

## **MODULE 1**

### **Supply Chain Management (SCM)**

Supply chain management (SCM) is the management of the flow of goods and services and includes all processes that transform raw materials into final products.

OR,

Supply chain management (SCM) is the optimization of a product's creation and flow from raw material sourcing to production, logistics and delivery to the final customer.

It involves the active streamlining of a business's supply-side activities to maximize customer value and gain a competitive advantage in the marketplace.

The supply chain is how a company turns raw materials into finished goods and services for the customer. It starts with the harvesting of the raw material. The commodity could be crops, animals, timber, gold, or other natural resources.

The commodity then goes to the manufacturer. That's when it becomes a finished product. There can be several steps in this process and they can involve locations in several different countries.

The finished product goes to one of three places: a wholesaler, a retailer, or directly to the consumer.

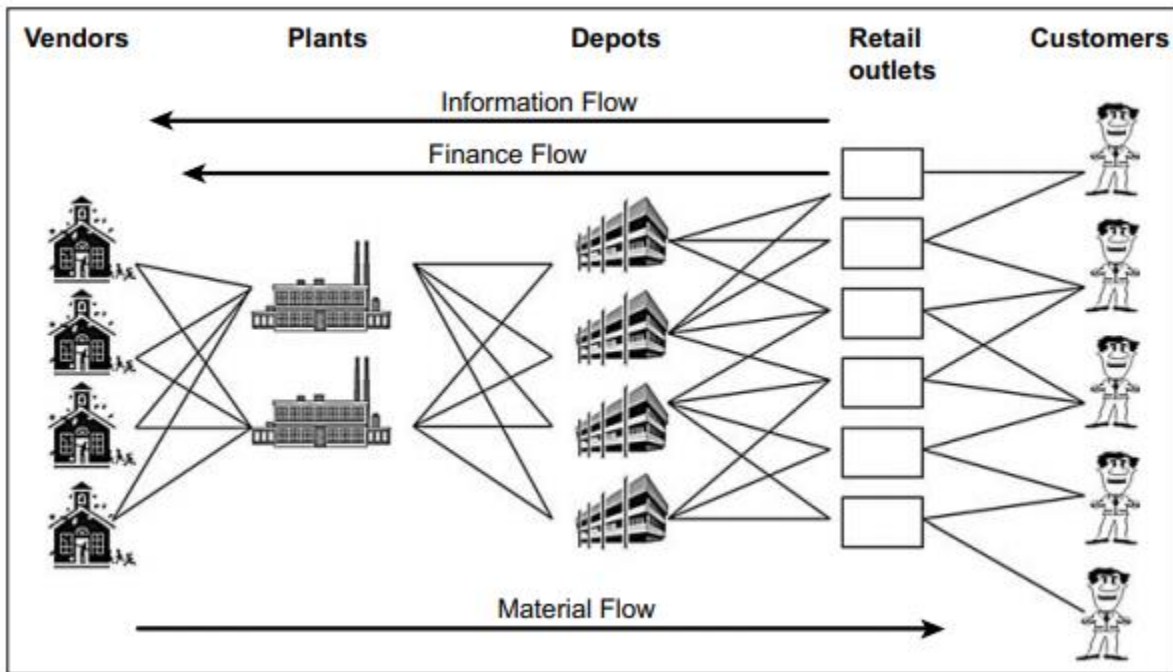
### **Fundamentals of SCM**

Supply Chain encompasses all activities involved in the transformation of goods from the raw material stage to the final stage, when the goods and services reach the end customer. SCM involves planning, design and control of flow of materials, information and finance along the supply chain to deliver superior value to the end customer in an effective and efficient manner.

A typical supply chain may involve a variety of stages, including the following:

- Customers
- Retailers
- Wholesalers/distributors
- Manufacturers
- Component/raw material suppliers

Each stage in a supply chain is connected through the flow of products, information, and funds. These flows often occur in both directions and may be managed by one of the stages or an intermediary.



The objective of every supply chain should be to maximize the overall value generated. The value (also known as supply chain surplus) a supply chain generates is the difference between what the value of the final product is to the customer and the costs the supply chain incurs in filling the customer's request.

$$\text{Supply Chain Surplus} = \text{Customer Value} - \text{Supply Chain Cost}$$

The value of the final product may vary for each customer and can be estimated by the maximum amount the customer is willing to pay for it. The difference between the value of the product and its price remains with the customer as consumer surplus. The rest of the supply chain surplus becomes supply chain profitability. The higher the supply chain profitability, the more successful is the supply chain.

#### SCM Objectives:

- Firstly, the objectives of SCM are to meet or exceed the required or demanded customer service level in targeted markets/segments and to optimize total supply chain investment and cost. This service/cost approach has long been regarded as central to supply chain management. This approach requires companies to have a clear understanding of both issues. Customer service requirements, dictated by the market place, "sets the spec" for the supply chain. Achieving this level of service at the optimal cost focuses attention on the elimination of "non value adding activities" (NVAs) throughout the supply chain.

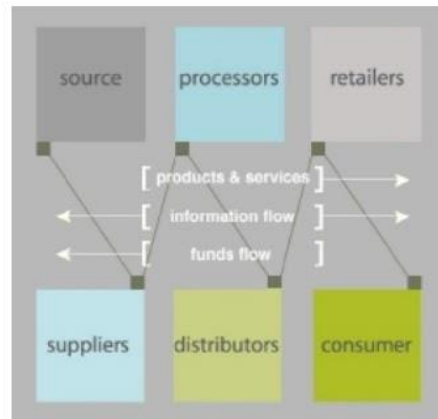
#### SCM philosophy:

- Secondly, every product or service is delivered to the final consumer (the only source of "real" money in the chain) through a series of often complex movements between companies which comprise the complete chain. An inefficiency anywhere in the chain will result in the chain as a whole failing to achieve its true competitive potential. In other words, supply chains are increasingly competing with other supply chains rather than, in the more

traditional axiom, companies simply competing with other companies. The phrase “supply chain” is used to indicate that the chain is only as strong as its weakest link.

