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Information Sharing in a Supply Chain

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Abstract

Advances in information system technology have had a huge impact on the evolution of supply chain management. As a result of such technological advances, supply chain partners can now work in tight coordination to optimize the chain-wide performance, and the realized return may be shared among the partners. A basic enabler for tight coordination is information sharing, which has been greatly facilitated by the advances in information technology. This paper describes the types of information shared: inventory, sales, demand forecast, order status, and production schedule. We discuss how and why this information is shared using industry examples and relating them to academic research. We also discuss three alternative system models of information sharing -- the Information Transfer model, the Third Party Model, and the Information Hub Model.

1. Introduction

In supply chain management, the focal point for the partners is that the unit of analysis is changed from a business unit (like a plant or a warehouse) to a supply chain (including parts suppliers, manufacturers, distributors, logistics service providers, wholesalers and retailers). The integration and optimization of three -- material, information and financial -- flows in the supply chain form the core concern of supply chain management. It suggests extensive coordination among multiple functions and independent companies engaged in the delivery of a product or a service to end consumers. Traditional transaction-based intra-organizational relationships give way to partnerships in which information, processes, decisions and resources are shared among partner companies.

There are several major underlying trends that have formed the key drivers for supply chain management. The first is the globalization of businesses. Modern businesses attempt to deploy global resources to maximize the potential opportunities in the global community. This, however, entails the challenges of dealing with long delivery lead times, high buffer stock, complex logistics and high cost of coordination, as companies try to coordinate the three flows across the globe. Another driver is the innovations in the retail landscape. General merchandise store chains like Wal-Mart, wholesale clubs like Price Club, category specialist chains like Toys-R-Us, mail order companies like Lands' End, and virtual electronic stores like Amazon have revolutionized the retail side of supply chains. Innovations like Vendor-Managed Inventory (VMI), everyday low pricing, activity-based costing and cross-docking have triggered industry-wide efforts in supply chain management like Efficient Consumer Response (ECR) [1] or Efficient Foodservice Response (EFR) [2].

On the supply side, a key driver of supply chain management is the availability of cost-effective information technologies (IT). In fact, although it is recognized that a supplv chain that makes decisions based on global information would clearly dominate one with disjoint decisions by separate and independent entities in the supply chain, a well coordinated supply chain has not been easy to achieve. Significant investments are required to allow information to be shared across entities so that the activities and decisions throughout the supply chain can be coordinated. Recent advances in cost-effective IT have, however, made the cost-benefit tradeoff favorable toward well coordinated supply chain management. Specific examples of such technologies include client-server architecture, TCP/IP, relational DBMS (Data Base Management Systems), ERP (Enterprise Resource Planning), EDI (Electronic Data Interchange), object-oriented programming environments, wireless communications and the Internet. Thanks to these technologies, companies can now replace costly logistics flows and inventories by information. How to deploy these technologies and coordinate supply chain-wide activities constitutes the latest advances in supply chain management.

The objective of the present paper is to study information sharing in the specific context of global supply chain management. While there exist several works on information sharing in the general context (e.g., [3]), no work specifically addresses information sharing in the supply chain. The present paper reports on some common types of information sharing in a supply chain. It is only a small step toward answering the more challenging and frequently asked questions such as "What is the minimum set of information to share with my supply chain partners without risking any potential exploitation?"

The paper is organized as follows. Section 2 describes the types of information shared and the associated benefits. Section 3 discusses alternative system models to facilitate information sharing. Section 4 addresses the challenges of information sharing.

2. Types of Shared Information

2. 1. Inventory Level

One of the most common data shared between supply chain partners is inventory level. As [4] indicate, inventory and communication are economic substitutes. Access to supply chain inventory status can contribute to lowering the total inventory level in the supply chain. To see this, consider two companies in a supply chain in which a retail chain purchases products from a manufacturer. If the retailer and the manufacturer independently manage their respective inventories without sharing inventory status information, they may end up having duplicate safety inventories, or stockouts at both locations.

