Supply Chain Management

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This book contains the course content for Supply Chain Management.

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Abbreviations

3PL	-	Third Party Logistics
4PL	-	Fourth Party Logistics
B2C	-	Business-to-Consumer
CPFR	-	Collaborative Planning, Forecasting and Replenishment
CRM	-	Customer Relationship Management
CRP	-	Continuous Replenishment Program
ERP	-	Enterprise Resource Planning
ICT	-	Information and Communications Technology
ISCM	-	Internal Supply Chain Management
IT	-	Information Technology
JIT	-	Just-in-time
PDA	-	Personal Digital Assistants
SC	-	Supply Chain
SCM	-	Suppliers Relationship Management
SCM	-	Supply Chain Management
SCOR	-	Supply Chain Operations Reference Model
UPS	-	Unit Parcel Service
VMI	-	Vendor Managed Inventory
WWW	-	World Wide Web

Chapter I

Supply Chain Management

Aim

The aim of this chapter is to:

%4 = define supply chain and supply chain management

%4 = explain the key parts and flows of supply chain

%4 = understand the need of supply chain management

%4 = describe the supply chain drivers

Objectives

The objectives of this chapter are to:

describe the supply chain concept

explain the decision phases in supply chain management

understand the marketing mix model

Learning outcome

At the end of this chapter, the students will be able to:

state the barriers of supply chain management

examine the strategies in supply chain management

get an overview of supply chain management

1.1 Introduction

The global market faces a fierce competition today. The introduction of products with shorter life cycles and the heightened expectations of customers have forced business enterprises to invest in, and focus attention on, their supply chains. This, together with continuing advances in communications and transportation technologies (e.g., mobile communication, internet, and overnight delivery), has motivated the continuous evolution of the supply chain and of the techniques to manage it effectively. Recently, the pressure of the competitive market and new information technologies has affected the structures of the production systems, calling for:

reduction of time to market

higher flexibility of the systems

drastic reduction of costs

extended quality concept

1.2 Supply Chain

A supply chain is a system of organisations, people, technology, activities, information and resources involved in moving a product or service from supplier to customer.

A supply chain is a network of retailers, distributors, transporters, storage facilities, and suppliers that participate in the production, delivery and sale of a product to the consumer.

These activities are associated with the flow and transformation of goods from the raw materials stage to the end user, as well as the associated information and funds flows.

Supply chain activities transform natural resources, raw materials and components into a finished product that is delivered to the end customer.

In simple terms, a supply chain is the link between a firm or business and its suppliers and customers.

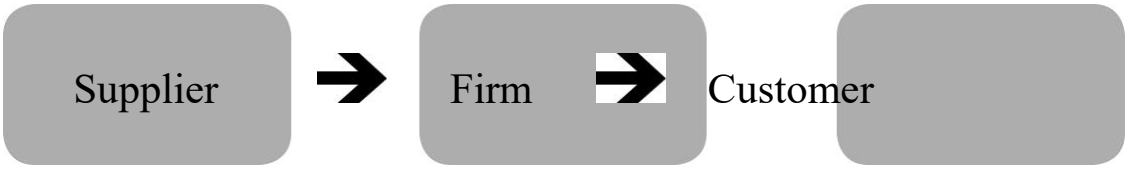


Fig. 1.1 A conceptual model of a basic supply chain

The supply chain, which is also referred to as the logistics network, consists of suppliers, manufacturing centres, warehouses, distribution centres, and retail outlets, as well as raw materials, work-in-process inventory, and finished products that flow between the facilities.

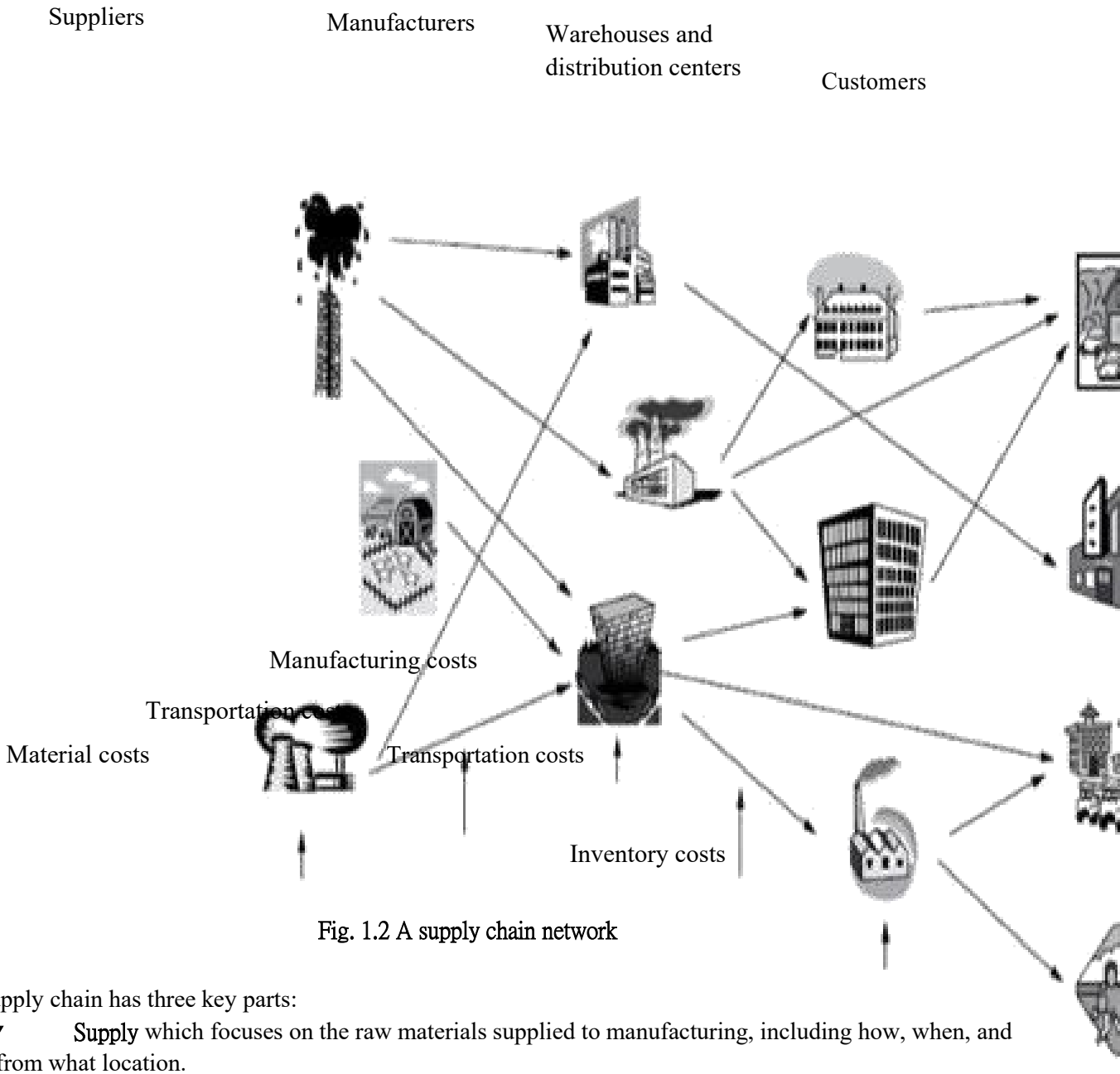


Fig. 1.2 A supply chain network

A supply chain has three key parts:

▼▼ Supply which focuses on the raw materials supplied to manufacturing, including how, when, and from what location.

▼▼ Manufacturing which focuses on converting these raw materials into finished products.

▼▼ Distribution which focuses on ensuring that the products reach the consumers through an organised network of distributors, warehouses, and retailers.

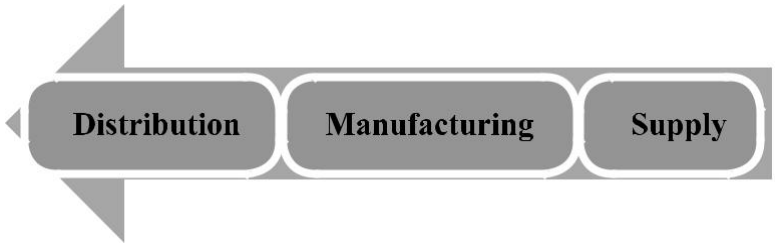


Fig. 1.3 Key parts of supply chain

A supply chain encompasses all activities in fulfilling customer demands and requests.

In sophisticated supply chain systems, used products may re-enter the supply chain at any point where residual value is recyclable.

A supply chain strategy refers to how the supply chain should operate in order to compete in the market. The strategy evaluates the benefits and costs relating to the operation. The supply chain strategy focuses on the actual operations of the organisation and the supply chain that will be used to meet a specific goal.

The supply chain integrates, coordinates and monitors the flow of materials, information, and funds.

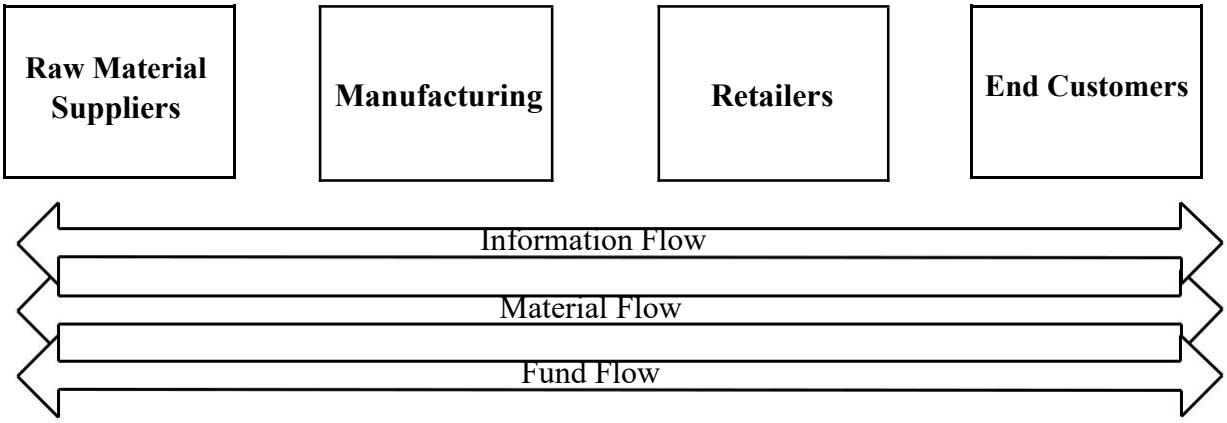


Fig. 1.4 Flows in a supply chain

(Source: http://mdcegypt.com/Pages/Purchasing/Supply%20Chain/Introduction%20to%20Supply%20Chain%20Management/Introduction%20to%20Supply%20Chain%20Management.asp)

1.3 Supply Chain Management

Supply chain management (SCM) is the oversight of materials, information, and finances distributed from supplier to consumer. The supply chain also includes all the necessary stops between the supplier and the consumer. Supply chain management involves coordinating this flow of materials within a company and to the end consumer.

The Council of Supply Chain Management Professionals defines supply chain management as follows: "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities". Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies.

Supply chain management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, and finance and information technology.

SCM is also called the art of management of providing the right product, at the right time, right place and at the right cost to the customer.

Supply chain management can be divided into three main flows:

- ▼▼ The **Product** flow includes moving goods from supplier to consumer, as well as dealing with customer service needs.
- ▼▼ The **Information** flow includes order information and delivery status.
- ▼▼ The **Financial** flow includes payment schedules, credit terms, and additional arrangements.

Supply chain management is a set of approaches utilised to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimise system-wide costs while satisfying service level requirements.

1.4 Objective of Supply Chain Management

A supply chain is a global network of organisations that cooperate to improve the flows of material and information between suppliers and customers at the lowest cost and the highest speed. The final objective of a supply chain is customer satisfaction.

The supply chain management takes into consideration every facility that has an impact on cost and plays a role in making the product match to customer requirements: from supplier and manufacturing facilities through warehouses and distribution centres to retailers and stores.

The main purpose of the supply chain is to maximise overall value generated. Value is the difference between what the cost supply chain incurs and the worth end product has to the customer. Value of the commercial supply chain is correlated with its profitability generally known as supply chain surplus.

For example, A customer purchase a personal computer from IBM at $2,000, which indicates the revenue supply chain achieved. All the stages incur costs to make sure the efficient transfer of funds, information, storage of the product, transportation to the final consumer etc. The difference between the supply chain cost and revenue generated from personal computer represent the supply chain surplus or profitability.

Supply chain surplus can be defined as the total profit shared by all the stages and intermediaries of a supply chain. The greater the supply chain surplus the more successful is supply chain. But, Supply chain success is measured by its overall surplus not by the profit at each stage.

The supply chain management has to be efficient and cost-effective across the entire system; from transportation and distribution to inventories of raw materials, work in process, and finished goods, are to be minimized. The emphasis is not on simply to minimise transportation cost or reducing inventories but, rather, on taking a systems approach to supply chain management.

The objectives of supply chain management can be listed below:

- ▼▼ enhancing customer service
- ▼▼ expanding sales revenue
- ▼▼ reducing inventory cost
- ▼▼ improving on-time delivery
- ▼▼ reducing order to delivery cycle time
- ▼▼ reducing lead time
- ▼▼ reducing transportation cost
- ▼▼ reducing warehouse cost
- ▼▼ reducing supplier base
- ▼▼ expanding depth of distribution

1.5 Importance of Supply Chain Management

The importance of supply chain management comes into picture if there is sharp focus on the loss due to the absence of an effective supply chain strategy and / or the benefit due to an effective supply chain for any firm.

Basically, it refers that how good is the integration of supply chain that matters for any firm. The importance of having a robust supply chain management can be depicted from the following example:

- ▼▼ Suppose, ABC is any company that manufactures the cycle chains for a cycle manufacturing company XYZ. Another company PQR manufactures bits used in the cycle chain manufactured by ABC. Now, in coming days, as per the market forecast, XYZ shall need 50,000 units of cycle chain, information that is not available with ABC. Accordingly, PQR also does not know how many bits to produce in order to meet ABC's requirement. The result would be either both ABC and PQR hold high safety stock inventory or lose business respectively with XYZ and ABC. Now, if in this example showing only three supply chain partners, absence of a critical information among the partners, that is of production forecast at XYZ firm results into either a higher inventory level or loss of future business.

The importance of supply chain management is to:

- ▼▼ reduce inventories along the chain
- ▼▼ share better information among the partners
- ▼▼ plan in consultation rather than in isolation

1.6 Activities of Supply Chain Management

There are three levels of activities of supply chain management that different parts of the company will focus on:

- ▼▼ Strategic: At this level, strategic decisions concerning the whole organisation, such as the size and location of manufacturing sites, partnerships with suppliers, products to be manufactured and sales markets are taken. Such decisions have a long-lasting effect on the firm. This includes decisions regarding product design, what to make internally and what to outsource, supplier selection, and strategic partnering and the flow of material through the logistics network.
- ▼▼ Tactical: Tactical decisions focus on adopting measures that will produce cost benefits such as using industry best practices, developing a purchasing strategy with favoured suppliers, working with logistics companies to develop cost effect transportation and developing warehouse strategies to reduce the cost of storing inventory. Such decisions are typically updated anywhere between once every quarter and once every year. These include purchasing and production decisions, inventory policies, and transportation strategies, including the frequency with which customers are visited.
- ▼▼ Operational: Decisions at this level affect how the products move along the supply chain. Operational decisions involve making schedule changes to production, purchasing agreements with suppliers, taking orders from customers and moving products in the warehouse. Such decisions refer to day-to-day decisions such as scheduling, lead time quotations, routing, and truck loading.

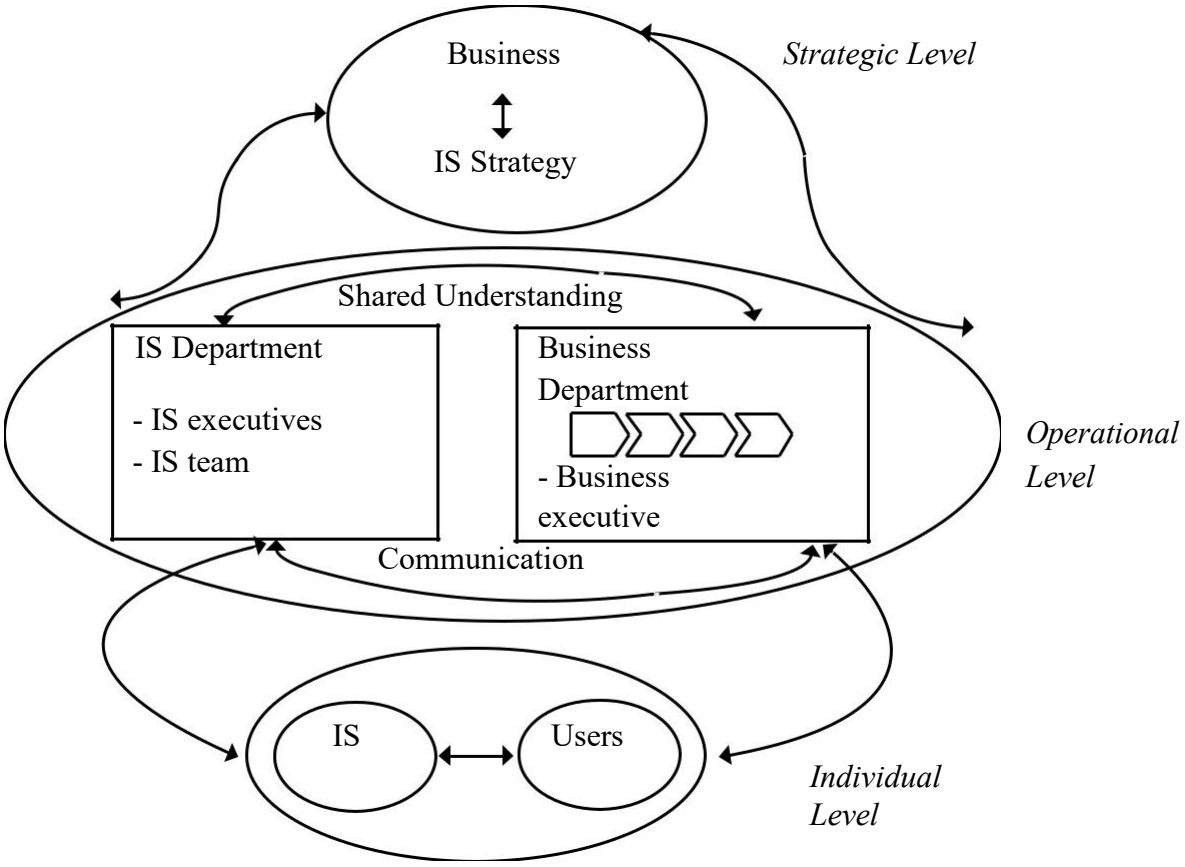


Fig. 1.5 Supply chain management activities
(Source: http://businessitalignment.wordpress.com/page/2/)

1.7 Decision Phases in a Supply Chain

Successful supply chain management requires many decisions relating to the flow of information, product, and funds. These decisions fall into three categories or phases, depending on the frequency of each decision and the time frame over which a decision phase has an impact. The design, planning, and operation of a supply chain have a strong impact on overall profitability and success.

Supply chain strategy or design

During this phase, the supply chain is structured and configured.

It is designed that, how resources will be allocated, and what processes each stage will perform.

Strategic decisions made by companies include:

- ▼▼ location and capacities of production and warehouse facilities
- ▼▼ products to be manufactured or stored at various locations
- ▼▼ modes of transportation to be made available along different shipping legs
- ▼▼ type of information system to be utilized

Supply chain design decisions are typically made for the long term (in years) and can be expensive to alter on short notice. Consequently, when a company makes these decisions, they must take into account uncertainty in anticipated market conditions over the next few years.

Supply chain planning

During this phase, the time frame considered is a quarter to a year. It starts with a forecast of demand in the coming year.

As a result, the supply chain's configuration determined in the strategic phase is fixed. The configuration establishes constraints within which planning must be done. Planning establishes parameters within which a supply chain will function over a specified period of time. Companies start the planning phase with a forecast for the coming year of demand in different markets.

Planning decisions include those regarding markets to which a given production facility will supply and target production quantities at different locations.

The companies must include uncertainty in demand, exchange rates, and competition over this time horizon in their decisions.

Given a shorter time horizon and better forecasts than the design phase, companies in the planning phase try to incorporate any flexibility built into the supply chain in the design phase and exploit it to optimise performance.

As a result, companies define a set of operating policies that govern short-term operations.

Following are the planning decisions undertaken in supply chain:

- ▼▼ which markets will be supplied from which locations
- ▼▼ planned buildup of inventories
- ▼▼ subcontracting, backup locations
- ▼▼ inventory policies
- ▼▼ timing and size of market promotions

iii. Supply chain operation

The time horizon is weekly or daily, and 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, the following activities are undertaken:

- ▼▼ 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 ▼▼ place replenishment orders

There is less uncertainty about demand information because operational decisions are being made in the short term horizon (minutes, hours, or days).

The goal during the operation phase is to exploit the reduction of uncertainty and optimise performance.

The main aim here is to implement the operating policies as effectively as possible.

1.8 Process View of Supply Chain

The process view of supply chain can be categorised as:

Cycle view: In this, processes in a supply chain are divided into a series of cycles, each performed at the interfaces between two successive supply chain stages.

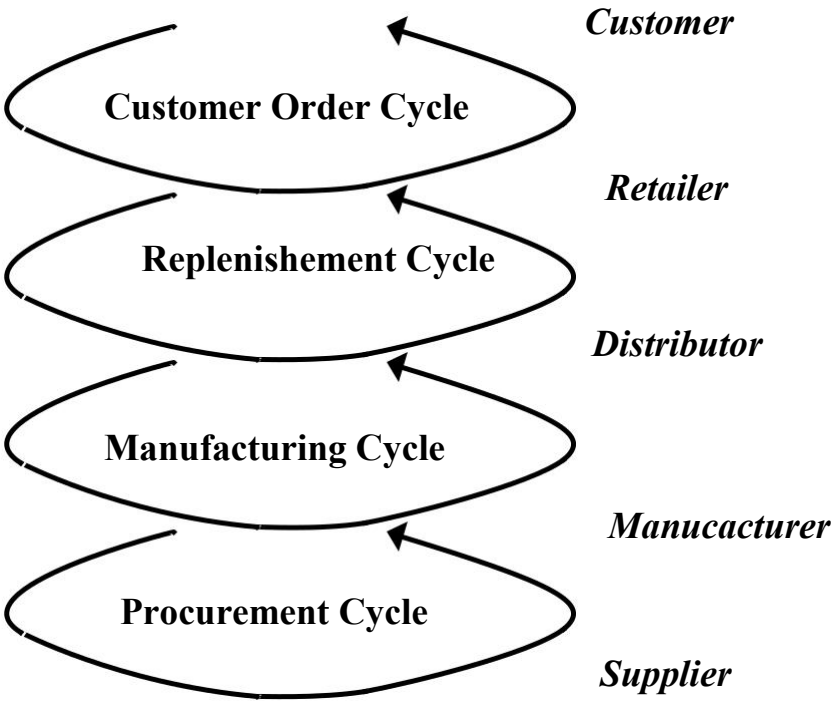


Fig. 1.6 Cycle view of supply chain

(Source: http://iem.csu.edu.tw/member/huangck/images/%E4%BE%9B%E6%87%89%E9%8F%88%E7%AE%A1%E7%90%86/Ech01.pdf)

Each cycle occurs at the interface between two successive stages:

▼▼ Customer order cycle (customer-retailer)

▼▼ Replenishment cycle (retailer-distributor)

▼▼ Manufacturing cycle (distributor-manufacturer)

▼▼ Procurement cycle (manufacturer-supplier)

Cycle view clearly defines processes involved and the owners of each process specify the roles and responsibilities of each member and the desired outcome of each process.

Push/pull view: In this, processes in a supply chain are divided into two categories depending on whether they are executed in response to a customer order (pull) or in expectation of a customer order (push).

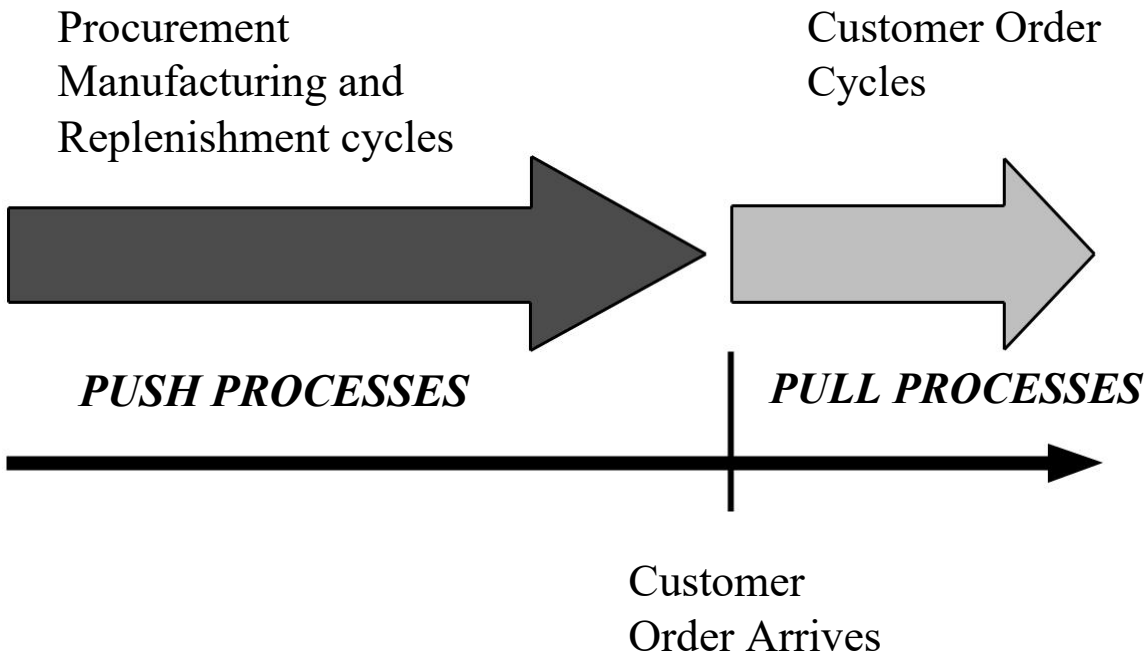


Fig. 1.7 Push/pull view of supply chain

The flows in supply chains helps in:

▼▼ Close connection between design and management of supply chain flows (product, information, and cash) and supply chain success.

▼▼ Playing a significant role in the success or failure of a firm.