#### External Supply Chain or Macro Supply Chain:

- The representation in Figure 1 of a “macro” supply chain shows materials flowing from the raw material source through the various stages in the chain to the final consumer. Money then flows back down the chain. The point is that every link matters and that value is added, and profit generated, at each link along the way.



*Figure 1 - The External Supply Chain*

1. Most businesses can be described in terms of the five functions: buy; make; store; move; and, sell. This is known as the “micro” or internal supply chain as shown in Figure 2.



*Figure 2 - The Internal Supply Chain*

2. Traditionally these functions have been managed in isolation, often working at cross purposes. SCM means thinking beyond the established boundaries, strengthening the linkages between the functions, and finding ways for them to pull together. A recognition that the whole is greater than the sum of the parts calls for more effective integration between purchasing and procurement (buy), production planning and control (make), warehouse management (store), transport management (move) and customer relationship management (sell), as illustrated in Figure 3.



*Figure 3 - Integrating the Internal Supply Chain*

### **Managing the Flows:**

For a supply chain to achieve its maximum level of effectiveness and efficiency, material flows, money flows and information flows throughout the entire chain must be managed in an integrated and holistic manner, driven by the overall service and cost objectives. The view of a macro chain shown in Figure 1 (above) indicates the way in which material, money (funds) and information flow between the companies which participate in the chain. Similar logic can be applied to the functions which comprise the micro chain. It can be argued that managing the information flows is the most critical of these activities. This is because the flow or movement of materials or money is usually triggered by an associated information movement. Effective management of material and financial flows is, therefore, predicated upon the effective management of the related information flows. For this reason, information and communications technology (ICT) is becoming an increasingly important SCM enabler.

### **Supply Chain Relationships:**

Finally, this holistic approach requires a reappraisal of the way in which both internal and external customer/supplier relationships are created and managed. SCM is not a “zero-sum” game based on adversarial relationships. Rather, it needs to be a “win-win” game based on partnership approaches. This point is relevant to the interactions between the key “internal” supply chain functions of buy, make, store, move and sell, as well as to relationships between an organization and its external customers and suppliers. One of the biggest manifestations of the application of supply chain philosophy in recent years has involved the move away from adversarial relationships with key external suppliers towards relationships which are based on mutual trust and benefits, openness and shared goals and objectives.

### **Evolution of Supply Chain Management**

- The First Revolution (1910-1920): The Ford Supply Chain
- The Second Revolution (1960-1970): The Toyota Supply Chain
- The Third Revolution (1995-2000): The Dell Supply Chain

#### **The First Revolution (1910-1920): The Ford Supply Chain**

- Ford Motor Company built a tightly Integrated Chain and owned every part of the chain
- Bulk of the Manufacturing was done in house

- Ford required 81 hours to complete a finished product, from iron ore mine to the finished product
- They owned the rails and timber
- Ford built a highly efficient but an inflexible supply chain that could produce only one model (Model T), Ford could not handle wide variety of products. Ford model was not sustainable in the long run
- General Motors, Ford's competitor offered a wide variety of products (models & colours)

### **The Second Revolution (1960-1970): The Toyota Supply Chain**

- Wider trend towards product variety
- Supply Chains were flexible and efficient
- The inventory holding level was low
- Toyota assembled the final product in house
- Toyota followed the *keiretsu* system (set of companies with interlocking business relationships and share holdings). Toyota Motors had a very long relationship with the suppliers
- Suppliers were located very close to the assembly plants, it just took couple of minutes to transport. This type of manufacturing was called Lean Manufacturing
- Some disadvantages included, replicating the same model outside Japan, Suppliers getting complacent as they were permanent relations with the company.

### **The Third Revolution (1995-2000): The Dell Supply Chain**

- Advancement in Information Technology
- Dell allowed customers to customize their own PC's and allowed them to track production
- Dell's suppliers were technologically advanced and very cost effective unlike Toyota
- Dell maintained a medium term relationship with suppliers
- Dell integrated suppliers electronically
- Suppliers were not located close to the plant
- Wide Variety of products and customization

## **Role of Supply Chain Management (SCM) in Economy**

- The growth of global supply chains has changed the distribution of incomes across countries. Participation in these supply chains, initiated by the successful completion of low value-added manufacturing tasks, contributed to industrialization and high rates of economic growth in several developing economies.
- SCM has a positive effect on employment because it creates jobs for unskilled labour. By increasing the demand for unskilled labour, it may even increase their wages, thereby reducing income inequality.
- Foundation for Economic Growth – Societies with a highly developed supply chain infrastructure (modern interstate highway system, vast railroad network, numerous modern ports and airports) are able to exchange many goods between businesses and consumers quickly and at low cost. As a result, the economy grows. In fact, the one thing that most poor nations have in common is no or a very poorly developed supply chain infrastructure.
- Improves Standard of Living – Societies with a highly developed supply chain infrastructure (modern interstate highway system, vast railroad network, numerous modern ports and airports) are able to exchange many goods between businesses and consumers quickly and at low cost. As a result, consumers can afford to buy more products with their income thereby raising the standard of living in the society. For instance, it is estimated that supply chain costs make up 20% of a product's cost in the U.S. but 40% of a product's cost in China. If transport damage is added in, these costs make up 60% of a product's cost in China. The high Chinese supply chain cost is a major impediment to improving the standard of living for Chinese citizens. Consequently, China has embarked on a massive effort to develop its infrastructure.
- Job Creation – Supply chain professionals design and operate all of the supply chains in a society and manage transportation, warehousing, inventory management, packaging and logistics information. As a result, there are many jobs in the supply chain field. For example, in the U.S., logistics activities represent 9.9% of all dollars spent on goods and services in 2006. This translates into 10,000,000 U.S. logistics jobs.
- Manufacturing managers decide where to locate the company based on the costs of production. Many companies outsource jobs to countries like India, China & Philippines that have a lower cost of living. By 2013, Asia accounted for 26.5% of global manufacturing output of products that are part of the supply chain. China was responsible for half of the global intermediate output.
- Nowadays natural disasters are occurring more often, this affects the supply chain, for example in 2011, Japan's earthquake and the resultant tsunami created the most damage to the world's supply of automobiles, electronics, and semiconductor equipment.

