CPFR: an emerging supply chain tool

Gene Fliedner
Decision and Information Sciences Department, Oakland University, Rochester, Michigan, USA

Keywords
Forecasting, Collaboration, Planning, Supply-chain management

Abstract
This paper examines collaborative planning, forecasting, and replenishment (CPFR), a Web-based tool to coordinate the various supply chain management activities including production and purchase planning, demand forecasting, and inventory replenishment between supply chain trading partners. This paper identifies what CPFR is, explains the CPFR process, cites benefits that have been achieved, identifies obstacles to implementation, and discusses the future of CPFR.

Introduction
The 1980s witnessed the development of just-in-time (JIT) as a philosophy to improve operations. Success attributable to JIT is due in part to the practice of externally synchronizing the production planning, operations scheduling, purchasing, and shipping activities of the various trading partners comprising the supply chain. The fabrication and assembly supply chain depicted in Figure 1 is representative of the supply chain found in the automotive industry. Through early communication of production planning information originating with the original equipment manufacturers (OEMs) and sequentially proceeding upstream through the supply chain, operating schedules, purchase plans, and shipping activities of the trading partners have been synchronized. Synchronization of inbound OEM materials management activities has resulted in reduced inventories, improved capacity utilization, higher customer service levels, and a host of additional reported benefits for all participants.

The exchange of planning information on the outbound side of distribution from the OEM to the retailer for the supply chain in Figure 1 has been largely overlooked. To date, the points of collaboration of most supply chains have focused on the synchronization of production plans that commence with the OEM and integrate production, purchase and shipping plans upstream. Evidence of this abounds in today’s markets when analysts cite lack of future earnings visibility and excessive inventory accumulations.

Recently, a methodology referred to as collaborative planning, forecasting and replenishment (CPFR) is being espoused as a means of integrating all members of the supply chain, including distribution and retail activities. As depicted in the simplified supply chain of Figure 2, the point of collaboration utilizing CPFR becomes the retail level demand forecast, which is then used to synchronize replenishment and production plans throughout the entire supply chain. This paper examines CPFR, explaining the CPFR process, tracing its short evolution, citing benefits that have been achieved, identifying obstacles to implementation, and proposing the next logical development in the future of CPFR. For improved supply chain management (Lumus and Vokurka, 1999), CPFR is emerging as an important tool.

CPFR process
CPFR is a Web-based attempt to coordinate the various activities including production and purchase planning, demand forecasting and inventory replenishment between supply chain trading partners. Its objective is to exchange selected internal information on a shared Web server in order to provide for reliable, longer term future views of demand in the supply chain. As such, CPFR is being used to replace the 15-year-old approach of electronic data interchange (EDI).

There are two principal drawbacks of EDI. First, it is a slower approach. EDI may require manual entering of identical data (Joachim, 1986) by both trading partners and is typically done in batch file transfer mode (Cooke, 1986), which further delays the exchange of information. Second, EDI is more expensive than CPFR given its proprietary nature, variety of standards, and the reliance on value added networks, or VANs (Cooke, 1999). The software used in EDI applications is less ubiquitous. It makes
use of a variety of industry standards or trading partner exact specifications, which limits its use. On the other hand, CPFR is gaining acceptance due in part to technology breakthroughs associated with Web-based communications (Wolfe, 1998).

A varied number of steps in the CPFR process have been identified depending upon the level of detail used to specify the process (Automatic ID News, 1998; DesMarteau, 1998; Schachtmann, 2000a; Schenck, 1998a, b).

Regardless of the number of steps, CPFR uses a cyclic and iterative approach to derive consensus supply chain forecasts:

1 **Step one: creation of a front-end partnership agreement.** This agreement specifies:
   - objectives (e.g. inventory reductions, lost sale elimination, lower product obsolescence) to be gained through collaboration;
   - resource requirements (e.g. hardware, software, performance metrics) necessary for the collaboration; and
   - expectations of confidentiality concerning the prerequisite trust necessary to share sensitive company information, which represents a major implementation obstacle.