1.9 Linking Competitive (Business) and Supply Chain Strategies

The competitive strategy defines the set of customer needs which a firm seeks to satisfy through its products and services. It includes low cost, rapid response, product differentiation etc.

Supply chain strategy determines the nature of material procurement, transportation of materials, and manufacture of product or creation of service, distribution of product.

Consistency and support between supply chain strategy, competitive strategy, and other functional strategies is important.

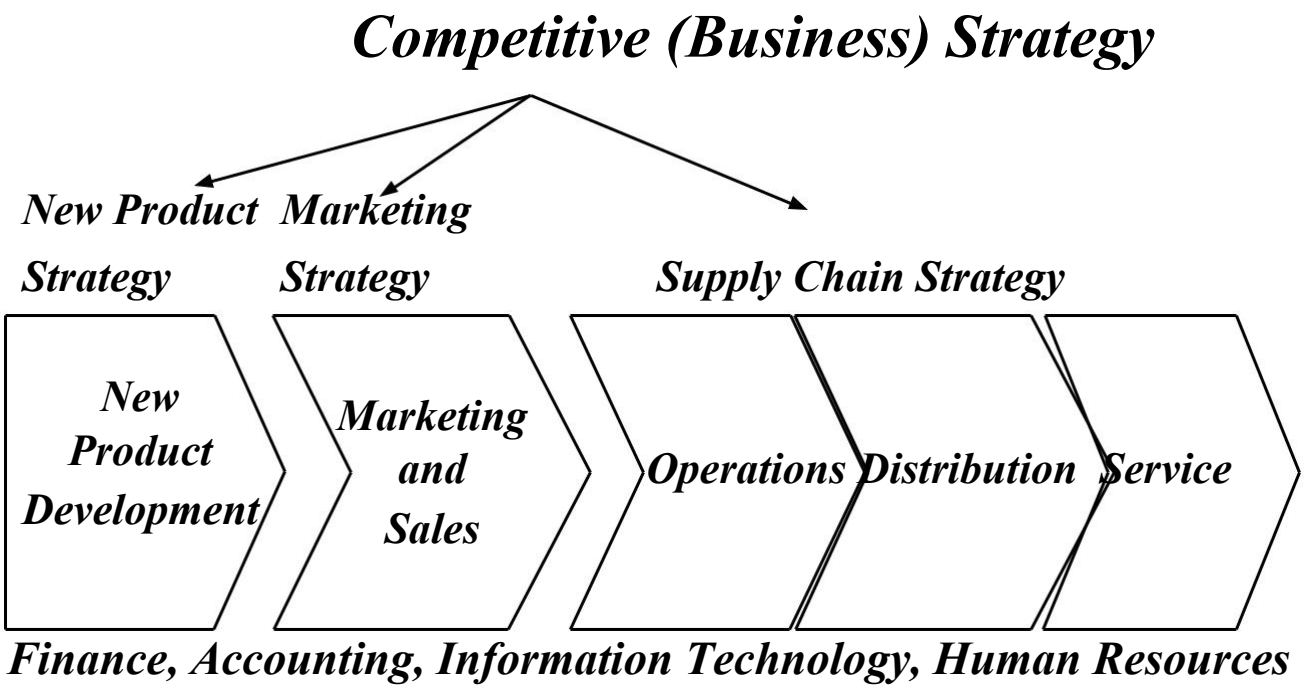


Fig. 1.8 Linking competitive (business) and supply chain strategies
(Source: http://www.clt.astate.edu/asyamil/SCM_Chopra/chopra3_ppt_ch02.ppt)

1.10 Supply Chain Drivers

Supply chain drivers determine the supply chain performance. For each driver, managers must make tradeoffs between efficiency (cost) and responsiveness. The drivers of supply chain include:

Inventory: It consists of all raw materials; work in process, and finished goods within a supply chain. Inventory is maintained in the supply chain because of mismatches between supply and demand. Increasing inventory gives higher responsiveness but results in higher inventory carrying cost.

Transportation: It involves moving inventory from one point in the supply chain to another point. A number of decisions have to be taken in designing a supply chain regarding transportation. The six basic modes of transportation are:

air
truck (road)
rail
ship
pipeline
electronic transportation (the newest mode for music, documents etc)

Facilities: A facility is a place where inventory is stored, manufactured or assembled. Hence, facilities can be categorised into production facilities and storage facilities. The facilities related decisions involve location, capacity, manufacturing methodology or technology and warehousing methodology.

Information: It consists of data and results of analysis regarding inventory, transportation, facilities, customer orders, customers, and funds. Good information drives good decisions.

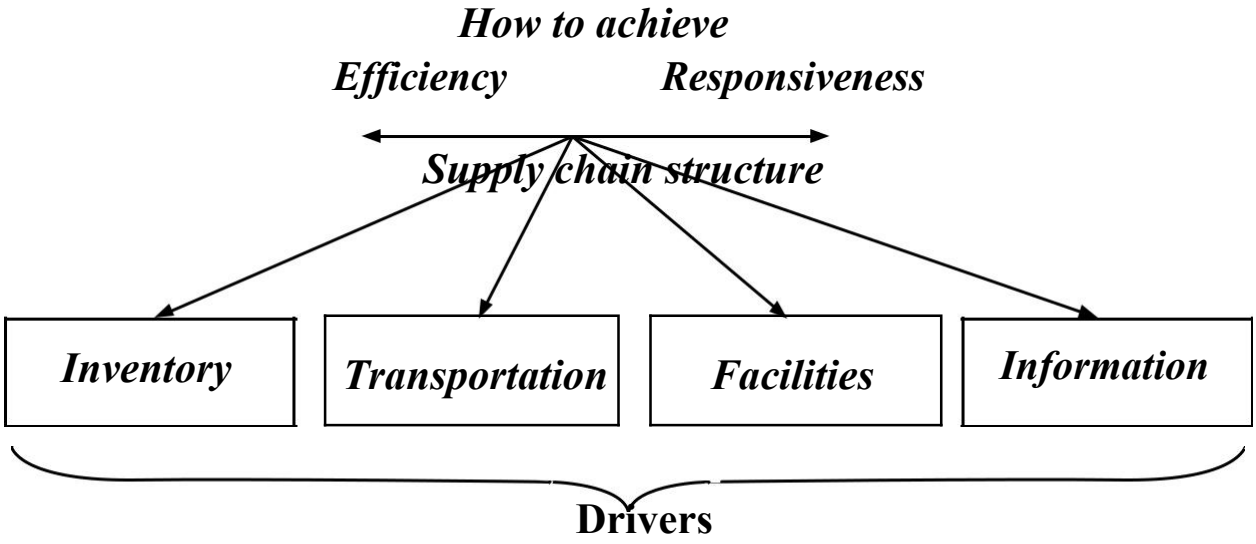


Fig. 1.9 Supply chain drivers

(Source: http://www.clt.astate.edu/asyamil/SCM_Chopra/chopra3_ppt_ch02.ppt)

1.11 Barriers of Supply Chain Management

The obstacles of supply chain management include:

- ▼▼ lack of top management support
- ▼▼ non-aligned strategic and operating philosophies
- ▼▼ inability or unwillingness to share information
- ▼▼ lack of trust among supply chain members
- ▼▼ unwillingness to share risks and rewards
- ▼▼ inflexible organisational systems and processes
- ▼▼ cross-functional conflicts
- ▼▼ inconsistent or inadequate performance measures
- ▼▼ resistance to change
- ▼▼ lack of training for new mindsets and skills

1.12 Scope of Supply Chain Activities

The scope of supply chain activities includes:

- ▼▼ sourcing and procurement
- ▼▼ production scheduling and manufacturing
- ▼▼ order processing
- ▼▼ inventory management
- ▼▼ warehousing
- ▼▼ customer service
- ▼▼ distribution
- ▼▼ reverse logistics

1.13 Marketing Mix Model

▼▼ Marketing managers and strategists have used the 'Four P's' model of marketing mix to define their business strategy for product specification, delivery and promotion.

▼▼ The term "marketing mix" became popular after Neil H. Borden published his 1964 article, *The Concept of the Marketing Mix*. Culliton described the marketing manager as a "mixer of ingredients". McCarthy

proposed a Four P classification in 1960.

▼▼ These four P's are the parameters that the marketing manager can control, subject to the internal and external constraints of the marketing environment. The goal is to make decisions in the target market in order to generate a positive response.

▼▼ Any organisation, before introducing its products or services into the market; conducts a market survey. The sequence of all 'P's as above is very much important in every stage of product life cycle. These four most important 'P's of marketing mix are generally accepted to be:

Price (the amount a customer pays for the product)

Product (specification and branding)

Promotion (all of the communications that a marketer may use in the marketplace, advertising, public relations, personal selling and sales promotion.)

Place (the location where a product can be purchased, distribution channel)

Fig. 1.10 Elements of marketing mix

(Source: http://www.designersplus.co.uk/unit1/elements_of_the_e_business_domain/level3.html)

▼▼ The Marketspace Model (de Meyer *et al*) is a useful model that identifies three key features of e-business that are enabled through technology, as an extension of the traditional '4 P's' marketing model. Customer relationship is rightly placed at the centre, because the customer is uniquely identified. The on-line nature of the internet, relationships between organisations and customers are becoming more interactive.

▼▼ Interactivity is the two-way exchange of information and ideas with the customer through an on-line interface, which enhances the richness of customer relationships and gives rise to new paradigms of product design and customer service, such as internet forums.

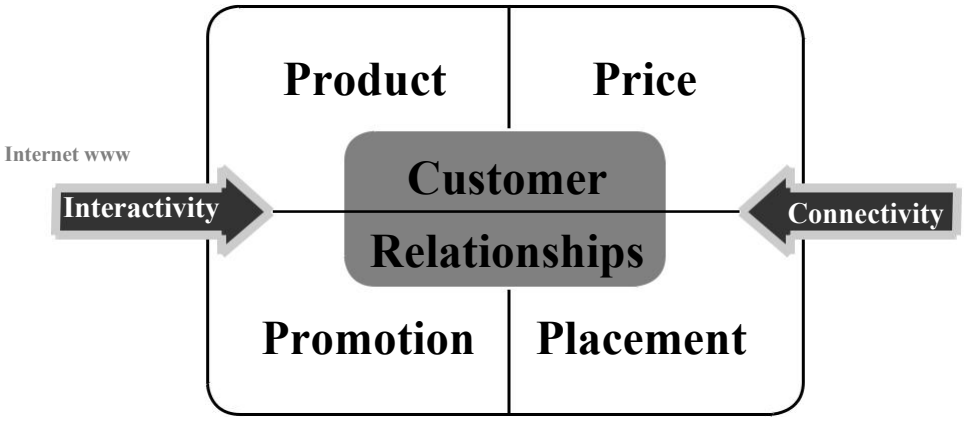


Fig. 1.11 Market space model

Summary

The introduction of products with shorter life cycles and the heightened expectations of customers have forced business enterprises to invest in, and focus attention on, their supply chains.

A supply chain is a network of retailers, distributors, transporters, storage facilities, and suppliers that participate in the production, delivery and sale of a product to the consumer.

A supply chain strategy refers to how the supply chain should operate in order to compete in the market. The strategy evaluates the benefits and costs relating to the operation. The supply chain strategy focuses on the actual operations of the organisation and the supply chain that will be used to meet a specific goal.

The supply chain integrates, coordinates and monitors the flow of materials, information, and funds.

SCM is also called the art of management of providing the right product, at the right time, right place and at the right cost to the customer.

The supply chain management takes into consideration every facility that has an impact on cost and plays a role in making the product match to customer requirements: from supplier and manufacturing facilities through warehouses and distribution centres to retailers and stores.

Successful supply chain management requires many decisions relating to the flow of information, product, and funds. These decisions fall into three categories or phases, depending on the frequency of each decision and the time frame over which a decision phase has an impact. The design, planning, and operation of a supply chain have a strong impact on overall profitability and success.

Planning decisions include those regarding markets to which a given production facility will supply and target production quantities at different locations.

The competitive strategy defines the set of customer needs which a firm seeks to satisfy through its products and services. It includes low cost, rapid response, product differentiation etc.

Marketing managers and strategists have used the 'Four P's' model of marketing mix to define their business strategy for product specification, delivery and promotion.

The Marketspace Model (de Meyer *et al*) is a useful model that identifies three key features of e-business that are enabled through technology, as an extension of the traditional '4 P's' marketing model.

References

Objectives of supply chain management [Online]. Available at: <http://wiki.answers.com/Q/What_are_objectives_of_supply_chain_management#ixzz1Fyi6LwK4>. [Accessed 14 March 2011].

The objective of a supply chain [Online]. Available at: < http://mba-lectures.com/supply-chain/1113/the-objective-of-a-supply-chain.html>. [Accessed 13 March 2011].

Importance of Supply Chain Management - SCM, a set of critically important functions [Online]. Available at: <http://www.supplychainmanagement.in/scm/importance-of-supply-chain.htm>. [Accessed 13 March 2011].

Decision Phases in a Supply Chain [Online]. Available at: <http://www.sbaer.uca.edu/publications/supply_chain_management/pdf/03.pdf>. [Accessed 14 March 2011].

Creaney, N., 2008. *Legal Issues for IT Professionals* [Online]. Available at: <http://knol.google.com/k/n-/-/1hzaxtdr9c09g/7>.[Accessed 13 March 2011].

Recommended Reading

Mentzer J. T., 2001. *Supply chain management*, Sage Publications, 2nd ed., p.512.

Chopra, S., & Meindl P., 2003. *Supply Chain Management: Strategy, Planning, and Operations*, Prentice Hall, 2nd ed., p.592.

Hugos M. H., 2006. *Essentials of supply chain management: Essentials (John Wiley) Series*, John Wiley and Sons, 2nd ed., p.290.

Self Assessment

A supply chain has _____ key parts.

two

three

four

five

_____ focuses on converting these raw materials into finished products.

Manufacturing

Distribution

Production

Supply chain

Which flow includes moving goods from supplier to consumer, as well as dealing with customer service needs?

Product flow

Information flow

Financial flow

Materials flow

What is the term given to the difference between what the cost supply chain incurs and the worth end product has to the customer?

Lead time

Sales revenue

Value

Supplier-base

Which decisions focus on adopting measures that will produce cost benefits such as using industry best practices?

Tactical decisions

Strategic decisions

Operational decisions

Supply chain design decisions

Supply chain design decisions are typically made for _____.

months

years

days

weeks

Which of the following statements is false?

- Strategic decisions made by companies include location and capacities of production and warehouse facilities.
- Operational decisions involve making schedule changes to production.
- Tactical decisions focus on adopting measures that will produce cost benefits such as using industry best practices and developing a purchasing strategy with favoured suppliers.
- Tactical decisions affect how the products move along the supply chain.

Which of the following statements is false?

- Cycle view clearly defines processes involved and the owners of each process specify the roles and responsibilities of each member and the desired outcome of each process.
- The competitive strategy defines the set of customer needs which a firm seeks to satisfy through its products and services.
- Increasing inventory gives lower responsiveness but results in higher inventory carrying cost.
- Supply chain drivers determine the supply chain performance.

There are _____ P's' in the model of marketing mix used by marketing managers and strategists.

- five
- two
- four
- three

_____is the two-way exchange of information and ideas with the customer through an on-line interface.

- Interactivity
- Customer relationship
- Promotion
- Internet

Chapter II

Designing the Supply Chain Network

Aim

The aim of this chapter is to:

define supply chain distribution network

explain the factors influencing distribution in supply chain

understand the role of distribution in supply chain management

describe the concept of e-business

Objectives

The objectives of this chapter are to:

describe the impact of e-business in supply chain

explain the network design in the supply chain

understand the supply chain model

Learning outcome

At the end of this chapter, the students will be able to:

analyse the advantages and disadvantages of e-business

examine the role of network in supply chain

summarise the concept supply chain network design

2.1 Introduction

The supply chain network consists of suppliers, manufacturing centres, warehouses, distribution centres, and retail outlets, as well as raw materials, work-in-process inventory, and finished products that flow between the facilities. It is the collection of physical locations, transportation vehicles and supporting systems through which the products and services the firm markets are managed and ultimately delivered. All organisations have or can purchase the components to build a supply chain network.

Physical locations included in a supply chain network can be manufacturing plants, storage warehouses, major distribution centres, ports, etc. Transportation modes that operate within a supply chain network can include the many different types of trucks, trains, container ships or cargo planes. The many systems which can be utilised to manage and improve a supply chain network include order management systems, warehouse management system, transportation management systems, strategic logistics modelling, inventory management systems, replenishment systems, supply chain visibility, optimisation tools and more. Emerging technologies and standards are now making it possible to automate these supply chain networks in a real time mode making them more efficient than the simple traditional supply chain.

2.2 Role of Distribution Network

Distribution is the steps taken to move and store a product from the production stage to the customer stage in a supply chain. Distribution directly affects cost and the customer experience and therefore drives profitability. There is a system of intermediaries between the producer of goods and/or services and the final users. A strong and efficient distribution network is one of the most important assets a manufacturer can possess.

The distribution is one of the four elements of the marketing mix. The other three parts of the marketing mix are product, pricing, and promotion.

Distribution is a key driver of the overall profitability of a company because it directly impacts both the supply chain costs and customer experience.

Good distribution system serves the effectiveness of realising marketing strategy. This strategy is aimed at reaching certain levels of customer service.

Distribution process involves each intermediary passing the product down the chain to the next organisation, before it finally reaches the consumer or end-user. This process is known as the distribution chain or the channel. Each of the elements in these chains will have their own specific needs, which the producer must take into account, along with those of the all-important end-user.

A number of alternate channels of distribution may be available:

- ▼▼ Distributor, who sells to retailers
- ▼▼ Retailer (dealer), who sells to end customers
- ▼▼ Advertisement typically used for consumption goods

Distribution channels may not be restricted to physical products from producer to consumer in certain sectors. Both direct and indirect channels may be used. Hotels, for example, may sell their services directly or through travel agents, tour operators, airlines, tourist boards, centralised reservation systems, etc.

There has been some sort of innovations in the distribution of services. For example, there has been an increase in franchising and in rental services. There has also been some evidence of service integration, with services linking together, particularly in the travel and tourism sectors. For example, links now exist between airlines, hotels and car rental services.

Supply chain distribution often introduces middlemen into the economic market.

Historically, supply chains were primarily found in the manufacturing and production industries. These companies transform raw materials such as timber, minerals, steel, and fabric into valuable goods ready for use by consumers.

Manufacturing and production companies may not have resources available for delivering products into retail stores where consumers can safely shop and purchase items, so they depend upon supply chain distribution to complete the process.

There is an increasing number of complicated supply chains. So, the distribution network design plays a key

role in controlling the cost of doing business.

The distribution network design involves:

- ▼▼ locating production plants and distribution warehouses
- ▼▼ determining the best strategy for distributing the product from the plants to the warehouses and from the warehouses to the customers

The aim is to select the optimum numbers, locations and capacities of plants and warehouses to open so that all customer demand is satisfied at minimum total costs of the distribution network (including transportation and production costs).

Since, controlling of the cost of doing business is an important factor; it can put supply chain network optimisation goals ahead of competitors. The choice of distribution network can achieve supply chain objectives from low cost to high responsiveness.

2.3 Factors Influencing Distribution Network Design

At the highest level, performance of a distribution network should be evaluated along two dimensions:

- ▼▼ customer needs that are met (influence the company's revenues)
- ▼▼ cost of meeting customer needs (decide the profitability of the delivery network)

Elements of customer service influenced by network structure are:

- ▼▼ Response time: the time between when a customer places an order and receives delivery.
- ▼▼ Product variety: the number of different products/configurations that a customer desires from the distribution network.
- ▼▼ Product availability: the probability of having a product in stock when a customer order arrives.
- ▼▼ Customer experience: includes the ease with which the customer can place and receive their order.
- ▼▼ Order visibility: the ability of the customer to track their order from placement to delivery.
- ▼▼ Returnability: the ease with which a customer can return unsatisfactory merchandise and the ability of the network to handle such returns.

Generally, a customer always wants the highest level of performance along with the above dimensions. However, in practice, this is not always the case. For example, customers ordering a book at Amazon.com are willing to wait longer than those that drive to a nearby store to get the same book. On the other hand, customers can find a far larger variety of books at Amazon compared to the nearby store.

There can be customers who can tolerate a large response time. The firms target these customers and require few locations that may be far from the customer. They focus on increasing the capacity of each location. On the other hand, firms that target customers who value short response times need to locate close to them. Such firms must have many facilities, with each location having a low capacity. Thus, a decrease in the response time, which the customers desire, increases the number of facilities required in the networks. For example, ABC provides its customers with books on the same day but requires about 400 stores to achieve this goal for most of the country. Amazon, on the other hand, takes about a week to deliver a book to its customers, but only uses about 5 locations to store its books.

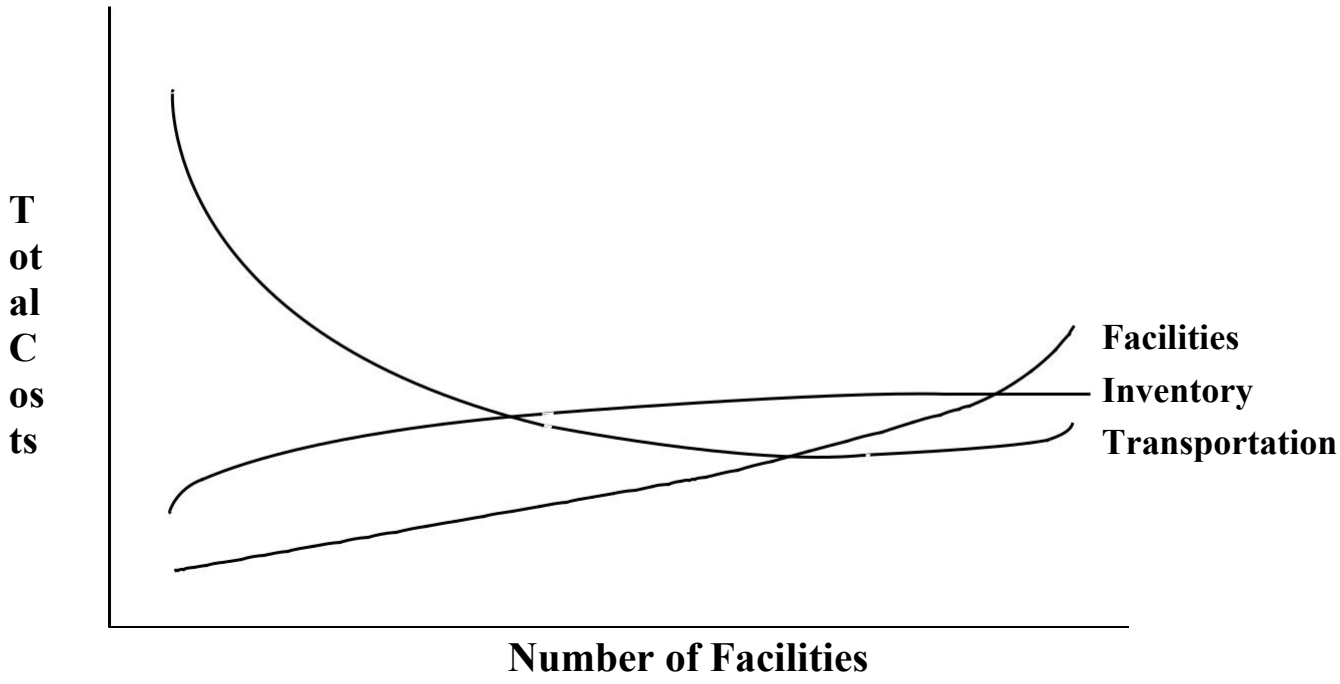


Fig. 2.1 Relationship between number of facilities and logistics cost

Changing the distribution network design affects the following supply chain costs:

▼▼ inventories

▼▼ transportation

▼▼ facilities and handling ▼▼ information

As the number of facilities in a supply chain increases, the inventory and resulting inventory costs also increase as shown in the above figure. As long as inbound transportation economies of scale are maintained, increasing the number of facilities decreases total transportation cost.

A distribution network with more than one warehouse allows reduction of transportation cost relative to a network with a single warehouse. Facility costs decrease as the number of facilities is reduced, because a consolidation of facilities allows a firm to exploit economies of scale. Total logistics costs are the sum of inventory, transportation, and facility costs for a supply chain network.

Distribution network design options must therefore be compared according to their impact on customer service and the cost to provide this level of service.

2.4 Design Options for a Distribution Network

Distribution network design options must be compared according to their impact on customer service and the cost to provide this level of service. There are two key decisions while designing a distribution network:

Will product be delivered to the customer location or picked up from a predetermined site?

Will product flow through an intermediate location?

The distribution networks have their relative strengths and weaknesses. Based on the choices for the two decisions, there are five distinct distribution network designs that are classified as follows:

Manufacturer storage with direct shipping (Drop shipping)

▼▼ The product is shipped directly from the manufacturer to the end customer, bypassing the retailer (who takes the order and initiates the delivery request). All inventories are stored at the manufacturer. Information flows from the customer, via the retailer, to the manufacturer, while product is shipped directly from the manufacturer to customers.

▼▼ The biggest advantage of drop shipping is the ability to centralise inventories at the manufacturer. A

manufacturer can aggregate demand and provide a high level of product availability with lower levels of inventory than individual retailers.

- The benefits from such sort of centralisation are highest for high value, low volume items with unpredictable demand and vice verse. Thus, drop shipping would not offer a significant inventory advantage to an online grocer selling a staple item like detergent.
- Transportation costs are high with drop shipping because the average outbound distance to the end consumer is large and package carriers must be used to ship the product that have high shipping costs per unit compared to truckload carriers.
- With drop shipping, a customer order with items from several manufacturers will involve multiple shipments to the customer. This loss in aggregation in outbound transportation further increases cost.
- Supply chains save on the fixed cost of storage facilities when using drop shipping because all inventories are centralised at the manufacturer.
- There can be some savings of handling costs too because the transfer from manufacturer to retailer no longer occurs. Handling costs can be significantly reduced if the manufacturer has the capability to ship orders directly from the production line.
- A good information infrastructure is needed so that the retailer can provide product availability information to the customer even though the inventory is located at the manufacturer.
- The information infrastructure requirement is simpler for direct sellers like Dell because two stages (retailer and manufacturer) do not need to be integrated.
- Response times tend to be large when drop shipping is used because the order has to be transmitted from the retailer to the manufacturer and shipping distances are on average longer from the manufacturer's centralised site. Also, the response time need not be identical for every manufacturer that is part of a customer order.
- Manufacturer storage with drop shipping allows a high level of product variety to be made available to the customer.
- Drop shipping provides a good customer experience in the form of delivery to the customer location. The experience, however, suffers when a single order containing products from several manufacturers is delivered in partial shipments.

