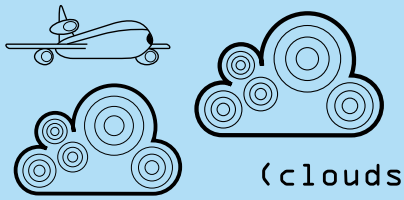
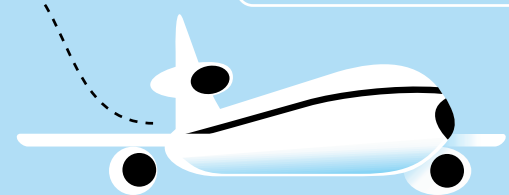
Weatherconditions



(clouds)

Plane-type



Cloud-type

ECR is a journey, not a destination. Each new achievement opens up new horizons. Seamlessly integrating supply chain and demand management is only now becoming possible

Unleashing the power of intelligence

STRATEGIES

by Hau L Lee
Stanford

When the Efficient Consumer Response (ECR) initiative was first published in 1993 – identifying up to $30 billion waste in the US grocery supply chain – the industry had a wake-up call.

The ECR movement that followed, involving manufacturers, distributors and retailers, revolutionised the grocery supply chain. Although there were organisational resistances, and not every initiative turned out to be a success, the momentum has been sustained, and ECR has become a global movement. Practices such as information sharing, partnerships between manufacturers and distributors, logistics restructuring, vendor-managed inventory, collaborative planning, joint replenishment, UPC standards, electronic means of sharing data and making transactions, and the use of industry-standards in e-commerce, have made a significant impact.

The industry may not have reached the extended level of ECR practices that the

ILLUSTRATION BY INGELA PETERSON

Table 1: Summary of intelligent supply chain examples

Case example management	Supply chain foundation	Innovations in intelligent supply chain
Seven-Eleven Japan	Integrated and timely information systems, strong partnerships, agile logistics	Statistical analyses of correlations among and trends of product demands, timing differences, customer characteristics, store and local market condition characteristics and product substitutions; develop replenishment plans, store product offerings, shelf configurations, and new product development.
Longs Drugs Stores	Integrated databases, close links with suppliers, deep knowledge from corporate buyers	Advanced forecasting techniques using forecast errors to self-improvement; explicit treatment of supplier performance; incorporation of seasonal profiles of products; and integration of forecasting, inventory and transportation

early pioneers hoped for, but I think it is fair to say its supply chain has had a major facelift.

The ECR movement has also had a major impact on other industries. Practices which originated from the grocery and consumer goods industry have now been extended to industries as diverse as foodservices, pharmaceutical, hi-tech and automobile after-market and services. Supply chain integration has become a cornerstone of competitiveness and enormous savings have been reported in those companies that have been successful in zealously pursuing such initiatives.

However, despite all this progress, a lot still needs to be done to realise the full potential of total supply chain integration. First, although we have had some successes implementing the current set of initiatives, the vast majority of companies have not realised these gains. There are still tremendous barriers – both organisational and technological – to widespread adoption.

We have to find new ways to make it easier for companies to work with one another. Many executives are still not fully aware of the large potential of these initiatives. We also need to find ways to help small and medium-sized companies to participate.

But at the same time, we also need to look beyond current ECR practices and initiatives. What's the next wave of innovation in supply chain management that could lead companies to higher grounds of competitiveness?

Two exciting new developments are emerging. First, for companies which have put in place sound information systems to track data flows across the supply chain – as well as strong supply chain partnership relationships – it's time for them to turn data and relationship into "intelligence". This intelligence can help the supply chain develop the best products to provide the greatest level of satisfaction for the customers, in an optimal way.

Companies are turning data into intelligence and...

Second, those companies which have streamlined their supply chains and seen their operating performance improved can realise much greater potential value by co-ordinating their marketing efforts and demand management instruments with their supply chain management initiatives. The potential here is not only for cost savings, but profit and sales enhancements leading eventually to higher market values of the firm.

...aligning marketing with supply chain initiatives

These two forces combined are what I call "intelligent demand-based supply chain management".

Intelligent supply chain management

When supply chain partners are willing to collaborate and are sharing information with one another, we can potentially co-ordinate product development, product introduction and replenishment using

Hau Lee is Professor of Operations, Information and Technology at Stanford University's Graduate School of Business. He also serves on the scientific advisory boards of Nonstop Solutions and DemandTec. In addition, he is on the board of Manugistics.