2 **Step two: joint business planning.** Typically partners identify and coalesce individual corporate strategies to create partnership strategies, design a joint calendar identifying the sequence of planning activities to follow which affect product flows, and specify exception criteria for handling planning variances between the trading partners’ demand forecasts (Schenck, 1998b). A 1998 pilot study conducted between Wegman Foods and Nabisco to develop weekly collaborative forecasts for 22 Planters Peanut products took approximately five months to complete steps one and two (Stedman, 1998a).

3 **Step three: development of demand forecasts.** Forecast development may follow preexisting company procedures. Retailers should play a critical role as shared point-of-sale (POS) data permits the development of more accurate and timely expectations (compared with extrapolated warehouse withdrawals or aggregate store orders) for both retailers and vendors (Lewis, 1999). Given the frequency of forecast generation and the potential for vast numbers of items requiring forecast preparation, simple forecast procedures are commonly used within CPFR. Simple techniques are easily used in conjunction with expert knowledge of promotional or pricing events to modify forecast values accordingly.

4 **Step four: sharing forecasts.** Retailer (order forecasts) and vendor (sales forecasts) then electronically post their latest forecasts for a list of products on a dedicated server. The server examines pairs of corresponding forecasts and issues an exception notice for any forecast pair where the difference exceeds a pre-established safety margin (e.g. 5 percent). If the safety margin is exceeded, planners from both firms may collaborate electronically to derive a consensus forecast. Given the number of individual product forecasts, a rules-based response system will ultimately be needed in order to accommodate the large number of potential exception messages (Verity, 1997).

5 **Step five: inventory replenishment.** Once the corresponding forecasts are in agreement, the order forecast becomes an actual order, which commences the replenishment process. Each of these steps is then repeated iteratively in a continuous cycle, at varying times, by individual products and the calendar of events established between trading partners. It has been suggested that partners review the front-end partnership.
agreement annually, evaluate the joint business plans quarterly, develop forecasts weekly to monthly, and replenish daily (Schenck, 1998b).

**A brief CPFR development history**

In 1996, Benchmarking Partners (now known as Surgency) initially spearheaded the concept, with funding support from Wal-Mart, IBM, SAP and Manugistics (Caldwell et al., 1996; Verity, 1997). Approximately 50 retailing and manufacturing companies operating as the Dynamic Information Sharing Committee under sponsorship of the Voluntary Interindustry Communications Standards (VICS) are now coordinating further CPFR development (Chain Store Age, 1997; Verity, 1997).

In its short existence, CPFR has evolved considerably. Initially referred to as collaborative forecasting, the concept represented an exchange of early demand expectations between trading partners. It was subsequently referred to as collaborative forecasting and replenishment (CFAR) to denote the collaborative forecasting and replenishment objectives of the approach between trading partner relationships downstream from OEMs. An early pilot study conducted between supply chain partners Wal-Mart and Warner Lambert utilizing CFAR cut weeks of inventory out of the Listerine supply chain (Schenck, 1998a). As it has evolved today, CPFR emphasizes coordinating the activities of production and purchase planning, demand forecasting and inventory replenishment through collaboration among all supply chain trading partners, as depicted in Figure 2.

A 1998 study conducted by KPMG Consulting found 96 percent of retailers sharing information "regularly" with their suppliers with almost half sharing information with manufacturing partners on a daily basis (Chain Store Age, 1998). The potential benefits of sharing information for enhanced planning visibility in the supply chain are enormous. Various estimates for cost-savings attributable to improved supply chain coordination have been proposed, including $30 billion annually in the food industry alone (Fisher, 1997).

**Current CPFR applications**

The practice of collaboration has been spurred on by a variety of industry initiatives, such as JIT, computer-assisted ordering, vendor-managed inventory (VMI), efficient consumer response (ECR), and the collection and exchange of retail POS data. These initiatives encourage supply chain partners to collaborate and share information over the control and reduction of inventories (Stedman, 1998b).