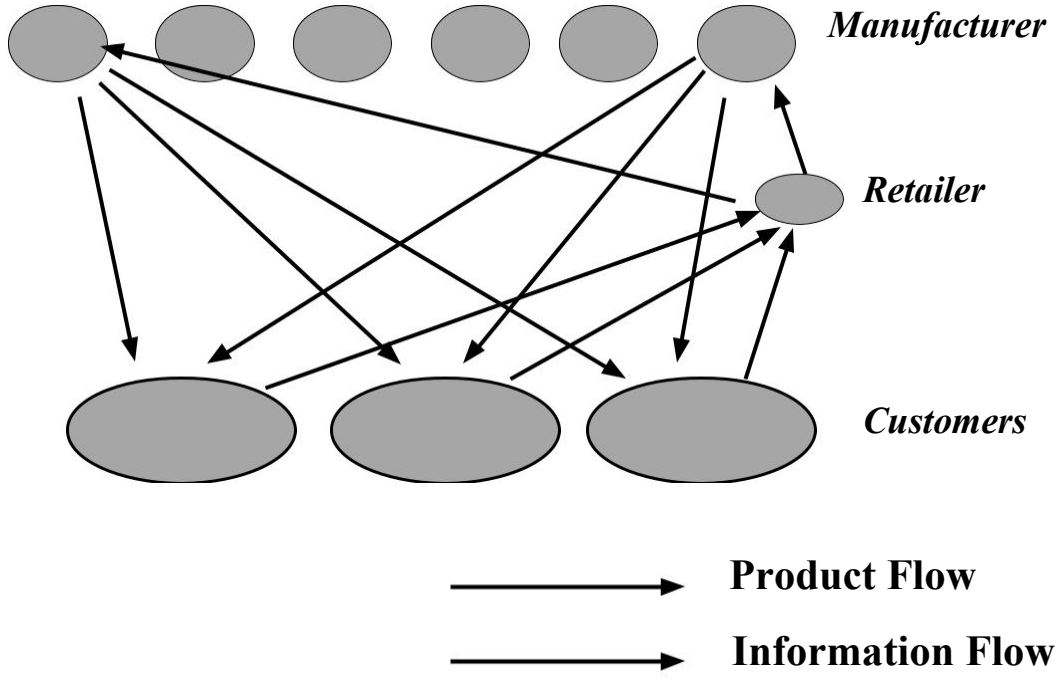


Fig. 2.2 Manufacturer storage with direct shipping

(Source: http://www1.ximb.ac.in/users/fac/visiting/vfac.nsf/23e5e39594c064ee852564ae004fa010/89b99a7daf20080665257086002ecac4/$FILE/Facility%20Decisions%20and%20Network%20Design.ppt)

Manufacturer storage with direct shipping and in-transit merge

- Unlike drop shipping where each product in the order is sent directly from each manufacturer to the end customer, in-transit merge combines pieces of the order coming from different locations so that the customer gets a single delivery. Information and product flows for the in-transit merge network. For example, when a customer orders a PC from ABC along with a XYZ monitor, the package carrier picks up the PC at the ABC factory, the monitor at the XYZ factory and merges the two together at a hub before making a single delivery to the customer.
- The ability to aggregate inventories and postpone product customisation is a significant advantage of in-transit merge.
- As from above example, in-transit merge allows ABC and XYZ to aggregate all their inventories at the factory. This approach will have the greatest benefits for products with high value whose demand is hard to estimate.
- The transportation costs are lower than drop shipping because of the merge that takes place at the carrier hub prior to delivery to the customer.
- An order with products from many manufacturers thus requires only one delivery to the customer. Fewer deliveries save transportation cost and simplify receiving process.
- Overall supply chain facility and handling costs are somewhat higher than drop shipping.
- Sophisticated information infrastructure is needed to allow the in-transit merge.
- The information, operations at the retailer, manufacturers, and the carrier must be coordinated.
- Response times may be higher because of the need to perform the merge.
- Customer experience should be better than drop shipping because the customer receives only one delivery for their order instead of many partial shipments.
- The main advantage of in-transit merge over drop shipping is the lower transportation cost and improved customer experience.
- The major disadvantage is the additional effort during the merge.

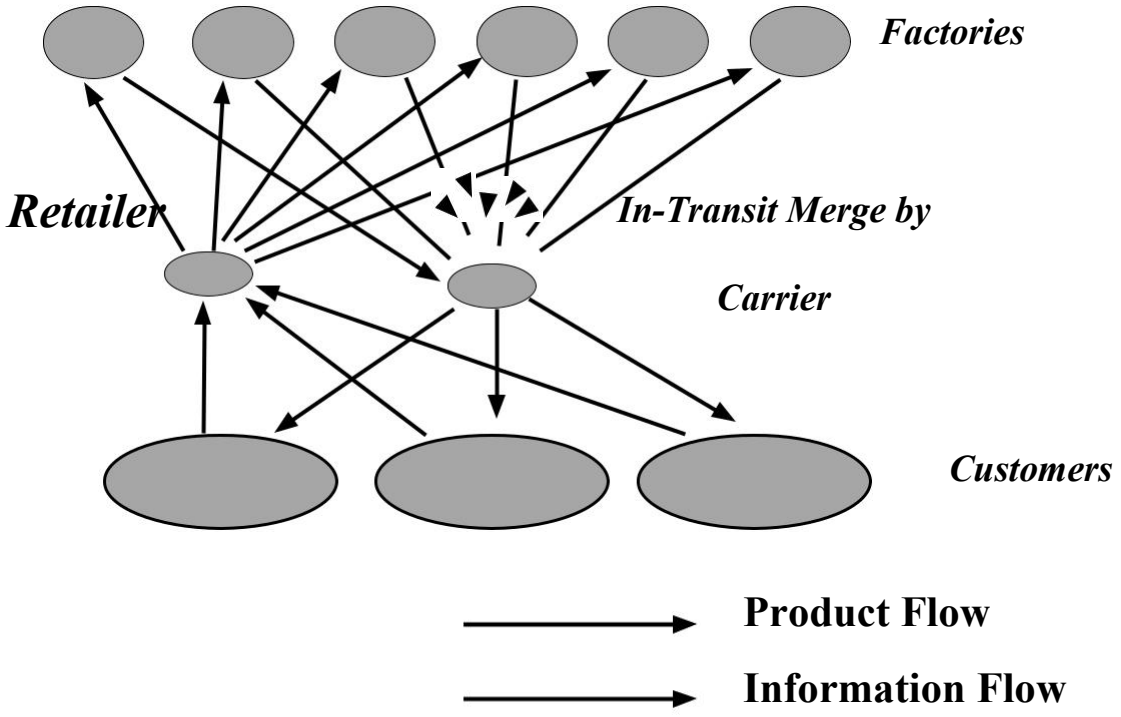


Fig. 2.3 Manufacturer storage with direct shipping and in-transit merge (Source: http://www1.ximb.ac.in/users/fac/visiting/vfac.nsf/23e5e39594c064ee852564ae004fa010/89b99a7daf20080665257086002ecac4/$FILE/Facility%20Decisions%20and%20Network%20Design.ppt)

Distributor storage with package carrier delivery

▼▼ Under this option, inventory is not held by manufacturers at the factories but is held by distributors or retailers in intermediate warehouses and package carriers are used to transport products from the intermediate location to the final customer. Information and product flows when using distributor storage with delivery by a package carrier.

▼▼ Transportation costs are somewhat lower for distributor storage compared to manufacturer storage because an economic mode of transportation (e.g. truckload) can be employed for inbound shipments to the warehouse, which is closer to the customer.

▼▼ Unlike manufacturer storage where multiple shipments may need to go out for a single customer order with multiple items, distributor storage allows outbound orders to the customer to be bundled into a single shipment further reducing transportation cost.

▼▼ For faster moving items, transportation savings from distributor storage relative to manufacturer storage increase.

▼▼ Compared to manufacturer storage, facility costs are somewhat higher with distributor storage because of a lack of aggregation. From a facility cost perspective, distributor storage is not good for extremely slow moving items.

▼▼ The information infrastructure needed with distributor storage is significantly less complex than the manufacturer storage.

▼▼ Response time with distributor storage is better than with manufacturer storage because distributor warehouses are closer to customers and the entire order is aggregated at the warehouse on shipping.

▼▼ Distributor storage can handle somewhat lower variety than manufacturer storage.

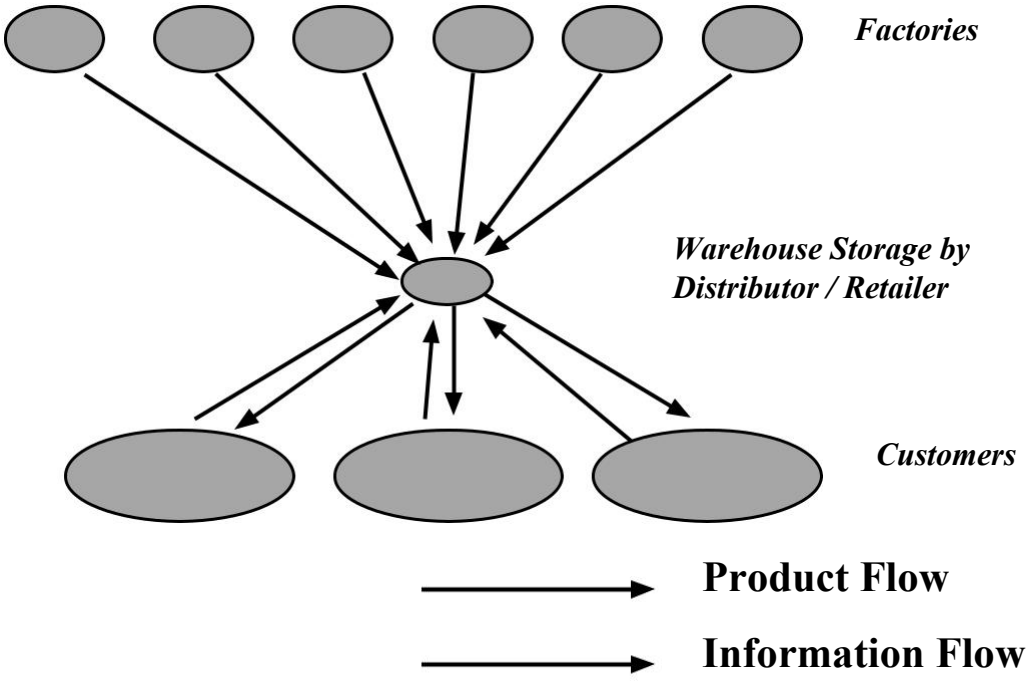


Fig. 2.4 Distributor storage with package carrier delivery (Source: http://www1.ximb.ac.in/users/fac/visiting/vfac.nsf/23e5e39594c064ee852564ae004fa010/89b99a7daf20080665257086002ecac4/$FILE/Facility%20Decisions%20and%20Network%20Design.ppt)

Distributor storage with last mile delivery

▼▼ Last mile delivery refers to the distributor / retailer delivering the product to the customer's home instead of using a package carrier. Peapod and Albertson's have used last mile delivery in the grocery industry. Unlike package carrier delivery, last mile delivery requires the distributor warehouse to be much closer to the customer, increasing the number of warehouses required.

- Distributor storage with last mile delivery requires higher levels of inventory because it has a lower level of aggregation.
- Transportation costs are highest using last mile delivery. This is because package carriers aggregate delivery across many retailers and are able to obtain better economies of scale than available to a distributor or retailer attempting last mile delivery.
- Last mile delivery is cheaper in dense cities.
- Transportation costs are reasonable for bulky products where the customer is willing to pay for home delivery. For example, home delivery for water and large bags of rice has proved quite successful in China, where the high population density has helped decrease delivery costs.
- Facility and processing costs are very high using this option given the large number of facilities required. For example, a grocery store doing last mile delivery performs all the processing until the product is delivered to the customer's home unlike a supermarket where there is much more customer participation.
- The information infrastructure with last mile delivery requires the additional capability of scheduling deliveries.
- Response times are faster than the use of package carriers.
- Product variety is generally lower than distributor storage with carrier delivery.

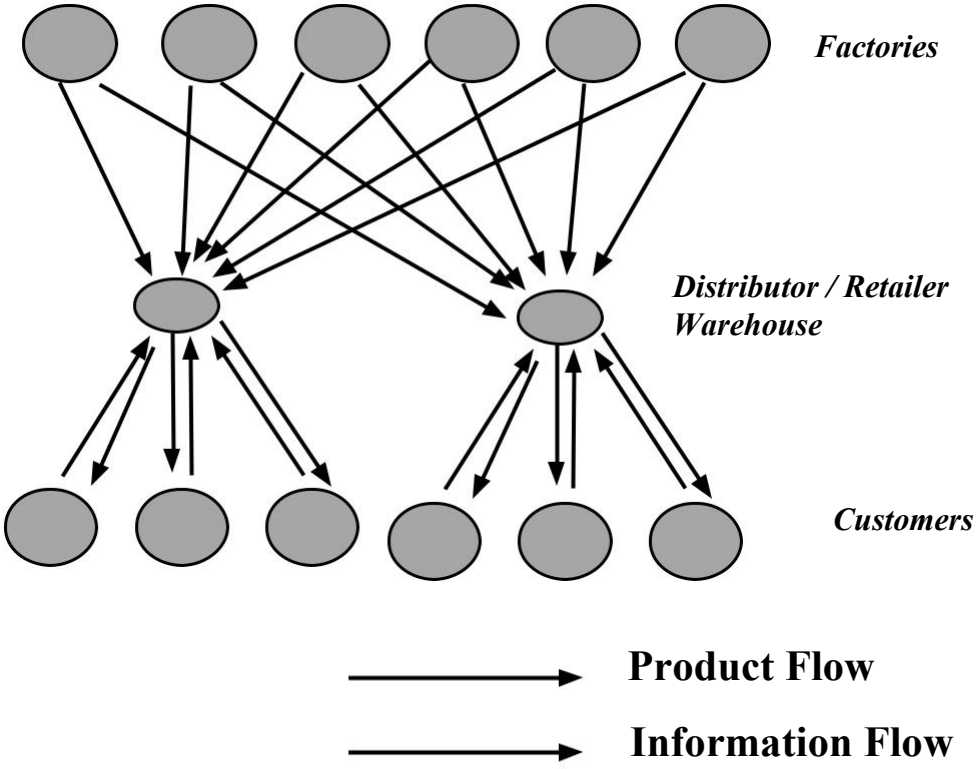


Fig. 2.5 Distributor storage with last mile delivery

(Source: http://www1.ximb.ac.in/users/fac/visiting/vfac.nsf/23e5e39594c064ee852564ae004fa010/89b99a7daf20080665257086002ecac4/$FILE/Facility%20Decisions%20and%20Network%20Design.ppt)

Manufacturer or distributor storage with costumer pickup

- In this approach, inventory is stored at the manufacturer or distributor warehouse but customers place their orders online or on the phone and then come to designate pickup points to collect their orders. Orders are shipped from the storage site to the pickup points as needed.
- Inventory costs using this approach can be kept low with either manufacturer or distributor storage to exploit aggregation.
- Transportation cost is lower than any solution using package carriers because significant aggregation is possible when delivering orders to a pickup site.

▼▼ Facility costs are high if new pickup sites have to be built.

▼▼ A significant information infrastructure is needed. A good coordination is needed between the retailer, the storage location, and the pickup location.

▼▼ The main advantage of a network with consumer pickup sites is that it can lower delivery cost, thus expanding the set of products sold as well as customers served online.

▼▼ The major hurdle is the increased handling cost at the pickup site.

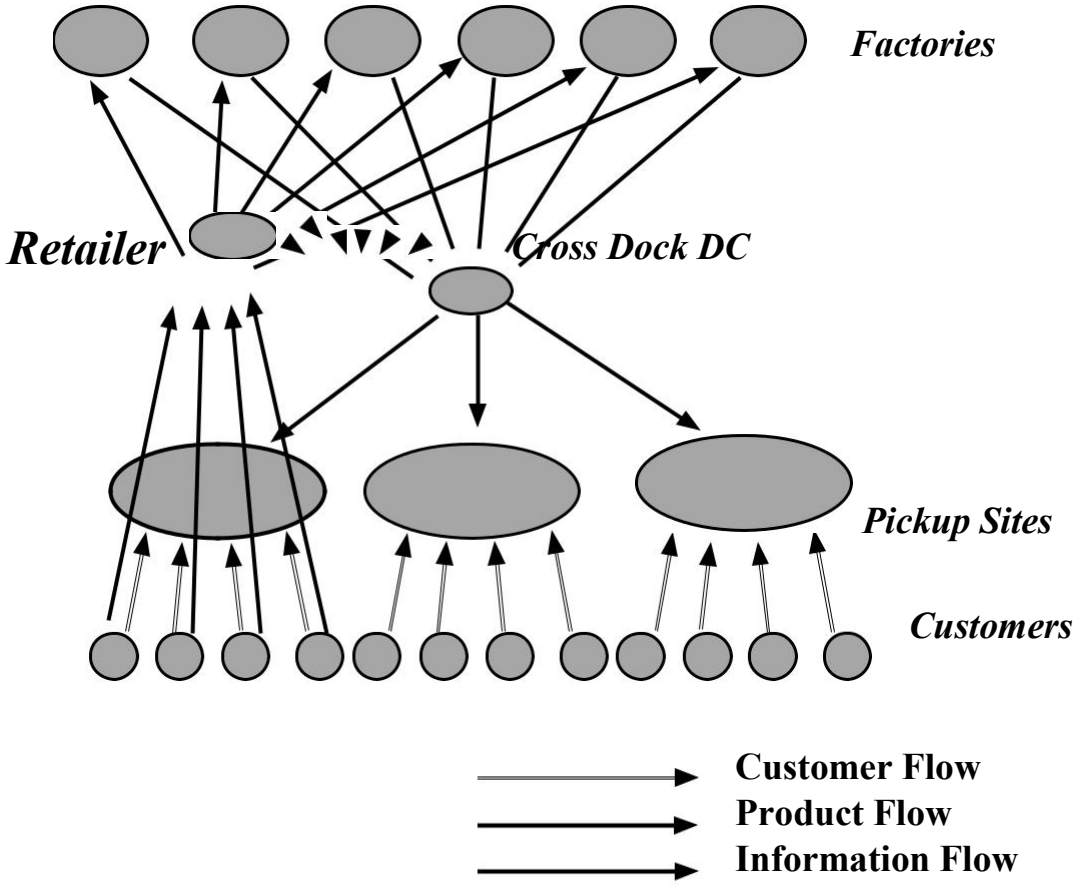


Fig. 2.6 Manufacturer or distributor storage with costumer pickup (Source: http://www1.ximb.ac.in/users/fac/visiting/vfac.nsf/23e5e39594c064ee852564ae004fa010/89b99a7daf2008066525708600 2ecac4/$FILE/Facility%20Decisions%20and%20Network%20Design.ppt)

2.5 E-business and its Impact

Electronic business, commonly referred as eBusiness or e-business, or an internet business, may be defined as the application of information and communication technologies in support of all the activities of business.

E-business is a term used to describe businesses that run on the internet, or utilise internet technologies to improve the profitability of a business.

The entire process of setting up a website, helping the prospective customers navigate through the website, showing them the available products, offering discounts and vouchers and doing everything possible to encourage the prospective clients and converting them into customers, comes under the area of e-business.

By selling products and services online, an e-business is able to reach a wider consumer base. This function of e-business is referred to as e-commerce, and the terms are occasionally used interchangeably. E-business is a vast term encompassing the various business processes that aim to integrate the vendors or traders with the consumers and suppliers using the internet.

E-commerce, on the other hand, is a subset of e-business and refers to online transactions that can be accounted for in monetary terms. For instance, accepting credit card payment for products sold to consumers or making payments for shopping online are examples of e-commerce. Thus, simply saying, e-commerce refers to the last

stage of e-business which involves collecting payments for the goods sold by the business firm.

Wherein, commerce constitutes the exchange of products and services between businesses and groups and individuals, electronic commerce focuses on the use of information and communication technologies to enable the external activities and relationships of the business with individuals, groups and other businesses.

An e-business may also use the internet to acquire wholesale products or supplies for in-house production. This facet of e-business is sometimes referred to as e-procurement.

Using email and private websites as a method for dispensing internal memos and white sheets is another use of the internet by e-business.

A central server or email list can serve as an efficient method for distributing necessary information. The trend continues with new technologies, such as internet-enabled cell phones and laptops.

It can be used for buying and selling of products. The electronic chat is widely in use nowadays which saves time. The technical support operators can remotely access a customer's computer and assist them in correcting a problem.

Organisations are finding that their ability to respond to unpredicted changes in the market is becoming a key factor in survival. The ability to adjust e-business processes to customer references (flexibility) has become a necessity for online systems.

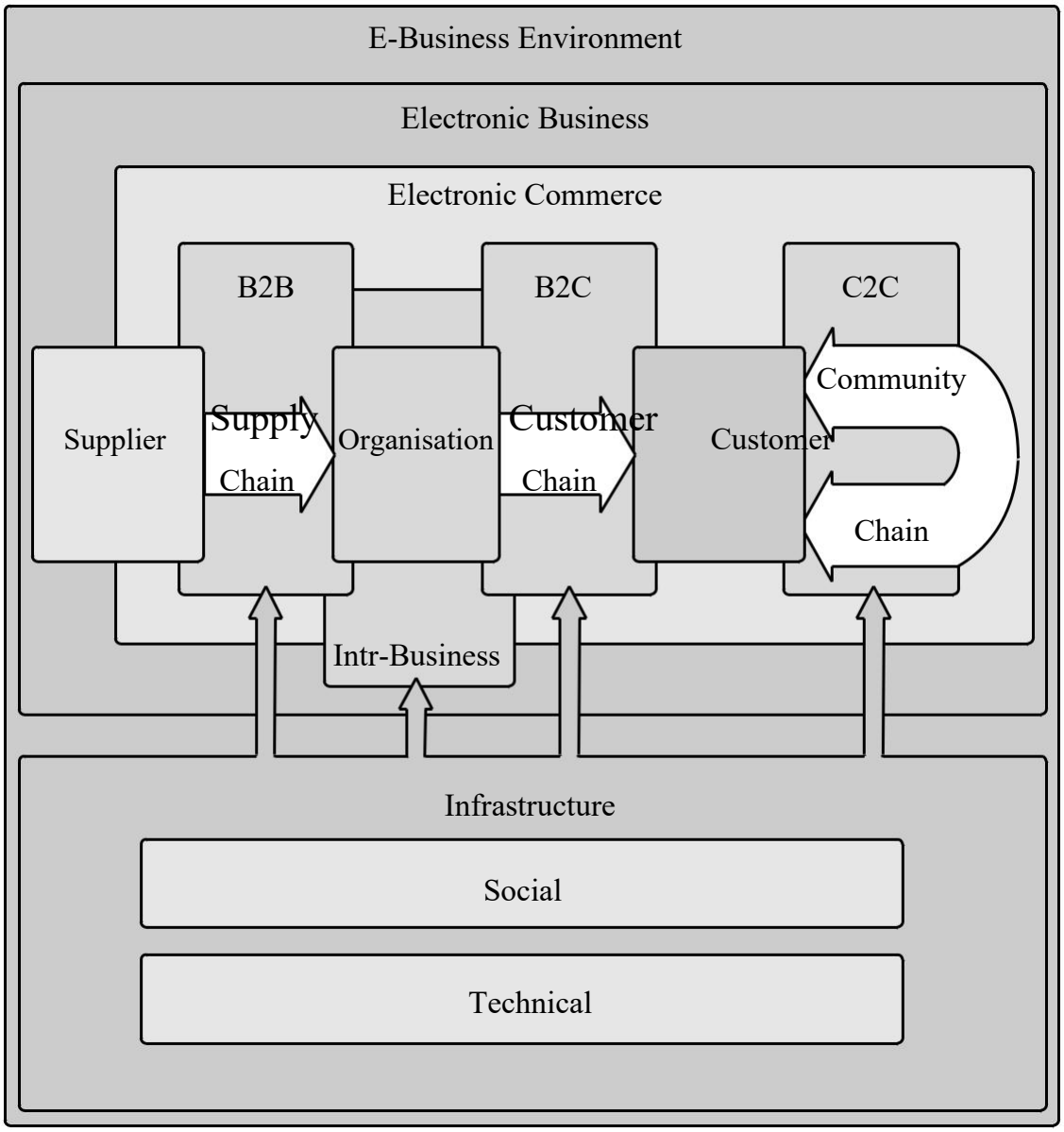


Fig. 2.7 Elements of e-business domain

(Source: http://www.designersplus.co.uk/unit1/elements_of_the_e_business_domain/level3.html)

B2B = Business to Business
B2C = Business to Consumer
C2C = Consumer to Consumer

Fig. 2.8 Areas of e-business
(Source: http://www.ipsrsolutions.com/ebusiness.htm)

2.5.1 Advantages of E-business

The advantages of e-business are described below:

Worldwide presence

▼▼ This is the biggest advantage of conducting business online. A firm engaging in e-business can have a nationwide or a worldwide presence.

▼▼ There are many examples which had the advantage by the use of e-business. IBM was one of the first companies to use the term e-business for servicing customers and collaborating with business partners from all over the world. Dell Inc. is another success story which too had a blooming business selling personal computers throughout the United States, only via telephone and the internet till the year 2007. Hence, worldwide presence is ensured if companies rethink their business in terms of the Internet.

%4 = Cost effective marketing and promotions

▼▼ Nowadays, the web is used to market products guarantees worldwide.

▼▼ Advertising techniques like pay per click advertising ensure that the advertiser only pays for the advertisements that are actually viewed.

▼▼ Affiliate marketing is a sort of marketing where customers are directed to a business portal because of the efforts of the affiliate who in turn receive a compensation for their efforts meeting with success. Affiliate marketing has helped both the business and the affiliates. The cost effective online advertising strategies are used in e-business.

%4 = **Developing a competitive strategy**

▼▼ In order to ensure a competitive advantage, an effective strategy should be there to maintain the advantage and earn profits.

▼▼ It can be a cost strategy or a differentiation strategy.

▼▼ For example, till the year 2007, Dell Inc. was selling computers only via the internet and the phone. It adopted a differentiation strategy by selling its computers online and customizing its laptops to suit the requirements of the clients. Thus, e-business resulted in Dell Inc. managing to capture a vast market using the differentiation strategy.

%4 = **Better customer service**

▼▼ Customer services help in encouraging the customer to know more about the product or service.

▼▼ For example, on visiting a website, the customer is greeted by a pop-up chat window. Moreover, payments can be made online; home-delivery of products can be done.