Table 1 (cont): **Summary of intelligent supply chain examples**

Case example management	Supply chain foundation	Innovations in intelligent supply chain
Nonstop Solutions	Scientific replenishment methods	Advanced methods for data cleansing to weed out and normalise data under special effects, creation of appropriate demand profiles, responsive replenishment through updating demand forecasting using early demand signals
Cisco	Extensive use of Internet technology for supplier and customer connection; extensive use of outsourced manufacturing	Creation of intelligent eHub to connect multi-tier supplier network; early detection of supply/demand problems and optimal response identification; supply chain synchronisation through optimal plans; and design collaboration among supply chain partners

advanced scientific methods based on optimisation techniques. "Intelligence" is what makes data powerful, and the next frontier is to insert intelligence into all aspects of the supply chain processes.

Information sharing is a foundational step in supply chain integration. Information sharing allows companies to have visibility of point of sales, demand forecasts, inventory, capacity, shipment plans, and many other kinds of data. But once visibility is achieved, intelligence is needed to:

1. Determine when things are out of control, which requires massive synthesis of the data to understand patterns and trends. This is exactly analogous to statistical process control that has formed the basis of quality management in manufacturing.

2. Identify ways to resolve the out-of-control conditions. We need intelligence to evaluate alternative ways to respond to these conditions, so the full impact to every member of the supply chain, as well as a multitude of performance measures, can be assessed.

3. Create reaction plans

4. Co-ordinate and synchronise the plans for all members of the supply chain, so they now work in harmony.

Intelligent supply chain management can be applied to product introductions and replenishment, where optimal forecasting and replenishment plans are the key objective. We can also use intelligent supply chain management to improve product development – to help multiple partners collaborate on determining the optimal designs of products that lead to attributes such as lower product costs, design for manufacturability, availability of materials, and customer reception.

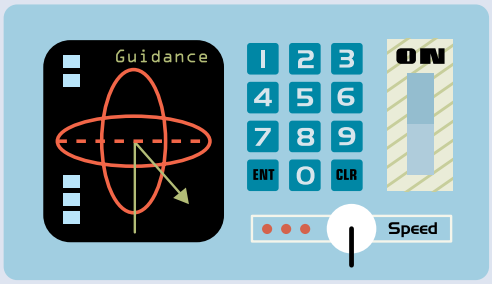
Table 1 summarises different ways in which intelligence is introduced in these case examples.

Intelligent supply chain: the case of Seven-Eleven Japan

Seven-Eleven Japan (SEJ) is the largest convenience store chain in Japan. For the last fiscal year ending February 2000, SEJ's total sales were ¥1,963 billion (about US$18 billion) with record net income of ¥68.2 billion (US$620 million). It is the country's most profitable retailer, and has the highest sales per square foot in Japan. Its annual inventory turnover is consistent at 55. As of March 31 2000, SEJ was the third most valuable retail company in the world (after Wal-Mart and Home Depot).

Behind SEJ's success is the way it operates its supply chain. The company has created a solid information system which provides it with timely and comprehensive signals about market demands, together with a strong network of suppliers and logistics providers. It has

Warning: Cloudy sky



a very agile logistics system which can deliver fresh and perishable products to stores three times a day.

But the key differentiator between SEJ and its competitors lies in its intelligent process to turn data into useful information for product replenishment, as well as new product creation.

SEJ has an extensive data system that captures detailed point of sales (POS) data, consisting of product ID, quantity, time of day of purchase, and estimates of the age and gender of the customer. This sales data is passed on to SEJ's headquarters via ISDN lines, where data is aggregated. The data is also processed by a store computer system which controls all computer equipment and peripherals in the store, and enables store managers to analyse hourly sales trends and stockout rates of all SKUs by customer groups.

At SEJ's headquarters, such detailed data is analysed using statistical methods to find correlations, trends, and special relationships between stores and products. These results are reviewed weekly by senior management. The analyses help determine what products to drop, replenishment plans, store category management, shelf configuration, plus special delivery requirements for some stores.

To illustrate the sophistication of the statistical analyses, let me cite a few examples. In one instance, the sales of two competing brands of noodles were found to be roughly the same in quantity. However, detailed analysis revealed that the sales of one brand always came after another brand had stocked out, and hence the first brand had merely served as a substitute for the second brand. This enabled the company to stock more of the second brand, instead of blindly following the sales data (which would have led to equal stocking of the brands).

