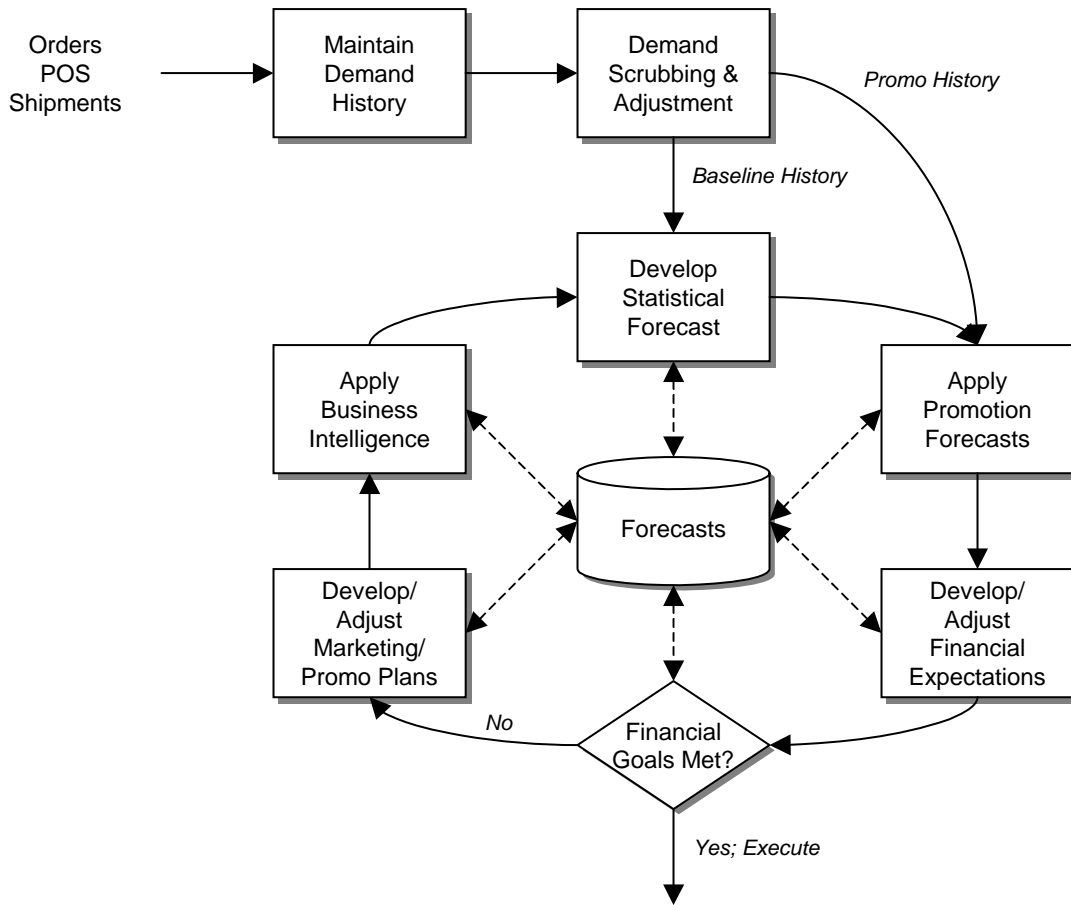


Exhibit 3 – Forecast Creation – A Circular Process



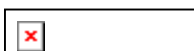
An important realization in the development of improved forecasting is that it is a circular process. That is, the firm plays a proactive role in creating self-fulfilling prophecies. If forecasts based on the best available analysis fail to meet financial objectives, then product plans, advertising and marketing programs can be instituted which have a proactive effect on future demands. In exhibit 3, showing a forecast creation process, it can be seen that any such process begins with whatever information is available to the system – orders, point-of-sale data, and shipments, for example. From there, a demand history is maintained on a perpetual basis. Some scrubbing or adjustment can be performed, based on market and customer intelligence. A variety

of statistical forecasting tools are available in this area, from simple averaging smoothing methods and regression analysis, to Pareto analysis, frequency analysis and econometric models. The point to bear in mind is that forecasting should involve an analysis of data and selection of tools that effectively improve accuracy at a reasonable cost.

