

## Module IV

### Coordination in Supply Chain:

- Collaborative planning and replenishment strategies,
- CPFR,
- Managing uncertainties in inventory.



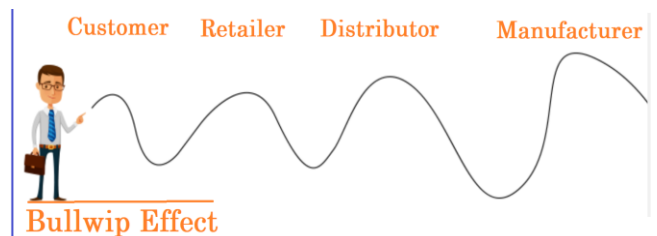
### Supply Chain Management - Coordination - Topics

1. Lack of Supply Chain Coordination and the Bullwhip Effect
2. Other Effects of Lack of Supply Chain Coordination on Supply Chain Performance
3. Obstacles to Coordination in a Supply Chain
4. Managerial Levers to Achieve Coordination
5. Building Strategic Partnerships and Trust within a Supply Chain
6. Achieving Coordination in Practice

- Coordination implies actions by various agents in the supply chain that are aimed at an increase in total supply chain profits.
- Channel coordination (or supply chain coordination) aims at improving supply chain performance by aligning the plans and the objectives of individual enterprises. It usually focuses on inventory management and ordering decisions in distributed inter-company settings.
- Managing demand and supply at maximum efficiency requires coordination among supply chain stakeholders.
- To optimally balance demand and supply, there must be visibility of true demand across all links in the supply chain from consumers to the upstream chain.
- Information sharing is a key component to gain visibility.
- Synchronization has a significant effect on performance in every aspect of the chain including manufacturing, procurement, distribution, and customers.
- Companies that adopt collaborative approach tend to increase visibility across the network, allowing them to minimize variability than those who do not.

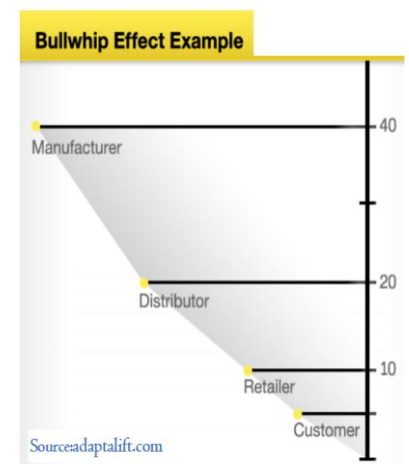
### Lack of Supply Chain Coordination - Bullwhip Effect

Everyone tries to protect themselves from stock-out situations and missed customer orders, by keeping extra inventory to hedge against variability in the supply chain. Hence, huge buffers of inventories up to six months can exist between the end customer and raw material supplier. This bullwhip effect ultimately causes the upstream manufacturers to have increased uncertainty which results in lower forecast accuracies leading to higher inventories.



### Example of the bullwhip effect

- Let's say that an actual demand from a customer is 8 units,
- The retailer may then order 10 units from the distributor; an extra 2 units are to ensure they don't run out of floor stock.
- The supplier then orders 20 units from the manufacturer, allowing them to buy in bulk so they have enough stock to guarantee timely shipment of goods to the retailer.
- The manufacturer then receives the order and then orders from their supplier in bulk; ordering 40 units to ensure economy of scale in production to meet demand.



- Now 40 units have been produced for a demand of only 8 units; meaning the retailer will have to increase demand by dropping prices or finding more customers through marketing and advertising.
- A lack of coordination creates a “bullwhip effect” in the supply chain.
- Due to this effect, fluctuations in sales become larger and larger fluctuations in orders at higher stages in the supply chain.
- This leads to situations wherein large shortages or large surplus capacities are felt in the supply chain cyclically.
- The bullwhip effect reduces the profit of a supply chain by making it more expensive to provide a given level of product availability.

#### Bullwhip effect - increases costs for the supply chain:

- It increases manufacturing cost.
- It increases inventory cost.
- It increases replenishment lead times.
- Increases transportation cost.
- Increases labor cost in shipping and receiving.

All items cost increase because excess capacity has to be installed to take care of unnecessary Peaks in demand.