In another instance, the company noted the sizes of milk bought by customers were different at certain times of the day. In the early morning hours, commuters and school children on their way to work or school preferred a smaller size of milk cartons. At midday, lunch-hour business drove sales of medium-sized milk cartons. And in the afternoon, shopping by home-makers created the demand for larger sized milk.

This information enabled SEJ to have different product mixes in its three deliveries during each day to the stores.

SEJ has also used its statistical analyses of POS data to generate product ideas for its suppliers. Forecasts and trends of customer preferences were shared with suppliers, and joint plans developed to introduce new products as well as to support replenishments.

Superb data and logistics helps SEJ deliver three times a day

For example, SEJ was able to observe the upward sales trend of half-prepared fresh

The key competitive differentiator for SEJ is its ability to turn data into useful information for product replenishment and new product creation

noodles early on, and developed a hugely successful new product category of fresh noodles jointly with manufacturer Nisshin. When the general downward sales trend of dry ramen noodles began, SEJ's noodles category sales were actually increased.

The case of Longs Drug Stores

Longs Drug Store is a major drug chain in North America, with 381 retail outlets totalling $3.5 billion annual sales. The company has always emphasised high customer service since its founding more than 60 years ago. One form this took was a corporate target of "never-empty shelves" which unfortunately often also meant "lots of dusty inventory".

Pharmacists and buyers certainly have knowledge of seasonal patterns of their major drugs, such as flu and allergy seasons, but it would not be possible for them to manage the hundreds of thousands of SKUs that the company sells. In addition, the complexity of the interactions of multiple brands, dosage, bottle size, and packages of a drug, was too much for anyone to master.

In early 1997, Stephen Roath, then President of the company, invested in a technology supplied by a start-up company, Nonstop Solutions. He'd claimed: "We have to use more science in our demand chain management processes."

Nonstop Solutions technology utilises state-of-the-art data-driven methodologies to eliminate as much guesswork as possible and optimise the activities in the demand chain – forecasting, inventory control, transportation, material handling and warehousing.

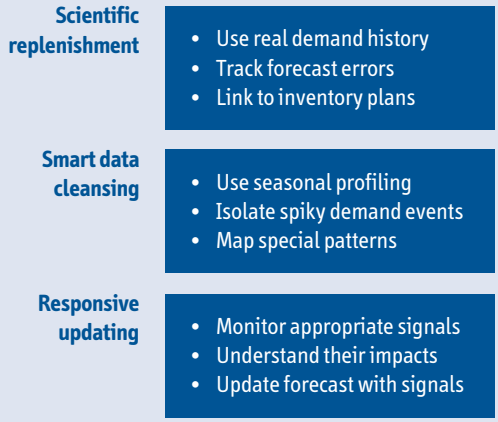
The core intelligence embedded in Nonstop's replenishment system consists of the following features, based on extensive data:

1. Statistical analyses of day-of-week, seasonality, and trend effects in customer demands of products.
2. Distinct treatment of individual SKUs based on distinct characteristics of the products.
3. Tracking and analyses of forecast errors to continuously fine-tune and self-adjust the demand forecasting methodology.
4. Explicit treatment of supply uncertainties (supplier fill rate and delivery performance).
5. Integration of demand forecasting, inventory planning, and transportation logistics in planning decisions.

Today, Longs' performance is the envy of its competitors in the market place. Availability levels at its stores are at 99 per cent. Inventory at its distribution centres has dropped by 79 per cent from 1997 to today, while the corresponding store inventory has dropped by 32 per cent. This amounts to a relief of $90 million in capital.

Longs cut inventory by 79 per cent, saving $90 million

Figure 1 **Intelligent replenishment**



At a time when working capital is a valuable asset, this relief has enabled Stephen Roath to expand by acquisition. While the industry average inventory turns for pharmaceutical chains is at 5.8, Longs' average of 9.4 is 160 per cent better. Longs is now the most efficient drug chain in the industry, by a significant margin. The annual savings the company has identified from using scientific methods to run its data-rich demand chain was $36 million.

And all these go to the bottom line. In 1999, Longs achieved a close to 20 per cent increase in pharmacy sales, a 10 per cent increase in net incomes overall – despite the declines in reimbursements and overall pharmacy margins facing all drug retailers in the era of managed care. Longs has continued to maintain sales growth since then.

The evolution of Nonstop

Interestingly, the Nonstop replenishment system is powerful, not just because of the science behind the replenishment decisions. There are additional basic and fundamental steps which the company has undertaken to enhance the "intelligence" of its system. Figure 1 describes some of the central features of intelligent replenishment.