A solution to this inefficiency is to coordinate the management of inventories at the two sites. Indeed, it was proven in [5] that "echelon-based" inventory control is optimal under certain assumptions. The echelon inventory is the combined inventory at the site and at its downstream partner. In [6], it was also shown that a variation of the order-up-to policy based on the echelon inventory level would achieve near-optimum in more realistic conditions. Such a policy is in the same spirit of Synchronous Manufacturing System. "[The] production rule will adjust the production rate at a stage according to the inventory levels at the downstream stages. Specifically, the production rate at a stage will decrease (increase) when the inventory levels at those downstream stages are higher (lower) than their target levels," (see [6]). To implement echelon-based inventory control, the upstream company should keep track of the inventory level at the downstream of the supply chain and start production only when the echelon inventory position is low enough. This way, the upstream company can better determine when and what to produce, and downstream companies can improve the service level with less inventory.

In practice, sharing of inventory information is implemented in different forms. CRP (Continuous Replenishment Programs) or Vendor-Managed Inventory (VMI) is a practice often employed by two neighboring partners in a supply chain (e.g., Procter & Gamble and Wal-Mart). In a typical CRP relationship, the buyer shares its inventory data with the vendor and asks the vendor to manage his inventory within a guideline.

Example 1. (Apple-Fritz's Supplier Hub, see [7]) In the past, supplier lead times to Apple Computer's Sacramento, California, and Fountain, Colorado plants were both long and unreliable, due to the Fact that most of the suppliers are located in Asia with supplier shipments subjected to possible delays in transportation and customs clearing. The supply chain between an Asian supplier and Apple involves at least five steps — ocean freight processing, customs clearance, long-haul transportation, warehousing, and local transportation. In the mid-1990's, Apple established a "supplier hub" at each plant and outsourced the management of inbound logistics to Fritz Companies, a third-party logistics service provider. The supplier hub is located close to the Apple plant and serves as a shared warehouse for these suppliers. Each supplier is expected to carry a prescribed days' of supply of the parts at the hub, and maintains title to the inventory. Apple shares multiple weeks of demand forecasts with these suppliers. Fritz manages the entire inbound logistics for Apple by assuming the responsibility of(i) consolidating freight between Asia and the supplier hub, (ii) clearing customs, (iii) managing the hub, and (iv) managing the local transportation to Apple. The supplier hub maintains a very elaborate information system called FLEX. It provides the visibility of pipeline inventory in different stages of the entire supply chain: requested by purchase orders from Apple, reserved but not shipped at the supplier, shipped from the supplier with customs entry not yet filed, in customs clearing, picked up at port of entry and en route to the plant, in stock at the hub, and pulled for delivery to Apple's plant. Using FLEX, Apple and its partners can keep track of inventories of hub materials in the supply chain. Fritz ensures accurate data entry in every step of the pipeline. Cl

Recently, even the possibility of sharing inventory information among competitors is under discussion. For example, Japan's semiconductor makers proposed a system under which chip makers from Japan, Korea, the United States and Europe jointly survey their inventory levels [8]. The benefit of this horizontal information sharing is to mitigate the chronic problems associated with volatile business cycle. DRAM businesses, being at the farthest upstream in the computer supply chain, experience an extreme form of volatility. It is caused by multiple factors including business cycle, double forecasting, shortage gaming, and third-party speculation (see [9] and [10]). As a result, industry sales data and market prices are so noisy that estimating the real market demand becomes a major challenge. Information sharing among key manufacturers, if properly implemented, can at least mitigate this information distortion, and each manufacturer can better estimate the market demand and make better production, capacity and inventory planning decisions.

While access to the industry-wide inventory status may be beneficial to the individual manufacturers, there is a concern whether manufacturers will sincerely share their true inventory information (see [11] to [14]). This is because each party has an incentive to overstate its inventory level to discourage others from producing more chips or building additional capacity. If every manufacturer acts selfishly and anticipates the same behavior of others, information sharing will not be sustained as an equilibrium. It will be interesting to see whether the proposed horizontal information sharing will actually take place in spite of the incentive problem.

2.2. *Sales Data*

In the traditional supplier-buyer relationship, companies communicate demand information exclusively in the form of orders. Indeed, orders from downstream serve as a critical source of information about future businesses. But if the supplier depends solely on orders for future production planning, a problem arises. Since orders are 'processed' result of various information and conjectures by the buyer, orders data often distort the true dynamics of the marketplace - a phenomenon called "the bullwhip effect" ([9] and [10]). Thus, the information transferred in the form of orders tends to be distorted and can misguide upstream partners in their inventory and production decisions. In particular, the variance of *orders* is often larger than that of *sales*, and the distortion tends to increase as one moves upstream (see Figure 1). The distortion injects additional uncertainties into order fulfillment processes and makes demand forecasting even more difficult. It ultimately hurts the efficiency of the supply chain in the form of excess raw material inventory, unplanned purchases of supplies, additional manufacturing expenses created by excess capacity, inefficient utilization and overtimes, excess warehousing expenses, premium shipping costs, and poor customer service level.