It reduces product availability due to some orders not getting filled when demand peaks. So, some retail outlets may go out of stock.

Leads to problems of relationships - everybody claims that they have done right. But still there is a problem in the supply chain either as unfilled orders or excess inventory not having the order from downstream side.

The main reasons for coordination problems in supply chain are distributed owners of various stages of production & distribution, and product variety.

The fundamental challenge is for supply chains to achieve coordination in spite of multiple ownership and increased product variety.

#### Obstacles to Coordination in a Supply Chain:

##### Incentive obstacles

If a transport manager's incentive compensation is based on average transport cost, he tries to optimize his incentive objective without considering its effect on other supply chain stages.

If the sales force has incentive for selling to dealers, they push sales to dealers even though there is no sale in the period to customers. This will reduce orders from the dealers in the subsequent periods.

##### Information processing obstacles

If each supply stage depends on orders from its previous stage without considering the ultimate sales to the consumer bull whip effect will appear.

##### Operational obstacles

Economic batch quantities result in large lot sizes which are released periodically.

##### Pricing obstacles

Quantity discounts and sales promotion discounts to dealers create distortions in orders.

##### Behavioral obstacles



Each stage of the supply chain thinks locally and it is unable to see the effect on the total supply chain and other supply chain stages.

### Managerial Levers to Improve Coordination in Supply Chains: (Source: Chopra and Meindl)

- Aligning goals and incentives
- Improving information accuracy
- Improving operational accuracy
- Designing pricing strategies to stabilize orders.
- Building Partnerships and trust



### Achieving Coordination in Practice

1. Quantify the bullwhip effect.
2. Get top management commitment for coordination.
3. Devote resources to coordination.
4. Focus on communication with other stages.
5. Try to achieve coordination in the entire supply chain network.
6. Use technology to improve connectivity in the supply chain.  
ERP is still helping the internal operations of companies. It has to be extended to the full supply chain. Extra effort is required to make the ERP systems facilitate collaborative forecasting and planning across the supply chain.
7. Share the benefits of coordination equitably.

### Supply Chain Collaboration Initiatives:

1. JIT
2. ECR, CR, and QR
3. VMI

#### 1. JIT – A purchasing-related application:

- A management strategy that enables a company to receive goods as close as possible, when they are actually needed.
- It minimizes the need for a company to store large quantities of inventory, thereby improving efficiency and providing a substantial cost saving.
- It enhances cash flow and reduces the amount of capital needed to run the business.
- The success of the JIT production process relies on steady production, high-quality workmanship, no machine breakdowns, and reliable suppliers.
- **JIT** is also known as the Toyota Production System (TPS) because the car manufacturer Toyota adopted the system in the 1970s.
- Kanban is a scheduling system often used in conjunction with JIT to avoid overcapacity of work in process.
- Retailers, restaurants, on-demand publishing, tech manufacturing, and automobile manufacturing are some examples of industries that have benefited from just-in-time inventory.



#### 2. ECR, CR, & QR:

##### ECR (Efficient Consumer Response):

Strategy to increase the level of services to consumers through close cooperation among retailers, wholesalers, and manufacturers.

##### Key Elements:

1. **Efficient assortment** – Product offerings should be rationalized to better meet customer needs and improve supply chain performance
2. **Efficient product introductions** – New products should be introduced in response to real customer needs, and only after the impact on supply chain performance has been considered.

3. **Efficient promotions** – Prices should be kept as stable as possible. The supply chain impact of promotions and market specials should be carefully considered.

### CR (Continuous Replenishment)

- It's a supply chain strategy in which frequent replenishment (**restoration**) takes place from the supplier to the retailer/distributor in order to maintain better flow in supply chain and minimize bullwhip effect.
- Decision of quantity and time to replenish lies with supplier and not the retailer.
- Need agreement between supplier and retailer.
- In order to implement CR, the supplier needs to set an objective i.e., fill rate etc.
- Supplier needs to implement IT systems to establish real time flow of information in the supply chain about sales. Ex.: Distribution center withdrawals, Retailer's point of sales etc.
- These data are important to predict normal sales and deviations in demand, based on which inventory level is decided.
- The system itself suggests how much to replenish time to time. The associated benefits of CR are reduced inventory, reduced stock out, minimization of bullwhip effect, improved customer service, reduced administration cost and enhanced perception value in trading partner.

