THE VALUE OF INFORMATION SHARING IN THE RETAIL SUPPLY CHAIN: TWO CASE STUDIES

Tonya Boone and Ram Ganeshan

PREVIEW

Retail supply chains are complex, with each company in the chain having multiple echelons of distribution. Forecasting and requirements planning are further challenged by managers' reliance on "local" rather than chain-wide retail demand to make key operational decisions. A frequent consequence is the *bullwhip effect*. Using two case studies, Tonya and Ram show how information sharing – both within the company's boundaries and with external partners – can mitigate the bullwhip effect and reduce supply-chain costs.

INTRODUCTION: THE "BULLWHIP" EFFECT

A retail supply chain is a network of firms, activities, organizations, and technologies. The network procures raw material from vendors, transforms the materials into intermediate and finished product, and distributes finished product to retail outlets. Many retail supply chains are complex, with companies in the supply chain having multiple echelons of distribution.

In a multitiered supply chain, decisions are often based on "local" information, rather than actual demand at the retail level. Each individual company in the supply chain forecasts its demand, plans its stocking levels, and makes its replenishment decisions independent of the other companies.

It is typical to see retail distribution centers (DCs) forecasting store shipments, and then ordering from the manufacturer based on these forecasted needs. Meanwhile, the manufacturer stocks its DC based on its own forecasts of retail requirements. Such independent forecasting by members in the supply chain gives rise to what is called the *bullwhip effect,* which refers to the increased volatility in orders as these propagate through the supply chain. The inherent volatility in orders makes forecasting more difficult, leads to unwarranted increases in inventory throughout the supply chain, and results in inefficient use of working capital and production capacity. Further, products that have volatile demand at the customer level face the added risk of higher stock-outs.

The bullwhip effect originally was named by planners at Procter and Gamble (P&G) who coined the term

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after observing erratic swings in orders and inventory for their Pampers disposable diapers. Although the retail demand for the Pampers brand was fairly constant, retailers were changing their forecasts based on their own idiosyncratic planning processes. Some, for example, were adjusting forecasts for promotions or perceived requirements. These adjustments were sending a distorted signal of actual retail demand up the chain. Wholesalers based their planning on these signals, which amplified the errors in demand forecasts when they placed their wholesale orders with the manufacturer. It was as if demand was responding to the crack of a whip.

P&G also discovered that its own orders to material suppliers, such as 3M, followed a similar pattern: wild fluctuations in orders that bore little resemblance to the actual demand for diapers (Siems, 2005). The bullwhip phenomenon is reminiscent of the children's game of "Telephone," where each successive participant passes along a message by whispering it to the next person, with the result that the final message bears little or no resemblance to the original one.

Lee et al. (1997) enumerate the key causes of the problem:

(i) Each member of the supply chain is independently updating forecasts;
(ii) Pricing and promotions occur at all levels in the supply chain;
(iii) Companies place orders in batches; and
(iv) There may be special order requirements (such as minimum order quantities or rationing) of each of the members in the chain.

In many industries, firms have taken steps to mitigate the bullwhip effect. One initiative was to integrate a company's *internal* information repositories, bringing all relevant forecast and transactional information into a central location. Another was information integration among the *external* partners in the supply chain.

KEY POINTS

• Independent forecasting by members in the supply chain gives rise to the *bullwhip effect*, which refers to the increased volatility in orders as these propagate through the supply chain.

• To mitigate the bullwhip effect, firms can create centralized information repositories that provide internal (within the firm) and external (among supply-chain partners) information visibility.

• The first case study illustrates how a midsize retailer invested in merchandising technology that centralized its internal information, enabling it to reformulate its buying process and to streamline supply-chain operations.

• The second case study shows how sharing information with external partners using initiatives such as Collaborative Planning, Forecasting, and Replenishment (CPFR) will better match supply to retail demand and improve working-capital efficiency.

VMI, CRP, AND CPFR

Approaches to information visibility are many, and they differ from company to company, even within the same industry. In the consumer-products industry, in addition to using *electronic data interchange* (EDI) for order transmission, firms have initiated *vendor-managed inventories* (VMI). In this system, the supplier of the product keeps track of the retail inventories, and replenishes the retail stocks as needed.

Barilla SpA, a pasta manufacturer, gathered inventory information at the distributor's location and replenished distributor inventories based on targets it had set for the distributors. Within weeks of implementation, inventory in their Marchese DC decreased by 16.7% while increasing the service level from around 93% to almost 100% (Hammond, 1995). In the grocery industry, where the process is called *continuous replenishment planning* (CRP), Campbell's Soup replenishes its retailers to match the rate at which customers buy its soups off the shelves.