While data is becoming more available as a result of advances in information technologies, we have to be careful to ensure this data is free from distortions due to external events, actions taken by supply chain partners, and other sources that could corrupt it. Data cleansing and normalisation are necessary steps, or else sub-optimal or even inefficient planning decisions will result, hurting all the members of the supply chain.

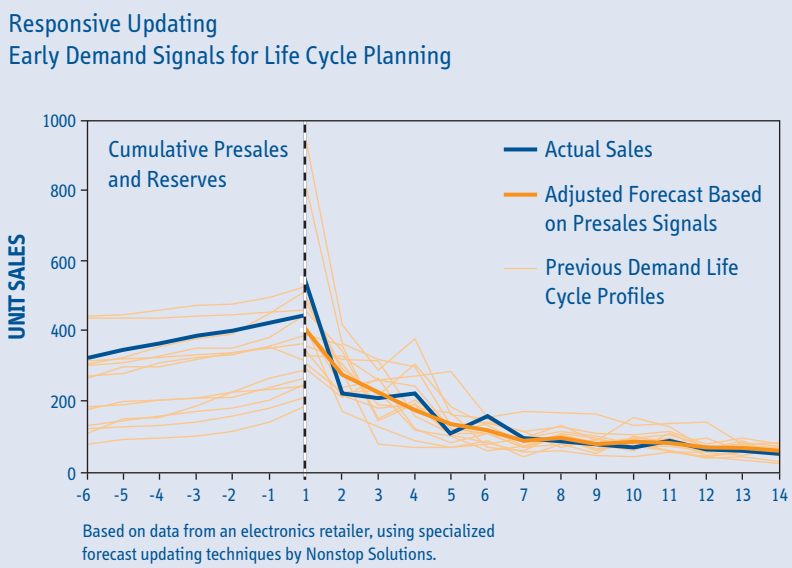
Data distortions must be minimized

For example, weather plays a big role in demand for flu drugs, holidays trigger higher demand for indigestion drugs, changes in packaging sizes by manufacturers may result in shifting demand patterns, as do promotions by manufacturers or retailers. Finally, natural disasters such as earthquakes in California or the September 11 2001 terrorist attacks may also have immediate effects on sales volumes.

Another common source of data problems is simply data entry errors. Using statistical methods to isolate the effects of such special events, and create special profiles for different products, is one way to add intelligence in our use of data for supply chain management.

Another basic fundamental step is to create intelligence through early demand signals. Professor Marshall Fisher has coined the term "accurate response" as a way to use early demand signals to help predict later sales. Figure 2 illustrates that, although many possible demand profiles (based on historical data of similar past products) of a new product are possible, once we observe the early demand signals

Figure 2 **Using early demand signals to improve forecasts**



and then use them to update the demands subsequently, a much more accurate forecast results.

The case of Cisco

Much has been said recently about Cisco's huge inventory write-off in 2001, due to the rapid downturn of the telecommunication and networking industry. In fact, Cisco has become the poster child of the bullwhip effect (greater demand distortion at upstream supply chain than at downstream), being a victim of highly inflated customer demands in 1999 and 2000, when the economy was still overheated.

The exaggerated demands by its customers had resulted in a huge build-up of pipeline inventory in its multi-tiered supply chain. But when demands started to turn south, it took a while before many of the upstream suppliers realised the drastic downturn, and before long, the supply chain was flooded with excess inventory.

However, Cisco hasn't sat still. It has always led the pack in using the Internet to run its supply chain – to accept customer orders, make procurements, test products and manage contract manufacturers, for example.

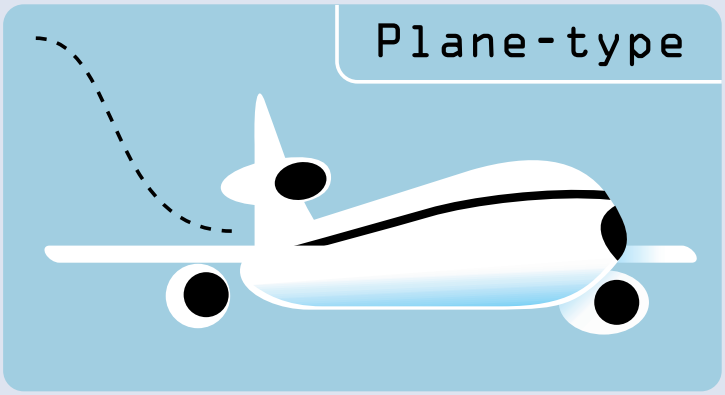
But planning and co-ordination was what it failed to do well in 2001. In response, the company has now created an "intelligent" private exchange with its multi-tier supply network, called the eHub. The eHub connects Cisco via the Internet with its multi-tier suppliers, so that demand information, inventory and capacity data, commitments, and performance measures are visible to all. But visibility is not the only objective of the eHub.