2.5.2 Disadvantages of E-business

The disadvantages of e-business are described below:

%4 = **Sectoral limitations**

▼▼ Lack of growth in some of the sectors can be on the account of product or sector limitations.

▼▼ For instance, food sector has not experienced growth of sales and revenue generation because of a number of practical reasons like food products being perishable items. Also, consumers do not look for food products on the internet since they prefer going to the supermarket to buy the necessary items as and when the need arises.

%4 = **Costly e-business solutions for optimisation**

▼▼ Substantial resources are required for redefining product lines in order to sell online.

▼▼ Upgrading the computer systems, training personnel, and updating websites require substantial resources. Moreover, electronic data management and enterprise resource planning is necessary for ensuring optimal internal business processes.

From the above discussion, it is observed that the advantages clearly overshadow the disadvantages of e-business.

2.6 Distribution Networks in Practice

%4 = The ownership structure of the distribution network can have as big as an impact as the type of distribution network.

%4 = The choice of a distribution network has very long-term consequences.

%4 = Consider whether an exclusive distribution strategy is advantageous.

%4 = Product, price and commoditisation criticality have an impact on the type of distribution system preferred by customers.

2.7 Distribution Network Design in the Supply Chain

The objective of strategic distribution network planning is to determine a plan that indicates the most economic way to ship and receive product while maintaining or increasing customer service requirements, i.e., to maximise profits and optimise service. Strategic distribution network planning typically answers the following:

%4 = How many distribution centres should exist?

%4 = Where should the distribution centre(s) be located?

%4 = How much inventory should be stocked at each distribution centre?

%4 = What customers should be serviced by each distribution centre?

%4 = How should the customer `order` from the distribution centre?

%4 = How the distribution should centres `order` from vendors?

%4 = How frequently should shipments be made to each customer?

%4 = What should the service levels be?

%4 = What transportation methods should be utilised?

%4 = How to measure the balance between logistic costs and customer service correlation?

2.8 Factors Affecting Network Design Decisions

Following are the factors that influence the decision of distribution network design:

%4 = Centralisation vs. Regionalisation

▼▼ In distribution network planning, there is a well-established relationship between the number of distribution points, transportation costs and customer service targets.

▼▼ Graphically, the point at which these three entities merge is the optimum balance of facility and transportation costs to develop a low-cost, high service distribution network.

▼▼ As the distribution networks become more centralised, the internal support structures such as facility management, order entry, customer service and data processing also do the same. Degree of centralisation achieved determines the cost savings over decentralised networks.

▼▼ However, service levels, limitations on total facility size and risk mitigation must be factored into the decision.

%4 = Energy

▼▼ Considerable shifts in the cost of energy (for example, electricity, fuel, etc.) can have an impact on operating costs and, as a result, on distribution.

▼▼ Distribution projects may fail once the cost of energy turns into an influencing factor, for example, energy-intensive facilities such as refrigerated warehouses.

▼▼ Thus, it is critical to work with all energy providers to determine the load that an operation would put on the local energy system and develop solutions that conserve energy while achieving goals. Some interesting energy solutions can be abatement programs (high power generator or solar power) to run normally on a reduced energy load or high-efficiency units.

▼▼ Even if the transportation is handled via third party carriers, rising fuel costs make a very sensitive component of distribution costs.

▼▼ Some strategies to consider mitigating this can be cube out containers, transportation management systems, private fleet concerns etc.

%4 = Flexibility

▼▼ When designing a distribution facility, versatile equipment should be specified.

▼▼ In the beginning, the latest technology can make a good start but becomes a waste of money if it can't keep a pace with unpredictable events.

▼▼ Planning for probable or doubtful changes in the distribution profile should drive the warehouse design and equipment specifications.

▼▼ For the majority of distribution operations, flexible equipment is the more practical choice.

%4 = Global marketplace

▼▼ Preparedness is the critical element in a global marketplace.

▼▼ The supply chain is ever-changing and has a global impact that needs to be considered.

▼▼ This could be as minor as a domestic customer wanting direct shipments to an international location, or as major as an acquisition by a global company or addition of a key global account.

▼▼ Transportation systems should be designed with exports in mind. Proper customs documentation and

international shipping paperwork should be done. Operations should be designed in a manner that product re-labelling or special packaging for international customers can be done easily.

▼▼ Facilities may be needed to accommodate inbound or outbound airfreight or ocean freight containers.

▼▼ Customer service functions may need to operate in 24-hour mode to assist customers in all time zones.

%4 = **Government involvement**

▼▼ The involvement of government has an impact on distribution.

▼▼ The distribution system should be aware of legislation that involves their industry.

▼▼ Many decisions are made daily at a local, state, and federal level that impact distribution operations. Taxes, labour regulations, transportation restrictions and infrastructure decisions are continually up for review and discussion at every level of government.

%4 = **Information systems**

▼▼ In today's e-world, timely and accurate information is needed. The days of daily distribution activity and nightly updates to financial systems are done.

▼▼ Today distribution execution systems must be:

%4 = **Real-time***:* Customer requirements are moving toward being able to instantly track an order through every step of the fulfilment process to delivery. The information is linked to internet where a customer can easily log in and see the exact status of their order. Real-time interfaces and host system updates enable the customer.

%4 = **Paperless:** Language and educational barriers result in error-prone paper documents that are often misinterpreted, at best resulting in loss within the distribution operation or, worse still, lost customers due to fulfilment issues. The solution is paperless systems requiring operator validation.

%4 = **Standardised:** Standardised, industry-tailored software is now the rule.

%4 = **Modularity**

▼▼ As companies in the distribution space move, their business will typically jump to a new distributor or distributors.

▼▼ The ability to quickly take on significant business volumes dictates that modularity is a necessity for a thriving distribution organisation.

▼▼ Modularity must be evident in:

%4 = **Assets:** Distribution assets must be modular, providing the ability to easily expand facilities, capacities and equipment to meet increasing demands and diverse products. Many companies design this into a facility.

%4 = **Work assignments**: The workforce must be able to handle new work assignments and transfer knowledge to new employees effectively.

%4 = **Labour management systems:** These systems must be able to handle the addition of new operations quickly and economically so that performance can be measured and costs can be kept under control.

%4 = **Off-highway vehicles**

▼▼ In many countries, issues regarding the environment and air quality continue.

▼▼ These issues for stringent air-quality regulations will impact the warehouse.

▼▼ Electric vehicles will take over as the preferred models in the warehouse.

%4 = **Pace**

▼▼ Access to a web site can now order product, specify their service requirements, pay for their order on-line, and track the order right to their doorstep.

▼▼ For distributors, this means that the pace of distribution must increase significantly to account for the reduced times, shorter product lives, increased inventory turnover and greater customer expectations that is considered standard in the modern business-to-business and business-to-consumer marketplace.

▼▼ For example, if a customer places an order today with next-day delivery, a company picks and ships the

order the next day. This won't be competitive and the entire supply chain needs to keep pace, from vendor compliance to information and execution systems in order to support the new economy.

%4 = People

▼▼ Team-based, participatory organisational culture and a total dedication to customer satisfaction are the components of success in supply chain distribution network.

▼▼ For example, employee celebration days, employee suggestion programs, revised organisational designs, compensation or incentive or bonus plans, and other processes that directly tie the distribution associate.

%4 = Price

▼▼ The service and quality are key factors in selecting a distribution partner.

▼▼ Modern free enterprise demands efficient, effective and low-cost distribution.

▼▼ The goal of a successful distribution operation should be to operate within their core values at the lowest cost possible. The path to competitive pricing is to operate efficiently and flexibly at low cost.

%4 = Accountability

▼▼ A successful distribution operation must have accountability.

▼▼ Accountability is made possible by effective leadership, clear communications and efficient systems and equipment to enable productive operations and a fulfilling work environment. Effective leadership make difficult decisions while maintaining the commitment of the organisation. Accountability requires establishing standards, identifying improvement opportunities and measuring performance.

%4 = Reverse logistics

▼▼ The challenge is the question of handling the products that are coming back into the operation.

▼▼ The decision on whether to accept the product, whether a refused shipment, an authorized customer return, or an unexpected return must be planned for and communicated with the distribution operation.

%4 = Third party logistics

▼▼ A growing number of companies are turning to third party logistics organisations to handle the customer fulfilment in the supply chain.

▼▼ Companies that are accustomed to true partnering with customers and suppliers have less trouble moving to the third party logistics and achieving the potential cost savings.

▼▼ The key steps are to conduct a complete search for the right third party logistics vendor, thoroughly review cost proposals and contracts to ensure there is financial benefit, and work with the third party logistics.

%4 = Variety

▼▼ Special packaging, pricing, labelling and delivery requirements are becoming the norm and must be addressed in any distribution plan. These tasks should be designed into the operation.

▼▼ Many companies invest large amounts of capital setting up specialised packing or value-added services to gain competitive advantages.

▼▼ Properly planned, these services can give profits, providing differentiation in a competitive marketplace.

2.9 Supply Chain Model

%4 = The supply chain models, which address both the upstream and downstream sides.

%4 = The Supply-Chain Operations Reference model (SCOR) measures total supply chain performance. It is a process reference model for supply-chain management, spanning from the supplier's supplier to the customer's customer. It is the most widely used model.

%4 = It includes delivery and order fulfilment performance, production flexibility, warranty and returns processing costs, inventory and asset turns, and other factors in evaluating the overall effective performance of a supply chain.

%4 = SCOR is based on five distinct management processes: Plan, Source, Make, Deliver, and Return.

▼▼ **Plan** - Processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, and delivery requirements.

▼▼ Source - Processes that procure goods and services to meet planned or actual demand.

▼▼ Make - Processes that transform product to a finished state to meet planned or actual demand.

▼▼ Deliver - Processes that provide finished goods and services to meet planned or actual demand, typically including order management, transportation management, and distribution management.

▼▼ Return - Processes associated with returning or receiving returned products for any reason. These processes extend into post-delivery customer support.

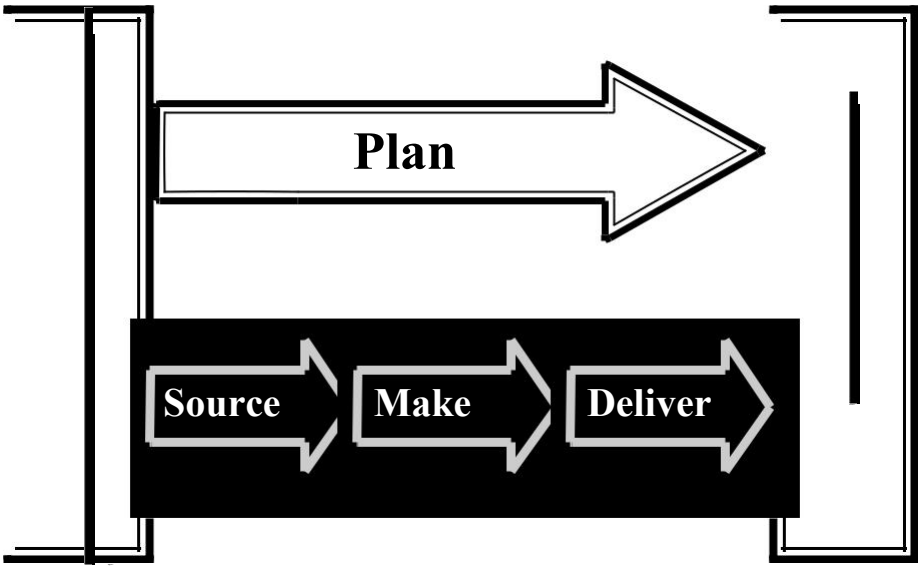


Fig. 2.9 Supply chain model

Summary

%4 = The supply chain network is the collection of physical locations, transportation vehicles and supporting systems through which the products and services the firm markets are managed and ultimately delivered.

%4 = Emerging technologies and standards are now making it possible to automate these supply chain networks in a real time mode making them more efficient than the simple traditional supply chain.

%4 = The distribution is one of the four elements of the marketing mix. The other three parts of the marketing mix are product, pricing, and promotion.

%4 = Distribution is a key driver of the overall profitability of a company because it directly impacts both the supply chain costs and customer experience.

%4 = There is increasing number of complicated supply chains. So, the distribution network design plays a key role in controlling the cost of doing business.

%4 = Since, controlling of the cost of doing business is an important factor; it can put supply chain network optimisation goals ahead of competitors. The choice of distribution network can achieve supply chain objectives from low cost to high responsiveness.

%4 = Distribution network design options must be compared according to their impact on customer service and the cost to provide this level of service.

%4 = Transportation costs are high with drop shipping because the average outbound distance to the end consumer is large and package carriers must be used to ship the product that have high shipping costs per unit compared to truckload carriers.

%4 = With drop shipping, a customer order with items from several manufacturers will involve multiple shipments to the customer. This loss in aggregation in outbound transportation further increases cost.

%4 = Electronic business commonly referred to as eBusiness or e-business, or an internet business, may be defined as the application of information and communication technologies in support of all the activities of business.

%4 = E-business is a term used to describe businesses that run on the internet, or utilize internet technologies to improve the profitability of a business.

%4 = The Supply-Chain Operations Reference model (SCOR) measures total supply chain performance. It is a process reference model for supply-chain management, spanning from the supplier's supplier to the customer's customer. It is the most widely used model.

References

%4 =Supply Chain Edge: 15 Key Factors That Impact Your Distribution Network Effectiveness [Online]. Available at <http://www.investorwords.com/1498/distribution_network.html#ixzz1G0TR7yBo>. Accessed 15 March
2011.

%4 = Chopra, S., & Meindl P., 2001. *Supply Chain Management: Strategy, Planning, Operation.* Prentice Hall, New Jersey, 3rd ed., 636 pages.

%4 =Supply Chain Edge: 15 Key Factors That Impact Your Distribution Network Effectiveness [Online]. Available at: < http://www.buzzle.com/articles/advantages-and-disadvantages-of-e-business.html>. Accessed 15 March 2011.

Recommended Reading

%4 = Chopra S., 2010. *Supply Chain Management*, Pearson Education India, 4th ed., ISBN8131730719, 9788131730713, p.578.

%4 = Joris J. A. Leeman, 2010. Supply Chain Management, BoD – Books on Demand, ISBN 3839137918, 9783839137918, p.250.

- Shah J., 2009. *Supply Chain Management: Text and Cases,* Pearson Education India, ISBN 8131715175, 9788131715178, p.472.

Self Assessment

%4 = Supply chain distribution often introduces _____ into the economic market.

common men

middlemen

suppliers

distributors

%4 = Which of these is not involved in the distribution network design?

Locating production plants and distribution warehouses

Determining the best strategy for distributing the product from the plants to the warehouses and from the warehouses to the customers

Controlling the cost of doing business

Achieve supply chain objectives from high cost to low responsiveness

%4 = _____ is the ability of the customer to track their order from placement to delivery.

Customer experience

Product availability

Order visibility

Product variety

%4 = A _____ always wants the highest level of performance along with the above dimensions.

supplier

customer

distributor

retailer

%4 = A decrease in the response time, which the customers desire, increases the number of facilities required in the _____.

networks

distribution

supply chain

location

%4 = Which of the following supply chain costs are not affected by change in the distribution network design?

Inventories

Transportation

Facilities and handling

Customers

%4 = The biggest advantage of _____ is the ability to centralise inventories at the manufacturer.

drop shipping

direct shipping and in-transit merge

distributor storage with package carrier delivery

distributor storage with last mile delivery

%4 = Which of theses is not an advantage of e-business?

Sectoral limitations

Worldwide presence

Cost effective marketing and promotions

Developing a competitive strategy

%4 = Which sector has not experienced growth of sales and revenue generation because of a number of practical reasons like perishable items?

Retail

Chemical

Software

Food

%4 = _____ is the critical element in a global marketplace.

Preparedness

Designing

Implementation

Execution

Chapter III

Designing and Planning Transportation Networks

Aim

The aim of this chapter is to:

%4 = define transportation system in supply chain

%4 = explain the different modes of transportation in supply chain

%4 = understand the transportation network design options

%4 = describe the transportation infrastructure

Objectives

The objectives of this chapter are to:

%4 = describe the objectives of transportation infrastructure policy

%4 = explain the transportation network design in the supply chain

%4 = understand the concept of trade-off in transportation

Learning outcome

At the end of this chapter, the students will be able to:

%4 = understand the pros and cons of different transportation modes

%4 = examine the different design options and trade-offs

%4 = get an overview of design and plan of transportation networks

3.1 Introduction

The importance of supply chain management has been growing in various areas because of the trend of nationalisation and globalisation in recent decades. For industries, it helps to optimise the existing production and distribution processes based on the same resources through management techniques for promoting the efficiency and competitiveness of enterprises. Transportation system is the key element in a supply chain. It joins the separated activities. Transportation occupies one-third of the amount in the supply chain costs and transportation systems influence the performance of supply chain system enormously. Transporting is required in the whole production procedures, from manufacturing to delivery to the final consumers and returns. A good coordination between each component can give the maximum benefits.

3.2 Transportation in Supply Chain

%4 = Transportation refers to the means of distributing goods, supplies, resources, information, people, and energy from the original point (beginning of supply chain) to the destination point (customer).

%4 = It also involves handling, packaging, managing the time the goods are fetched and delivered, and maintaining coordination, especially when inter-modal or a combination of two or more transport modes is used.

%4 = An intelligent transportation system may be defined as a planned network of elements or physical components that play different roles in the transportation of goods, supplies, resources, information, people, and energy from one place to another.

%4 = The elements or physical components of a transport system are referred as the facilities.

%4 = A transport system consists of:

▼▼ fixed facilities

▼▼ flow entities

▼▼ control system

%4 = The fixed facilities are the physical components of the system that are fixed in space and constitute the network of links and nodes of the transportation system. For example, the links could be roadway or railway track and the nodes could be intersections, interchanges, transit terminals, harbours or airports.

%4 = Flow entities are the units that negotiate the fixed facilities. These include people, vehicles, container units, railroad cars, and so on. In the case of a road system, the fixed facilities accommodate a wide variety of vehicle types, ranging from bicycles to large tractor-trailer combinations.

%4 =The control system consists of vehicular control and flow control. Vehicular control refers to the technological way in which individual vehicles are guided on fixed facilities. Such controls can be manual or automated.

%4 = The characteristics of the vehicle and the characteristics of the vehicular control system are considered by proper geometric design of fixed facilities. For example, in the case of highway facilities, where the vehicles are manually controlled, these include driver's characteristics, such as time a driver takes to perceive and react to various stimuli.

%4 = The flow control system consists of the means that permit the efficient and smooth operation of streams of vehicles and the reduction of conflicts between vehicles. This system includes various types of signing, marking, and signal systems and the underlying rules of operation.

%4 = Civil engineering is the branch of engineering involving design of the fixed facilities. The design includes soil and foundation engineering design, structural engineering design, the design of drainage systems, and geometric design, which is concerned with the physical proportioning of the elements of fixed facilities.

%4 = The success of any supply chain is closely linked to the appropriate use of transportation. For example, Wal- Mart has effectively used a responsive transportation system to lower its overall costs. Wal- Mart use cross-docking process in which product is exchanged between trucks so that each truck going to a retail store has products form different suppliers.

%4 = There are two keys players in any transportation that takes place within a supply chain: shipper and carrier.

%4 = The shipper is that party that requires the movement of the product between two points in the supply chain.

%4 = The carrier is the party that moves or transports the product. For e.g., when ABC uses uninterruptible power

supply to ship its computers from the factory to the customer, ABC is the shipper & uninterruptible power supply is the carrier.

%4 = The management of the supply chain requires a coordinated approach to manage all activities to provide the greatest value to the customer.

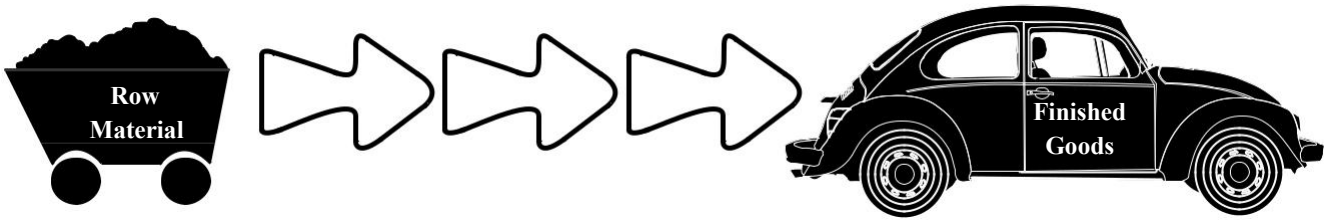


Fig. 3.1 Flow of product along the supply chain

(Source: http://www.marcbowles.com/courses/adv_dip/module4/module6/m6two.htm)

3.3 Importance of Transportation

The importance of transport has been enumerated below:

%4 = Basic service for increasing national income

▼▼ As national income rises, infrastructure adopts to support changing patterns of demand, with the shares of power, transport and communication.

▼▼ Transport is one of the most important services within any country and a vital sector of growth.

%4 = Create new economic activity

▼▼ Since, economic development in a country requires adequate and effective transport services; the degree to which transport creates new activity is a necessary condition within the economy.

▼▼ Transport is one of the essential elements of an integrated plan for area development.

%4 = Indicator of development

▼▼ Existence of high quality transport network, availability of number of mechanised motor transport, adequate number of railway, air and shipping services as per the demand of the users are indicators of the development in any country.

▼▼ Effective transportation systems have been playing a vital role in the economic prosperity of a country.

%4 = Enlarge the trading activities

▼▼ The industrially developed countries lay more emphasis on the development of trade.

▼▼ The search for an integrated system combines the merits of the individual transportation modes and eliminates the uneconomic and unproductive activities.

%4 = Promotes industrialisation

▼▼ It increases wealth, promotes industrialisation and transforms the organisation of industry and raises the standard of living of the people.

3.4 Role of Transport in Supply Chain

%4 = Transport system provides the vital linkage between production and consumption. Development of transport infrastructure helps the globalisation of production process.

%4 = Transport is essential in an economy because the demand and supply of goods does not reach equilibrium at any particular area or point of time.

%4 = The need for dispatch of the goods arises as they are often produced in one place to be sold and consumed in another place.

%4 = Thus, transport provides the vital link between the production and consumption point and the objective of production is not fulfilled till the commodity reaches the consumer.

%4 = It forms an integral part of the production, distribution and marketing systems.

%4 = Transport infrastructure services are critical for diversification and modernisation of production and distribution process.

%4 = Transport is the key factor to link dispersed areas. Transport increases the economic efficiency of resources. The economic efficiency of resources of various countries is increased with the growth of different mode of transportation.

%4 = Transport reduces the cost of production and distribution by effective, planned, integrated and co-ordinated network.

%4 = Developed or developing nations depend largely on transport development for better utilisation of resources.

%4 = The adequacy of transport infrastructure is a key factor in the ability of countries to compete in international trade. Competition for new exports and location of global industries largely depends on the quality of transport infrastructure. Increased globalisation of world trade in many countries arouses not only from the liberalisation of trade policies but also from advances in transportation.

%4 = Transport helps to stabilise prices. Goods can be transported to places, where there is scarcity for it. By this the consumers can get their desired products or commodities at a reasonable price. Similarly, by transporting goods to the market, the producer gets fair price on their products.

%4 = Transport curbs monopoly of the trader. Facilities for quick transport of commodities from one place to another, restricts the traders to charge high price to the consumers. The demand for a product increases because of non-availability of a product in the market.

3.4.1 Transportation Modes in Supply Chain

Transport modes are the means to achieve mobility of supplies. They fall into one of three basic types, depending on what surface they are transported:

▼▼ land (road, rail and pipelines)

▼▼ water (shipping)

▼▼ air

Each mode is characterised by a set of technical, operational and commercial characteristics.

%4 = Road transportation

▼▼ Road infrastructures are large consumers of space with the lowest level of physical constraints among transportation modes.

▼▼ Physiographical constraints are significant in road construction with substantial additional costs to overcome features such as rivers or rugged terrain.

▼▼ Road transportation has an average operational flexibility as vehicles can serve several purposes.

▼▼ These systems have high maintenance costs, both for the vehicles and infrastructures. Rapid movements of cargo occur in small batches. With containerisation, road transportation has become a crucial link in cargo distribution.

▼▼ Trucks are used generally which lowers the cost and have good accessibility. The trucks are able to access many more locations than planes or railroads.

▼▼ Regional truck lines are excellent for small, frequent shipment and are most effective over short distances.

▼▼ But, the factors which lower the use of trucks are their speed, capacity and range.

%4 = Rail transportation

▼▼ Railways have an average level of physical constrains linked to the types of locomotives.

▼▼ Heavy industries are traditionally linked with rail transport systems. The process of containerisation has improved the flexibility of rail transportation by linking it with road and maritime modes.

▼▼ Rail is by far the land transportation mode offering the highest capacity of cargo carried. Gauges are often complicating the integration of rail systems worldwide.

▼▼ Railroads cost much less than other modes when shipping large quantities or bulky goods over long distances.

▼▼ Trains run on a more consistent time schedule than trucks or airlines. They are often able to travel in weather that would slow or stop trucks and airplanes.

▼▼ Disadvantages include inflexibility, potential damage of goods and ineffectiveness with small shipments.

%4 = Pipelines

▼▼ Pipeline routes are practically unlimited as they can be laid on land or under water.

▼▼ They are used for transport of homogenous materials.

▼▼ The costs are lower than other transportation modes. Pipeline construction costs vary according to the diameter and increase proportionally with the distance and with the viscosity of fluids. Pipeline terminals are very important since they correspond to refineries and harbors.

▼▼ Pipelines are ideal for materials such as water, oil, and gas. Pipelines have high initial costs since they must be built but once they are constructed transportation costs are much lower than other modes.

▼▼ They are unable to transport a variety of materials.

%4 = Maritime transportation

▼▼ Ships are one of the oldest methods of transporting goods and they are virtually the only way to transport large volumes of good over-seas. Although this method is slower than shipping by air, a ship can carry much more cargo than an airplane. Costs are reduced significantly by choosing ships over air transport. Because of the physical properties of water such as buoyancy and limited friction, maritime transportation is the most effective mode to move large quantities of cargo over long distances.

▼▼ Main maritime routes are composed of oceans, coasts, seas, lakes, rivers and channels.

▼▼ However, due to the location of economic activities maritime circulation takes place on specific parts of the maritime space. The construction of channels and dredging are attempts to facilitate maritime circulation by reducing discontinuity. Comprehensive inland waterway systems are there.

▼▼ Maritime transportation has high terminal costs, since port infrastructures are among the most expensive to build, maintain and improve and also high inventory costs.