While many VMI or CRP-like initiatives have resulted in significant improvements in retail operations, they are "passive": firms in the partnership share data and transfer the responsibility of forecasting and/or replenishment to the supplier. In contrast, some retailers have turned to a more proactive collaboration initiative, called *collaborative planning, forecasting, and replenishment* (CPFR). The distinguishing feature of CPFR is that members of the retail supply chain collaborate on business plans, and jointly execute the processes of forecasting and replenishment.

CPFR was the brainchild of the Voluntary Inter-industry Commerce Standards (VICS) association, a nonprofit formed in 1986 to develop standards and guidelines for improving supply-chain efficiency. VICS membership includes major retailers, like Wal-Mart, and manufacturers, like P&G. VICS' "CPFR committee" offers detailed guidelines (see cpfr.org) on how members of a retail supply chain can collaborate to improve efficiency. The guidelines are based on standard technologies and are scalable, enabling ready implementation across different industries.

We now present two case studies. The first illustrates the benefits from information centralization, while the second outlines a successful CPFR initiative. In the first

case, a midsize retailer is able to centralize information and reorganize supply-chain operations, gaining efficiencies in procurement, distribution, and replenishment. The second case is a simulation of the CPFR

process in a retail supply chain. Both cases reveal how transparency of information can reduce the bullwhip effect and improve working-capital efficiency.

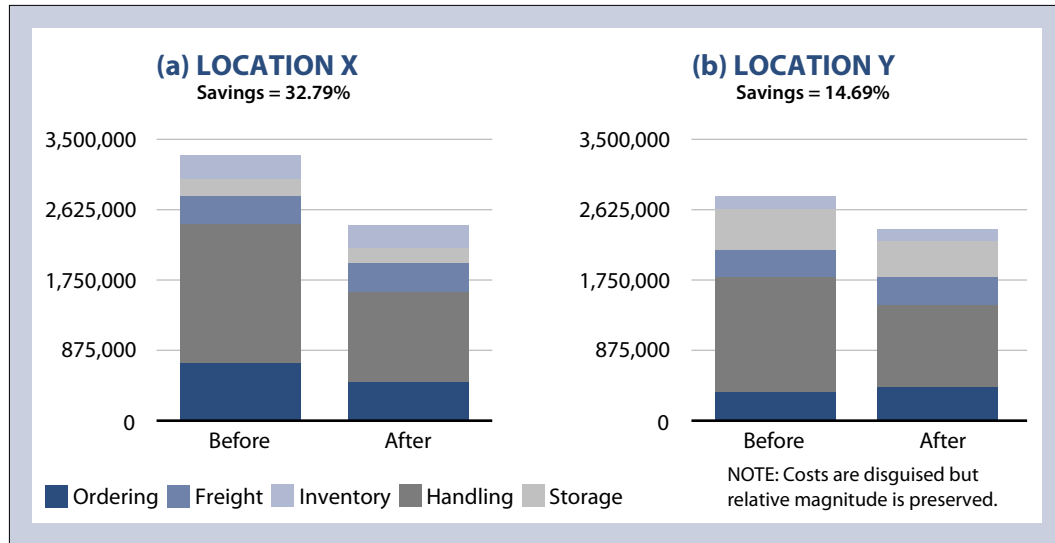## CASE STUDY 1 – THE VALUE OF *INTERNAL* INFORMATION VISIBILITY

This retailer is small to midsized, with annual sales just under $1 billion. It operates in more than twenty locations, each location having multiple retail outlets. Depending on location, the retail outlets are department stores, mass-merchandisers, or convenience stores.

Corporate headquarters sets overall financial goals and merchandising policies, coordinates resources across retail locations, and maintains responsibility for financial reporting. The Chief Operating Officer, located at the corporate headquarters, oversees operations for the entire retail organization.

Traditionally, however, each retail location has operated independently, making forecasting, buying, replenishment, and distribution decisions locally. A Retail Manager at each location is responsible for the operations of all the outlets in that area. Reporting to the Retail Manager is a team of buyers and merchandising managers who plan assortments, forecast needs, and make replenishment decisions for their product categories. Based on inventory levels and outstanding orders, each buyer places orders (via phone, fax, or electronically) to the vendors. The vendors ship these items to an area distribution center, where they are unloaded, manually checked for errors, ticketed, and stocked in storage bays. Finally, the product is moved to the store-front to be sold.