Visibility of demand, inventory, capacity etc, is key

Cisco has also added intelligence to provide co-ordinated planning and optimisation capabilities. The aim? To predict demand and supply conditions in future, so any potential problems such as capacity shortfall or excess inventory can be identified. The eHub's planning system will have the capability to evaluate alternative resolution paths, and re-optimise the production and replenishment plans for the multi-tier supply network. The optimisation engine, powered by Manugistics, will evaluate impacts to different contingency plans in response to supply chain problems, as well as assess the trade-offs along multiple-performance measures.

It is still too early to assess the success of the eHub. But Cisco is hopeful the intelligence embedded in it will enable the supply network to practice "proactive" instead of "reactive" supply chain management, thereby reducing the bullwhip effect and forging better partnership relationships.

Finally, in the near future, Cisco intends to use the eHub to engage supply



Joint NPD is a major new opportunity

chain partners in design collaboration. Design ideas, new product concepts, design and manufacturing interfaces, new material uses, alternative bill of materials, and market reception, are all exchanges that could be facilitated by e-markets such as the eHub.

Design collaboration and joint product development are emerging as a major new battleground for manufacturers and retailers to gain a competitive edge. Many of the emerging e-markets, such as Covisint, e2open and Exostar are pursuing "intelligent" design collaboration in their future business plans.

Demand-based management

Demand-based management (DBM) refers to managing the whole enterprise based on the true demand and requirement of the customers. It is a very basic management principle, but some supply chain managers have missed the point – supply chain management and demand management must be integrated.

Demand management, ie, management of all the instruments which could impact demand, should of course, be based on the full knowledge and actions of the supply chain. Likewise, supply chain management should also be based on the full knowledge and actions of marketing instruments.

These two are inter-dependent. Acting as if the two are independent and separable management functions leads to gross inefficiencies. Unfortunately, since supply chain operations and marketing are often two distinct functions managed by two distinct groups, the two are often not well co-ordinated.

I use the term DBM to denote the full integration of supply chain and demand management. There are two aspects to demand-based management. First, we need to manage the many instruments used in influencing demand. These include pricing, promotions (discounts, rebates, and many others), assortment, shelf management, and deal structure (terms and conditions, price protection, return policies, etc). In order to make the right decisions regarding these instruments, we must:

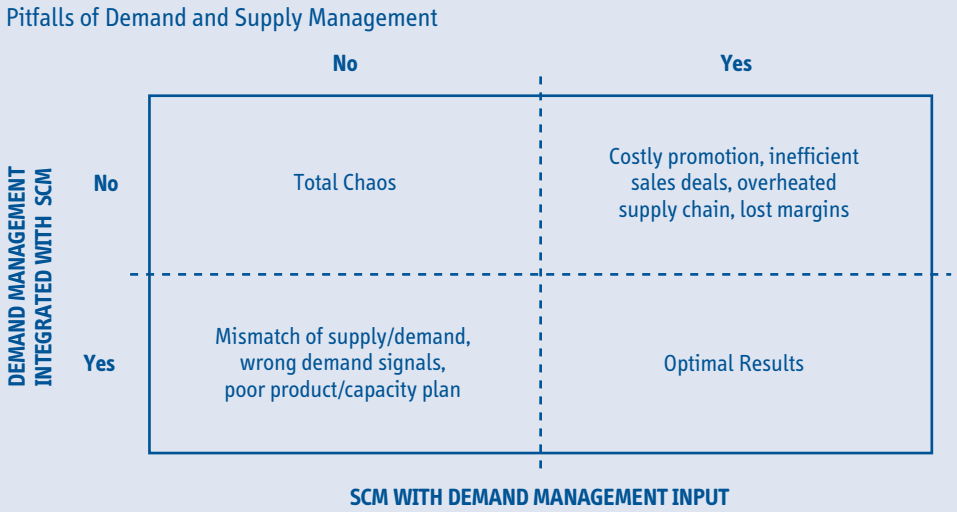
1. Understand the impact of changing the levels of these instruments on demand for the product under consideration, as well as all related products. Note that the effects of these instruments can be interactive.