- Wings, landing gears, and other major airline parts are also made in Japan, so the quake disrupted the production of Boeing's 787 Dreamliner. U.S. gross domestic product slowed in 2011 as 22 Japanese auto part plants suspended production.

## **The Importance of Supply Chain Management**

### **1. SCM Boosts Customer Service**

- Customers expect the correct product assortment and quantity to be delivered.
- Customers expect products to be available at the right location. (i.e., customer satisfaction diminishes if an auto repair shop does not have the necessary parts in stock and can't fix your car for an extra day or two).
- Right Delivery Time – Customers expect products to be delivered on time (i.e., customer satisfaction diminishes if pizza delivery is two hours late or Christmas presents are delivered on December 26).
- Right After Sale Support – Customers expect products to be serviced quickly. (i.e., customer satisfaction diminishes when a home furnace stops operating in the winter and repairs can't be made for days)

### **2. Reduce Operating Costs**

- Decreases Purchasing Cost – Retailers depend on supply chains to quickly deliver expensive products to avoid holding costly inventories in stores any longer than necessary. For example, electronics stores require fast delivery of 60" flat-panel plasma HDTV's to avoid high inventory costs.
- Decreases Production Cost – Manufacturers depend on supply chains to reliably deliver materials to assembly plants to avoid material shortages that would shut down production. For example, an unexpected parts shipment delay that causes an auto assembly plant shutdown can cost \$20,000 per minute and millions of dollars per day in lost wages.
- Decreases Total Supply Chain Cost – Manufacturers and retailers depend on supply chain managers to design networks that meet customer service goals at the least total cost. Efficient supply chains enable a firm to be more competitive in the market place. For example, Dell's revolutionary computer supply chain approach involved making each computer based on a specific customer order, then shipping the computer directly to the customer. As a result, Dell was able to avoid having large computer inventories sitting in warehouses and retail stores which saved millions of dollars. Also, Dell avoided carrying computer inventories that could become technologically obsolete as computer technology changed rapidly.

### 3. Improve Financial Position

- **Increases Profit Leverage** – Firms value supply chain managers because they help control and reduce supply chain costs. This can result in dramatic increases in firm profits. For instance, U.S. consumers eat 2.7 billion packages of cereal annually, so decreasing U.S. cereal supply chain costs just one cent per cereal box would result in \$13 million dollars saved industry-wide as 13 billion boxes of cereal flowed through the improved supply chain over a five year period.
  - **Decreases Fixed Assets** – Firms value supply chain managers because they decrease the use of large fixed assets such as plants, warehouses and transportation vehicles in the supply chain. If supply chain experts can redesign the network to properly serve U.S. customers from six warehouses rather than ten, the firm will avoid building four very expensive buildings.
  - **Increases Cash Flow** – Firms value supply chain managers because they speed up product flows to customers. For example, if a firm can make and deliver a product to a customer in 10 days rather than 70 days, it can invoice the customer 60 days sooner.
4. **Proliferation in Product Lines:** Customers look for more variety in their demand for products, companies should make use of this opportunity to introduce more variety of products, this may include different fragrance or size or combo packs etc. A typical product like soap has 50 odd variety, this can be observed when we go for shopping in a super market. The unit for measuring “Variety” is called SKU or Stock –Keeping Unit, each variety of soap is treated as a different SKU. For example Hindustan Unilever (HUL) have about 1200 SKU’s in their personal care products.
5. **Shorter Product Life Cycles:** With increased competition, product life cycles across all industries are becoming shorter. For example, technology leaders like Apple works with a life cycle as short as 6 months. So a firm like Apple , which has, on an average, just 5 days of inventory, as compared to the industry average of 35 days.
6. **Higher Level of Outsourcing:** firms increasingly focus on their core activities and outsource non-core activities to other competent players, example: Bharti Tele-Ventures, India’s number one private telecom service provider, has outsourced network-management services, IT services and call centre operations. The trend towards outsourcing is irreversible but a higher level of outsourcing makes supply chains more vulnerable, thereby forcing firms to develop different types of supply chain capabilities within the organization.
7. **Globalization of Manufacturing:** Many companies are restructuring their production facilities to be at par with global standards. Unlike in the past, when firms use to source components, produce goods and sell them locally, now firms are integrating their supply chain for the entire world market.



## **DECISIONS IN A SUPPLY CHAIN**

Successful SCM involves several decisions with varying time frames, this can be broadly classified as Design Decisions & Supply Chain Operations.

### **1. DESIGN DECISIONS:**

- What activities should be carried out by the firm and what activities should be outsourced
- Capacity and location of various facilities
- How to select partners to perform outsourced activities and what should be the nature of the relationship with those partners

### **2. OPERATIONS DECISIONS:** Once the design decisions are in place, the firm has to take decisions regarding the management of SC operations on a daily/weekly/monthly basis, these include:

- Demand Forecasting
- Procurement Planning & Control
- Production Planning & Control
- Distribution Planning & Control
- Inventory Management
- Transportation Management
- Customer Order Processing
- Relationship Management with partners in the chain

## **DECISION PHASES IN A SUPPLY CHAIN**

### **1. Supply Chain Strategy or Design:**

- During this phase, a company decides how to structure the supply chain over the **next several years**.
- It decides what the chain's configuration will be, how resources will be allocated, and what processes each stage will perform.
- Strategic decisions made by companies include whether to outsource or perform a supply chain function in-house, the location and capacities of production and warehousing facilities, the products to be manufactured or stored at various locations, the modes of transportation to be made available along different shipping legs, and the type of information system to be utilized.