Figure 1: The Bullwhip Effect

Lee et al (in [9] and [10]) identify four sources of the bullwhip effect: (i) demand signal processing, (ii) rationing game, (iii) order batching and (iv) price fluctuations. Consider a retailer who tries to read market trends by applying some forecasting technique (e.g., exponential smoothing) to the order data. In so doing, a larger than average sale in a single period could lead to the retailer adjusting his forecasts upward, so that an even larger order would be placed to his upstream. When this practice is repeated at upstream companies using the 'distorted' orders from downstream, the larger than average sale could be greatly amplified. To avoid double or triple forecasting, actual sales data (along with inventory information) need to be shared. P&G routinely receives sell-through data from its major customers' distribution centers and point-of-sales (POS) data from some retail stores. IBM and HP ask for sell-through data as part of their agreement with computer reseller. Using sell-through and/or POS data, manufacturers can better forecast the demand and develop a better production plan that lowers the overage and underage costs. Lee et al. [15] quantified the value of such information sharing.

Order batching results when a retailer orders in large batches, and therefore infrequently. The upstream supplier consequently receives demand information only infrequently, at the times when the retailer orders. This does not help the supplier in providing good customer service. Sales information sharing by the retailer enables the supplier to be better prepared for volatile market demand. The value of such sharing was quantified in [16] and [17].

Promotions by the manufacturer to retailers can lead to erratic order patterns, but also distort the true demand data to the manufacturer. Again, sales information sharing helps to present a better picture.

Order rationing in times of shortages often leads retailers to inflate their orders in order that they might gain a better share of the items in short supply. manufacturers not realizing such gaming behaviors may be misled into believing a much higher demand than otherwise. By having sales data, manufacturers would be in a much better position to differentiate real demands and the so-called "phantom" demands.

Example 2: (Seven Eleven Japan, see [18]) Seven Eleven Japan (SEJ) is the largest convenience store chain in Japan. They not only outsell McDonald's in Japan's fast food market, but also rank number 2 in paperback and magazine sales and number 1 in battery and ladies' stockings sales. Their inventory turns is 55 per year, in contrast with Wal-Mart's 6.7. The secret of their success is the extensive use of POS transactions data. The headquarters receives POS data from stores, along with the gender and estimated age of the customer (entered on a separate key pad). This way SEJ can analyze the sales trend by item, by hour, and by customer's age and gender. This information is used to determine the store's stocking levels, as well as shelf space configuration, merchandising, and new product development. The POS data are also transmitted to wholesalers and manufacturers for better production schedule and new product development. By sharing the retail POS data with SEJ's headquarters, wholesalers and manufacturers, SEJ maintains the largest per-square-foot sales in the industry. □

2.3. Order Status for Tracking/Tracing

A typical supply chain involves multiple functions and independent companies in the delivery of goods and services to the end consumer. As a result, it is difficult for a customer to find out the status of an order, since the customer does not always know who else besides the retailer is involved or where in the supply chain the order is being processed. Recently, supply chain members started sharing their order status information, so that a high rate of first-call problem resolution could be achieved. For example, partners in the supply chain may hot-link their web sites or allow access to each other's order databases. By calling the retailer or visiting its web site, the customer can find the order status no matter where and in which supply chain partner's possession the order is. This one-stop inquiry is a big a contrast to the traditional process in which a customer is referred several times to other chain partners or is called back hours or days later.