Although the methodology is applicable to any industry, CPFR applications to date have largely focused on the food, apparel, and general merchandise industries. Many forces drive the need for the early exchange of reliable information in these particular industries. One of these driving forces is competition. Merchandise retailers such as Wal-Mart and K-Mart have expanded product offerings into food items in order to enhance the value of their customer service offerings through one-stop shopping. In response, food retailers developed the ECR initiative in 1993, which was aimed at increasing supermarket efficiencies in light of the competitive threat of the large retailer "supercenter" concept. ECR has ultimately propelled the development of CPFR.

A second driving force is the innovative nature of products, or the length of the life cycle and the duration of retail trends in these industries. In the apparel industry, for example, the life cycle of some garments is six months or less. Yet, manufacturers of these garments typically require up-front commitments from retailers that may exceed six months making long-term fashion forecasts risky. General merchandise retailers know this year’s newest toy has a short product life cycle. It is imperative to get the latest trend in consumer products to market quickly; otherwise, either tremendous lost revenues or markdown prices will be experienced. Long manufacturing lead times necessitate supply chain planning visibility.

A third driving force is the longer, more complex supply chain given moves to offshore production. International sourcing for apparel and general merchandise has lengthened the supply chain and cycle time, again necessitating supply chain planning visibility.

A fourth driving force behind CPFR is the nature of the supply chain cost structure. Global markets and more competitors are likely to move the supply chain system towards universal participation by all retailers in CPFR in an effort to cut costs (Raghunathan, 1999). All of these driving forces support the need to respond quickly to volatile demand and other market signals. These forces stimulate the development of supply chain visibility tools such as CPFR (Fisher, 1997). This helps to explain the increasing exploration of CPFR among food, apparel, and general merchandise firms.
In a recent survey of 120 businesses conducted by Industry Directions, a supply-chain consulting firm, 33 percent of the respondents indicated plans to implement a CPFR pilot project within six months, while another 42 percent indicated initial research into CPFR is being conducted (Schachtman, 2000b). Although the number of respondents was not cited, Progressive Grocer's Annual Report of the grocery industry indicated that 33 percent of all executives plan to implement CPFR programs with trading partners over the next year. This figure increases to 37 percent for retailers and 45 percent among wholesale executives (Lewis, 2000).

**CPFR benefits**

The early exchange of information between trading partners provides for reliable, longer term future views of demand in the supply chain. The forward visibility based upon information sharing leads to a variety of benefits within supply chain partnerships (Yu et al., 2001). Because CPFR is relatively new, data to evaluate its impact empirically are not readily available. Anecdotal evidence provided from the results of several pilot programs highlight benefits, which are:

1. **Retailer benefits:**
   - increased sales;
   - higher service levels (in-stock levels);
   - faster order response times;
   - lower product inventories, obsolescence, deterioration.

2. **Manufacturer benefits:**
   - increased sales;
   - higher order fill rates;
   - lower product inventories;
   - faster cycle times;
   - reduced capacity requirements.

3. **Shared supply chain benefits:**
   - direct material flows (reduced number of stocking points);
   - improved forecast accuracy;
   - lower system expenses.

The results of several pilot programs indicate potential benefits for retailers including higher sales, higher service levels (in-stock levels), and lower inventories. Manufacturers have experienced similar benefits plus faster cycle times and reduced capacity requirements (Hill, 1998; Ireland and Bruce, 2000; Schachtman, 2000b; Wolfe, 1998). For example, the Nabisco/Wegman Foods pilot study produced a supply chain sales increase of 36 to 50 percent through a more efficient deployment of inventory (Lewis, 2000; Loudin, 1998; Schachtman, 2000b). KPMG Consulting conducted a poll of both retailers and manufacturers in 1998 concerning the frequency and the benefits derived from information exchange (Chain Store Age, 1998). Manufacturers cited significant improvements in cycle time and inventory turns. Retailers indicated that order response times as short as six days for domestic durables and 14 days for nondurables were being achieved. Four out of ten cited at least a 10 percent improvement in both response times and inventory turns. Forty-five percent cited reductions of at least 10 percent in associated costs. In pilot tests conducted with several vendors, Proctor & Gamble has experienced cycle time reductions of 12 to 20 percent (Schachtman, 2000b). Proctor & Gamble estimates greater supply chain collaboration and integration will result in an annual savings by the year 2003 of $1.5 to $2 billion, largely reflecting the reduction in pipeline inventory (Chain Store Age, 1998).