Demand Management Extends the Processing

With improvements to forecasting and a reliable level of accuracy as deliverables, the firm looks next at its demand management and capacity planning systems. For any such system to work effectively, the firm must meticulously collect the necessary data from every party and person, who can generate valuable information about demand – internal sales representatives, customer service personnel, channel partners, distributors, customers and consumers. This data must then be refined frequently, and updated to match actual consumption and replenishment needs. Any alterations to changing consumer preferences, customer needs, buying patterns, competitive moves, and market conditions need to be part of the input to a dynamic system of analysis, direction and response.

With increased forecast accuracy and less forecast bias as the objectives, the firm sets about considering the alternatives to accepting poor incoming information, including working closer with key customers to determine actual needs, performing deeper supply chain analysis, applying demand smoothing, and collaborating with those network partners having useful information in their databases. In the first instance, the firm typically encounters the problem that most customers do not know much more about their current needs than the supplier. By working the data together, and analyzing trends and histories from a mutual perspective,



accuracy generally climbs, often doubling. The key element, of course, is having a high degree of trust in the relationship, as this information is shared.

The second key is to make the effort as active as possible. That means the partners should be less inclined to accept the customer demand pattern as sacrosanct. Demand smoothing requires the partners to look for ways to minimize the variability, or the volatility, of the accepted forecast. That requires them to separate the inherent demand variability, caused by natural consumption factors, from the artificial variability introduced by supply chain practices. Promotions, sales contests, and all of the end-of-the-period pushes contribute to unnatural variation. Encouraging demand patterns that are smoother and more reliable can lead to better accuracy and much higher efficiencies in the resulting processing. Working closely with key customers to plan the promotions and special events together and to maintain a flow of information on how the event is progressing by sector or retail store is one step in the right direction. With this cooperation, supply can be balanced with actual activity, and inventory flow matched with consumption.

The Key is Balancing Demand and Supply

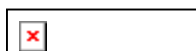
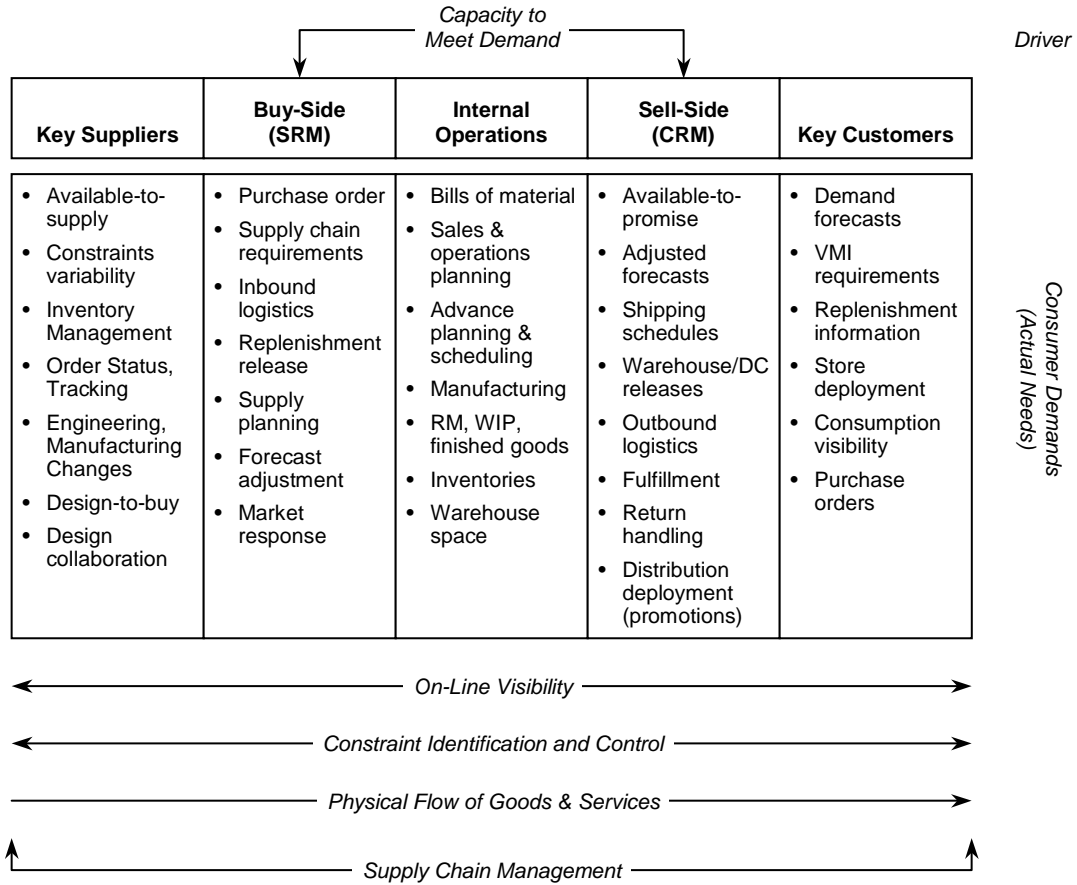
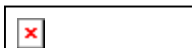