▼▼ Maritime transportation is linked to heavy industries, such as steel and petrochemical facilities adjacent to port sites.

%4 = Air transportation

▼▼ Air is considered a premium mode of transportation because of the speed of delivery and the low impact on the cargo (items are less likely to be broken than those shipped by rail or truck).

▼▼ Airplanes are also able to cover much longer distances in a short time.

▼▼ Savings resulting in speed of delivery are greater than extra costs.

▼▼ Air transport constraints can be the site, the climate, fog and aerial currents. For instance, a commercial plane needs about 3,300 meters of runway for landing and for take off.

▼▼ Air activities are linked to sectors like finance and tourism, which lean on the long distance mobility of people.

▼▼ The mode of transportation has been accommodating growing quantities of high value goods and is playing a growing role in global supply chain management.

%4 = Intermodal transportation

▼▼ Intermodal transport refers to a variety of modes that is used in combination so that the respective advantages of each mode are better exploited.

▼▼ The intermodal transportation applies for passenger movements, such as the usage of the different, but interconnected modes of a public transit system,

▼▼ Containerisation has been a powerful vector of intermodal integration, enabling maritime and land transportation modes to more effectively interconnect.

%4 = Telecommunications

▼▼ Telecommunications are structured networks with a practically unlimited capacity. They have very low constraints that include the physiographic and oceanic masses that may impair the setting of cables.

▼▼ They provide for the instantaneous movement of information.

▼▼ Wave transmissions, because of their limited coverage, often require substations, such as for cellular phone networks.

▼▼ Satellites use a geostationary orbit which is getting crowded.

▼▼ High network costs and low distribution costs characterise many telecommunication networks.

3.5 Transportation Infrastructure and Policies

▼▼ Infrastructures are the fixed installations that allow a vehicle to operate.

▼▼ It can consist of a way, terminal and facilities for parking and maintenance.

▼▼ For rail, pipeline, road and cable transport, the entire way the vehicle travels must be built up. The airway and seaway do not need to be built up. However, they require fixed infrastructure at terminals.

▼▼ Terminals such as airports, ports and stations, are locations where passengers and goods can be transferred from one vehicle or mode to another.

▼▼ The terminals for automobiles are parking lots, while buses and coaches can operates from simple stops. For goods, terminals act as trans-shipment points, though some cargo is transported directly from the point of production to the point of use.

▼▼ The financing of infrastructure can either be public or private. Transport is a necessity for the public; roads, and in some countries railways and airports are funded through taxation.

▼▼ New infrastructure projects involve large spending, and are often financed through debt. Many infrastructure owners therefore impose usage fees, such as landing fees at airports, or toll plazas on roads. Independent of this, authorities impose taxes on the purchase or use of vehicles.

%4 = Transport policy

▼▼ Transport Corporation of India Limited is the largest private sector integrated Logistics Company in India.

▼▼ Any transport policy should be able to ensure safe, affordable, quick, comfortable, reliable and sustainable access.

▼▼ Integrated land use and transport planning in all cities should be encouraged so that travel distances are minimized. The access of business to markets and the various factors of production should be improved.

▼▼ It should bring about a more equitable allocation of road space.

▼▼ The transport infrastructure should favour the establishment of quality focused transport systems that are well integrated, providing seamless travel.

▼▼ Various mechanisms should be established for enhanced coordination in the planning and management of transport systems.

▼▼ There should be intelligent transport systems for traffic management and the use of cleaner technologies should be promoted.

3.6 Design Options For Transportation Network

▼▼ In most cases, trucking or road freight provide the most flexible means of distribution of finished products to retail locations. The supply chain utilises several modes for transportation at various stages of the supply chain.

▼▼ Traditionally, marine transport has been the backbone of international trade. It remains the major mode of transport when the supply chain extends overseas.

▼▼ In recent years there has been a tremendous growth in air freight and products with short shelf lives and high value are increasingly moving by air.

▼▼ One supply chain which is very much dependent on time definite air freight services is the high tech industry.

▼▼ The use of a quick and reliable, time definite service as opposed to a long sea voyage should be readily apparent when the focus of modern supply chain management is considered.

▼▼ Whereas each mode has its specific cost and service attributes, the use of any or a particular combination is important and on the terms of contract between the supplier and the firm for transportation.

▼▼ The questions related to transport in supply chain are:

%4 = What are the transportation options?

%4 = Which one to select? On what basis?

%4 = Direct shipping network

▼▼ In this case, the manufacturer ships directly go from the manufacturing plant to the retailer without using a distribution centre or a warehouse.

▼▼ It reduces costs associated with warehousing or intermediate distribution centres.

▼▼ The time related to order processing is also reduced when goods are shipped directly to retail stores.

▼▼ This is a valid approach, provided the supplier is able to respond quickly and cost effectively.

▼▼ Using less than truck load carrier, the cost and transit time both increase.

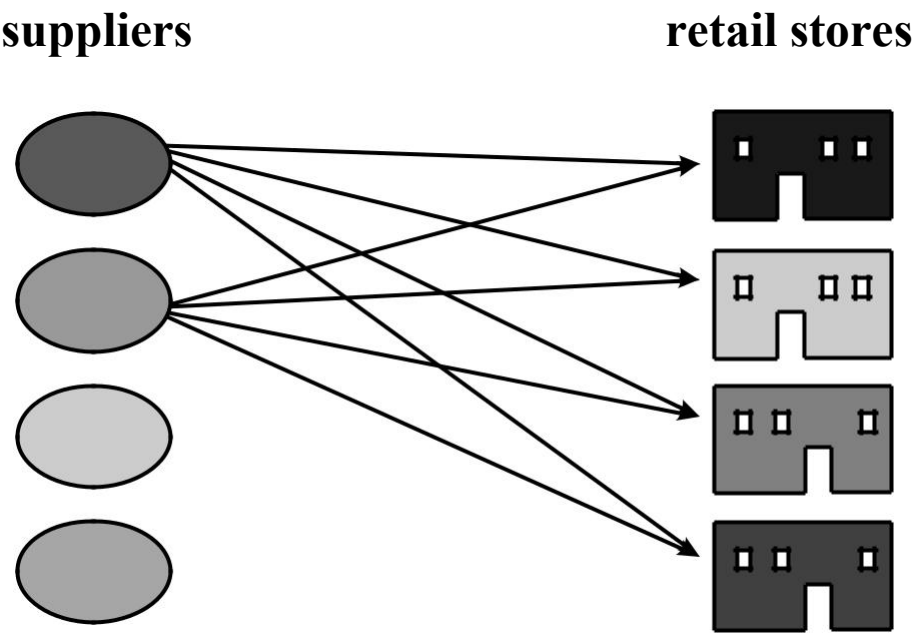


Fig. 3.2 Direct shipping network

(Source: http://www.marcbowles.com/courses/adv_dip/module4/module6/m6four1.htm)

%4 = Direct shipping with milk runs

▼▼ A milk run is a route in which a truck delivers products from a supplier to a number of retail outlets.

▼▼ It reduces cost by eliminating the need for direct small shipments using less than truck load shipments.

▼▼ For example, Toyota uses milk runs both in Japan and in the USA to support its just-in-time manufacturing (Chopra & Meindl, 2001).

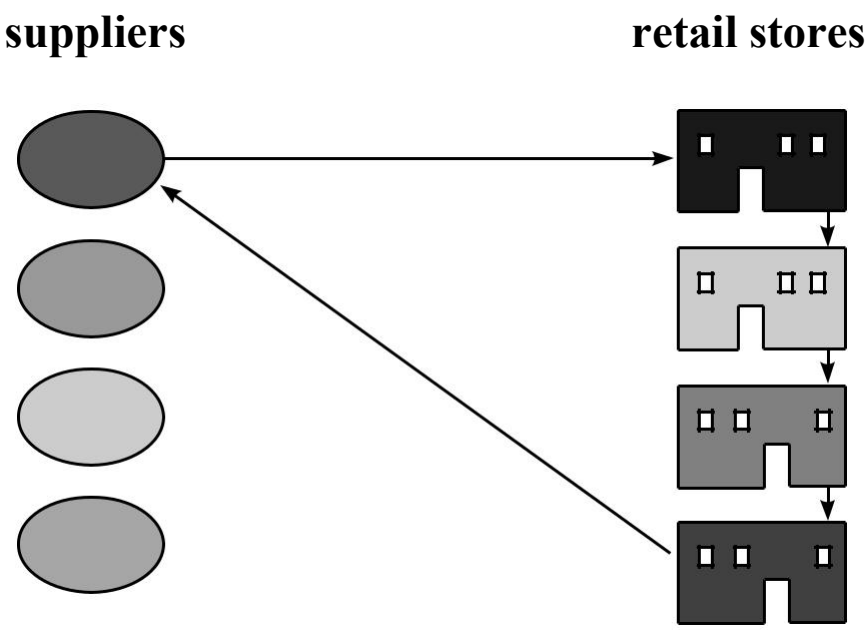


Fig. 3.3 Direct shipping network with milk runs

(Source: http://www.marcbowles.com/courses/adv_dip/module4/module6/m6four1.htm)

%4 = Shipments via central distribution network

▼▼ Supplier does not send shipment to buyer location. The buyer divides location by geographic origin; a distribution centre is built for each region.

▼▼ Supplier sends their shipment directly to buyer location.

▼▼ The distribution centre is a layer between supplier and buyer location and can play two different roles: one is to store inventory and other to serve as a transfer location.

▼▼ The trucks carry goods to the distribution centre, which is sorted and consolidated with other products and transferred to loading dock to load on a truck.

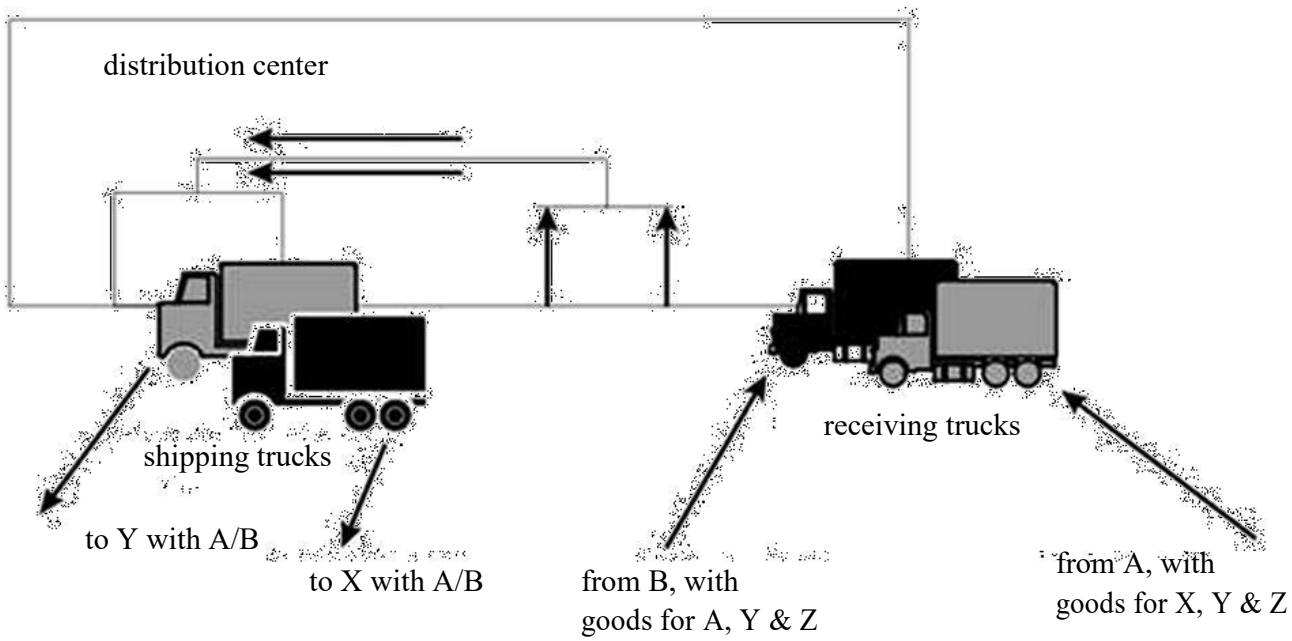


Fig. 3.4 Shipments via central distribution network

(Source: http://www.marcbowles.com/courses/adv_dip/module4/module6/m6four1.htm)

%4 = Shipping via DC using milk runs

▼▼ Milk run can be used from a distribution centre if there are small lots to be delivered to each buyer.

%4 = Tailored network

▼▼ The tailored network is the integration of supply chain services with the core product in order to give each customer a value added product which has been tailor made according to the requirement.

▼▼ Thus, it becomes a key differentiator of a product in an age of mass production when there is a very limited scope of differentiation among the core products themselves.

▼▼ It is the combination of options that reduces the cost and improves responsiveness of supply chain.

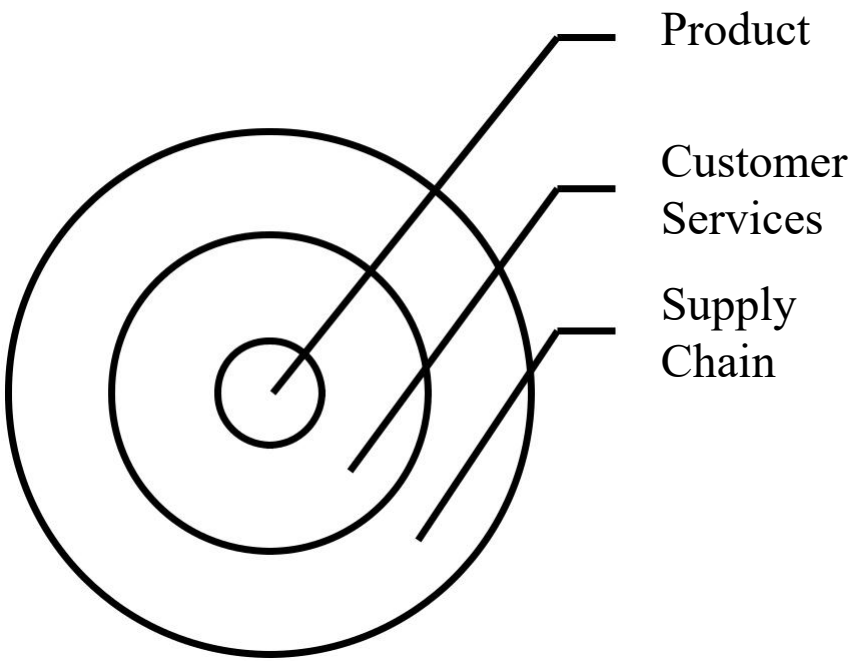


Fig. 3.5 A tailored network

3.7 Tailored Transportation

%4 = The use of different transportation networks and modes based on customer and product characteristics is tailored transportation.

%4 = The factors affecting tailoring are:

▼▼ customer distance and density

▼▼ product demand and value

▼▼ customer order size

3.8 Trade-off in Transportation Design

%4 = A trade-off implies a decision to be made with full comprehension of both the sides- up and down of a particular choice.

%4 = Whatever decision is taken must be a trade-off that best meets the interest of the consumer whilst retaining profitability of the firm.

%4 = The design task is to trade-off the factors of decision making to meet the demands of the marketplace.

%4 = All transportation modes have their pros and cons which make the decision of selecting the ideal transportation mode.

%4 = Basically, the two major decisions a supply chain manager needs to make with respect to trade-offs in transportation are:

▼▼ trading transportation costs over inventory costs and subsequently overall costs

▼▼ trading transportation costs over inventory aggregation

%4 = Inventory aggregation decreases the supply chain costs if the product has a high value to weight ratio, high demand uncertainty and customer's orders are large and vice versa.

%4 = The effect of a transportation mode on a supply chain aids in the decision making process; i.e., does one transportation mode make the supply chain more customer responsive than the other even though it is quite expensive, or is there a cheaper mode that responds a lot more slower to customer demands than another.

%4 = The supply chain manager has to make the appropriate decision and it is most likely based on the following factors:

▼▼ cost

▼▼ ability to fill the transporting vehicle

▼▼ protection of contents from theft, weather etc.

▼▼ shipping time

▼▼ availability of insurance on contents, delivery and other items and factors of importance

▼▼ difficulty of arranging shipment like strict governmental regulations

▼▼ delivery accommodation, for instance, how many other modes need to be employed apart from the primary mode to get products to the final consumer?

▼▼ seasonal considerations like weather, flight delays in rainy seasons ▼▼ size of the product to be shipped like cars, computer components ▼▼ perishability of the product been shipped

3.9 Routing and Scheduling in Transportation

%4 = Routing and scheduling refers to the selection of customers visited by particular vehicle and the sequence in which they will be visited.

%4 = Routing and scheduling must be done to reduce transportation cost and at the same time make deliveries in the earliest time possible and meet the promised level of customer responsiveness.

%4 = The efficient mobility of goods is the optimal routing and scheduling.

%4 = The objective to minimise cost can be by: ▼▼ decrease in number of vehicles

▼▼ reducing total travelling distance and time

▼▼ reduce service failures (delays)

Two basic approaches in routing and scheduling are:

%4 = Savings matrix method

The savings matrix method steps are:

▼▼ identify the distance matrix

▼▼ identify the savings matrix

▼▼ assign customers to vehicles or routes

▼▼ sequence customers within routes

%4 = From the figure below, it is clear that the visit starts and ends at the same destination AB. The savings (X, Y) is the distance saved in the trips. So, the trips are combined to make a single trip.

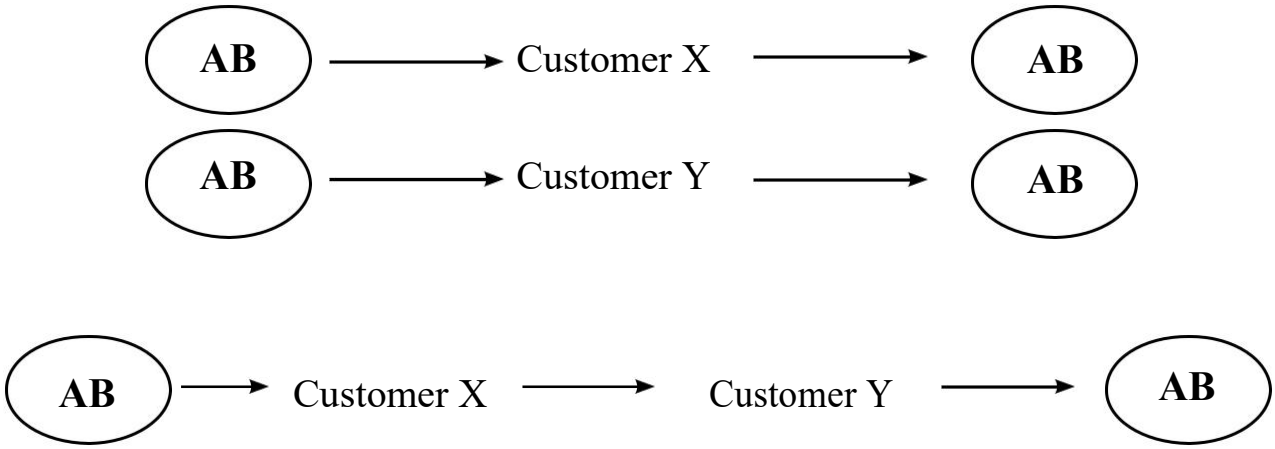


Fig. 3.6 Savings matrix method

ii. Generalised assignment method

The generalised assignment method steps are:

▼▼ assign seed points for each route

▼▼ evaluate insertion cost for each customer

▼▼ assign customers to routes

▼▼ sequence customers within routes

3.10 Making Transportation Decisions in Practice

The following points should be considered while making any decisions related to transportation in supply chain:

%4 = alignment of transportation strategy with competitive strategy

%4 = consideration of both in-house and outsourced transportation

%4 = designing a transportation network that can handle e-commerce

%4 = use of technology to improve transportation performance

%4 = designing flexibility into the transportation network

Summary

%4 = Transportation system is the key element in a supply chain. It joins the separated activities. Transportation occupies one-third of the amount in the supply chain costs.

%4 = The fixed facilities are the physical components of the system that are fixed in space and constitute the network of links and nodes of the transportation system.

%4 = The success of any supply chain is closely linked to the appropriate use of transportation.

%4 = There are two key players in any transportation that takes place within a supply chain namely shipper and carrier.

%4 = The adequacy of transport infrastructure is a key factor in the ability of countries to compete in international trade. Competition for new exports and location of global industries largely depends on the quality of transport infrastructure.

%4 = Increased globalisation of world trade in many countries arouses not only from the liberalization of trade policies but also from advances in transportation.

%4 = The financing of infrastructure can either be public or private. Transport is a necessity for the public; roads, and in some countries railways and airports are funded through taxation.

%4 = The tailored network is the integration of supply chain services with the core product in order to give each customer a value added product which has been tailor made according to the requirement.

%4 = Routing and scheduling must be done to reduce transportation cost and at the same time make deliveries in the earliest time possible and meet the promised level of customer responsiveness.

%4 = The efficient mobility of goods is the optimal routing and scheduling.

References

%4 = Supply Chain Management [Online]. Available at: <http://www.slideshare.net/thadeshvar/supply-chain-management-presentation-731970>. [Accessed 16 March 2011].

%4 = Slack B., Rodrigue J. P., & Comtois C. *Transportation Modes: An Overview* [Online]. Available at: <http:// people.hofstra.edu/geotrans/eng/ch3en/conc3en/ch3c1en.html>. [Accessed 17 March 2011].

%4 = Transportation in the Supply Chain [Online]. Available at: <http://www.clt.astate.edu/asyamil/scm_chopra/ chopra3_ppt_ch13.ppt>. [Accessed 18 March 2011].

%4 =Transportation: An Important Tool in Supply Chain Management [Online]. Available at: <http://www.xomba. com/transportation_important_tool_supply_chain_management>. [Accessed 18 March 2011].

Recommended Reading

%4 = Chase, 2006. *Operations Management for Competitive Advantage*, Tata McGraw-Hill Education, 11th ed., p.875.

%4 = Tyndall, G., 1998. *Supercharging Supply Chains: New Ways to Increase Value Through Global Operational Excellence.* John Wiley and Sons, New York, p.269.

%4 = Meredith, J.R., & Shafer, S.M., 2007. *Operations Management for MBAs.* John Wiley and Sons, New York, 3rd ed., p.445.

Self Assessment

%4 = Which is the key element in a supply chain which joins the separated activities?

Infrastructure

Production

Transportation

Distribution

%4 = _____ is the branch of engineering involving design of the fixed facilities.

Civil engineering

Genetic engineering

Mechanical engineering

Software engineering

%4 = The _____is that party which requires the movement of the product between two points in the supply chain.

shipper

carrier

distributor

consumer

%4 = As _____ rises, infrastructure adopts to support changing patterns of demand, with the shares of power, transport and communication.

per capita income

national income

gross income

firm's income

%4 = Which of the following statements is false?

Competition for new exports and location of global industries largely depends on the quality of transport infrastructure.

The adequacy of transport infrastructure is a key factor in the ability of countries to compete in international trade

Transport is the key factor to link dispersed areas.

Transport increases the social efficiency of resources.

%4 = Transport curbs monopoly of the _____.

supplier

consumer

trader

distributor

%4 = Which of the following transportation modes are large consumers of space with the lowest level of physical constraints among transportation modes?

Road

Railways

Airways

Marine

%4 = Which of the following transportation modes is the mostly used in road transportations?
buses
cars
trucks
trams

%4 =_____ is by far the land transportation mode offering the highest capacity of cargo carried.
Pipelines
Railways
Airways
Shipping

%4 = Which of these is not the factor affecting tailoring?
customer distance and density
product demand and value
customer order size
transportation options

Chapter IV

Sourcing and Pricing

Aim

The aim of this chapter is to:

%4 = define sourcing and pricing

%4 = explain the concept of in-house and outsource in supply chain

%4 = understand the need of effective sourcing decisions

%4 = describe the procurement process

Objectives

The objectives of this chapter are to:

%4 = describe the concept of supplier selection and scoring

%4 = explain the direct and indirect procurement

%4 = understand the method of scoring and assessment of suppliers

Learning outcome

At the end of this chapter, the students will be able to:

%4 = understand the strategy of revenue management

%4 = analyse the management of revenue for multiple customers

%4 = state the benefits of outsourcing

4.1 Introduction

Sourcing strategy deals with planning, designing and building a reliable and competitive supplier base, determining the strategy for procurement, defining pricing strategies and supply chain requirements. The strategy involves confirming to the objectives of stake holders in operations, finance, marketing and distribution. Some supply chain managers favour "everyday low pricing" strategies to reduce demand distortion, improve customer service, and lower costs. Others apply "high-low pricing" strategies to clear slow moving items and build retail traffic, thereby increasing revenues.

4.2 Sourcing

%4 = Sourcing is the entire set of business processes required to purchase goods and services.

%4 = Sourcing processes include:

▼▼ supplier scoring and assessment

▼▼ supplier selection and contract negotiation

▼▼ design collaboration

▼▼ procurement

▼▼ sourcing planning and analysis

%4 = The most significant decision is either to outsource or perform in-house.

%4 = In business, the term word sourcing refers to a number of procurement practices, aimed at finding, evaluating and engaging suppliers of goods and services. The methodology involved in procuring the necessary materials, supplies, and services necessary to sustain a supply chain system.

%4 = A thorough understanding of a company's business strategy, the resources required to deliver that strategy, the market forces and the unique risks within the company associated with implementing specific approaches is essential for success.

%4 = To ensure the achievement of desired results and continued alignment with business objectives, a periodic review of the sourcing strategy is needed.

%4 = The sourcing strategies used in supply chain management includes:

▼▼ Single sourcing: Single sourcing is a method whereby a purchased part is supplied by only one supplier. A Just-in-time (JIT) manufacturer will frequently have only one supplier for a purchased part so that close relationships can be established with a less number of suppliers. These close relationships and mutual interdependence promote high quality, reliability, less time and cooperative action.

▼▼ Multisourcing: Multi-sourcing is a method whereby procurement of a good or service is from more than one independent supplier. It is used sometimes in a company to induce healthy competition between the suppliers in order to achieve higher quality and lower price.

▼▼ Outsourcing: Outsourcing is the process of having suppliers that provide goods and services previously provided internally. Outsourcing involves the replacement of internal capacity and production by that of the supplier. This third party can increase the supply chain surplus relative to performing the activity in house. Outsourcing makes the sense only if it increases the supply chain surplus without increasing the risks.

▼▼ Insourcing: Insourcing is the process where the goods or services are developed internally.

4.3 In-house and Outsource

%4 = Insourcing (or in-house, contracting in) is defined as the delegation of operations from production within a business to an internal but independent entity that specializes in that operation for example, either by hiring local subcontractors or building a facility.