### **2. Supply Chain Planning:**

For decisions made during this phase, **the time frame considered is a quarter to a year**.

Companies start the planning phase with a forecast for the coming year (or a comparable time frame) of demand and other factors such as costs and prices in different markets. Planning

includes making decisions regarding which markets will be supplied from which locations, the subcontracting of manufacturing, the inventory policies to be followed, and the timing and size of marketing and price promotions.

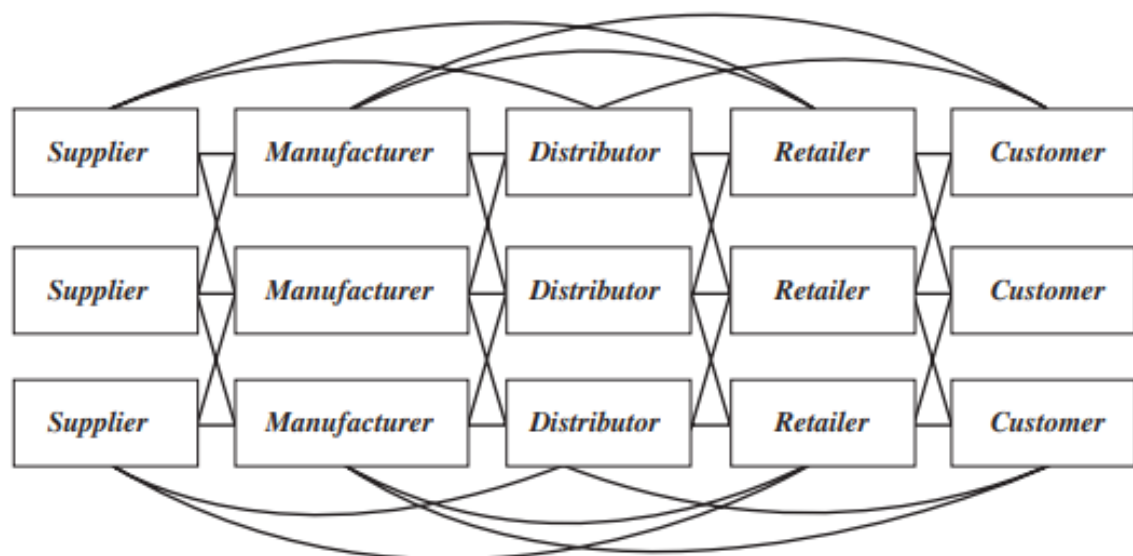
In the planning phase, companies must include uncertainty in demand, exchange rates, and competition.

### 3. Supply Chain Operation:

The time horizon here is weekly or daily. During this phase, companies make decisions regarding individual customer orders. At the operational level, supply chain configuration is considered fixed, and planning policies are already defined. The goal of supply chain operations is to handle incoming customer orders in the best possible manner.

During this phase, firms allocate inventory or production to individual orders, set a date that an order is to be filled, generate pick lists at a warehouse, allocate an order to a particular shipping mode and shipment, set delivery schedules of trucks, and place replenishment orders. Because operational decisions are being made in the short term (minutes, hours, or days), there is less uncertainty about demand information.

#### Supplier Manufacturer-Customer Chain:



The supply chain encompasses all activities involved in the transformation of goods from the raw material stage to the final stage, when the goods and services reach the end customer. Supply chain management involves planning, design and control of flow of material, information and finance along the supply chain to deliver superior value to the end customer in an effective and efficient manner. A typical supply chain is represented in the above Figure. Supply chain not only includes manufacturers, suppliers and distributors but also transporters, warehouses and customers themselves. We can observe from the figure that a manufacturer receives material from several suppliers and, in turn, distributes the products through multiple distributors, then to customers through retailers. A typical supply chain involves managing all the three flows (material, Information & finance) in the chain. To integrate material flow across the chain, information and financial flow across the chain also have to be integrated.

In certain situations, apart from the forward flow of material and products, firms are also interested in the reverse flow of material, examples: product returns, warranty claims etc

### **Enablers/Drivers of Supply Chain Management**

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Managing Supply Chain is a complex process, Logistics (transportation) costs form a big part of the costs, in U.S.A logistics costs used to account for 15% of the GDP (Gross Domestic Product) in the 1980's, now due to technological advancements and innovations, the Logistics costs now forms only 8.5% of GDP.

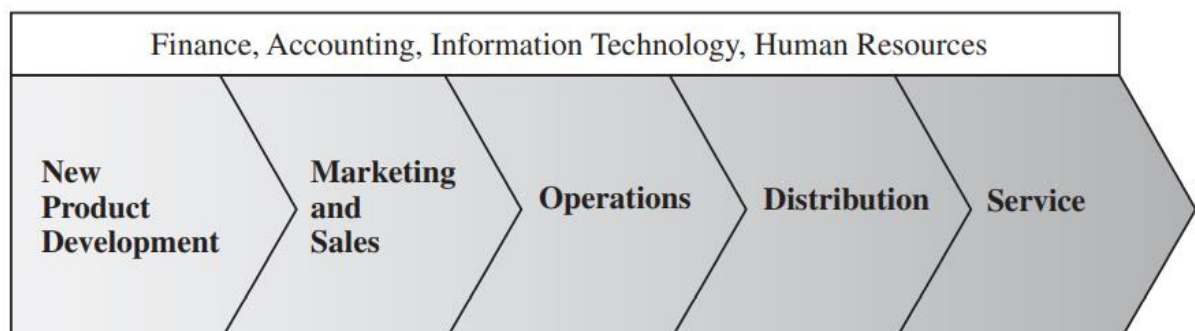
Reduction in supply chain costs are attributed to three enablers, they are;

- Improvement in communication & IT
- Entry of Third Party Logistics Provider
- Enhanced Inter Firm Coordination Capabilities

### **Supply Chain Strategies**

A company's competitive strategy defines, relative to its competitors, the set of customer needs that it seeks to satisfy through its products and services. For example, Wal-Mart aims to provide high availability of a variety of products of reasonable quality at low prices. Most products sold at Wal-Mart are commonplace (everything from home appliances to clothing) and can be purchased elsewhere. What Wal-Mart provides is a low price and product availability. Another company, McMaster-Carr sells maintenance, repair, and operations (MRO) products. It offers more than 500,000 products through both a catalog and a Web site. Its competitive strategy is built around providing the customer with convenience, availability, and responsiveness. With this focus on responsiveness, McMaster does not compete based on low price, the competitive strategy at Wal-Mart is different from that at McMaster.