### QR (Quick Response)

QR is a management concept created to increase consumer satisfaction and survive increasing competition from new competitors. It intends to shorten the lead time from receiving an order to delivery of the products and increase the cash flow.

The QR (Quick Response) system, a production and distribution system for quick response to the market, was developed for the U.S. textile industry to survive the global competition with low-cost foreign companies.

### CPFR - Collaborative Planning, Forecasting and Replenishment:

- Collaborative Planning, Forecasting, and Replenishment (CPFR) takes a collaborative approach to supply chain management and information exchange among trading partners.
- CPFR is a business practice that combines the intelligence of multiple trading partners in the planning and fulfillment of customer demand.
- **CPFR has its origins in Efficient Consumer Response (ECR).**

ECR's core elements still apply under CPFR. But CPFR extends the business processes to include:

- Information systems for capturing and transferring POS (point – of – sale), inventory, and other demand & supply information between trading partners.
- Formalized sales forecasting and order forecasting processes
- Formalized exception handling processes
- Feedback systems to monitor and improve supply chain performance.

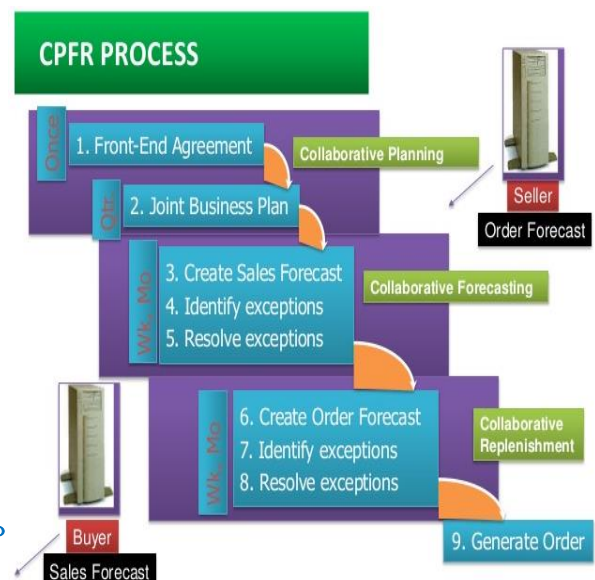
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The steps involved in installing a CPFR systems are:

1. Develop Front End Agreement
2. Create Joint Business Plan
3. Create Sales Forecast
4. Identify Exceptions for Sales Forecast
5. Resolve/Collaborate on Exception Items
6. Create Order Forecast
7. Identify Exceptions for Order Forecast
8. Resolve collaborates on Exception Items
9. Order Generation → Delivery Execution

#### I. Develop Front End Agreement

This step is where the retailer/distributor and manufacturer establish the guidelines and rules for the collaborative relationship.



The front-end agreement addresses each party's expectations and the actions and resources necessary for success.

The output of this step is a published CPFR front-end agreement that gives both partners a co-authored blueprint for beginning the relationship or redefining it in accordance with the CPFR standard.

## **2. Create Joint Business Plan**

In this step, the manufacturer and retailer exchange information about their corporate strategies and business plans in order to collaborate on developing a joint business plan. The partners first create a partnership strategy and then define category roles, objectives, and tactics.

The result from this step is a mutually agreed-on joint business plan that clearly identifies the roles, strategies, and tactics for the items in the agreement.

## **3. Create Sales Forecast**

In this step, retailer point of sale data, casual information, and information on planned events are used to create a sales forecast that supports the joint business plan.

A sales forecast is initially generated by one party, communicated to the other party, and then used as a baseline for the creation of an order forecast.

## **4. Identify Exceptions for Sales Forecast**

This step identifies the items that fall outside the sales forecast constraints set jointly by the manufacturer and distributor.

Examples of such items are seasonal products.

The output from this step is a list of exception items. This information is necessary in step five.

## **5. Resolve/Collaborate on Exception Items**

This step involves resolving sales forecast exceptions by querying shared data, email, telephone conversation, meetings, and so on and submitting any resulting changes to the sales forecast.

Collaborative negotiations between the retailer/distributor and the manufacturer resolve item exceptions. An adjusted forecast is then submitted.