Example 3: (MicroAge-UPS Tracking [19]) As a personal computer (PC) distributor, MicroAge carries 35-50 days of PC inventory bought from manufacturers like IBM in unconfigured forms. Upon receiving an order from a reseller, MicroAge configures the final product by loading other hardware and software. This configure-to-order process by Micro-Age is in the spirit of the "postponement strategy" or "last point differentiation" ([20] and [21]). The configured PCs are then packaged and drop-shipped by UPS, as the logistics provider, directly to end customers, thereby bypassing resellers. While the customer order passes through multiple parties, the order status is maintained at a single point by UPS. Hence, UPS manages the shipment status function including claims processing, order tracking, tracing and research through a system called UPS Host Access. Host Access receives data into a mainframe environment multiple times a day, and runs hand in hand with INI – MicroAge's Windows-based invoice/order entry application operating on a mainframe. INI produces a seven-day running delivery report for all UPS shipments. All members of the post-shipment service center have direct access to Host Access. When the customer calls a reseller for order status, the reseller can access Host Access on the Internet and check the status. Alternatively, the customer can directly access the web site. Host Access can also be used to generate proactive phone calls to the receiving party if delivery is delayed for some reason. Finally, on-line claims can be submitted through Host Access. Cl

The key benefit of this type of information sharing is the improvement of the quality of customer service, reduction in payment cycle, and savings in labor cost of manual operations. The quality of service improves as problems are resolved in a single call in a matter of minutes rather than hours and days. Since delivery problems delay the payment of product sales or service fees, fast resolution also shortens the payment cycle time. Furthermore, automated answering service is more productive compared with manual answering service, so it saves labor cost as well.

2.4. Sales Forecast

As mentioned earlier, members of a supply chain can eliminate the bullwhip effect and its related inefficiencies by avoiding independent multiple forecasts. VMI indeed delegates a site's replenishment decisions to upstream suppliers, but the degree of delegation is minimal. In a typical VMI arrangement, the vendor is asked to ship a predetermined quantity of order when the buyer's inventory level falls under a certain level. In some cases, the vendor has the liberty of shipping any quantity, but must keep the downstream site's stock from exceeding some predetermined maximum level. Such constraints often exist because the retailers are concerned that an uncontrolled vendor may have the incentive to ship too many units to the retailer. However, such constraints do not leave much for the vendor to use her judgment on future market demand. This is sometimes unfortunate, since the vendor may have plenty of expertise and market information to judge the future market movement better than the retailer. For example, Warner-Lambert, a pharmaceutical manufacturer, possesses deep knowledge on how weather conditions could impact the sales of their pharmaceutical products. To exploit the vendors' superior forecasting capabilities, retailers including Wal-Mart formed an initiative called Collaborative Forecasting and Replenishment (CFAR), which calls for the retailers and the manufacturers to exchange knowledge and jointly develop forecasts and replenishment plans.

The common form of forecast sharing involves a downstream site sharing the information to the supplier, as it is closer to the market and is thus better positioned to forecast future market demand. Companies like SUN, HP and Texas Instrument share their forecasts with suppliers as part of their Quantity-Flexible (QF) contracts (see [23]). Forecasts serve as advanced notification for future orders to the supplier, who uses such information to develop her production plan. However, as the buyer can influence the supplier's inventory decision by manipulating his forecasts, a potential incentive problem lurks behind the QF contract. That is, the buyer has an incentive to induce the supplier to carry a high inventory (at her expense) by overstating the demand. In expectation of this strategic behavior, the supplier may not take the forecasts seriously. Thus, information sharing will not take place as an equilibrium. To overcome this problem, the QF contract is structured so that the buyer is allowed to make limited changes to the forecast quantities for future periods, and hence the term "quantity flexible."

2.5. Production/Delivery Schedule

A manufacturer could make use of its supplier's production or delivery schedule to improve its own production schedule. For example, US auto companies have access to the production schedule for their orders at steel suppliers. A Taiwanese semiconductor manufacturer allows her global customers access to her production schedule. UPS receives delivery requirements information downloaded from MicroAge every two hours. SEJ's trucking companies receive delivery requirements multiple times a day as an advance notice for efficient scheduling of his fleet. Thus, information about input/job availability helps a buyer expand the planning horizon of his own production schedule. Also he can quote more accurate due dates to his customers.

Similarly, production schedules at a manufacturing site can be useful inputs to the supplier in ensuring reliable resupply. Motorola, for example, has used a program called "Scheduling Sharing," whereby computer and peripherals manufacturers that are the customers of Motorola's chip division would share their production schedules with Motorola. This enables Motorola to develop its own production plan, as well as to use the most cost-effective means to replenish the customers' stockpiles so that their production schedule would not be disrupted by not having adequate chips.