The competitive strategy is defined based on how the customer prioritizes product cost, delivery time, variety, and quality. A McMaster-Carr customer places greater emphasis on product variety and response time than on cost. A Wal-Mart customer, in contrast, places greater emphasis on cost. A firm's competitive strategy will be defined based on its customers' priorities. Competitive strategy targets one or more customer segments and aims to provide products and services that satisfy these customers' needs. The relationship between competitive and supply chain strategies start with the value chain for a typical organization.



The value chain begins with new product development, which creates specifications for the product. Marketing and sales generate demand by publicizing the customer priorities that the

products and services will satisfy. Marketing also brings customer input back to new product development. Using new product specifications, operations transforms inputs to outputs to create the product. Distribution either takes the product to the customer or brings the customer to the product. Service responds to customer requests during or after the sale. These are core processes or functions that must be performed for a successful sale. Finance, accounting, information technology, and human resources support and facilitate the functioning of the value chain.

A product development strategy specifies the portfolio of new products that a company will try to develop. It also dictates whether the development effort will be made internally or outsourced. A marketing and sales strategy specifies how the market will be segmented and how the product will be positioned, priced, and promoted. A supply chain strategy determines the nature of procurement of raw materials, transportation of materials to and from the company, manufacture of the product or operation to provide the service, and distribution of the product to the customer, along with any follow-up service and a specification of whether these processes will be performed in-house or outsourced.

Supply chain strategy specifies what the operations, distribution, and service functions, whether performed in-house or outsourced, should do particularly well. Because our focus here is on supply chain strategy, we define it in more detail. Supply chain strategy includes a specification of the broad structure of the supply chain and what many traditionally call “supplier strategy,” “operations strategy,” and “logistics strategy.” Strategic fit requires that both the competitive and supply chain strategies of a company have aligned goals. It refers to consistency between the customer priorities that the competitive strategy hopes to satisfy and the supply chain capabilities that the supply chain strategy aims to build.

To achieve strategic fit, companies must accomplish the following:

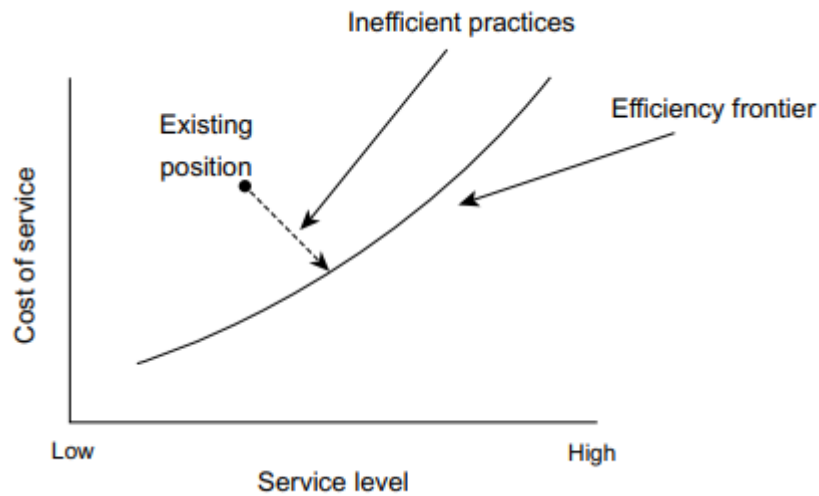
1. The competitive strategy and all functional strategies must fit together to form a coordinated overall strategy. Each functional strategy must support other functional strategies and help a firm reach its competitive strategy goal.
2. The different functions in a company must appropriately structure their processes and resources to be able to execute these strategies successfully.
3. The design of the overall supply chain and the role of each stage must be aligned to support the supply chain strategy.

Examples of strategic fit not working;

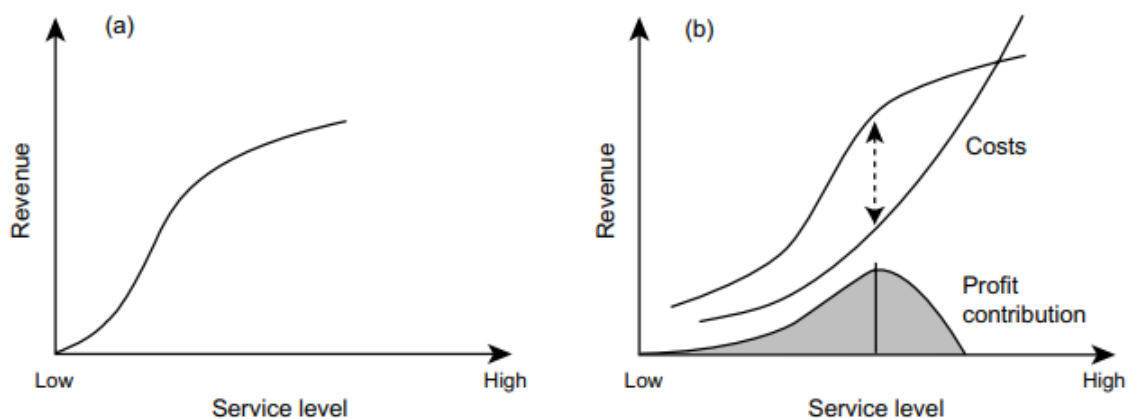
A company’s marketing department is publicizing its ability to provide a large variety of products quickly; simultaneously, distribution is targeting the lowest cost means of transportation. In this situation, it is likely that distribution will delay orders as distribution will use inexpensive but slow modes of transportation.