%4 = Insourcing is a business decision made to maintain control of critical production or competencies.

%4 = The independent entity is internal yet not a part of the organisation and will usually have a specialised team who will be proficient in the providing the required services.

%4 =For example, Toshiba insourced with UPS (Unit Parcel Service) in a way that UPS now is in control of the supply chain for Toshiba. If a customer's laptop at home needs repair, UPS will pick it up and fix it at the Toshiba/UPS

Repair Centre and deliver it back to the customer. UPS is the in charge of delivering products for Toshiba.

%4 = Organisations sometimes take such business decisions because it enables them to maintain a better control of what they outsource. For example, organisations involved in production usually opt for insourcing in order to cut down the cost of labor and taxes. (e.g., American labor is often cheaper than European labor), transportation, etc. Since the year 2006, the trend towards insourcing has increased.

%4 = According to recent studies, there is more wok insourced than outsourced in the U.S and U.K. These countries are currently the largest outsourcers in the world. The U.S and U.K outsource and insource work equally.

%4 = Insourcing is loosely referred in call centers that are doing the work of the outsourcing companies. Some of the companies that outsource include Dell, Wipro, and Symantec etc.

%4 = Outsourcing (or contracting out, sub-servicing) refers to the process of contracting to a third-party.

%4 = Outsourcing involves the contracting out of a business function - commonly one previously performed in-house - to an external provider. The two organisations may enter into a contractual agreement involving an exchange of services and payments.

%4 = For example, BMW outsourced with Boss Sound System in a way that Boss does all the music for the BMW cars. It is cheaper for BMW to make a deal with Boss sound system instead of opening a new factory to produce speakers and subwoofers. Boss is the in charge of doing sound systems in BMW.

%4 = The ability of businesses to outsource to suppliers outside the nation is referred to as off-shoring or offshore outsourcing.

%4 = Outsourcing has the following benefits:

▼▼ Cost savings: Outsourcing lowers the overall cost of the service to the business, involving reducing the scope, defining quality levels, re-pricing, re-negotiation, and cost re-structuring. Labour arbitrage is the access to lower cost economies through off-shoring, which has generated by the wage gap between industrialised and developing nations.

▼▼ Focus on core business: Resources (for example, investment, people, and infrastructure) are focused on developing the core business. Organisations outsource their IT support to specialised IT services companies.

▼▼ Cost restructuring: Operations leverage is a measure that compares fixed costs to variable costs. Outsourcing changes the balance of this ratio by offering a move from fixed to variable cost and also by making variable costs more predictable.

▼▼ Improve quality: Contracting out the service with a new service level agreement achieves an improved quality.

▼▼ Knowledge: Outsourcing helps to access to intellectual property and wider experience and knowledge.

▼▼ Contract: Services are provided to a legally binding contract with financial penalties.

▼▼ Operational expertise: Access to operational best practice that would be too difficult or time consuming to develop in-house.

▼▼ Access to talent: Access to a larger talent pool and a sustainable source of skills, particularly in science and engineering.

▼▼ Capacity management: Services and technology where the risk in providing the excess capacity is borne by the supplier needs capacity management.

▼▼ Catalyst for change: Outsourcing can be used as a catalyst for major step change that cannot be achieved alone and the outsourcer becomes a change agent in the process.

▼▼ Enhance capacity for innovation: Companies increasingly use external knowledge service providers to supplement limited in-house capacity for product innovation.

▼▼ Reduce time to market: Outsourcing helps to accelerate the development or production of a product through the additional capability brought by the supplier.

▼▼ **Commodification:** Outsourcing enables to buy the product at the right price.

▼▼ Risk management: An outsourcer is better able to provide the mitigation of risks.

▼▼ **Tax benefit:** Countries offer tax incentives to move manufacturing operations to counter high corporate

taxes within another country.

▼▼ **Scalability:** The outsourced company is prepared to manage a temporary or permanent increase or decrease in production.

▼▼ **Creating leisure time:** It optimises the work-leisure balance.

4.4 3PL and 4PL

%4 = Third-party logistics (3PL) involves using external organisations to execute logistics activities that have previously been performed within an organisation itself.

%4 = The third-party logistics includes any form of outsourcing of logistics activities previously performed in-house. For example, a company with its own warehousing facilities employing external transportation.

%4 = **Third party logistics, 3PL provider performs one or more of the logistics activities relating to the flow of product,** information and funds.

%4 = **Traditionally, 3PLs focused on specific functions such as transportation, warehousing and information** technology.

%4 = Third parties increase the supply chain surplus effectively if they are able to aggregate supply chain assets to a **higher level than a firm itself. It can be done by:**

▼▼ capacity aggregation

▼▼ inventory aggregation

▼▼ transportation aggregation by transportation intermediaries

▼▼ transportation aggregation by storage intermediaries

▼▼ warehousing aggregation ▼▼ procurement aggregation

▼▼ information aggregation

▼▼ receivables aggregation

▼▼ relationship aggregation

▼▼ lower costs and higher quality

%4 = There can be following risks of using a third party logistics:

▼▼ loss in continuation of process

▼▼ underestimation of the cost of coordination

▼▼ reduced customer supplier contact

▼▼ loss of internal capability and growth in third party power

▼▼ sensitive data and information leakage ▼▼ ineffective contracts

%4 = A fourth-party logistics (4PL) targets management of the entire process, whereas a third party logistics (3PL) service provider targets a function.

%4 = 4PL may be a general contractor who manages other 3PLs, truckers, forwarders and custom house agents.

%4 = Outsourcing a noncore activity such as logistics does not guarantee any growth in SC surplus.

%4 = **The basic advantage that a 4PL may provide comes from greater visibility and coordination over the firm's** supply chain, which requires sophisticated information technology which is both costly and needs expertise.

4.5 Benefits of Effective Sourcing Decisions

The benefits of the effective sourcing decisions are listed below:

%4 = Better economies of scale can be achieved if orders are aggregated.

%4 = **More efficient procurement transactions can significantly reduce the overall cost of purchasing.**

%4 = Good procurement processes can facilitate coordination with suppliers.

%4 = Design collaboration can result in products that are easier to manufacture and distribute, finally resulting in lower overall costs.

%4 = Appropriate supplier contracts can allow for the risk sharing.

%4 = By increasing competition through the use of auctions, the firms can achieve a lower purchase price.

4.6 Supplier Scoring and Assessment

%4 = Suppliers are an intrinsic part of the supply chain. Poor performance of the suppliers can hinder the business activities. Supplier performance should be compared on the basis of the supplier's impact on total cost.

%4 = There are factors besides purchase price that influence total cost are:

- ▼▼ replenishment lead time
- ▼▼ on-time performance
- ▼▼ supply flexibility
- ▼▼ delivery frequency or minimum lot size
- ▼▼ supply quality
- ▼▼ inbound transportation cost
- ▼▼ pricing terms
- ▼▼ information coordination capability
- ▼▼ design collaboration capability
- ▼▼ exchange rates, taxes, duties
- ▼▼ supplier viability

%4 = Supplier evaluation provides with an in-depth assessment of performance set against objective and detailed criteria.

4.6.1 Scoring Suppliers

%4 = The first part of supplier's evaluation process is the scoring of suppliers. Performance in terms of delivery, lead time, and the quality of items supplied, the price, service levels etc. can be done.

%4 = It assesses all of the suppliers against the set standards.

%4 = Some scoring systems offer the opportunity to utilise weighting according to the importance of certain criteria. For example, if price is viewed as very important, then that will be given a greater importance than something viewed as less important, which could be invoicing procedures etc.

%4 = Often there are various sub-divisions within any one measure. For example, the price of the product is not just about its cost. Other factors affecting price include the stability of the price, acceptability and accuracy of the invoicing procedures and notice given about any changes to the price etc. So there are other hidden factors that need to be taken into consideration.

4.6.2 Ranking Suppliers

%4 = The analysis is complete when the supplier is ranked after scoring.

%4 = This provides the customer with a real insight into who is performing well, who is average and who is weak at the bottom of the association.

%4 = The ability of ranking is that it can be used to share information with suppliers, so that those who are performing poorly can work towards improving their performance. Often details of other suppliers may not be shared, but individual suppliers will be furnished with details of their score and rank.

%4 = The ranked suppliers can be grouped (typically into A, B, C groups). Specific groups may then result in targeted action (often along the lines of develop, maintain or exit).

%4 = A true picture finally emerges of the supplier performing well and the weakest link to some extent.

%4 = The table below is the method for supplier's scoring and ranking.

Factors influencing total cost	Purchase				Production
		Inventory		Transportation	Introduction
	Price of Component	Cycle	Safety	Cost	Time
Replenishment lead time			X		
On-time performance			X		
Supply flexibility			X		
Delivery frequency		X	X	X	
Supply quality	X		X		
Inbound transport cost				X	
Pricing terms	X	X			
Information coordination			X	X	
Design collaboration	X	X	X	X	X
Exchange rates and taxes	X				
Supplier viability			X		X

Table 4.1 Scoring and assessment of suppliers

4.7 Supplier Selection

%4 = The selection of the supplier can be performed through:

▼▼ **Offline competitive bids:** It is a transparent procurement method in which bids from competing contractors, suppliers, or vendors are invited by advertising the scope, specifications, and terms and conditions of the proposed contract as well as the criteria by which the bids will be evaluated. This aims at obtaining goods and services at the lowest prices by stimulating competition, and by preventing partiality.

▼▼ Reverse auctions: In a reverse auction, sellers compete to obtain business, and prices typically decrease over time. A reverse auction is a type of auction in which the roles of buyers and sellers are reversed. In an ordinary auction, buyers compete to obtain a good or service, and the price typically increases over time.

▼▼ Direct negotiations: Direct negotiations refer to exclusive negotiations between an agency and a supporter without first undergoing a genuine competitive process. Direct negotiations are sometimes referred to as directly sourced, single-invited or non-competed contracts.

%4 = Supplier evaluation is based on total cost of using a supplier and not just the purchase price.

%4 = Buyers usually use a price-only auction.

4.8 Design Collaboration

%4 = 50-70 % of the cost in a manufacturing is through procurement and 80% of the cost of a purchased part is fixed in the design phase.

%4 = It is important to employ design for logistics and for manufacturability.

%4 = Design collaboration with suppliers can result in reduced cost, improved quality, and decreased time to market.

%4 = Throughout the supply chain, manufacturers must become effective design coordinators.

4.9 Procurement Process

%4 = Procurement is the acquisition of goods or commodities by a company, organisation, institution, or a person.

%4 = Procurement in supply chain is the process in which the supplier sends product in response to orders placed by the buyer.

%4 = The goal of such process is to enable orders to be placed and delivered on schedule at the lowest possible overall cost.

%4 = Based on the consumption purposes of the acquired goods and services, procurement activities are often split into two distinct categories. The two categories are:

▼▼ Direct procurement (involves the components used to make finished goods, coordination and visibility with supplier should be improved to focus on the direct materials)

▼▼ Indirect procurement (involves the goods used to support the operations of a firm, decreasing the transaction cost for each order should be the focus)

Direct procurement and indirect procurement				
		TYPES		
		Direct procurement	Indirect procurement	
		Raw material and production goods	Maintenance, repair, and operating supplies	Capital goods and services
FEATURES	Quantity	Large	Low	Low
	Frequency	High	Relatively High	Low
	Value	Industry specific	Low	High
	Nature	Operational	Tactical	Strategic
	Examples	Crude oil in petroleum industry	Lubricants, spare parts	Machinery, computers

Table 4.2 Categories of procurement

4.10 Sourcing Planning and Analysis

%4 = The procurement spending and supplier performance should be periodically analysed by the firm and analysis must be as an input for future sourcing decisions and to ensure appropriate economies of scale.

%4 = Supplier performance analysis should be used to differentiate the suppliers with complementary strengths:

▼▼ cheaper but lower performing suppliers should be used to supply base demand

▼▼ higher performing but more expensive suppliers should be used to buffer against variation in demand and supply from the other source

4.11 Pricing and Revenue Management for Multiple Customers

%4 = Pricing is one of the most important elements of the marketing mix, which generates a turnover for the organisation.

%4 = The remaining 3P's are the variable cost for the organisation: costs to produce, design, distribute and promote a product. Price must support these elements of the mix.

%4 = Pricing reflects the supply and demand relationship. Pricing should take into account the following factors:

▼▼ fixed and variable costs

▼▼ competition

▼▼ company objectives

▼▼ proposed positioning strategies

▼▼ target group and willingness to pay

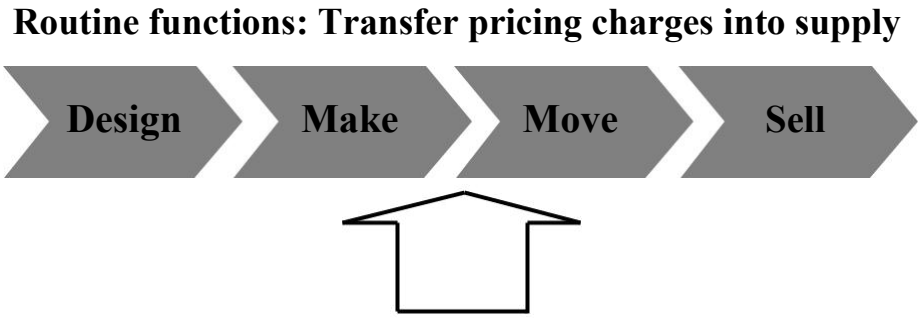


Fig. 4.1 Pricing charges into supply chain

%4 = Revenue management encompasses a wide range of opportunities to increase revenue. It predicts consumer behaviour at the micro-market level and optimises product availability and price to maximise revenue growth.

%4 = The primary aim is selling the right product to the right customer at the right time for the right price. The essence of this discipline is in understanding customer's perception of product value and accurately aligning product prices, placement and availability with each customer segment.

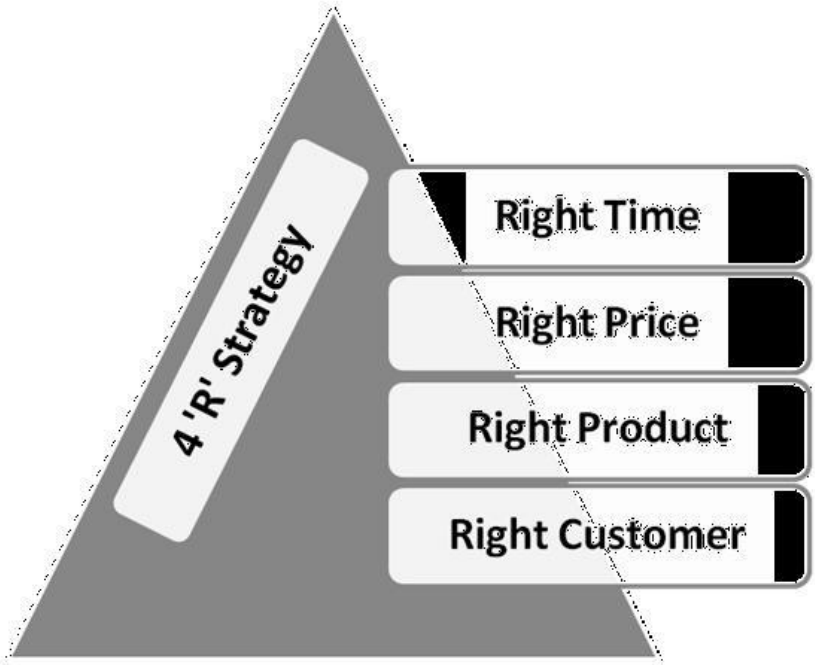


Fig. 4.2 The 4 "R" strategy of revenue management

The primary levels of revenue management are:

%4 = Pricing

▼▼ Pricing involves redefining pricing strategy and developing disciplined pricing tactics.

▼▼ The value created for customers are anticipated and then specific prices to capture that value are set.

▼▼ A company may decide to price against their competitors or even their own products, but the most value comes from pricing strategies that closely follow market conditions and demand.

▼▼ A pricing strategy dictates what a company wants to do; pricing tactics determine how a company actually captures the value.

▼▼ Price optimisation involves constantly optimising multiple variables such as price sensitivity, price ratios,

and inventory to maximise revenues.

▼▼ A successful pricing strategy and pricing tactics can drastically improve a firm's profitability.

%4 = Inventory

▼▼ The price or allocation of capacity is fixed in inventory management.

▼▼ Discount on products can increase volume i.e., by lowering prices on products, a company can overcome weak demand and gain market share, which ultimately increases revenue so long as each product sells for more than its marginal cost.

▼▼ When demand is strong for a product but the threat of cancellations looms (e.g. hotel rooms or airline seats), firms often overbook in order to maximize revenue from full capacity.

%4 = Marketing

▼▼ Temporarily decreasing the price of their products, companies sell high volume of products.

▼▼ There should be a balance between volume growth and profitability. An effective promotion helps maximise revenue when there is uncertainty about the distribution of customer willingness to pay.

▼▼ When a company's products are sold in the form of long-term commitments, such as internet or telephone service, promotions help attract customers who will then commit to contracts and produce revenue over a long time horizon.

%4 = Channels

▼▼ Different distribution channels may represent customers with different price sensitivities. For example, customers who shop online are usually more price sensitive than customers who shop in a physical store.

▼▼ Different channels often have different costs and margins associated with those channels.

▼▼ Multiple channels to retailers and distributors push more products without loss in quality.

4.12 Perishable Products and Seasonal Demand

%4 = Seasonal items like fruits, fish, winter cosmetics, fashion apparel, etc. generally exhibits different demand patterns at various times during the season.

%4 = Production and inventory planning must consider this property for cost effectiveness and optimisation of resources.

%4 = Economic order quantity, number of orders to be placed and/or the time to place each order should be checked due to four different types of problems that may be encountered in practice.

%4 = The first problem assumes a fixed planning horizon and perishable products such as Christmas trees or fashion merchandise whose value deteriorates as the item gets aged. Under constant demand assumption, solution for this type of problem is to capture the deterioration in value by increasing holding cost. Holding prices or exchange rates fixed over some time period is called pegging.

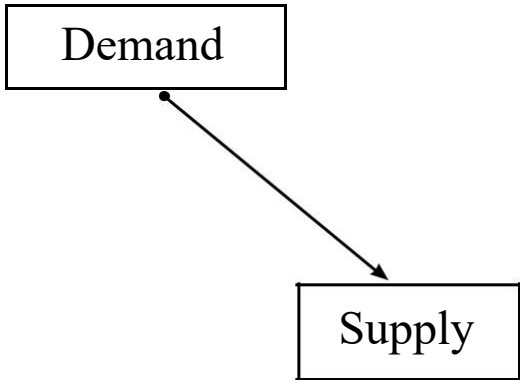


Fig. 4.3 Pegging in SCM

%4 = The second problem is similar to first, except that the demand is assumed to increase as time proceeds.

%4 = The third problem allows a specific number of integer orders during the planning horizon.

%4 = The fourth problem allows the ordering cost to increase as time progresses.

%4 = Warehousing refers to the activities involving storage of goods on a large-scale in a systematic and orderly manner and making them available conveniently when needed.

%4 = It refers to holding or preserving goods in huge quantities from the time of their purchase or production till their actual use or sale.

%4 = It creates time utility by bridging the time gap between production and consumption of goods.

%4 = Warehousing arises due to the following reasons:

- ▼▼ seasonal production of goods
- ▼▼ seasonal demand
- ▼▼ large-scale production
- ▼▼ quick supply
- ▼▼ continuous production
- ▼▼ price stabilisation

%4 = The functions of warehouses are: ▼▼ storage of goods

▼▼ protection of goods ▼▼ risk bearing

▼▼ financing

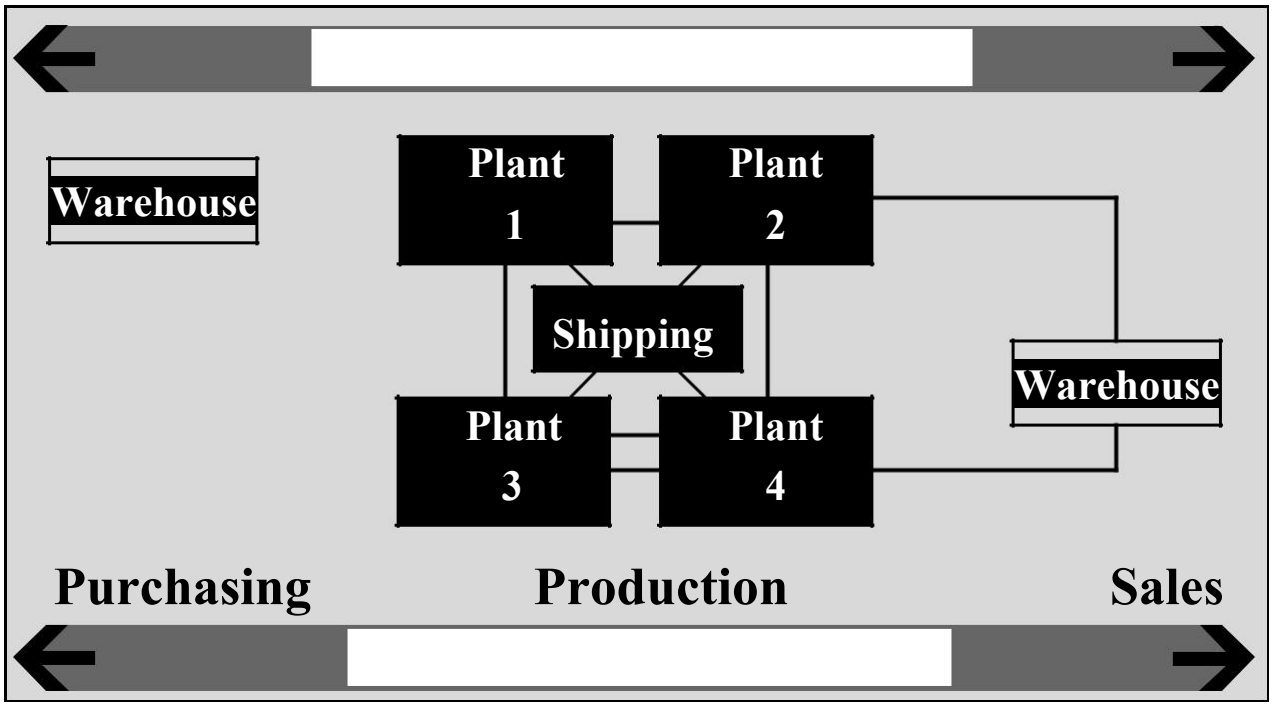


Fig. 4.4 Warehousing in SCM

(Source: http://en.sap.info/product-clustering-provides-transparency/3264)

Summary

%4 = Sourcing strategy deals with planning, designing and building a reliable and competitive supplier base, determining the strategy for procurement, defining pricing strategies and supply chain requirements.

%4 = Sourcing is the entire set of business processes required to purchase goods and services.

%4 = A Just-in-time (JIT) manufacturer will frequently have only one supplier for a purchased part so that close relationships can be established with a less number of suppliers.

%4 = Single sourcing is a method whereby procurement of a good or service is from more than one independent supplier. It is used sometimes in a company to induce healthy competition between the suppliers in order to achieve higher quality and lower price.

%4 = Outsourcing involves the contracting out of a business function - commonly one previously performed in-house - to an external provider.

%4 = Third-party logistics (3PL) involves using external organisations to execute logistics activities that have previously been performed within an organisation itself.

%4 = The first part of supplier's evaluation process is the scoring of suppliers. Performance in terms of delivery, lead time, and the quality of items supplied, the price, service levels etc. can be done.

%4 = Direct negotiations refer to exclusive negotiations between an agency and a supporter without first undergoing a genuine competitive process.

%4 = Revenue management encompasses a wide range of opportunities to increase revenue. It predicts consumer behaviour at the micro-market level and optimises product availability and price to maximise revenue growth.

References

%4 = Supply Chain Resource Cooperative [Online]. Available at: <http://scm.ncsu.edu/public/terms/s.html> Accessed 18 March 2011].

%4 = Supplier Scoring – The Importance of Ranking Your Suppliers [Online]. Available at: <http://supplychain-mechanic.com/?p=104> [Accessed 18 March 2011].

%4 = Pricing and Revenue Management in the Supply Chain [Online]. Available at: <http://www.clt.astate.edu/asyamil/SCM_Chopra/chopra3_ppt_ch15.ppt> 2007, Pearson Education, [Accessed on 18 March 2011].

%4 = Gupta, Y., Sundararaghavan P. S., & Ahmed M., 2003. *Ordering policies for items with seasonal demand*, International Journal of Physical Distribution & Logistics Management, Vol. 33, pp.500 – 518. Available at: <http://www.emeraldinsight.com/journals.htm?articleid=846884&show=html>.[Accessed 18 March 2011].

Recommended Reading

%4 = Chopra S., 2010. *Supply Chain Management*, Pearson Education India, 4th ed., p.578.

%4 = Mohanty R.P., & Deshmukh S.G., 2005. *Supply Chain Management (Theories & Practices)*, Dreamtech Press, p.376.

%4 = Chopra, S., & Meindl P., 2006. *Supply Chain Management*, Pearson Education India, 3rd ed., p.636.

Self Assessment

%4 = _____is the entire set of business processes required to purchase goods and services.

Sourcing

Pricing

Assessment

Scoring

%4 = Which type of sourcing is the process of having suppliers that provide goods and services previously provided internally?

Outsourcing

Multisourcing

Single sourcing

Insourcing

%4 = _____is the access to lower cost economies through off-shoring, which has generated by the wage gap between industrialised and developing nations.

Off-shoring

In-sourcing

Labour arbitrage

Outsourcing

%4 = Which is the quality that enables to buy the product at the right price?

Labour arbitrage

Scalability

Commodification

Outsourcing

%4 = Which of the following statements is false?

Suppliers are an intrinsic part of the supply chain. Poor performance of the suppliers can hinder the business activities.

Supplier performance should be compared on the basis of the supplier's impact on total cost.

Supplier evaluation provides with an in-depth assessment of performance set against objective and detailed criteria.

The first part of supplier's evaluation process is the ranking of suppliers.

%4 = Which of the following statements is false?

The price of the product is only about its cost.

Some scoring systems offer the opportunity to utilize weighting according to the importance of certain criteria.

In a reverse auction, sellers compete to obtain business, and prices typically decrease over time.

Direct negotiations are sometimes referred to as directly sourced, single-invited or non-competed contracts.

%4 = _____usually use a price-only auction.

Buyers

Sellers

Distributors

Retailers

%4 = What percentage of the cost of a purchased part is fixed in the design phase?

30

50

80

90

%4 = _____in supply chain is the process in which the supplier sends product in response to orders placed by the buyer.