## **6. Create Order Forecast**

In this step, point-of-sales data, casual information, and inventory strategies are combined to generate a specific order forecast that supports the shared sales forecast and the joint business plan.

The order forecast allows manufacturers to allocate production capacity against demand, while minimizing safety stock. Inventory levels have decreased, and customer service responsiveness is increased.

## **7. Identify Exceptions for Order Forecast**

This step determines what items fall outside the order forecast constraints set jointly by the manufacturer and distributor.

The result is a list of exception items that have been identified based on the predetermined criteria established in the front-end agreement.

## **8. Resolve collaborates on Exception Items**

This step involves the process of investigating order forecast exceptions through querying shared data, email, telephone conversations, meetings, and so on and submitting any resulting changes to the order forecast.

The results of this step are the output of the negotiation and resolution of item exceptions, which are then submitted as an adjusted forecast. The increased real-time collaboration facilitates effective joint decision making and fosters confidence in the order that is eventually committed.

## **9. Order Generation**

This step marks the transformation of the order forecast into a committed order. Order generation can be handled by either the manufacturer or distributor, depending on competencies, systems, and resources. Regardless of who completes the task, the created order is expected to consume the forecast.

The result is a committed order generated directly from the frozen period of the order forecast. An order acknowledgement is sent as a result of the order.

## **Benefits of CPFR**

- Forecast accuracy improvements.
- Smoother ordering patterns
- Increased sales revenues
- Higher order fill rates
- Decrease in coupling inventory levels (i.e., safety stock)



- Reduction in cost of goods sold (COGS) based on better insight into end consumer demand, more accurate forecasts, less disruption in/more stable production schedules.

### Inventory: \$

**Inventory** is a stock or store of goods or services, kept for use or sale in the future. There are four types of inventory.

#### Manufacturing Inventory

- Raw materials & purchased parts.
- Partially completed goods called work in progress (WIP)
- Finished goods inventories
- Goods-in-transit to warehouses or customers (GIT)

#### Service Inventory

- Involves all activities carried out in advance of the customer's arrival.



### Inventory policy

Inventory policy addresses two questions concerning replenishment of inventory:

- When to order?
- How much to Order?

### Reasons for Carrying Inventory

- Protect Against Lead Time Demand
- Maintain Independence of Operations
- Balance Supply and Demand
- Buffer Uncertainty
- Economic Purchase Orders

### Uncertainty in the supply chain

Uncertainty in the supply chain is caused by many factors, chief among them are changes in demand and demand variability, seasonality, transportation, receiving variability, and quality issues. All of these factors impact the inventory levels you need to carry excess inventory in order to continue normal operations without risk of stock-outs in your stores or line-down situations in your factories. As a result, the natural solution is to hold excess inventory so that we can still meet our customers' demands despite whatever is happening in the world around us. This is an important part of risk mitigation, because companies today cannot afford lost production or lost sales as a result of any type of supply chain disruption.

### Types of Inventories

- Cycle Stock
  - Inventory for immediate use
  - Typically produced in batches (production cycle)
- Safety Stock
  - Extra inventory was carried out for uncertainties in supply and demand.
  - Also called buffer stock
- Anticipation Inventory
  - Inventory carried in anticipation of events.
  - Smooth out the flow of products in the supply chain.
  - Also called seasonal or hedge inventory
- Pipeline Inventory
  - Inventory in transit
  - Exists because points of supply and demand are not the same.
  - Also called transportation inventory
- Maintenance, Repair and Operating items (MRO)
  - Inventories are not directly related to product creation.

### Inventory Costs

- Holding Cost
  - Costs that vary with the amount of inventory held
  - Typically described as a % of inventory value
  - Also called carrying cost

- Ordering Cost
  - Costs involved in placing an order.
  - Sometimes it is called setup cost.
  - Inversely related to holding cost
- Shortage Cost
  - Occur when we run out of stock.

### Inventory Systems

Inventory systems answer the questions: when to order and how much to order.

There are 2 categories:

1. **Fixed-Order Quantity System** – an order of fixed quantity,  $Q$ , is placed when inventory drops to a reorder point, ROP.
2. **Fixed-Time Period System** – inventory is checked in fixed time periods,  $T$ , and the quantity ordered varies.