Another scenario in which a retailer has decided to provide a high level of variety while carrying low levels of inventory but has selected suppliers and carriers based on their low price and not their responsiveness. In this case, the retailer is likely to end up with unhappy customers because of poor product availability.

## Customer Service & Cost Trade Off



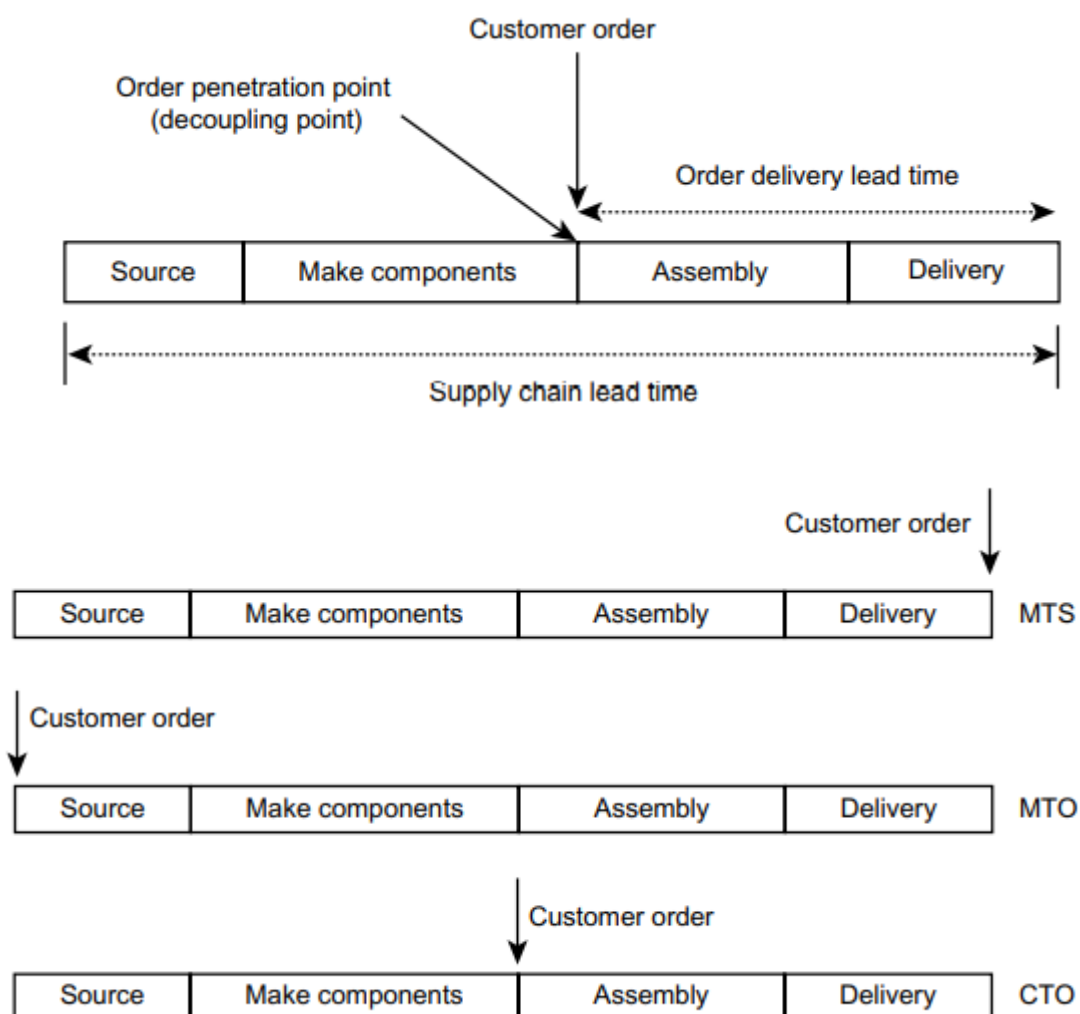
A firm must ensure a smooth fit between its business strategy and supply chain strategy. To understand the relationship between the supply chain strategy and the business strategy, an understanding of cost vs service needs to be made. As seen in the graph above, if the firm wants to improve its customer service then it should also accept the increase in costs associated with it, for example a pizza company if it has to reduce its delivery time from 40 minutes to 20 minutes then the cost will obviously increase. The “Efficiency frontier” line on the graph gives the firm an indication that the firm cannot go any point below it, it has to choose a point on the curve and operate. A firm may choose to provide a lower service level at lower cost and vice versa, but a firm cannot offer higher service level at low cost.



As seen in the graph (a) or the revenue curve (price x demand), it's a “S” shaped curve. What the shape “S” means is that initially there is a minimum level of service that a customer expects below which the firm won't be able to attract any customers, and as the service level increases the revenues also increase but beyond a certain point even if there is significant increase in service level there won't be any increase in customers or revenue. The “S” shape curve is the function of customer's genuine need and what competitors have to offer. In graph (b), there is an inclusion of total cost curve, the total cost curve increases exponentially as the service increases while the revenue follows an “S” shape. Hence it will be wise for the firm to operate at

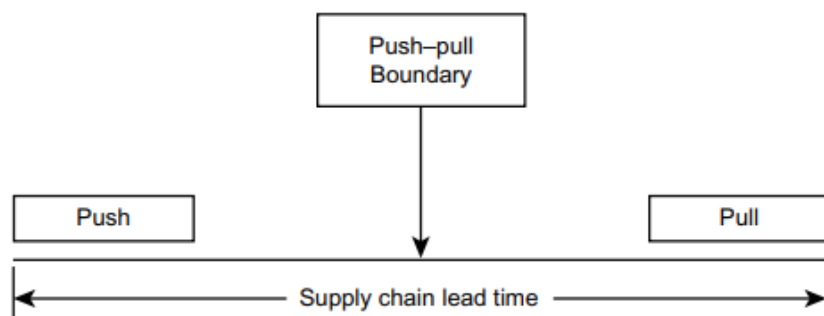
an optimal level of customer service where the revenues are maximum and corresponding total costs are low (as indicated by the double arrow) Market research becomes very important to identify the right market segment, also marketing and sales should work with supply chain to ensure the supply chain is well equipped to handle additional demand in a profitable way. Customer service, which is a very critical factor in Supply Chain Strategies consists of four dimensions, namely, Order Delivery Lead Time, Responsiveness, Delivery Reliability, and Product Variety.