2. Recognise the management objectives and constraints faced by the enterprise.

3. Incorporate the true supply chain costs corresponding to the demand resulting from the use of these instruments.

4. Link demand-based management decisions with supply chain planning and execution decisions, so that demand can be anticipated and met with the right

Figure 3 **When supply and demand management fail to connect**



amount of inventory. Otherwise, either excessive leftover inventory or stock-outs will result.

5. Carefully measure and monitor actual performance.

The second aspect of demand-based management deals with the co-ordination of the marketing instruments in the supply chain. For example, pricing or promotion efforts at a manufacturer could be wasted if the pricing or promotion efforts at the retailer are not co-ordinated. The marketing instruments used at different parts of the supply chain should be co-ordinated so that optimal desired results can be obtained.

Pitfalls of supply chain management without DBM

Integrate marketing and supply chain initiatives

Supply chain management has traditionally assumed that the demand pattern is exogenous. Hence, the demand for products or services is viewed as the key input to supply chain management. But in fact, demand is never truly exogenous.

Another side of the enterprise – the sales and marketing department – also uses its own instruments to influence demand. These instruments include pricing, promotions (discounts, rebates, and many other types), product mix or assortment, shelf management, order lead-time, and other special deals (terms and conditions).

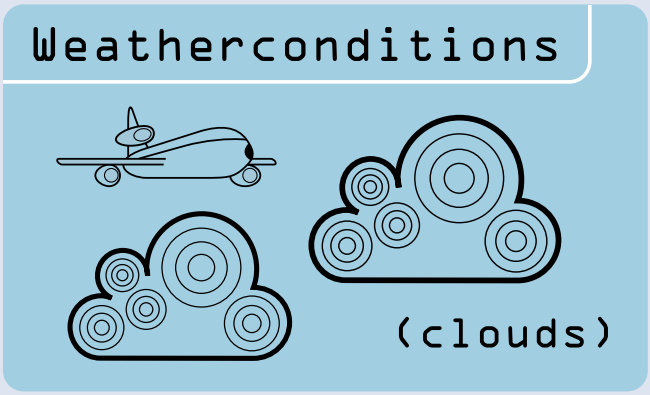
A common pitfall of supply chain management is that the people who manage the supply chain fail to recognise that demand is actually influenced by the enterprise's sales and marketing group. Or, conversely, the sales and marketing group fails to use the appropriate instruments that truly maximise profits or other objectives of the enterprise. Several enterprises have paid dearly for not addressing this disconnect.

Figure 3 highlights the main pitfalls of not integrating supply chain and demand management.

A few years ago, when Hewlett-Packard (HP) first introduced its home personal computer, the Pavilion, it also learned a hard lesson from supply chain management that did not capture the impact of demand management.

When demand for the Pavilion started to fall due to aggressive price cuts by Compaq and Packard Bell, the HP supply chain planning group decided to curb production of the product, only to discover later that its sales and marketing group had decided to match the competition's price cuts. The result was a painful Christmas season when HP faced crippling stock-outs of the Pavilion.

On the other hand, setting marketing instruments without regard to the true supply chain cost of the product can also be costly. For a long time, Barilla, a leading pasta manufacturer in Italy, offered special price discounts to



customers who ordered full truckload quantities. Such marketing deals, however, created customer order patterns that were highly spiky and erratic. The supply chain costs (manufacturing, inventory and handling) were so high they outstripped the benefits from full truckload transportation.

Campbell Soup's chicken noodle soup experience in the early 1990s is another example. Campbell promoted the product heavily around the winter season, when demand usually peaked. The result was that an even greater spike of demand occurred in the winter season. In order to meet this spiky demand, Campbell had to prepare the chicken in mass quantities in the spring, using excessive storage for chicken and other ingredients, and deploy full production capacities during the winter season. In fact, production facilities were used at high gear in overtime during the winter.

In order to make room for such production capacities in the winter, Campbell had to manufacture other products in advance, leading to high inventory and more storage needs. The overall result was that the increase in revenue due to the demand stimulated through promotion was overwhelmed by the huge costs incurred to produce the product. The lack of analysis of the true production cost in pricing and promotion decisions led to what Fortune Magazine termed "the Dumbest Marketing Ploy".

Optimising the marketing instruments for DBM can offer great value-creation opportunities. Extending the concept from an enterprise to a supply chain can unlock even more value. Some companies have seen 50 and 100 per cent net profit increases – releasing increased capital to help the enterprise expand market reach leading to even higher profits.