#### Fixed-Order Quantity System

- Assumes a constant demand rate of  $d$
- The inventory position,  $ip$ , is reduced by a rate of  $d$
- Order placed when the reorder point,  $rop$  is reached
- When inventory is received, the  $IP$  is increased by the order quantity,  $Q$
- There is a lead time,  $L$ , during which we have to wait for the order
- Inventory is checked on a continual basis
- $Q$  is computed as the economic order quantity, EOQ

#### Fixed-Time Period System

- Inventory levels checked in fixed time periods,  $T$
- A target inventory level,  $R$ , is restored when order received
- Sometimes called Periodic Review System
- Quantity ordered varies:

$$Q = R - IP$$

Where:  $Q$  = order quantity,  $R$  = target inventory level,  $IP$  = inventory position

### Inventory Control Techniques

The techniques or the tools generally used to effect control over the inventory are the following:

1. **Economic order quantity.**

Economic order quantity, or EOQ, is a formula for the ideal order quantity a company needs to purchase for its inventory with a set of variables like total costs of production, demand rate, and other factors.

The overall goal of EOQ is to minimize related costs. The formula is used to identify the greatest number of product units to order to minimize buying. The formula also takes the number of units in the delivery of and storing of inventory unit costs. This helps free up tied cash in inventory for most companies.

2. **Minimum order quantity.**

On the supplier side, the minimum order quantity (MOQ) is the smallest amount of set stock a supplier is willing to sell. If retailers are unable to purchase the MOQ of a product, the supplier won't sell it to you.

For example, inventory items that cost more to produce typically have a smaller MOQ as opposed to cheaper items that are easier and more cost effective to make.

3. **A-B-C Analysis.**

ABC System: In this technique, the items of inventory are classified according to the value of usage. Materials are classified as A, B and C according to their value.

Items in class 'A' constitute the most important class of inventories so far as the proportion in the total value of inventory is concerned. The 'A' items constitute roughly about 5-10% of the total items while its value may be about 80% of the total value of the inventory.

Items in class 'B' constitute intermediate position. These items may be about 20-25% of the total items while the usage value may be about 15% of the total value.

Items in class 'C' are the most negligible in value, about 65-75% of the total quantity but the value may be about 5% of the total usage value of the inventory.

The numbers given above are just indicative, actual numbers may vary from situation to situation. The principle to be followed is that the high value items should be controlled more carefully while items having small value though large in numbers can be controlled periodically.

#### 4. VED Analysis.

VED- Vital, Essential, Desirable- analysis is used primarily for control of spare parts. The spare parts can be divided into three categories – vital, essential or desirable – keeping in view the critically to production.

#### 5. Perpetual Inventory System.

Perpetual inventory management is simply counting inventory as soon as it arrives. It's the most basic inventory management technique and can be recorded manually on pen and paper or a spreadsheet.

#### 6. Fixation of stock level.

The object of fixing stock levels for each item of material is to maintain the required quantity of materials in the store and thereby the expenses may be reduced.

The different stock levels are: (1) Minimum stock level (2) Maximum stock level (3) Reorder stock level.

(1) Minimum stock level: It represents the minimum quantity of an item of material to be kept in the store at any time. Material should not be allowed to fall below this level. If the stock goes below this level, production may be held up for want of materials. This stock is also known as safety stock level or buffer stock.

(2) Maximum stock level: It is the stock level above which stock should not be allowed to rise. This is the maximum quantity of stock of raw materials which can be had in the stock. It is going above, it will be overstocking.

(3) Reorder stock level: It is the point at which the storekeeper should initiate purchase requisition for fresh supply. This level lies between the maximum level and the minimum level.

#### 7. Control Ratios.

The control ratios are mainly two:

- a) Inventory Turnover Ratio
- b) Input-output Ratio.

a) **Inventory Turnover Ratio:** Inventory Turnover is a ratio of the value of the materials consumed during a period to the average value of inventory held during that period.

If the inventory turnover rate in terms of value of materials is high, or if the length of the inventory turnover period is short, the material is said to be fast moving. So, if the rate of consumption is fast or if the inventory turnover rate is good, it is a healthy measure of efficiency of materials control, as the capital employed is properly utilized.

b) **Input-Output Ratio:** The Input-output Ratio is the ratio of the raw material put into manufacture and the standard raw materials content of the actual output. This ratio enables one to find out whether the usage of the materials is favourable or not. A standard ratio of input of materials and output of material should be determined, and the actual ratio should be compared with the standard ratio.