1. **Order Delivery Lead Time:** Order delivery time is the time taken by the supply chain to complete all the activities from order to delivery. The point at which the customer enters the supply chain is called the order penetration point. There are essentially three types of supply chains characterized by the customer order penetration point: make to stock (MTS), make to order (MTO) and configure to order (CTO). If customers expect their order (an order can either be a formal document or even an informal instruction, e.g., a customer asking a retailer for a tube of tooth paste is treated as an order) to be fulfilled instantaneously, then the supply chain is in the MTS business. If the supplier gives enough time to the firm to assemble the product before delivery, it is in the CTO business. If the customer gives enough time to the manufacturer to carry out the complete set of operations (source, make, assemble and deliver) after placing the order, it is in the MTO business



## Order Delivery Lead Time: Push-Pull of the SCM

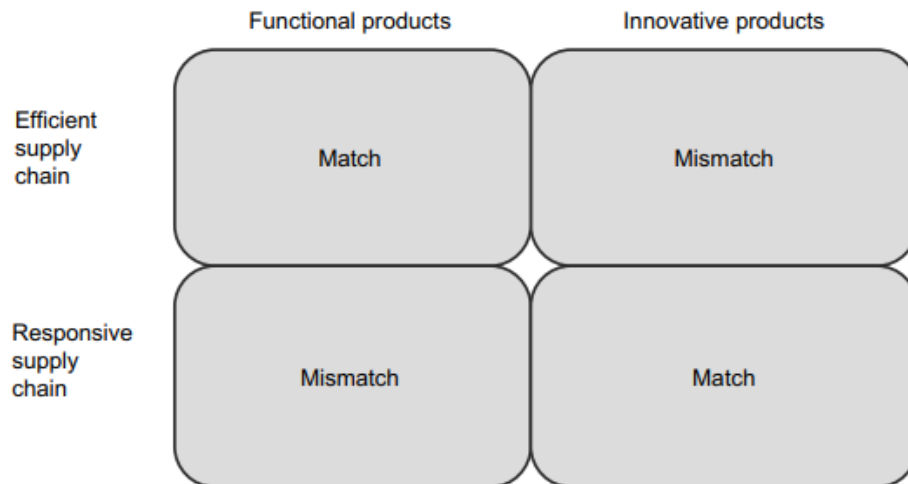
All the processes in the supply chain are divided into two categories based on their position in a supply chain with respect to the customer order point. As shown in Figure, all the processes carried out before the customer order point are managed through the push approach, and all the processes carried out after the customer order are managed through the pull approach. The interface between the push-based processes and the pull-based strategy is known as the push-pull boundary. All the processes managed by pull approaches do not face any uncertainty because they are carried out against specific orders. As they are executed against specific customer orders, they operate on customer pull and, hence, are known as pull-based processes. On the other hand, processes prior to the customer order are executed based on forecast, and as there is no known customer pull in this case, these activities are pushed within the chain; thus, they are known as push-based processes



## 2. Supply Chain Responsiveness:

Responsiveness captures the firm's ability to handle the uncertainty of market demand. In addition to delivery lead time, supply chains have also been characterized on the basis of the nature of demand uncertainty faced by products in the market place. Based on the nature of demand uncertainty, products can be classified as functional products or innovative products. Functional products (grocery) are those that satisfy the basic needs of a customer and therefore have low variety, stable and predictable demand, long life cycles and low profit margins. Innovative products (fashion and technology products) are those that try to satisfy a broad range of customers' wants and have the following features: high variety, unstable and very-hard-to-predict demand, short life cycles, high profit margins and frequent stock-outs and markdowns.

Firms must ensure an appropriate match between the type of supply chain and the nature of product characteristics. Demand unpredictability could occur either on the volume side or on the product-mix side. In some instances, it is difficult to estimate the overall volume of demand itself, resulting in volume uncertainty, while in others, the overall volume is predictable but predicting demand at the individual variant level is extremely difficult, leading to product-mix uncertainty. Hence as shown in figure below there should be a match of supply chain design and nature of products.



### 3. Delivery Reliability:

Delivery Reliability measures the customer demand that is satisfied within the promised delivery lead time. For firms operating on MTS model the percentage of orders getting served from the stock is the measure of delivery reliability. For firms operating on an MTO and CTO model, delivery reliability is the percentage of orders that are delivered within promised delivery lead time. Both MTS and CTO forms of business model need to hold high inventory for higher delivery reliability.

### 4. Product Variety:

Higher Product variety offers greater choice to customers, also its leads to greater complexity is supply chain and in turn increases the supply chain costs. Profitability has affected few firms due to product variety explosion, Firms have to decide on optimum product variety, Firms have to strike a balance between customer satisfaction and supply chain capabilities.

## Supply Chain Performance Measures

The Supply-Chain Council is an independent, non-profit, global corporation interested in getting the industry to standardize supply chain terms so that meaningful supply chain benchmarking can be carried out. It has developed the Supply Chain Operations Reference (SCOR) model as the industry standard for supply chain management. Several supply chain software vendors have adopted the SCOR performance measures in their performance management module. SCOR recognizes six major processes: Plan, Source, Make, Delivery, Return, and Enable.