2.6. Other Information Sharing

Other examples of information often shared in a supply chain include *performance metrics* and *capacity.* Performance metrics include product quality data, lead times, queuing delays at workstations and service performance. By sharing this type of information, the supply chain can identify the bottlenecks of the chain and improve the overall performance. Chrysler, for example, shares the quality and on-time delivery performance data of all its suppliers across the supply chain. Each supplier can log on to the system to check its performance and its relative standing among the suppliers in the same category. In the same spirit, supply chain partners can jointly develop a performance metric that measures the performance of the entire supply chain. For example, they can measure the sojourn time of an order in the supply chain tracking how much time each order spends at each workstation and stocking point. This metric will provide valuable information to improve the delivery time performance of the overall chain.

Capacity information can contribute to mitigating potential shortage gaming behavior, thereby countering a potential source of the bullwhip effect. By sharing planned capacity information with the downstream partners well in advance, supply chain partners can coordinate and prepare against possible shortages. Semiconductor foundries, for example, routinely share their capacity status with the buyers to weather through peaks and valleys of volatile demand.

The extent of information sharing in a supply chain is expanding. A recent study on the PC industry is a case in point [24]. The study identified some advanced form of information sharing whereby a PC manufacturer shares with its supplier its own demand forecasts, as well as the demand forecasts from its customers Figure 2 shows how PC supply chain partners are sharing information with their partners.

Figure 2: Information Sharing in the PC Supply Chain

3. Models of Information Sharing

The system model of information sharing is fast evolving over time as the internet emerges as a new cost-effective platform. By the system model we mean the mode of business and its supporting system architecture in which information is shared among supply chain partners. Three such models can be identified - the Information Transfer Model, the Third-Party Model and the Information Hub Model (see Figure 3).

Figure 3: Three Models of Information Sharing

3.1 Information Transfer Model

In this model a partner transfers information to the other who maintains the database for decision making. This is a natural evolution from the EDI-based transactional model. While EDI was originally designed to be a means to process 'transactions,' it has been extended to facilitate sharing of some information like POS and on-hand inventory ([25], p.78). The model is exemplified by the examples of UPS-MicroAge, SEJ, VMI and QF contracts. In VMI, the retailer sends sales and inventory information to the vendor, who replenishes the buyer's inventory using the information received. QF contracts typically require that the buyer sends his forecasts to the vendor, so that she can prepare for the coming weeks' orders. In the UPS-MicroAge relationship, MicroAge transfers its orders data to UPS, who plans and executes deliveries. Likewise, SEJ franchisees transfer sales and customer information to SEJ headquarters which analyzes and summarizes the findings.

Supply chain partners may use EDI for information sharing after agreeing on an EDI standard. They can use EDI through third-party VAN services like GEIS, Sterling and Promenos. While EDI is a well-established process in the business world, it has several drawbacks. First, there are multiple industry-specific standards (e.g., Ordernet for the pharmaceutical industry), the cross-industry standard ANSI X12, and the international standard EDIFACT. A company with business interests in multiple industries has to face a problem of dealing with multiple standards. Second, since EDI is designed for all companies in the one-fits-all spirit, it may not exactly meet the special needs of a supply chain. Third, EDI is designed primarily for transaction processing, especially around purchase order and invoice, and hence it has some severe limitations for information sharing. For example, EDI only handles rigid text formats. This may be sufficient in standard transaction processing, but would not be adequate to handle other kinds of information sharing, such as database tables, bar codes, images and HTML pages. Fourth, EDI is batch-oriented, working only in operational windows. Finally, small and medium size companies often are discouraged by the high cost of installing EDI.

Recently, innovative companies are extending the boundary of EDI and developing mechanisms that directly connect information systems of multiple companies. In addition, service companies now offer EDI on the Internet, thereby lowering the cost of EDI usage.

3.2. Third Party Model

The Third-Party Model involves a third party whose main function is to collect information and maintain it in a database for the supply chain. For example, in the Apple-Fritz example, Fritz plays the third party role in information sharing. (Note that Fritz has a role of managing transportation as well as information processing. Thus, if the former role is highlighted, the Apple-Fritz model may be categorized as the Information Transfer Model.)