Exhibit 4 – Inter-Enterprise Demand Management and Capacity Planning



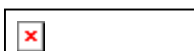
The real purpose of advanced collaboration is to bring a balance to *demand management* – caring for what is really needed in the supply chain – and *capacity planning* – making sure the right goods and services are available to meet the true demand. Exhibit 4 illustrates how this technique can be managed. Beginning outside of the model, consumer demand becomes the key driver. What is actually needed is what should trigger the supply chain capability. This information comes from cash register entries or actual consumer purchases. Working backwards from that driver, the key business customers become the first step in the process.



Demand forecasts can be generated in the usual, but hopefully enhanced, manner. VMI requirements should also be considered as those doing the actual re-stocking record what is moving and what is still there. Replenishment information, based on actual cash register records or store-planning systems should be fed upstream. Deployment needs throughout the stores should be recorded. Any factors relating to consumption visibility that reflects what is actually occurring at the consumer level is also valid data for planning purposes. And certainly, the purchase orders reflect what the customer thinks is necessary.

Moving to the internal sector, firms must establish what capacity is needed to meet demand. That requires a strong coordination between the buy-side and sell-side activities, something that is normally not at high levels of efficiency in most organizations. From the sell-side, the firm compares what it said was available-to-promise with the adjusted forecasts, trying to bring closer synchronization and accuracy. Shipping schedules are reviewed to match with the incoming customer data. Actual warehouse or distribution center releases are considered as well as the outbound logistics requirements and delivery reports. Any special fulfillment needs become a factor, as does any return handling. If promotions have been involved, distribution deployment to meet those needs is another factor of importance.

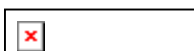
As the firm analyzes its capacity to meet demand, it considers internal operations. Now the way that bills of material have been filled is discussed, the results of the sales and operations planning activity are considered, and advanced scheduling and planning results are reviewed to make sure out of balance conditions are not occurring. Adjustments are made, if necessary, to raw material, work-in-process and finished goods – to determine that the right amount of the



right inventory is readied to meet the anticipated actual demand. The inventories and the warehouse space they occupy are reviewed to make sure high levels of order fill and on-time delivery will be maintained at the key customers.

Moving to the buy side, the firm reviews its purchase orders and supply chain requirements, basically to match forecast and demand against plans. Inbound logistics are considered to determine that shortages will not occur. Replenishment releases with key suppliers are adjusted, where appropriate. Supply planning documents and forecasts previously sent to key suppliers are also adjusted to have a dynamic relationship with what was anticipated as demand and what is actually occurring. Marketing information, which could signal a demand change, is vital to good processing on this side of the supply chain.