The buyers use a *legacy merchandising system* to generate orders, and the receivers use this system to unload, check, and transfer product to the store. While point-of-sale scanners tracked sales at the retail level, no such technology was being used in the ordering and receiving processes, making storage and retrieval of data and tracking of store and warehouse inventory a cumbersome manual task.

Figure 1. Supply Chain Costs Before and After Information Visibility

(a) LOCATION X
Savings = 32.79%

(b) LOCATION Y
Savings = 14.69%

Legend: Ordering, Freight, Inventory, Handling, Storage

NOTE: Costs are disguised but relative magnitude is preserved.

Then this retailer adopted a state-of-the-art merchandising system in an effort to increase efficiency in its supply chain. The retailer installed 128-bit scanners that capture the product bar codes as a transaction occurs (the products are tagged by vendors). Now all transactions – receiving product into DCs, moving them to the store, and the actual sale at the store – could be retrieved at corporate headquarters easily, securely, and accurately. The system had created information *visibility* by integrating sales data from all retail locations into a single database.

Figure 1(a) and (b) shows the impact of information visibility on yearly supply-chain costs at the retailer's two biggest locations, X and Y. The overall cost saving was estimated at 33% at Location X and 15% at Location Y.

Leveraging this new information visibility, the retailer was able to move its buyers to corporate headquarters. Planning could now be centralized, but continued to be based on "local" information. Each location still retained buyers for items unique to that location.

While centralizing the buying function reduced the number of buyers at Location X, it resulted in a 10% increase in ordering costs for Location Y; nevertheless, the retailer reaped a net saving on order-processing costs. Central buying also enabled more efficient planning: buyers now observe product turns in real time, and hence make better assortment decisions.

Since products from vendors are now scanned, the DCs' receiving operations could be streamlined, providing up to a 34% savings in handling costs for Location X and 27% for Location Y. The bar codes enabled corporate headquarters to track inventory accurately, reducing shrinkage costs by 6% at Location X and 4% at Location Y.

CASE STUDY 2 – *EXTERNAL* INFORMATION VISIBILITY: THE CPFR ADVANTAGE

This second case study illustrates the benefits of information sharing and visibility across the different companies in a retail supply chain. Using data on a fast-moving consumer-goods product, we simulated product flows through the supply chain. (For those interested, specific details are available from the authors.)

While information sharing can take several forms, our focus here is on CPFR, and specifically its forecasting component. The key lesson is this: simple changes in the location or management of the forecasting function

Figure 2. Actual Versus Forecasted Needs at Retail DC "D" and Manufacturing DC "M"
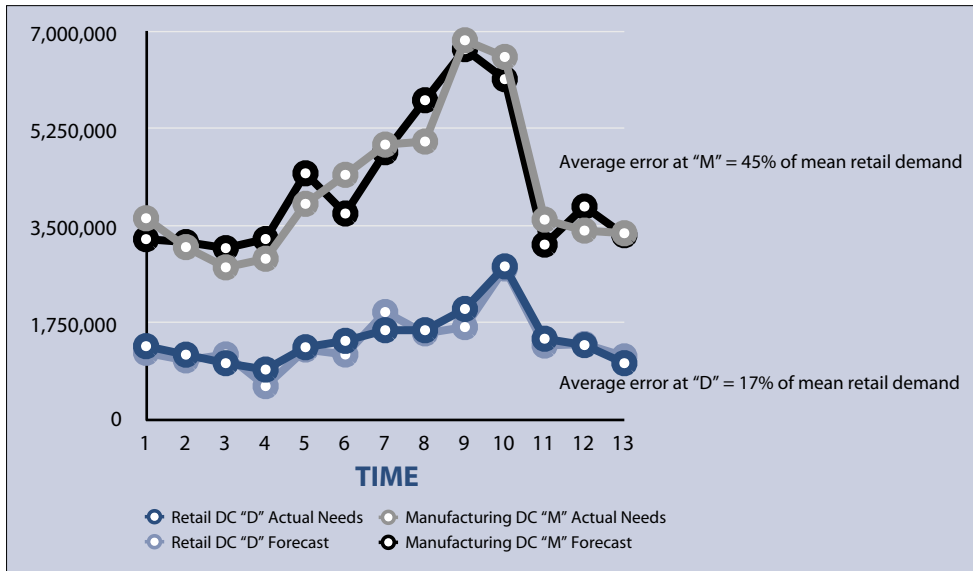
can produce substantial improvements in working-capital efficiency, even with the same forecasting tools.