In the KPMG survey, retailers and manufacturers noted benefits received by eliminating the middlemen out of the supply chain (Chain Store Age, 1998). Retailing respondents noted 66 percent of merchandise flowing directly to retail outlets, or passing through at most one distribution location before reaching the shelves. This figure was higher for manufacturers, as 73 percent noted either direct material flows or inventory that passed through only one distribution point before reaching the retailer.

In 1996, approximately $700 billion of the $2.3 trillion retail supply chain was in safety stock (Lewis, 1998). Supply chain inventory may be as great as $800 billion of safety stock being held by second and third tier suppliers required to provide JIT delivery to their larger customers (Hill and Mathur, 1999). According to the US Department of Commerce, there is $1 trillion worth of goods in the supply chain at any given time (Ulleldor, 1999). Even a small reduction in supply chain safety stocks is a sizeable dollar figure. In the KPMG survey, 42 percent of respondents indicated at least a 10 percent reduction in total inventory in the past 12 months (Chain Store Age, 1998). According to published reports, some companies have achieved 20-30 percent reductions in inventory. CPFR allows for a more efficient deployment of supply chain inventories.

Almost immediately after its initial efforts to collaborate on supply chain forecasts, Heineken's North American distribution operations experienced a 15 percent reduction in its forecast errors (Hill and Mathur, 1999). Enhanced knowledge of future events (e.g. promotions and pricing actions), past events (e.g. weather related phenomena), internal events (e.g. point-of-
sales data and warehouse withdrawals), and a larger skill set gained from collaboration may all contribute to enhance forecast accuracy (Lapide, 1999).

CPFR should result in lower product obsolescence and deterioration. For example, Riverwood International Corporation, a major producer of paperboard and packaging products is working to establish collaborative forecasting relationships with customers in order to make production scheduling and inventory control less risky. This company seeks to balance the need to stock up on inventory for sudden demand surges against the fact that paperboard starts to break down after 90 days (Stedman, 1998b). With a higher degree of collaboration and a timelier sharing of information between retailer and manufacturer, greater stability and accuracy in production schedules result making inventory planning more accurate. Furthermore, as production schedules more accurately reflect the needs of the retailer to satisfy near term demand, reductions in manufacturer capacity requirements are possible.

CPFR will result in lower system expenses. Some of the lower expenses will be due in part to previously cited benefits of lower inventories, lower product obsolescence and deterioration, and reduced capacity requirements. Expense reductions will also be attributable to more ubiquitous technology. For example, some of Heineken’s distributors transfer forecast information only with a Web browser and an Internet connection (Butler, 1999), which is less expensive than an EDI-based information exchange approach. With its integrative efforts to automate the supply chain planning system, Heineken’s North American operations also eliminated its data entry clerks that were once used to input distribution system forecasts into its distribution requirements planning (DRP) system (Hill and Mathur, 1999).

Almost immediately after its initial efforts to collaborate on supply chain forecasts, Heineken’s North American distribution operations cut order lead times in half (Hill and Mathur, 1999). As order lead times are lowered, order response time improves. Anecdotal evidence has noted 15-20 percent increases in fill rates and half the number of out-of-stock occurrences (Hill, 1999).

Obstacles to CPFR Implementation

As with most new corporate initiatives, there is skepticism and resistance to change. Several anticipated and actual obstacles to implementation have been anecdotally reported in the literature and are discussed below. These are:

- lack of trust in sharing sensitive information;
- lack of internal forecast collaboration;
- availability and cost of technology/expertise;
- fragmented information sharing standards;
- aggregation concerns (number of forecasts and frequency of generation);
- fear of collusion.