Procurement

Design collaboration

Sourcing

Pricing

%4 = _____reflects the supply and demand relationship.

Pricing

Sourcing

Competition

Fixed and variable costs

Chapter V

Information Technology in the Supply Chain

Aim

The aim of this chapter is to:

%4 = define customer relationship management

%4 = explain the role of information in supply chain

%4 = understand the concept of supply chain IT framework

%4 = describe the supply chain management goals

Objectives

The objectives of this chapter are to:

%4 = describe the concept of information technology in SCM

%4 = explain the internal supply chain

%4 = understand the benefits of e-commerce in SCM

Learning outcome

At the end of this chapter, the students will be able to:

%4 = understand the planning of enterprise resources

%4 = analyse the activities in customer relationship management

%4 = explain the integrated supply chain model

5.1 Introduction

Information is said to be the glue that holds supply chains together. Without information, the managers will not know the demand of the customers, the stock of inventory available with him and when to order, how much to order and when it should be shipped. This is where the role of IT comes into the picture. Web-based technologies continue to have significant impact on supply chain strategies. Web provides a virtual platform for eliminating information delays and significantly reducing transaction costs. For effective supply chain coordination, there should be a good coordination of material, information, and cash flows. The information technology involves data recognition equipment, communication technologies, factory automation and other hardware and services are included. Supply chain management (SCM) is concerned with the flow of products and information between supply chain members' organisations. In the integrated supply chain model, bi-directional arrow reflects the accommodation of reverse materials and information feedback flows.

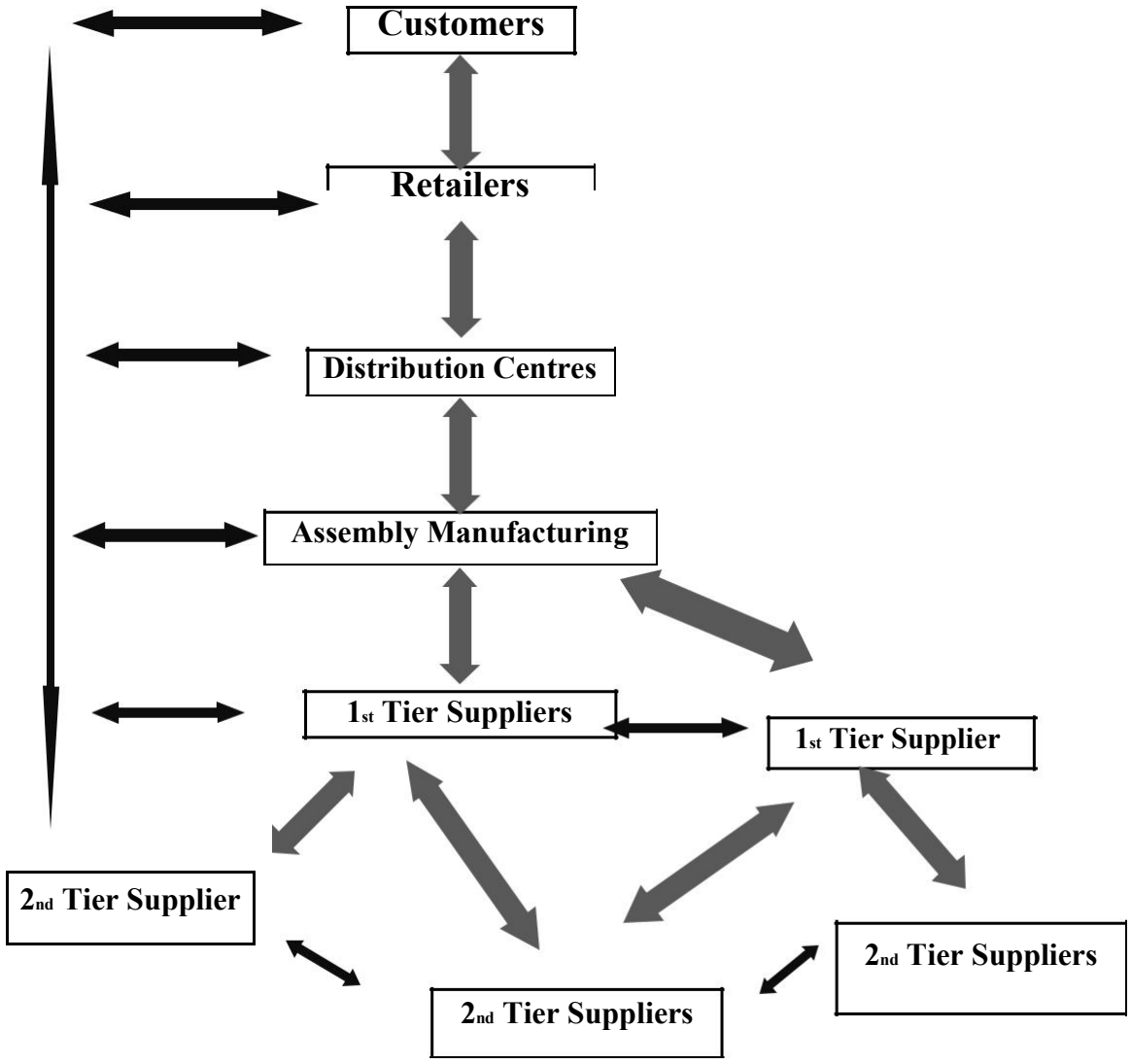


Fig. 5.1 Integrated supply chain model
(Source: http://otl.curtin.edu.au/tlf/tlf2001/ee.html)

For example, Wal-Mart is very well known for its supply chain. The company's cost of goods is 5% to 10% less than that of most of its competitors. Wal-Mart captures the information on sale of its products from all its stores, analyses the demand and then determines that how much inventory it should hold in each store and how much should be ordered. It sends the same information to all its key suppliers so as to ensure that the orders are fulfilled in time and the time is reduced.

5.2 Supply Chain IT Framework

%4 = Any supply chain management should perform following activities: ▼▼ getting information

▼▼ making decisions

▼▼ implementing decisions

▼▼ buffering against imperfections in information, decision-making, or implementation

%4 = A company's supply chain can be grouped into macro processes:

▼▼ Customer relationship management

▼▼ Internal supply chain management

▼▼ Supplier relationship management

▼▼ Transaction management

5.3 Role of Information in Supply Chain

%4 = Hardware and software used throughout the supply chain is used to gather and analyse information. The IT captures and delivers information needed to make good decisions.

%4 = **Effective use of IT in the supply chain can have a significant impact on supply chain performance.**

%4 = Relevant information available throughout the supply chain allows managers to make decisions that take into account all stages of the supply chain

%4 = It also allows performance to be optimised for the entire supply chain, not only for one stage.

%4 = **It leads to higher performance for each individual firm in the supply chain.**

%4 = Information must be accurate, accessible in timely manner and must be of right kind.

%4 = Information provides the basis for supply chain management decisions, inventory, facility and transportation.

%4 = It should provide the supply chain visibility.

%4 = Information is used at all phases of decision making: strategic, planning and operational.

%4 = For example, any location decisions can be strategic one and what products will be produced during today's production run is the operational decision to be made.

%4 = The demand patterns, carrying costs, ordering costs are inventory decisions to be made.

%4 = **Costs of transportation, customer locations, and shipment sizes include the transportation decision factors.**

%4 = **The location, capacity, schedules of a facility; need information about trade-offs between flexibility and efficiency**, demand, exchange rates, taxes, etc. are facility decisions.

5.4 Customer Relationship Management (CRM)

%4 = Customer relationship management includes methodologies, software, and internet capabilities that help an enterprise manage customer relationships in an organised way. It is a widely-implemented strategy for managing a company's interactions with customers, clients and sales prospects.

%4 = It is a methodology used to learn more about customer's needs and behaviours in order to develop stronger relationships with them.

%4 = For example, an enterprise might build a database about its customers describing relationships so that management, salespeople, people providing service, and the customer directly could access information, match customer needs with product plans and offerings, remind customers of service requirements and know what other products a customer had purchased.

%4 = CRM can enable an organisation to:

▼▼ identify the types of customers
▼▼ design individual customer marketing campaigns
▼▼ treat each customer as an individual
▼▼ understand customer buying behaviours

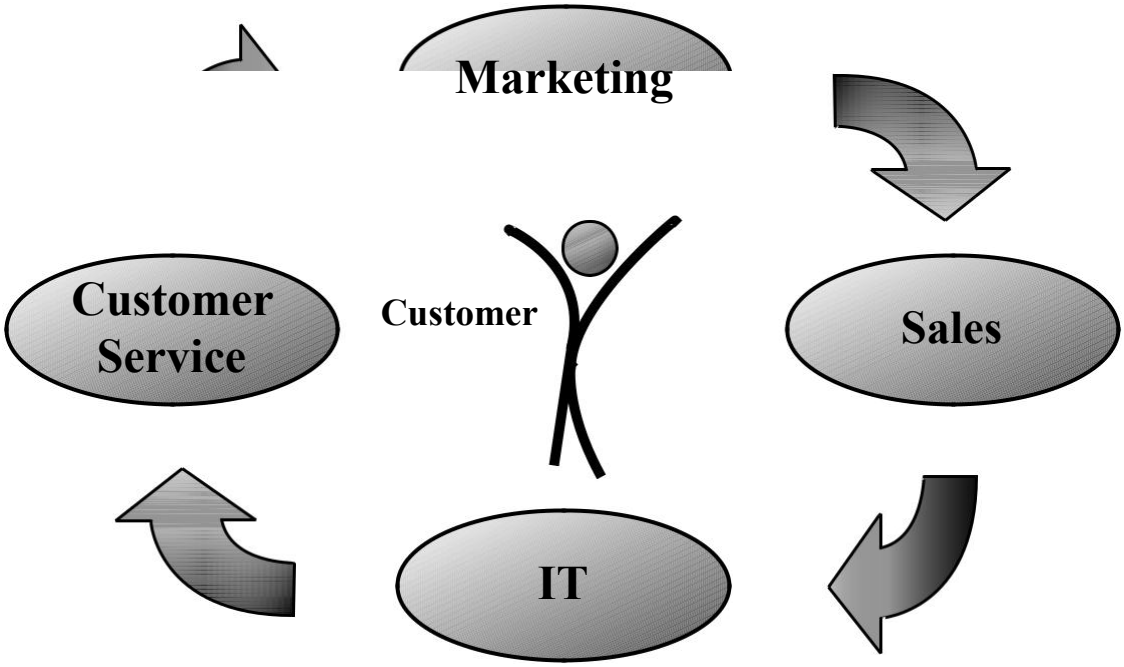


Fig. 5.2 Customer relationship management
(Source: http://phpcrmopensource.com/)

%4 = Key processes involved in CRM are: ▼▼ marketing ▼▼ selling ▼▼ order management ▼▼ call centre

%4 = The use of a CRM system have advantages to a company such as: ▼▼ quality and efficiency ▼▼ decreased costs ▼▼ decision support ▼▼ enterprise agility

%4 = The ability to meet customer r equirements is built upon the expectation that everything is done correctly in the supply chain. To provide quality service and satisfy customers, world-class companies along the supply chain are guided by the **Seven Rights of Fulfilment.**

Fig. 5.3 SCM goals: the seven rights of fulfilment
(Source: http://logisticssupplychainmanagement.blogspot.com/2008_09_01_archive.html)

5.5 Internal Supply Chain Management

%4 = Internal supply chain management includes all processes involved in planning for and fulfilling a customer order.

%4 = Internal supply chain management includes processes:

- ▼▼ strategic planning
- ▼▼ demand planning
- ▼▼ supply planning
- ▼▼ fulfilment
- ▼▼ field service

%4 = There must be strong integration between the internal supply chain management and CRM macro processes.

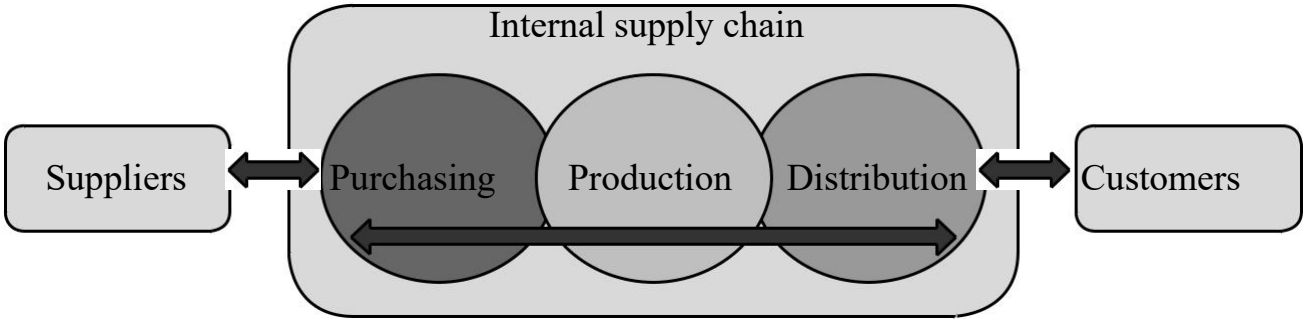


Fig. 5.4 Internal supply chain
(Source: http://reference.findtarget.com/search/Supply%20chain/)

5.6 Supplier Relationship Management

%4 = Supplier relationship management involves managing interactions of enterprise with the suppliers or organisations that supply the goods and services it uses.

%4 = The goal of supplier relationship management is to streamline and make the processes between an enterprise

and its suppliers effective.

%4 = Once the sourcing team has engaged a supplier, there is an essential need to maintain a balance of control in the new relationship.

%4 = Without proper control, the value of a contract can degrade by up to 30% in the first year based upon typical industry benchmarks; post contractual opportunities, (Procurement Strategy Council).

%4 = The process of SRM can be penned down as follows:

▼▼ identification of potential suppliers based on qualification needed

▼▼ evaluating and selecting suppliers on various parameters like product, price, capability, background, brand etc.

▼▼ entering into agreement with selected supplier in terms of price (sale); return policy, ordering policy etc. ▼▼ identifying key suppliers in different product categories based on sales volume and demand of product ▼▼ retailer need to regularly monitor the performance of suppliers

5.7 Transaction Management

%4 = A transaction is an agreement, communication, or movement carried out between separate entities or objects, often involving the exchange of items of value, such as information, goods, services, and money.

%4 = When conducting a transaction, there should be proper management.

%4 = A transaction which is not well managed can fail to create the value envisaged and may even destroy value.

%4 = A resource manager is the first to participate in a transaction. The transaction manager tracks all the resource managers who enlist in the transaction. One of the following three results can occur:

▼▼ the application either commits or aborts the transaction

▼▼ a resource manager aborts the transaction

▼▼ a failure occurs

%4 = Transaction manager informs the resource managers whether the transaction is committed or aborted. The transaction manager maintains a log in storage on disk. The log is a sequential file that records transaction events.

5.8 Enterprise Resource Planning (ERP)

%4 = Enterprise resource planning (ERP) integrates internal and external management information across an entire organisation, embracing finance/accounting, manufacturing, sales and service, etc.

%4 = ERP systems automate this activity with an integrated software application. Its purpose is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders.

%4 = ERP systems can run on a variety of hardware and network configurations, typically employing a database to store data.

%4 = The functional areas of ERP include:

▼▼ finance or accounting

▼▼ cash management, budgeting

▼▼ manufacturing

▼▼ scheduling, capacity, workflow management, quality control, cost management, manufacturing process, product lifecycle management

▼▼ supply chain management

▼▼ order to cash, inventory, order entry, purchasing, supply chain planning, supplier scheduling, inspection of goods, claim processing, commissions

▼▼ project management

▼▼ costing, billing, time and expense, performance units, activity management

▼▼ customer relationship management

▼▼ sales and marketing, commissions, service, customer contact, call center support

▼▼ data services

▼▼ self–service interfaces for customers, suppliers and employees

5.9 E-commerce

%4 = Electronic commerce or e-commerce refers to a wide range of online business activities for products and services. It refers to the business transaction in which the parties interact electronically. It creates a virtual marketplace.

%4 = It consists of the buying and selling of products or services over electronic systems such as the internet and other computer networks.

%4 = The amount of trade conducted electronically has grown extraordinarily with widespread internet usage.

%4 = The e-commerce includes:

▼▼ electronic funds transfer

▼▼ supply chain management

▼▼ internet marketing

▼▼ online transaction processing

▼▼ electronic data interchange

▼▼ inventory management systems

▼▼ automated data collection systems

%4 = Modern electronic commerce typically uses the World Wide Web (www) in the transaction's lifecycle. It can encompass a wider range of technologies such as e-mail, mobile devices and telephones.

%4 = While e-commerce and e-business terms are used interchangeably, they are distinct concepts. In e-commerce, information and communications technology (ICT) is used in inter-business or inter-organisational transactions and in business-to-consumer transactions.

%4 = In e-business, on the other hand, ICT is used to enhance one's business. It includes any process that a business organisation conducts over a computer-mediated network.

%4 = M-commerce (mobile commerce) is the buying and selling of goods and services through wireless technology i.e., handheld devices such as cellular telephones and personal digital assistants (PDAs). Japan is seen as a global leader in m-commerce.

%4 = Content delivery over wireless devices is faster, more secure, and scalable. It is believe d that m-commerce will surpass e-commerce as the method of choice for digital commerce transactions. This can be true for the
Asia-Pacific where there the number of mobile phone users is more than internet users.

%4 = E-commerce has the following advantages:

▼▼ E-commerce serves as an equaliser and enables start-up and small- and medium- sized enterprises to reach the global market.

▼▼ E-commerce makes mass customisation possible.

▼▼ E-commerce allows network production.

%4 =Amazon.com is a virtual bookstore. It does not have a single square foot of bricks and mortar retail floor space. Nonetheless, Amazon.com is posting an annual sales rate of approximately $1.2 billion. Due to the efficiencies of selling over the Web, Amazon has spent only $56 million on fixed assets. Thus, in many industries doing business through e-commerce is cheaper than conducting business in a traditional brick-and-mortar company.

%4 = E-tailing (or electronic retailing) is the selling of retail goods on the Internet. It is the most common form of business-to-consumer (B2C) transaction.

%4 = Dell has been using e-tailing and recorded multimillion dollar orders taken at its web site in 1997.

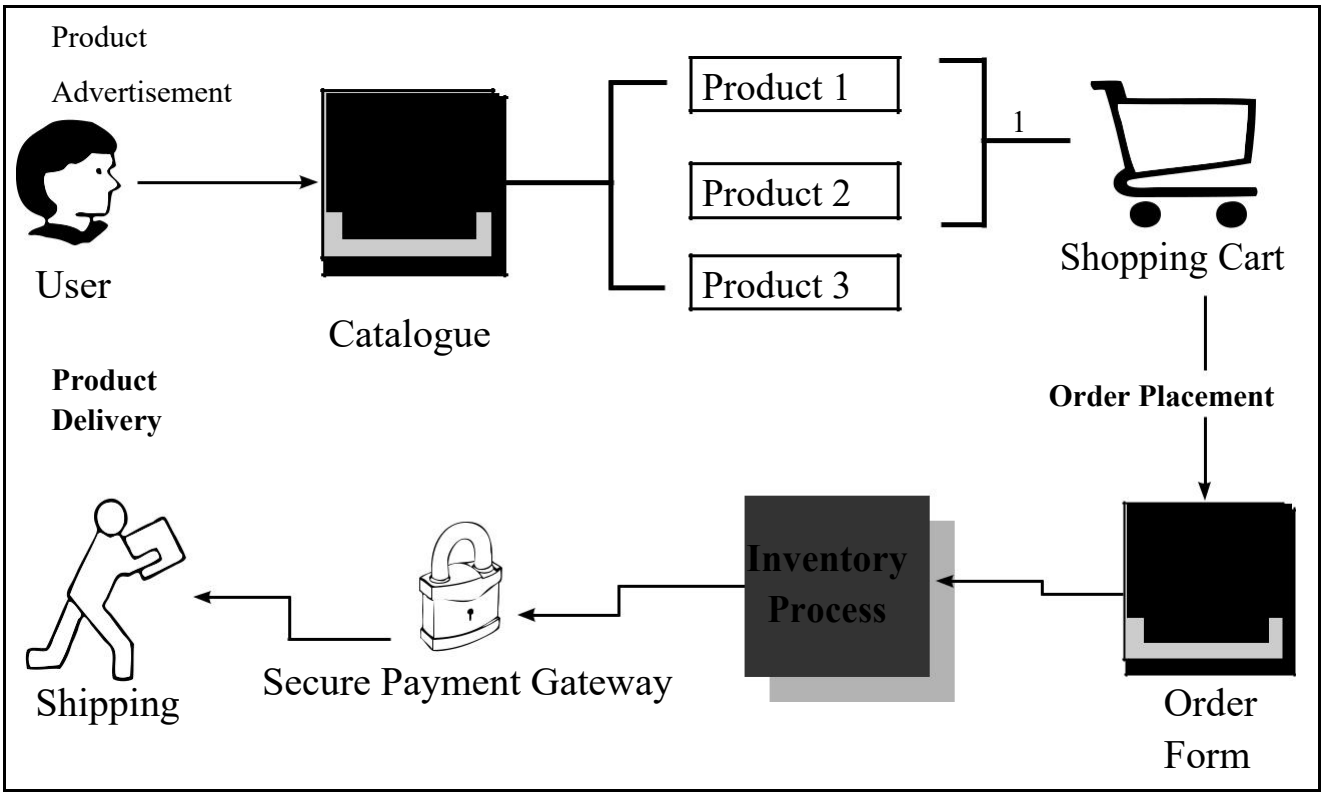


Fig. 5.5 E-commerce model
(Source: http://www.rajshriweb.com/benefits-of-eCommerce-website.php)

5.10 Supply Chain Information Technology in Practice

There are various companies that manage supply chain through use of IT, such as:

%4 = Amul
%4 = ICICI Bank
%4 = TELCO
%4 = Hindustan Unilever
%4 = Dell
%4 = Asian Paints

Amul – Taste of India

Amul was formed in 1946. Today, Amul is the leading food brand in India and has been accredited with ISO: 9001. Amul initiated the dairy co-operative movement in India and formed an apex co-operative organisation called Gujarat co-operative Milk Marketing Federation. Today 70,000 villages and 200 districts in India are part of it. It markets its products through 50 sales offices throughout India and distribution is done through a network of 4,000 stockists who in turn supply 500,000 retail outlets. Amul has linked distributors to the network & also incorporated web pages of top retailers on their website. Distributors can place their order on website *amulb2b.co.* Automated supply & delivery chain practices and just in time supply chain management is done with the technology of e-commerce.

Summary

%4 = Supply chain management (SCM) is concerned with the flow of products and information between supply chain members' organisations.

%4 = In the integrated supply chain model, bi-directional arrow reflects the accommodation of reverse materials and information feedback flows.

%4 = Relevant information available throughout the supply chain allows managers to make decisions that take into account all stages of the supply chain.

%4 = The location, capacity, schedules of a facility; need information about trade-offs between flexibility and efficiency, demand, exchange rates, taxes, etc. are facility decisions.

%4 = Customer Relationship Management includes methodologies, software, and internet capabilities that help an enterprise manage customer relationships in an organised way. It is a widely-implemented strategy for managing a company's interactions with customers, clients and sales prospects.

%4 = Internal supply chain management includes all processes involved in planning for and fulfilling a customer order.

%4 = The goal of supplier relationship management is to streamline and make the processes between an enterprise and its suppliers effective.

%4 = When conducting a transaction, there should be proper management.

%4 = Enterprise resource planning (ERP) integrates internal and external management information across an entire organisation, embracing finance/accounting, manufacturing, sales and service, etc.

%4 = M-commerce (mobile commerce) is the buying and selling of goods and services through wireless technology-i.e., handheld devices such as cellular telephones and personal digital assistants (PDAs). Japan is seen as a global leader in m-commerce.

References

%4 =Customer relationship management [Online]. Available at: <http://searchcrm.techtarget.com/definition/CRM>. [Accessed 18 March 2011].

%4 = Need for supplier chain relationship management ⁄Online]. Available at: <http http://bimtech-retail.com/ blog/2010/need-for-supplier-relationship-management-in-retail/>. [Accessed 19 March 2011[.

%4 = Enterprise resource planning ⁄Online]. Available at: <http://en.wikipedia.org/wiki/Enterprise_resource_ planning>. [Accessed 19 March 2011].

%4 = Resource Manager's Role in Transactions ⁄Online]. Available at: <http://msdn.microsoft.com/en-us/library/ ms679472%28v=vs.85%29.aspx>. [Accessed 16 March 2011].

%4 = Information Technology and the Supply Chain [Online]. Available at: <http://www.clt.astate.edu/asyamil/ SCM_Chopra/chopra3_ppt_ch16.ppt>. [Accessed 19 March 2011].

%4 = Andam Z. R., 2003. e-Commerce and e-business [Online]. Available at: <http://www.apdip.net/publications/ iespprimers/eprimer-ecom.pdf>. [Accessed 18 March 2011].

Recommended Reading

%4 = Chopra, S., & Meindl P., 2006. *Supply Chain Management*, Pearson Education India, 3rd ed., p.636.

%4 = John J. C., Langley C., Bardi E. J., Gibson B. J., Novack R. A., 2008. *Supply chain management: a logistics perspective,* Cengage Learning 8th ed., p.705.

%4 = Mahadevan B., 2010.*Operations Management: Theory and Practice*, Pearson Education India, 2nd ed., p.672.

Self Assessment

%4 = Who is at the top in the Integrated Supply Chain Model?

Customers

Retailers

Distribution centres

Manufacturing unit

%4 = Information must be _____accessible in timely manner and must be of right kind.

precise

accurate

disclosed

highly structured

%4 = There are _____ rights of fulfilment in supply chain.

eight

six

five

seven

%4 = According to Procurement Strategy Council, without proper control, the value of a contract can degrade by up to _____ in the first year based upon typical industry benchmarks; post contractual opportunities.

30 %

40 %

50 %

10 %

%4 = Which is the buying and selling of goods and services through wireless technology?

E-commerce

E-business

M-commerce

E-tailing

%4 = Which company has been using e-tailing and recorded multimillion dollar orders taken at its web site in 1997?

Wal-Mart

Hewlett-Packard

Dell

Procter & Gamble

%4 = Which company, formed in 1946, is the leading food brand in India?

Amul

Nestle

Hindustan Unilever

Heinz

%4 = _____ integrates internal and external management information across an entire organisation, embracing finance/accounting, manufacturing, sales and service, etc

Transaction management

Enterprise resource planning

Supplier relationship management

Internal supply chain management

%4 = Which of the following statements is false?

Information must be accurate, accessible in timely manner and must be of right kind.

Information provides the basis for supply chain management decisions, inventory, facility and transportation.