The third party company may also provide services for transactional processes. As an example, consider Instill Corporation (www.instill.com), which serves as an electronic interface between food service operators (e.g., restaurants) and food distributors. A member operator can browse the catalog on the Instill system and issue a purchase order to the Instill system. The purchase order is then forwarded to corresponding distributors. Instill manages the transaction cycle - catalog management, ordering, invoicing and payment. In addition to transactions processing, it offers a variety of information services like accounting, sales analysis, order tracking, rebate tracking and alert of special sales and promotional campaign. Distributors also receive various types of aggregate data that can be analyzed and utilized for their inventory control and product development. Digital Market (www.digitalmarket.com) sells similar services in electronic parts market. Using a mixed network of VAN and the Internet, a buyer requests price and due-date quotes from multiple vendors on his approved vendor list. Upon receipt of the quote request, a software agent on the vendor's side will generate an automatic reply by invoking a set of rules and checking the inventory status. If the dollar amount is beyond a certain threshold, then the system will request human intervention. Likewise, QRS (www.qrs.com) plays a similar role in the apparel and related industries, while Nonstop Solutions (www.nonstop.com) provides forecasting and inventory control services for the pharmaceutical industry.

3.3. Information Hub Model

The Information Hub Model is similar to the Third-Party Model except that the third party is replaced by a system. This model is exemplified by the product offered by Pandesic - a joint venture between SAP and Intel.

Example 4: (Pandesic (www.pandesic.com)) Pandesic offers what they call an "e-business solution," automating the full range of back-end processes for Web-based commerce. The Pandesic e-business solution is centered around an information hub that activates and coordinates various functional activities to complete a transaction. Its features include: accounting and inventory balancing, real time payments and financial reporting, warehousing, inventory management, customer profiling, catalog management, credit card processing and others. As an example, consider an end customer who visits the site of a retailer that uses the Pandesic e-business solution (a combination of software and hardware products as well as certain services). The site displays most up-to-date information showing the latest names, descriptions, prices, and the current warehouse availability of products. When the customer selects an item and gives her credit card information, the site processes the information with respective banks for authorization and payment. Once the credit card is approved, an order number is issued to the customer. Almost instantaneously, the order is forwarded to the distributor who will drop-ship the item to the customer. At the distributor's warehouse a pick list (along with a bar coded returns label) is printed, and the item is picked and packed. The inventory database is updated and runs a check whether a reorder point has been reached. If so, it will trigger a replenishment order to the manufacturer, and ultimately (after an MRP run) to his suppliers. The carrier is notified of the delivery requirement. As the package is picked up and moved by the carrier, the customer can visit the Web site at any time to track the shipment using the order number. In the mean time, the banks clear the accounts with the retailer, the warehouse, and the carrier. The general ledger, accounting payable, and accounts receivable are also updated. Note that a retail sale is processed simultaneously by multiple parties in a mixed format of transactions processing and information sharing - inventory data at the warehouse is shared between the distributor and the retailer, and delivery requirements and shipping status information are shared between the carrier and the retailer.

The information hub does not have to exist physically. As distributed object-oriented computing environments like Common Object Request Broker Architecture or Distributed Component Object Model [26] are developed, individual functional modules may reside at scattered locations and be called and invoked only as needs arise. Thus, the information hub could exist only as a logical entity.

4. Challenges

Information sharing in a supply chain faces several hurdles. The first and foremost challenge is that of aligning incentives of different partners. It would be naive of a partner to think that information sharing and cooperation will automatically increase his or her profit. In fact, each partner is wary of the possibility of other partners abusing information and reaping all the benefits from information sharing. For example, supply chain partners seldom share information that relates to sensitive cost data, e.g., production yield data or purchase price of parts. This is consistent with economists' finding that a powerful monopolistic or monopsonistic partner can extract all economic profit from his or her partner, but one way of defending a positive profit for the weaker party is to keep the cost hidden and maintain informational superiority. The profit associated with superior information is often called *the informational rent* [27].

Even when each partner is guaranteed a positive gain in return for information sharing, each partner can play a non-cooperative game and haggle over how *much.* This may potentially lead to a failure to share information. Thus, trust and cooperation become critical ingredients in a supply chain partnership. On the other hand, trust needs to be rationalized by a relevant economic return. Cooperative game theory [28] offers a starting point to the resolution of the problem, but reality is much more complicated with many additional factors and special considerations.