For this CPFR illustration, we have deliberately chosen a product whose sales are predictable with relatively low errors. We consider this product to be "internally saturated," in that planners have honed the forecasts over time to such levels that new forecasting tools will not significantly alter the forecasts. Demand for this product is seasonal, and it is sold through mass-merchandising and grocery channels. The product is manufactured at Location M, stored in a DC close to the manufacturing plant, and distributed through six retail DCs – Locations A through F – to more than 60 retail outlets.

Figure 2 shows a sample of actual and forecasted shipments over a 13-period (rolling) planning horizon at retail DC Location D. The forecasts have accurately captured the trend and seasonality in sales, leaving an average error of 17%. Based on forecast errors, safety stock targets and shipment plans were computed for the planning horizon. The average beginning inventory at Location D (i.e., the planned inventory to meet safety stock needs) was 383,458 pounds.

In each retail DC, planned shipments are offset by the shipment lead-times, and aggregated to arrive at the shipping needs of the manufacturing DC (Location

M) for the next 13 periods. These requirements are currently being forecast by the manufacturing DC.

Based on our simulations of activity at this manufacturing DC, we calculated that the forecast errors for this product averaged 8% for the DC but exploded to 45% as the product worked its way through the supply chain to final sale. This is the bullwhip effect *in action*: the independent forecasts were "locally" good, but the amplification in errors results in a poor forecast for the overall retail supply chain.

If this company institutes a CPFR process, the six DCs will have *visibility* into store sales data and store planning calendars (such as promotions and store openings), either by POS data directly or via technologies that give DC planners direct access to actual or anticipated store inventory positions. The manufacturing DC, meanwhile, will have complete information about the retail DC inventories.

The difference here is that the retail DCs and the manufacturing DC will *no longer have to forecast demand independently*. Instead, the manufacturer and retailer will collaboratively determine the forecasts and agree to a distribution plan to meet demand at the retail outlets (complete *information visibility*).

Table 1. Supply Chain Inventory Comparison

@ RETAIL DC LOCATIONS	PRE-CPFR	WITH CPFR
A	214,962	200,616
B	217,260	192,427
C	128,232	120,733
D	383,458	362,742
E	109,651	83,255
F	117,907	105,387
Total Retail DC Inventory	1,171,470	1,065,160
Manufacturing DC Location M	1,982,890	1,806,925
Total Supply Chain Inventory	3,154,360	2,872,085

Table 1 shows a comparison of the inventory levels pre- and post-CPFR. The total supply-chain inventory when CPFR is used is 2,872,085, an 8.95% decrease in inventory, while maintaining the same level of customer service, and realizing an estimated savings of almost half a million dollars a year for this product. The reduction in inventory is achieved through information visibility: since both the retail and the manufacturing DC are aware of the *actual* requirements through time, they can hold less in safety or buffer inventory. The remaining safety inventories typically cover uncertainties other than forecast errors – such as weather and transportation delays and other unforeseen contingencies to maintain the appropriate level of customer service.

This illustrative simulation has only focused on the inventory savings. CPFR also improves efficiencies in transportation management (by efficient load planning), capacity and production scheduling (by producing only when needed), and long-term flexibility of the supply chain (by responding faster to the customer).

IMPLEMENTATION COSTS AND GUIDELINES

While we have focused on the benefits of information visibility, it must be said that there are investment costs required to implement new information systems, and these costs are often significant. The retailer in the first case study had to invest in the merchandising system and upgrade its technology to modern 128-bit scanners. The implementation took several employee-months. While the benefits of integration far outweighed the costs for this particular retailer, one needs to have proper cost controls. The reorganization of the buying function entailed layoffs and altered job descriptions, as well.

External information integration is even more challenging, since it encompasses different entities and organizational cultures. VICS offers a 5-step set of guidelines for adoption of CPFR (collated from information in cpfr.org):

(i) Create a front-end agreement on objectives;
(ii) Develop a business plan that spells out forecasting needs, production schedules, and key performance metrics;
(iii) Create a joint forecast that is linked to an event calendar that tracks pricing, promotions, and other relevant information;
(iv) Agree on replenishment strategies; and, finally,
(v) Agree on a technology partner to bring CPFR to fruition.

Meeting these guidelines requires trust, flexibility, and leadership. It is our contention that the benefits of information visibility will be worth the costs in systems set-up.

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