One of the largest hurdles hindering collaboration is the lack of trust over complete information sharing between supply chain partners (Hamilton, 1994; Stedman, 1998b; Stein, 1998). The conflicting objective between the profit maximizing vendor and cost minimizing customer gives rise to the adversarial supply chain relationship. Sharing sensitive operating data may enable one trading partner to take advantage of the other. Similarly, there is the potential loss of control as a barrier to implementation. Some companies are rightfully concerned about the idea of placing strategic data such as financial reports, manufacturing schedules and inventory values online. Companies open themselves to security breaches (Stein, 1998). However, in a survey of 257 US manufacturing and service companies, AMR Research found only 16 percent of respondents that are established participants in a business-to-business trading exchange cite security and trust problems (D’Amico, 2000). The front-end partnership agreements, nondisclosure agreements, and limited information access may help overcome these fears.

A second hurdle hindering collaboration is a structural stumbling block. An unprecedented level of internal and external cooperation is required in order to attain the benefits offered by collaboration. Given that demand may be forecast many ways (e.g. by stock-keeping unit, product class, vendor, customer location, etc.), the various functional disciplines such as marketing, operations and finance of many firms have maintained separate demand forecasts and financial figures (Schachtman, 2000b). As a result, internal forecasts are frequently conflicting (Tosh, 1998). The plans derived from these forecasts are typically not synchronized internally and this inconsistency leads to planning decisions reflecting different expectations of the same business activity. The magnitude of the problem of inconsistent forecasts is
exacerbated when analyzing trading partner forecast consistency. There is the potential for a large number of pairs of inconsistent trading partner forecasts, which leads users to carry large buffer stocks given the demand uncertainties (Manufacturing Systems, 1998). Internal cooperation among the various functional disciplines needing forecast information for planning purposes is required. CPFR requires an earlier and a freer exchange of information among disciplines within an organization given the cross-functional nature of collaborative forecast teams. This creates greater company buy-in to the process. If departments are not collaborating for a single-number demand forecast, there is no sense in trying to collaborate with trading partners (Hill, 1999). Specifically, internal operations need to be synchronized first. Then, collaboration among trading partners may be pursued. Without internal collaboration, the entire CPFR process is undermined.

Similarly, there must be external cooperation and a certain degree of compatibility in the abilities of supply chain trading partners (Abend, 1998). The availability and cost of technology, the lack of technical expertise, and the lack of integration capabilities of current technology across the supply chain present barriers to implementation (Schenck, 1998a). The demand forecasting process design must integrate quantitative skills and methods with qualitative assessment by using a collaborative process that cuts across business functions, distribution channels, key customers, and geographic locations (Chase, 1998). Collaboration ensures all supply chain planners are utilizing the same internally and externally consistent forecast.

The necessary “bandwidth” and the associated reliability of this technology is also a barrier, as many companies presently do not have the network infrastructure to support the large number of potential new users (Stein, 1998). However, if the necessary trust in the relationship can be developed, synchronizing trading partner business processes with consumer demand need not be overly time consuming nor costly (Sherman, 1998). In order for this to be possible, emerging standards need widespread adoption as opposed to numerous, fragmented standards (Verity, 1997).

Widespread sharing and leveraging of existing information across functions within an organization and between enterprises comprising the supply chain may be possible given emerging standards being offered by the Voluntary Interindustry Commerce Standards (VICS) organization and the Uniform Code Council (UCC) promoting CPFR. Attaining a “critical mass” of companies willing to adopt these standards will be important in determining the ultimate success of collaborative practices. The cost of establishing and maintaining collaborative processes without common interfaces limits the number of trading partner relationships each participant is willing to invest in (Sherman, 1998). However, as the ability to collaborate is made easier, the number of supply chain trading partners wanting to collaborate will increase (Bobbin, 1998).