Another concern associated with information sharing is the confidentiality of information shared. Suppose, for example, that a supplier supplies a critical part to two manufacturers who compete in the final product market. Either manufacturer would not share information (like sales data) with the supplier unless it is guaranteed that the information is not leaked to the other manufacturer. But the situation becomes tricky if the supplier and one of the two manufacturers are the same company.

Note also that information sharing in certain settings can be a subject of antitrust regulations. Suppose that two retailers regularly share with the supplier their demand projection for the next ten weeks. The projection by one retailer may implicitly signal the plan of a sales/promotion campaign in some future week. When this information is relayed to the other retailer through the supplier, it may be potentially used as a price-fixing instrument between the two retailers. For example, the two retailers may take turns lowering the price by the use of forecast signals and avoid cut-throat price competition. This practice may be a subject of scrutiny by the antitrust authorities. Again, but for a different reason now, the supplier must make sure that the shared information will not be used beyond the original intent.

Technology is another constraint in information sharing. Implementation of a cross-organizational information system is costly, time-consuming and risky. Partners may not agree on the specifications of the technical system, e.g., EDI standards, or how to split the cost of investing in the system.

The timeliness and accuracy of the shared information could be another major hurdle. PC manufacturers often complain about not being able to get accurate sell-through data from their resellers. Some resellers share such data on a monthly basis, but then the definition of a month varies by resellers - some from the first day of the month to the first day of the next, some from 15th to 15th, and so on. In addition, some resellers would share the data on a weekly basis. Since the manufacturers are interested in the aggregate sell-through data of their products, significant efforts are needed to ensure consistency of the aggregated data.

Finally, we should note that information sharing is only an enabler for better coordination and planning of the supply chain. Hence, companies must develop capabilities to utilize the shared information in an effective way. We have heard that some manufacturers demand POS data from the retailers, but then did not know how to make use of the data to improve their forecasts. Consequently, the benefits of information sharing were not fully realized.

Information sharing will continue to form the basis of supply chain integration. Current advances in information technologies will accelerate such a practice. Nevertheless, whether the full value of information sharing can be realized or not depends on the extent to which we can overcome the challenges described in this section.