As per the SCOR model, supply chain performance measures fall under the following five broad categories:

- Cost
- Assets (Asset Management Efficiency)
- Reliability
- Responsiveness
- Agility



The SCOR model also uses 10 performance measures as shown in the table below:

SCOR Model Supply chain metrics	Customer facing		Internal facing		
	Reliability	Responsiveness	Agility	Cost	Assets
Perfect order fulfillment	•				
Order fulfillment cycle time		•			
Upside flexibility			•		
Upside adaptability			•		
Downside adaptability			•		
Overall value-at-risk			•		
Total cost to serve				•	
Cash-to-cash cycle time					•
Return on fixed assets					•
Return on working capital					•

#### Performance Measures using Financial Data:

1. **Total length of the chain:** The total length of the chain is arrived at by adding up the days of inventory for raw materials, work in progress and finished goods. The firm that has the minimum total length of the chain is said to have the best performance.

Calculating the Length of Various Stages of the Chain:

The following formulae (terms defined in Table below) are used to calculate the length of the various stages in the supply chain:

***DRM, DWIP, DFG = Days of raw material, work in process and finished goods, respectively***

$$DRM = RM \times 365 / CRM$$

$$DWIP = SFG \times 365 / CP, DFG = FG \times 365 / CS$$

$$Total\ length\ of\ chain\ in\ days = DRM + DWIP + DFG$$

The duration of time taken by the material flow is captured by this measure.

Terminologies explained below:

Terms from the income and expenditure statement	Symbol	Terms from the balance sheet	Symbol
Cost of raw materials*	CRM	Inventories (inclusive of raw materials, semi-finished goods and finished goods)	INV
Cost of production*	CP	Raw materials inventory	RM
Cost of distribution*	DC	Semi-finished goods inventory	SFG
Cost of sales*	CS	Finished goods inventory	FG
Net sales*	NS	Account receivables (excluding loans and advances)	AR
		Account payables	AP

2. **Supply chain inefficiency ratio:** This ratio measures the relative efficiency of internal supply chain management. The ratio will be low for the firms with better performance.

Evaluating the Efficiency of Supply Chain Management: The internal supply chain inefficiency ratio is a measure of the efficiency of internal supply chain management. To calculate this ratio, we consider total inventory carrying costs and the distribution costs to be components of the internal supply chain management costs. We calculate the internal supply chain inefficiency ratio as follows:

**$SCC = DC + INV \times ICC$  and  $SCI = SCC/NS$** , where SCC is the supply chain management costs, ICC is the inventory carrying cost and SCI is the supply chain inefficiency ratio.

3. **Supply chain working capital productivity:** The analysis of firms on this metric will also be based on the levels of inventory, accounts receivable and accounts payable. Firms with efficient supply chains will usually have high supply chain working capital productivity.

Supply Chain Working Capital Productivity: The supply chain working capital productivity is calculated using the following formula:

**$SWC = INV + AR - AP$**  where SWC is the supply chain working capital.

**$SWCP = NS/SWC$**  where SWCP is the supply chain working capital productivity.

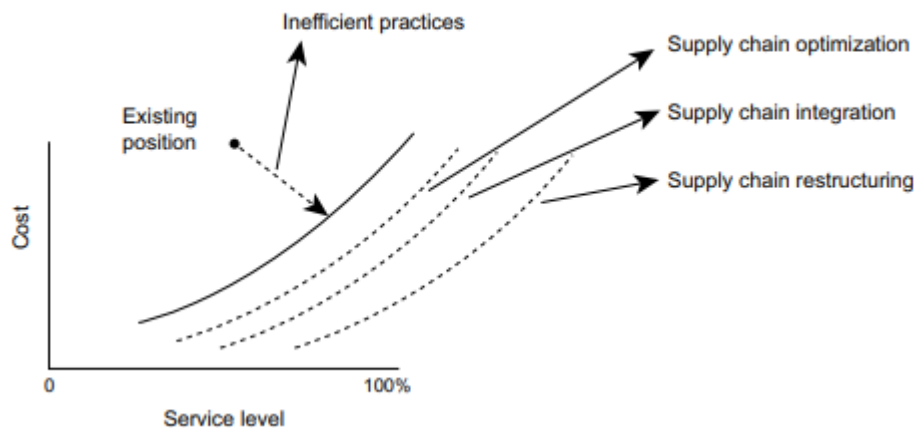
### **Supply Chain and Business Performance:**

The impact of various supply chain initiatives can be estimated in terms of costs and benefits using the following broad groupings:

- Cost reduction is achieved by – Reducing inventory – Reducing logistics expenses – Reducing direct material expenses – Reducing indirect material expenses
- Improving revenue and profitability by – Selling higher margin products – Achieving higher market share – Reducing backorder and lost sales – Attacking new markets – Decreasing supply time to market
- Improving operational efficiency by – Reducing procurement expenses – Increasing assets utilization – Delaying capital expenditure
- Reducing working capital by – Reducing inventory – Reducing accounts receivables

## Enhancing Supply Chain Performance:

There are three different ways in which a firm can shift its supply chain performance or efficiency frontier downward on the graph i.e.: integration, optimization and restructuring.



**Supply Chain Optimization:** By improving on the forecasting, location, transportation and inventory management decisions, a firm is in a position to improve on the cost and the service fronts and hence push the efficiency frontier downward. Initiatives involving improvement in the above practices can be achieved by using optimization tools—these set of initiatives are known as supply chain optimization.

**Supply Chain Integration:** It has been found that there are significant wastages at all departmental and organizational interfaces. However, better intra- and inter-firm integration of supply chains helps reduce waste in the system and improve the overall efficiency, which results in the downward movement of the efficiency frontier. To make this possible, organizations will have to make corresponding changes in the organization structure processes and performance measures.

**Supply Chain Restructuring:** Restructuring of supply chains helps a firm in moving the entire efficiency frontier in the downward direction. Supply chain restructuring involves significant changes in the supply chain structure in terms of the way material and information flows are managed in the chain. Some ways in which supply chains can be restructured include the following:

- Moving from the MTS model to the CTO model
- Reducing the number of stock points in distribution
- Differentiating fast-moving and slow-moving items in terms of material flow in chain
- Product and process redesign