Integration unlocks even more value

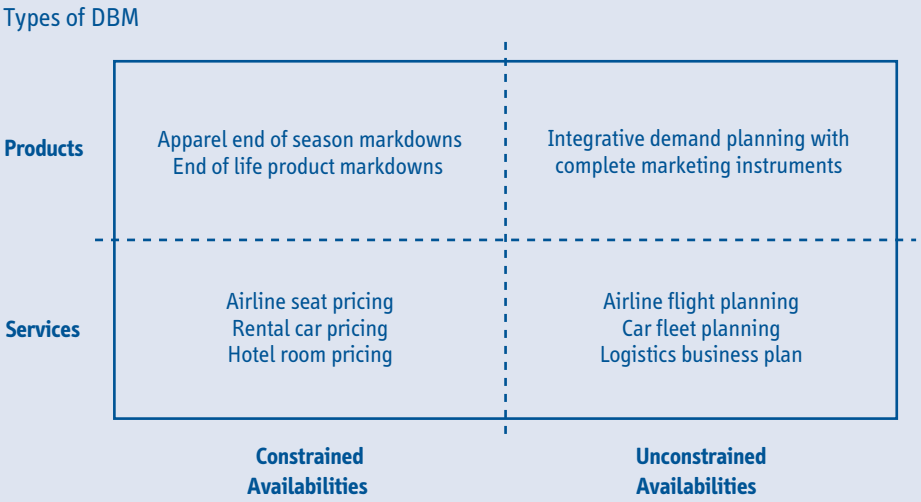
But this optimisation, a process involving both art and science, must be done right. In particular, the supply chain costs of the product must be adequately captured.

Types of demand-based management

DBM solutions can be classified in two dimensions. First, DBM can be used to serve products or services. Second, DBM can be used where the availability of the product or service is constrained, or is unconstrained. Constrained availability refers to cases in which the amount of products or services available is given, or fixed, and DBM is used to optimally price or promote the products or services so that the enterprise gets the most values out of them (see Figure 4).

Unconstrained availability refers to cases in which DBM is used to jointly determine marketing instruments and the predicted amount of products or services, again to maximise some targeted objective for the enterprise.

Figure 4 **Different types of demand-based management**



DBM solutions for products with constrained availability have been developed to create the optimal markdown prices for fashion apparel products or perishable produce, ie, products with short shelf lives.

ProfitLogic is an example of a company that has been successful in the fashion apparel market, with customers such as JC Penny, Ann Taylor and Eddie Bauer.

Similarly, solutions can also be used to create pricing schedules for high-technology products (including software products) when goods are entering the end-of-life phase of their product life cycles.

In both cases, these DBM tools assume that the quantities of the products available are given, ie, they are not decision variables themselves.

DBM solutions have also been used extensively for services with constrained availability. For example, there are now many software tools to help companies determine the pricing schedule for airline seats, rental cars and hotel rooms. Again, the quantities of services (number of seats in a flight, fleet size and the number of hotel rooms) are given, and these DBM tools focus on developing pricing schedules to improve the revenues of the enterprise. Talus (now part of Manugistics) is one of the leaders in this field.

My observation is that a good number of the DBM software tools in the constrained availability cases have focused on pricing as the key marketing instrument instead of the complete suite of promotion and other instruments. The objective has been revenue, instead of profit, maximisation.

Focus on profit, not sales

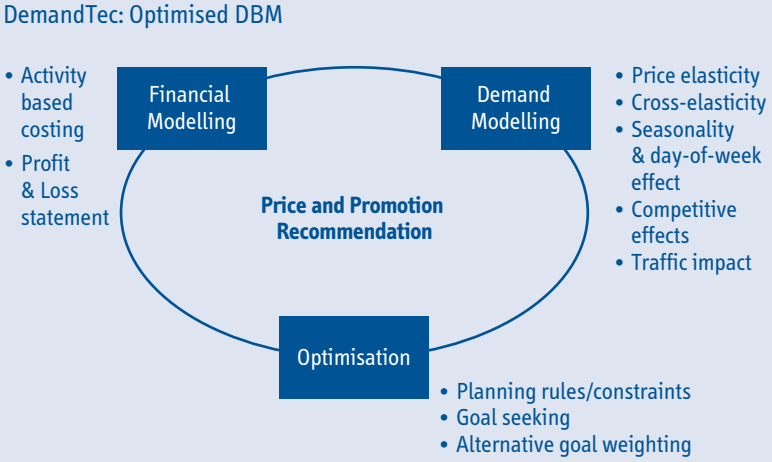
Moreover, some of these tools treat products or services in isolation. For example, if you are pricing a batch of computers at the end of the product life cycle, the DBM software might treat this batch in isolation from future product generations, and simply determine the pricing schedule of this single batch. In reality, aggressive pricing of a batch of computer products at the end of the product life cycle could cannibalise sales of the incoming new product.