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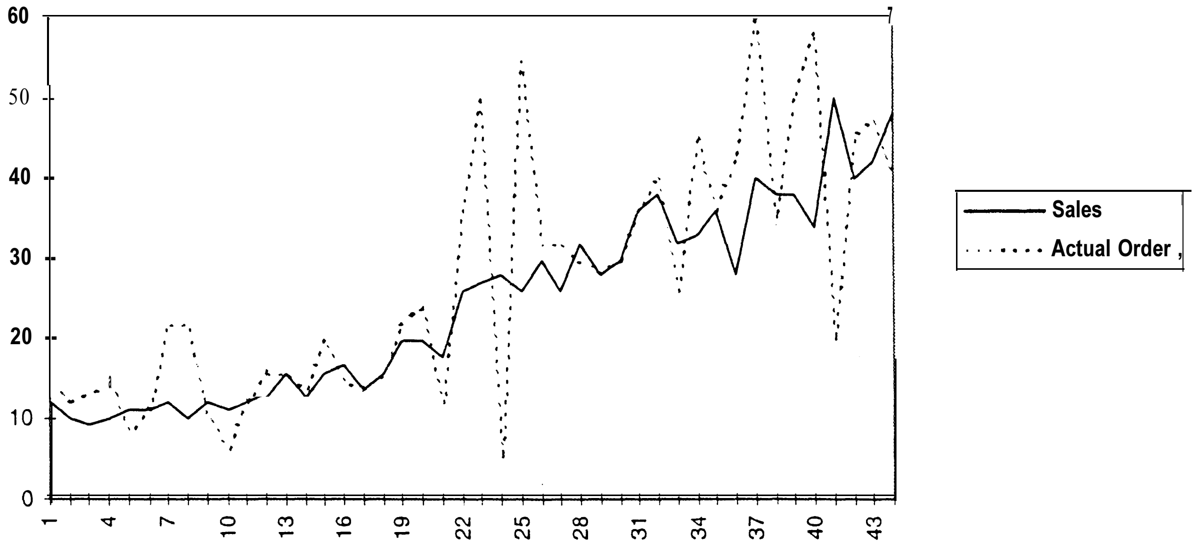
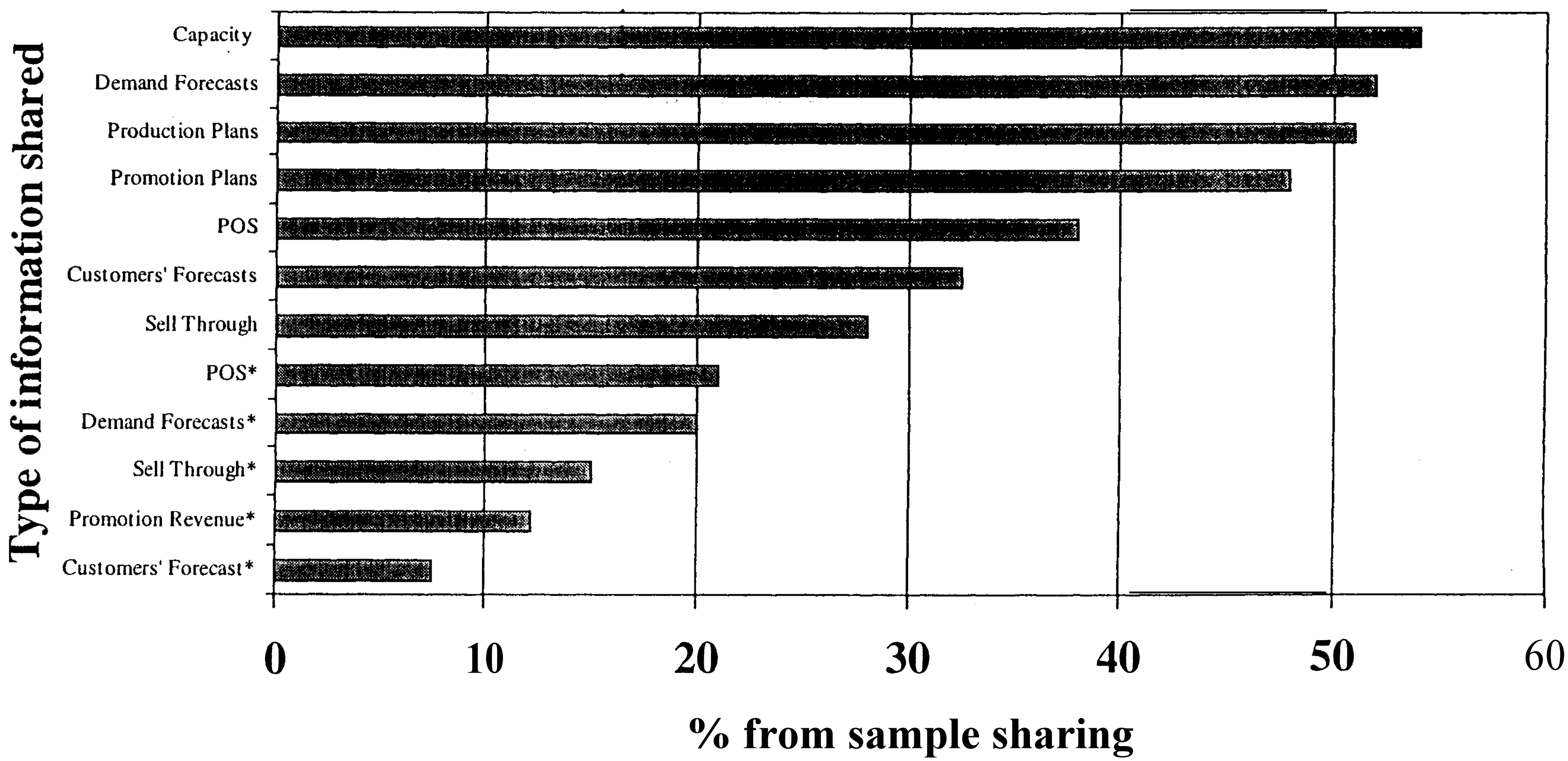


Figure 1. The Bullwhip Effect (Lee, Padmanabhan and Whang (1997))

Figure 2. Survey Results on Information Sharing



* indicates information shared electronically

Figure 3. Three Models of Information Sharing