An additional obstacle to adoption and implementation concerns two aspects of data aggregation; the number of forecasts and the frequency of forecast generation (Abend, 1998; Stedman, 1998a). Bar code scanning technology provides retailers the technology to forecast POS data by store whereas suppliers typically forecast orders at point of shipment such as warehouse. The POS store data is more detailed as it represents daily, shelf-level demands for individual stores. Point of shipment data represents the aggregate of all stores served by one warehouse, typically measured over a longer interval of time, such as a week. In the Wegman Foods/Nabisco pilot study, 22 weekly forecasts for individual products were developed collaboratively. In a full-blown collaboration for store-level planning, the number of daily collaborative forecasts would increase to 1,250 for Planters Peanuts alone (Stedman, 1998a). It is not uncommon for large retail stores to stock 75,000 or more items, supplied by 2,000 to 3,000 trading partners (Hickey, 1999). This obstacle must be coupled with the vast potential exception reporting given the large number of items to exchange information, which exacerbates this implementation obstacle. A variety of scenarios may be offered leading to exception reports (Katz and Hannah, 2000). Given the frequency of forecast variance review and the large number of potential exceptions that may occur, a rules-based approach to automatically resolve trading partner forecast variances will be required. In the development of collaborative forecasts, these aggregation concerns must be resolved. One means to synchronize business processes and overcome these obstacles will be the reliance upon a hierarchical forecast approach (Fiedner, 2001).

A final obstacle to implementation focuses on the fear of collusion leading to higher prices (Verity, 1996). It is possible that two or more suppliers or two or more retailers may conspire and share information harmful to the trading partner. Frequently this fear
The future of CPFR

Many companies are beginning to use their intranet to enhance collaboration of internal processes (Dalton, 1998) with enterprise resource planning (ERP) systems. Fortune Brands, a $4.8 billion company, is improving collaboration among sales, marketing, engineering, and manufacturing with ERP. ERP systems are increasingly being used to provide the interconnected transaction foundation among the various planning systems comprising a company’s intranet (Joachim, 1998). ERP permits an automatic transference of customer demand forecasts into a variety of corporate intranet planning modules. These advanced decision-support and enterprise execution systems largely focus on integrating and optimizing cross-functional, intra-organizational planning activities and transactions.

While ERP is being used successfully to standardize the internal financial and transactional processing needs of an organization, the next step for Fortune Brands is engaging its distributors in partnerships using Internet technologies to standardize its external financial and transactional processing needs. Although, ERP does not presently address interenterprise collaborative efforts, CPFR does.

Several approaches are being investigated to enhance collaborative relationships by way of extranets among supply chain partners (Joachim, 1998). Many of these efforts are based on “middleware” software, which is used to bridge the gap and facilitate interenterprise collaboration and synchronize trading partner business processes (Schachtman, 2000b). Presently, there are numerous ERP vendors, several of which offer software capable of varying degrees of integrating a customer demand forecast into a production planning module (Harrington, 2000). Some of these vendors are also emerging with an applications hosting business, whereby collaborative forecasting and planning setups for groups of users are offered. These new services are aimed at retailers and manufacturers that want to begin to use the Internet to exchange business data for collaborative purposes (Stedman, 1999).

CPFR in conjunction with ERP will increasingly be used to provide the interconnected transaction foundation among the various planning systems via the Internet. In a research survey conducted by InformationWeek of 200 information technology executives currently using or deploying ERP, 52 percent of the respondents indicated current involvement or future plans to create a business supply chain using ERP software (Stein, 1998). This system would enable suppliers, partners, distributors, and even consumers real-time access to the ERP system via an extranet. Specifically, supply chain participants utilizing CPFR systems will soon be able to connect ERP planning systems via the World Wide Web.

The future evolution of CPFR will permit an automatic transference of supply chain partner demand forecasts into vendor production schedules, accounting (accounts receivable and payable), human resource requirements, and supply chain planning applications such as the warehousing and inventory control applications of ERP systems. The next logical step in the development of CPFR is the interenterprise integration of various ERP system planning activities (Hickey, 1998, 1999) realized for all participants will include better collaboration, increased sales, lower operational costs, higher customer service levels and reduced cycle times, among a host of others.

References
Chain Store Age (1997), “Improving the supply chain”, Chain Store Age, Section 2, October, p. 21.
Chain Store Age (1998), “KPMG study points the way toward a more efficient supply chain”, Chain Store Age, Vol. 74 No. 10, p. 6c.