Since new products usually command a higher margin, it may not be desirable to aggressively mark down the existing product to get rid of the current inventory. When software tools do not capture the interaction effects of inter-generational products, then sub-optimal pricing decisions may result.

Unconstrained availability poses a more complex and difficult problem for DBM, since the decisions of marketing instrument setting and product/service volumes are jointly determined, so that the full supply chain costs related to product/service volumes have to be accounted for.

The complexity comes in multiple

Figure 5 **A model for optimised demand-based management**



dimensions: scale complexity due to hundreds of thousands of SKUs and hundreds or thousands of site outlets; instrument complexity due to the existence of many different marketing instruments; competition complexity due to the need to capture competitive effects (competitive brands or competitive sites/outlets); and temporal complexity due to the time lag and batching effects.

DBM software tools for unconstrained product availability must therefore be able to handle the significant challenges presented by the complexities outlined above, and activity-based costing models are crucial.

One tool, from DemandTec for example, uses demand history combined with special statistical techniques to create demand models that predict product demands when marketing instruments are varied, eg, price changes or special promotion plans.

DemandTec modelling techniques address a range of different challenges:

1. for products without a history (such as a new product), it makes use of the attributes of the product as a characterisation of the product, and then applies past data on such attributes to infer the demand of the product;

2. the interaction effects of multiple products are explicitly modelled, eg, products that are substitutes or complements of one another would have interactive effects when the price of one changes;

3. the time-effects of marketing instruments are captured, eg, price changes may have time-lag effects, or increased purchases of a product at one time may result in lower demand of the same product later, due to the consumers' batch-purchasing behaviours;

4. the simultaneous interaction effects of multiple marketing instruments are modelled; and

5. DemandTec uses detailed activity-based cost models to compute the supply chain costs of any marketing decisions, so that the model result is one which truly optimises net profits for the company.

Figure 5 describes the logical flows of the optimisation engines behind DemandTec's software.

One test of this software in six categories and more than 4,000 items, by Big V Supermarkets in New York, suggests the software-predicted responses to price changes within 90 per cent accuracy. Another customer has found its net profit margins more than doubled since the use of the software.

Conclusion

The ECR movement has propelled the supply chain success of a good number of companies. Now, some of these companies are using these sound ECR practices as a springboard to a new wave of supply

Use ECR as a springboard for innovation

Only intelligence can cope with complexity arising from scale, different marketing intruments, competition, time lags and batching effects

chain innovations. Two of these innovations – intelligence and demand-based management – are particularly exciting, with great potential. "Intelligent demand-based supply chain management" will, perhaps, be the next defining line of supply chain excellence.

Useful reading

1. Kurt Salmon Associates Inc, *Efficient consumer response: enhancing consumer value in the grocery industry*, Food Marketing Institute, Washington, DC, 1993.
2. Lee, H L, and S Whang, Demand chain excellence: a tale of two retailers, *Supply Chain Management Review*, Vol 5, No 3, March/April 2001, pp 40-46; also see Whang, S, Seven-Eleven Japan, Stanford University Case, 1998.
3. Vitamin efficiency, *Forbes*, November 1999.
4. Barlas, D, Managing the demand network: O'Reilly Auto Parts stock up, Line56.com, November 9 2001.
5. Fisher, M L, J H Hammond, W R Obermeyer and A Raman, Making supply meet demand in an uncertain world, *Harvard Business Review*, May-June 1994, pp 83-93.
6. Lee, H L, V Padmanabhan, and S Whang, The Bullwhip Effect in supply chains, *Sloan Management Review*, 38, 3, Spring, 1997, pp 93-102.
7. Grosvenor, F, and T A Austin, Cisco's eHub initiative, *Supply Chain Management Review*, July/August, 5, 4, pp 28-35, 2001.
8. Lee, HL, Ultimate enterprise value-creation through demand-based management, *Stanford Global Supply Chain Management*, SGSCM-W1-2001, September 2001.
9. Perrotta, P, Big V is early adopter of price optimisation, *Executive Technology*, February 11, 2002.