#### 8. Lean Manufacturing.

Lean is a broad set of management practices that can be applied to any business practice. Its goal is to improve efficiency by eliminating waste and any non-value-adding activities from daily business.

#### 9. Six Sigma.

Six Sigma is a brand of teaching that gives companies tools to improve the performance of their business (increase profits) and decrease the growth of excess inventory.



## Difference between Current Supply Chain Methods and CPFR

Current Supply Chain Methods	CPFR
Separate plans for Supplier, Manufacturer and Retailer	Shared plans developed jointly for Supplier and Manufacturer, Manufacturer and Retailer, and Supplier, Manufacturer and Retailer in a three-way implementation
Order Generation based in history (Shipments, DC level sales, or POS data)	Order Generation based in forecast, using DC/POS data, promotion planning and other marketing activities
Reactive	Proactive
Focused on execution	Focused on planning
Limited to Inventory and Logistics point of view	Includes Inventory, Logistics, Sales, Marketing, Procurement and Planning point of view
Goal is to cut company costs	Goal is trading partners' revenue growth
Related to inventory management	More related to category management
Works on efficient inventory replenishment only	Works on promotion, product introduction, inventory levels and replenishment all the way to the shelf effectiveness
Several forecasts for Supplier, Manufacturer and Retailer	Single shared sales forecast based on collaborative process

## Benefits of CPFR

### 1. Improved responsiveness to consumer demand

The reduction of out-of-stocks and shorter cycle times leads to a more responsive and reliable supply chain, thereby improving on-shelf availability and increasing consumer satisfaction. CPFR helps put the right product in the right place at the right time.

### 2. Greater forecast accuracy with single shared forecast

Sharing a single forecast along the supply chain enables participants to benefit from potential synergies and brings together trading partners' efforts. Depending on their position in the supply chain and supply chain activities, trading partners may have different views of the market and information, as well as varying consumer data, experiences and research data. Combining this knowledge is the foundation for greater forecast accuracy. Once planning processes are aligned, time horizons may be broadened in order to increase visibility and reaction time.

### 3. Improved relationship between the trading partners

The relationship will improve when collaboration takes place. Trading partners will gain a better understanding of their respective businesses by regularly exchanging information and establishing direct communication channels. Overall, the greatest benefits are to be gained from creating a 'win-win' situation.

#### **4. Increase in sales**

Collaboration on planning and forecasting potentially reduces out-of-stocks, lost sales and increases on-shelf availability, i.e. putting the right product in the right place at the right time. These improvements lead to an increase in sales to the consumer, which consequently means increased sales for all supply chain partners.

#### **5. Inventory reduction**

One reason for maintaining inventory is to compensate forecasting inaccuracy. Increased forecast accuracy facilitates a decrease in the safety stock, reducing inventory levels and increasing on-shelf availability.

#### **6. Cost reduction**

By aligning the production schedule with the agreed forecast, costs can potentially be reduced by decreasing set-up times, effort duplications and variations. Reduction in inventory will subsequently reduce capital costs, handling and administration costs.

#### **7. Improved production capacity utilization**

A more accurate forecast leads to more efficient production capacity utilization as planning information is more reliable.

### **LIMITATIONS OF CPFR**

#### **Issues with CPFR**

CPFR may be a simple concept however turning it into practice is a difficult task.

Since it involves collaboration with several trading partners, cultural challenges with each organization are realized and requires an across the board buy-in.

A change in business processes is required, along with an inward focus to develop a broad multi-enterprise view. Several challenges faced by organizations implementing CPFR are:

- Selection of CPFR partners – trading partners who wish to collaborate with each other need to assess the potential relationship according to anticipated, realistic benefits, pertinent to common business goals, organizations and cultural issues.
- Senior Management Buy In – senior management must sponsor each of the trading partners and get involvement from necessary resources, e.g. Human resources, technical infrastructure, time and project budget etc.
- Confidentiality – Sharing sensitive data reinforces the need to define rules around confidentiality.
- Cultural Change – Internal and external collaboration requires a mindset of change and capable to be flexible in adapting a collaborative approach.