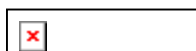
In terms of the key suppliers, an analysis is made of what was received from them and matched with what they said was available-to-supply. Any constraints that have entered the system or any problems that developed are considered as impacts on ability to fulfill orders. Constraint variability is fed into the network system by virtue of the software the partners accepted, to identify and eliminate any current or impending bottlenecks. Order status and tracking procedures are investigated to again discover any problems before they inhibit efficient processing. In advanced relationships, the supplier is providing engineering and manufacturing help and working on collaborative new designs. Inputs from all of these sectors become valuable in balancing the overall demand management and capacity planning system.

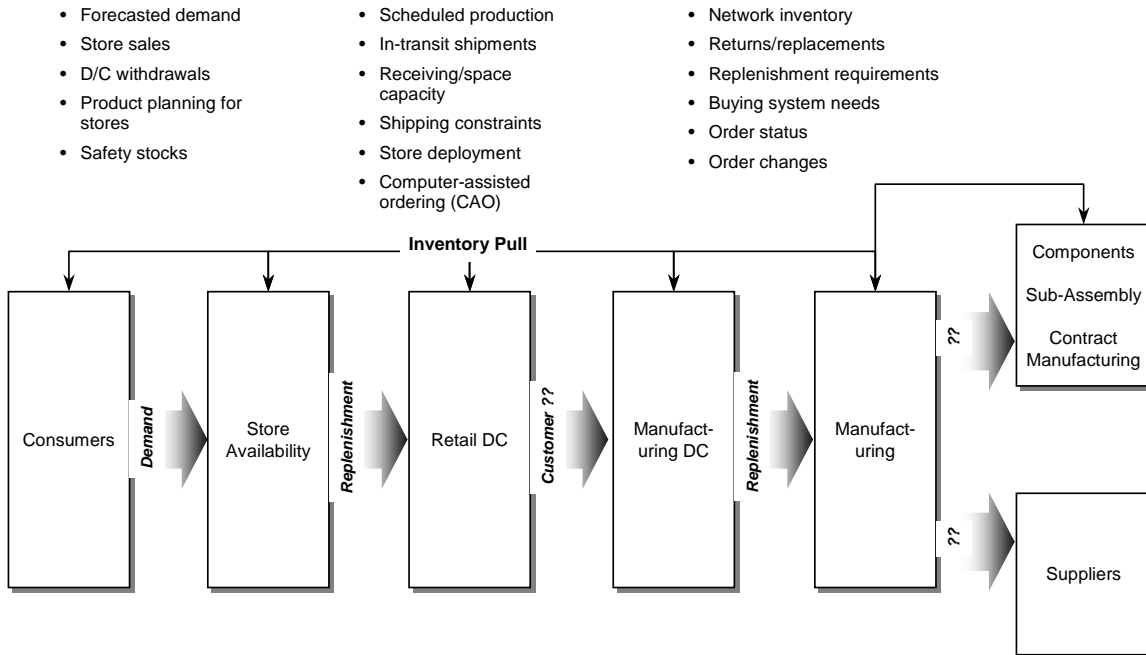


A simple procedure helps improve conditions across this system. An early step should be to form a partnership between purchasing and sales, as they pursue higher forecast accuracy and try to enhance demand management. Since procuring the correct amount of raw materials at the right time is critical to meeting any forecast, it is only reasonable that the firm should begin by including the provision of better information on what will be needed to its key suppliers. By systematically accumulating information on the sell side and sharing it on the buy side (with a few key suppliers), the firm increases the likelihood of being correct as it enters orders into planning. Visibility into customer requests, design activities, requests for samples, and request for information and quotations are helpful to any important supplier. Matching this data with sales histories, current market knowledge, and lifecycle conditions moves both parties closer to understanding what will really occur.

Accurate Capacity Planning Completes the Loop

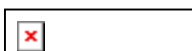
Exhibit 5 – Matching Capacity with Consumer Demand





As the interaction between demand management and capacity planning is better understood, and techniques are in place to tap all valuable data inputs, the firm and its partners set about to match capacity with its better knowledge of what is really in demand. Exhibit 5 illustrates such processing. Beginning with the input from the stores, catalog sales, Internet purchases, or telephone and fax orders, the consumption data triggers the required response. This demand is fed first into the business customer’s database to determine store and replenishment center availability to meet this demand. That means store sales and consumer orders are matched with the forecasted demand and any necessary adjustments are made.

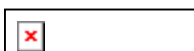
Before sending another demand signal upstream, retailers will answer the questions: Do we have enough current capacity to receive and store supplier deliveries or are there current receiving constraints? Do we have enough storage space to hold any increased inventories?



Safety stocks are analyzed to make certain they are still synchronized with the actual pull out of store supply. Product planning for the stores should be reviewed and revised for any noticeable change in demand pattern. The basic idea in this area is to determine that there are no capacity constraints affecting the efficient deployment and delivery of goods to the stores needing replenishment based on the consumption data.

As the store stocks are drawn down, a replenishment signal is sent to the appropriate retail or manufacturing distribution center. Here the scheduled production is viewed against actual withdrawal needs. Any in-transit shipments are factored into the analysis, so excess stocks are not dispatched. Receiving capacity at the stores is matched with the most economical shipping quantity and multiple store deployments are considered to optimize the delivery space in the truck or other carrier. Any other shipping constraints, especially related to having the correct number of trucks available at the right time, are considered before dispatching the vehicle to the stores. In some advanced systems, computer aided ordering (CAO) systems are used to match store needs with distribution and manufacturing capacity and to place accurate orders. Once again, the basic idea is to match demand and capacity at every key link in the network.

On the manufacturing side of the picture, the replenishment signal is now forwarded to the appropriate manufacturing site. Inventory in the network should be online and analyzed to determine what needs to be produced in addition to what is available in the system to meet the incoming demand signal and satisfy actual replenishment needs. The manufacturer answers questions like: Do we have sufficient capacity to meet the incoming signals? Do we have enough space to put away any inventories, especially for large promotional demands requiring



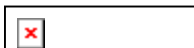
pre-storage of product? Do we have enough delivery equipment to get the products back to the retail DC or stores in time to meet demand?

Any returns or necessary replacements should be added or subtracted from the demand. If there are any buying system requirements, such as minimum order quantities or lead-time factors, they should be considered before making changes to planning and scheduling. Status of orders and any changes to blanket orders should be processed at this time. Finally, new orders or adjustments to orders are sent to suppliers and sub-assembly manufacturers or contract partners.

As indicated, any special event planning should be done across the end-to-end network, as well as coordinating any changes with the financial planning system affecting all constituents. Credits, consignments, payment terms and invoicing are checked against actual transactions and shipments. In this way, an accurate accounting of what is taking place occurs, and all firms get a better handle on the economic impact of any significant changes. Throughout the processing, lead times are studied to make certain there are no undue constraints entering the system that creates a disadvantage for the customer or end consumer.

Summary

An effective supply chain effort moves from the early savings made in sourcing and logistics to improving inventory management, planning, and scheduling. The accuracy of the sales forecast, and the proper handling or mishandling of market data and information on actual consumption, dramatically affect these process steps. While most firms suffer from low levels of forecast accuracy and often fail to take advantage of what is know about demand and supply,



improvements can be made. By applying the models described, forecast accuracy can be increased to 70 or 80%, and beyond for advanced firms. With better incoming data, all of the subsequent process steps improve. Then the firm can move to the balancing of demand management with capacity capabilities by taking advantage of shared market and production information with selected business partners.