Information should not provide the supply chain visibility.

Information is used at all phases of decision making: strategic, planning and operational.

%4 = Which of the following statements is false?

The IT captures and delivers information needed to make good decisions.

Effective use of IT in the supply chain can have a significant impact on supply chain performance.

It also allows performance to be optimised for the entire supply chain for only one stage.

Information leads to higher performance for each individual firm in the supply chain.

Chapter VI

Coordination in a Supply Chain

Aim

The aim of this chapter is to:

%4 = define Bullwhip effect

%4 = explain the role of coordination in supply chain

%4 = understand the concept of collaborative planning, forecasting and replenishment

%4 = describe the different managerial levers in supply chain coordination

Objectives

The objectives of this chapter are to:

%4 = describe the concept of CPFR

%4 = explain the benefits of effective coordination in supply chain

%4 = understand the advantages of building partnerships and trust

Learning outcome

At the end of this chapter, the students will be able to:

%4 = understand the impacts of Bullwhip effect in supply chain

%4 = examine the activities in continuous replenishment program

%4 = explain the countermeasures to supply chain variability

6.1 Introduction

Supply chain is the movement of materials as they flow from their source to the end customer. Supply chain includes purchasing, manufacturing, warehousing, transportation, customer service; demand planning, supply planning and supply chain management. It is made up of the people, activities, information and resources involved in moving a product from it's supplier to customer. Supply chain activities include:

%4 = design

%4 = manufacturing

%4 = procurement

%4 = planning and forecasting

%4 = order fulfilment

%4 = distribution

Coordination between the above mentioned activities within a supply chain is a strategic response to the challenges that arise from these dependencies.

SCM is the planning and coordination of activities, from procurement to production. There are a number of different people, entities, and processes that interact in order to execute supply chain objectives. Coordination mechanisms, then, provide tools for effectively managing these interactions. Increasing competition due to market globalisation, product diversity and technological breakthroughs stimulates independent firms to collaborate in a supply chain.

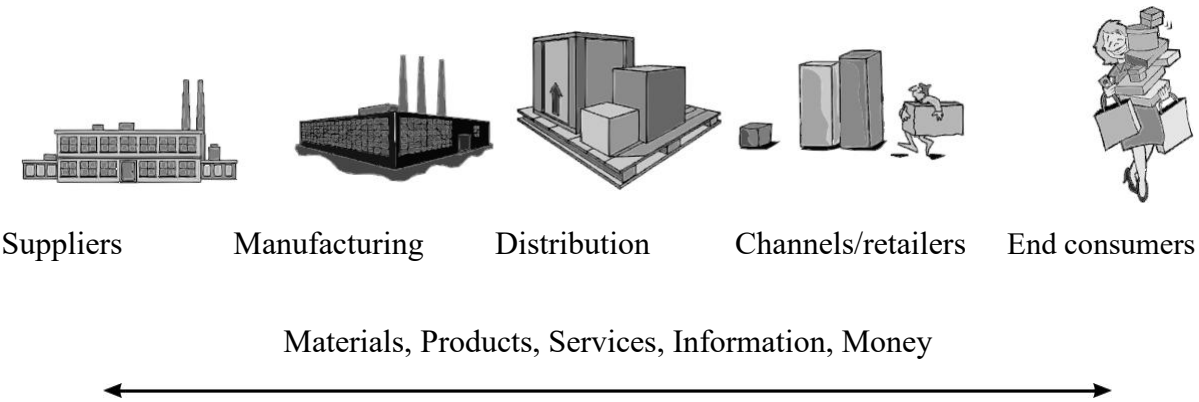


Fig. 6.1 A typical supply chain

(Source: http://www2.isye.gatech.edu/~jswann/teaching/6230/6230%20SC%20collaboration%202007%20PK.pdf)

6.2 Lack of Supply Chain Coordination

%4 = When all stages in the supply chain take actions together, it usually results in greater total supply chain profits.

%4 = SC coordination requires that each stage take into account the effects of its actions on the other stages.

%4 = Supply chain variability can be caused due to:

▼▼ lack of information sharing and visibility in the supply chain

▼▼ lack of supply chain coordination and integration ▼▼

inability to adapt to events in real time

▼▼ inability to fully figure out the immediate and future impact of planned

actions ▼▼ local optimisation of parts of the supply chain ▼▼ poor planning

▼▼ lack of process and quality control

▼▼ unexpected delays in the supply process

%4 = The lack of supply chain coordination can result in following effects:

- ▼▼ large demand and supply fluctuations result in the need for high inventories to prevent stock-outs
- ▼▼ poor customer service as all demand might not be met
- ▼▼ production scheduling and capacity planning becomes difficult due to large order changes
- ▼▼ extra manufacture expansion to meet peak demand
- ▼▼ high costs for large unexpected orders
- ▼▼ expedited shipments and overtime
- ▼▼ conflict between supply chain players

6.3 Bullwhip Effect

%4 = The Bullwhip effect (or whiplash effect) is an observed phenomenon in forecast-driven distribution channels. It occurs because the demand for goods is based on demand forecasts from companies, rather than actual consumer demand.

%4 = The concept is also known as the Forrester effect.

%4 = Since the oscillating demand magnification upstream a supply chain reminds someone of a cracking whip it became famous as the Bullwhip effect.

%4 = The bullwhip effect on the supply chain occurs when changes in consumer demand causes the companies in a supply chain to order more goods to meet the new demand.

%4 = The bullwhip effect usually flows up the supply chain, starting with the retailer, wholesaler, distributor, manufacturer and then the raw materials supplier.

%4 = The best illustration of the bullwhip effect is the well-known beer game.

%4 = In the game, participants play the roles of customers, retailers, wholesalers, and suppliers of a popular brand of beer. The participants cannot communicate with each other and must make order decisions based only on orders from the next downstream player. The ordering patterns share a common, recurring theme. The variability of an upstream site is always greater than downstream site. This order variability cause players' irrational decision making.

%4 = The bullwhip effect is a consequence of the player's rational behaviour within the supply chain.

%4 = Demand variations are amplified when moving up the supply chain.

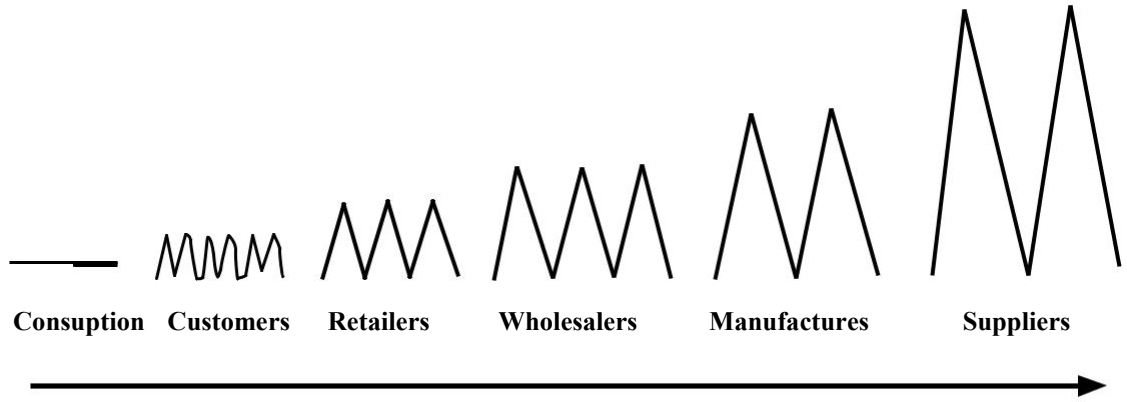


Fig. 6.2 Increasing order variability up the supply chain
(Source: http://web.rollins.edu/~tlairson/ecom/com515h.html)

Causes of the Bullwhip effect

%4 = The following causes can contribute to the Bullwhip effect:

- ▼▼ **Order batching:** Order batching occurs when larger orders are placed in an effort to reduce ordering costs, to take advantage of transportation economics such as full truck load economies, and to benefit from sales incentives. Larger orders thus results in more variance.

▼▼ Shortage gaming: Customers order more than they need during a period of short supply.

▼▼ Demand forecast inaccuracies: Each supply chain player adds a certain percentage to the demand estimates.

The result is no visibility of true customer demand.

▼▼ neglecting to order in an attempt to reduce inventory

▼▼ no communication up and down the supply chain

▼▼ delay times for information and material flow

▼▼ quantity discount

▼▼ misperceptions of feedback

▼▼ panic ordering reactions after unmet demand

Impacts of the Bullwhip effect

%4 = The Bullwhip effect can lead to:

▼▼ inefficient production

▼▼ excessive inventory as the producer needs to fulfil the demand of its predecessor in the supply chain

▼▼ low utilisation of the distribution channel

▼▼ hazard of stock-outs resulting in poor customer service ▼▼ leads to a row of financial costs

▼▼ the damage of public image and loyalty an organisation

▼▼ lead to contract penalties

▼▼ hiring and dismissals of employees to manage the demand variability induce further costs due to training and possible pay-offs

Countermeasures to the Bullwhip effect

%4 = While the Bullwhip effect is a common problem, many leading companies have been able to apply countermeasures to overcome it, such as:

▼▼ Countermeasures to order batching: High order cost is countered with electronic data interchange and computer aided ordering. Full truck load economics are countered with third-party logistics and assorted truckloads.

▼▼ Countermeasures to shortage gaming: The units are allocated based on past sales. The capacity and supply information must be shared. The order size flexibility must be reduced. One can reserve a fixed quantity for a given year and specify the quantity of each order shortly before it is needed.

▼▼ information sharing

▼▼ smooth the flow of products: coordinate with retailers to spread deliveries evenly, reduce minimum batch sizes and smaller and more frequent replenishments

▼▼ every day low price policy

▼▼ restrict returns and order cancellations

▼▼ providing access to point of sale data

%4 = Examples of the Bullwhip effect: Proctor & Gamble (Pampers); HP (printers)

%4 = Logistics executives at Procter & Gamble (P&G) examined the order patterns for one of their best-selling products, Pampers. This is a classic example of a product with very little consumer demand fluctuations. The sales at retail stores were fluctuating and the distributors' orders had high degree of variability. The swings of the orders of materials to their suppliers were even greater. While the consumers, the babies, consumed diapers at a steady rate, the demand order variabilities in the supply chain were amplified as they moved up the supply chain.

%4 = When Hewlett-Packard (HP) executives examined the sales of one of its printers at a major reseller, they found that there were some fluctuations over time. However, when they examined the orders from the reseller, they observed much bigger swings. They discovered that the orders from the printer division to the company's integrated circuit division had even greater fluctuations.

6.4 Managerial Levers

The following are the key areas of supply chain coordination:

▼▼ working capital (to be reduced)

▼▼ direct material costs (to be minimised)

▼▼ optional spend (to be reduced) and compliance (to be enforced)

▼▼ key cross-functional planning process (to be improved)

▼▼ product portfolio for growth (to be configured)

▼▼ manufacturing and supply chain network (to be restructured)

▼▼ product innovations (to be targeted) and time-to-market (to be reduced)

▼▼ goals and incentives (to be aligned)

▼▼ information accuracy and sharing

▼▼ pricing strategies (to be designed to stabilise orders)

▼▼ collaborative forecasting and planning

▼▼ operational performance (to be improved)

▼▼ replenishment lead time (to be reduced)

▼▼ lot sizes (to be reduced)

▼▼ encouraging retailers to order in smaller lots and reduce forward buying

▼▼ strategic partnerships and trust

6.5 Building Strategic Partnerships and Trust

%4 = A relationship with cooperation and trust should be designed for supply chain coordination. The supply chain relationships are based on power or trust.

%4 = Cooperation and trust in the work is essential for supply chain coordination because:

▼▼ alignment of incentives and goals

▼▼ actions to achieve coordination are easier to implement

▼▼ supply chain productivity improves by reducing duplication or allocation of effort to appropriate stage

▼▼ greater information sharing results

%4 = There are certain disadvantages of power-based relationship:

▼▼ results in one stage maximising profits, often at the expense of other stages ▼▼ can hurt a company when balance of power changes ▼▼ less powerful stages have sought ways to resist

%4 = Formal contracts should be used.

%4 = Trust and cooperation are built up over time as a result of a series of interactions and these positive interactions strengthen the belief in cooperation of other party.

%4 = The ideal goal in SC coordination is co-identification.

6.6 Continuous Replenishment Program (CRP) and Vendor Managed Inventory (VMI)

%4 = CRP focuses on improving the flow of products in the supply chain, both, forward to the customer and eventually the end consumer, and backward to the supplier.

%4 = The goals of CRP are to:

▼▼ increase inventory turns

▼▼ reduce inventory levels

▼▼ decrease stock-outs

▼▼ improve customer service levels

▼▼ boost warehouse efficiency

▼▼ enhance your trading partner's perception of value

%4 = Vendor Managed Inventory (VMI) is a term widely used when implementing CRP an arrangement where the supplier, not the customer, decides when and how much of the customer's stock is replenished. VMI focuses on assuring that products are replenished to stock in the most efficient way, without manual information such as orders having to be transferred between customer and supplier. Automatic electronic messages are used to keep track of the current stock situation and planned sales forecasts, so it can be determined when it is time to refill the stock and avoid stock-outs. VMI initiatives emerged in the late 1980s when department stores such as
Wal-Mart moved to automated VMI.

%4 = The objectives of VMI are to:

▼▼ increase in-stock inventory

▼▼ increase sales

▼▼ improve customer service

▼▼ increase gross margins

▼▼ reduce overall inventory in the supply chain

▼▼ stabilise vendor's production

%4 = In the CRP-VMI process, these electronic messages are
usually seen as: ▼▼ inventory report

▼▼ sales forecast

▼▼ order

response ▼▼

dispatch advice

▼▼ sales report

▼▼ invoice

%4 = Supplier benefits by CRP-VMI are:

▼▼ simplifies forecasting due to visibility to the customer's point-of-sale
data ▼▼ reduced customer ordering errors

▼▼ stock level visibility helps identify priorities (the supplier can see the potential need for an item before the item is ordered)

%4 = Customer benefits by CRP-VMI are:

▼▼ improved fill rates from supplier and end consumer

▼▼ decreased stock outs and inventory levels

▼▼ decreased planning and ordering costs (the responsibility is shifted to the supplier)

▼▼ improved service level overall (the right product at the right time)

▼▼ supplier is provides superior service

%4 = Dual benefits by CRP-VMI are:

▼▼ reduced data entry errors due to computer-to-computer communications

▼▼ improved overall processing speed

▼▼ better service offered to the end consumer by both parties

▼▼ true collaborative partnership between the supplier and the customer

▼▼ Long-term benefits include more efficient promotion handling, improved product introductions, more efficient product distribution and increased sales

6.7 Collaborative Planning, Forecasting and Replenishment (CPFR)

%4 = CPFR is a business practice that combines the intelligence of multiple trading partners in the planning and fulfilment of customer demand.

%4 = CPFR links sales and marketing best practices to supply chain planning and execution processes.

%4 = Its objective is to increase availability to the customer while reducing inventory, transportation and logistics costs. It is an attempt to address the Bullwhip effect issue.

%4 = The CPFR reference model provides a framework for planning, forecasting and replenishment process. A buyer and a seller work as collaboration partners to satisfy the customer demand which is at the centre of the model.

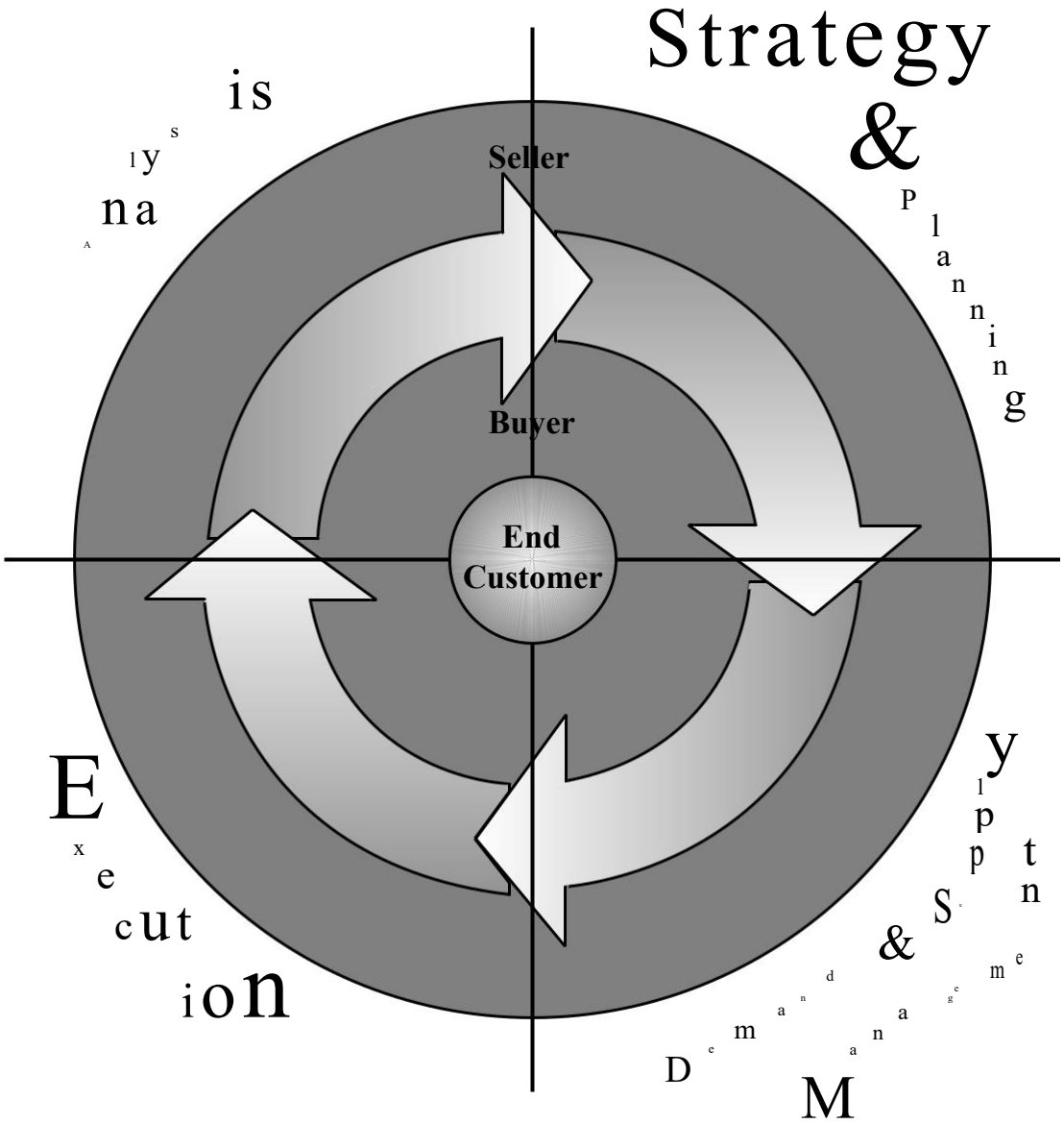


Fig. 6.3 CPFR model

(Source: http://www.sql-server-performance.com/articles/biz/BI_Collaborative_Planning_Forecasting_Replenishment_p1.aspx)

%4 = The importance of communication and collaboration can be seen from a well-documented example of Volvo and green cars. In the 80's, Volvo had a growing inventory of green cars. To reduce this growing inventory, a promotional campaign was initiated which turned out to be a huge success. The production department interpreted that the sales of green cars had a shoot up and assuming that demand has increased; they started producing more green cars. This again resulted in a growing inventory of green cars. Thus, if different entities collaborate and

communicate in their functioning, the situation is always much better.

%4 = CPFR comprises of four main collaboration activities:

▼▼ **Strategy and planning:** establishing the ground rules for the collaborative relationship and developing event plans.

▼▼ **Demand and supply management:** estimation of consumer demand and order and shipment requirements **over the planning horizon**

▼▼ **Execution:** orders and shipments are placed and delivered, products are received and stocked, sales transactions are recorded and payments are made

▼▼ **Analysis:** planning and execution are monitored, results are aggregated and key information is shared between the partners and plans and are adjusted for improving results

Summary

%4 = SCM is the planning and coordination of activities, from procurement to production. There are a number of different people, entities, and processes that interact in order to execute supply chain objectives.

%4 = Coordination mechanism provides tools for effectively managing these interactions. Increasing competition due to market globalisation, product diversity and technological breakthroughs stimulates independent firms to collaborate in a supply chain.

%4 = The Bullwhip Effect (or Whiplash Effect) is an observed phenomenon in forecast-driven distribution channels. It occurs because the demand for goods is based on demand forecasts from companies, rather than actual consumer demand. The concept is also known as the Forrester Effect.

%4 = Demand variations are amplified when moving up the supply chain.

%4 = VMI focuses on assuring that products are replenished to stock in the most efficient way, without manual information such as orders having to be transferred between customer and supplier.

%4 = Automatic electronic messages are used to keep track of the current stock situation and planned sales forecasts, so it can be determined when it is time to refill the stock and avoid stock-outs.

%4 = The CPFR reference model provides a framework for planning, forecasting and replenishment process. A buyer and a seller work as collaboration partners to satisfy the customer demand which at the centre of the model.

%4 = When all stages in the supply chain take actions together, it usually results in greater total supply chain profits.

%4 = SC coordination requires that each stage take into account the effects of its actions on the other stages.

References

%4 = Coordination in the Supply Chain [Online]. Available at: <http://www.clt.astate.edu/asyamil/SCM_Chopra/ chopra3_ppt_ch17.ppt>. [Accessed 14 March 2011].

%4 = Xu L., Beamon, Benita M., 2006. Supply chain coordination and cooperation mechanisms: an attribute-based approach. Journal of Supply Chain Management [Online]. Available at: http://www.highbeam.com/doc/1G1-143011706.html>. [Accessed 16 March 2011].

%4 = Decision Craft Inc, 2000. *Variability and Supply Chain* [Online]. Available at: <http://www.decisioncraft.com/ dmdirect/variability.htm>. [Accessed 14 March 2011].

%4 = The Bullwhip Effect in Supply Chain [Online]. Available at: <http://www.ehow.com/about_5230010_bullwhip-effect-supply-chain.html#ixzz1GeqgM5QD>. [Accessed 17 March 2011].

%4 = Supply Chain Coordination [Online]. Available at: <http://www2.isye.gatech.edu/~spyros/courses/IE3103/SC-Coordination.ppt>. [Accessed 16 March 2011].

%4 = Continuous Replenishment Program (CRP) and Vendor Managed Inventory [Online]. Available at: <http://swe. lawson.com/www/resource.nsf/pub/CRP_VMI.pdf/$FILE/CRP_VMI.pdf>. [Accessed 16 March 2011].

Recommended Reading

%4 = Mentzer J. T., 2001. *Supply Chain Management*, Sage Publications, 2nd ed., p.512.

%4 = Chopra, S., & Meindl P., 2006. *Supply Chain Management*, Pearson Education India, 3rd ed., p.636.

%4 = Mentzer J. T., 2004. Fundamentals of supply chain management: twelve drivers of competitive advantage, Sage Publications, p.293.

Self Assessment

%4 = A typical supply chain has _____ in the beginning of the chain.

manufacturing

distribution

suppliers

marketing

%4 = Which is the best illustration of the bullwhip effect?

beer game

wine game

game theory

SCM game

%4 = Which of the following statements is false?

The ordering patterns share a common, recurring theme.

The variability of an upstream site is always greater than downstream site.

The participants can freely communicate with each other and must make order decisions based only on orders from the next downstream player.

The order variability cause players' irrational decision making.

%4 = Which of the following statements is false?

The bullwhip effect on the supply chain occurs when changes in consumer demand causes the companies in a supply chain to order more goods to meet the new demand.

The bullwhip effect usually flows down the supply chain, starting with the retailer, wholesaler, distributor, manufacturer and then the raw materials supplier.

The bullwhip effect is a consequence of the players' rational behavior within the supply chain.

The Bullwhip effect is an observed phenomenon in forecast-driven distribution channels.

%4 = Which variations are amplified when moving up the supply chain?

Demand

Supply

Order

Income

%4 = _____occurs when larger orders are placed in an effort to reduce ordering costs.

Order variations

Demand forecast inaccuracies

Stock-outs

Order batching

%4 = Which is a classic example of a product with very little consumer demand fluctuations?

Procter & Gamble

Hewlett-Packard

Dell

Amul

%4 = In the CPFR reference model, what remains in its centre?

Seller

Buyer

End customer

Distributor

%4 = Volvo is associated with which inventory?

Green cars

Blue cars

Red cars

White cars

%4 = Each supply chain player adds a certain percentage to the _____estimates.

supply

demand

stock-outs

order

Chapter VII

Dimensions of Logistics

Aim

The aim of this chapter is to:

%4 = define logistics

%4 = explain the micro and macro dimension of logistics

%4 = understand the value added role of logistics

%4 = describe the economic impact of logistics

Objectives

The objectives of this chapter are to:

%4 = classify different logistics interfaces

%4 = explain the activities of logistics

%4 = understand the approaches to analyse logistic systems

Learning outcome

At the end of this chapter, the students will be able to:

%4 = understand the logistic system analysis concept

%4 =examine the factors affecting the cost and importance of logistics

%4 = explain the dimensions of logistics

7.1 Introduction

Logistics in the 21st century touches every aspect of the company's daily operations and has grown into a business especially of its own. Strategic planning and resource management is a part of logistics management, but logistics is also about how companies go about their day and its impact. As a business specialty, the explosion of globalism has promulgated the practice of logistics. In the days of mostly domestic companies, shipping departments in most companies were run by an experienced shipping clerk. Since, there were only few people who could adequately understand how to get things done, it was a difficult task. Firms want their packages shipped and delivered on time.

Logistics is essential for the company's competitive strategy and survival. The buyer is not interested in the promises of the seller that he can supply goods at competitive price. If the supplier fails to meet the terms with the predetermined supply of period, the seller may not only get his sale amount back, but may also be legally penalised, if the sales contract specifies so. The better delivery schedule is a good promotional strategy when buyers are unwilling to invest in warehousing and keeping higher level of inventories. Similarly, better and timely delivery helps in getting repeat orders through the goodwill created.

Effective logistics system contributes immensely to the achievements of the business and marketing objectives of a firm. It creates time and place utilities in the products and thereby helps in maximising the value satisfaction to consumers. By ensuring quick deliveries in minimum time and cost, it relieves the customers of holding excess inventories. It also brings down the cost of carrying inventory, material handling, transportation and other related activities of distribution. In nutshell, an efficient system of physical distribution/logistics has a great potential for improving customer service and reducing costs.

7.2 Macro and Micro Dimension

The dimensions of logistics are categorised as:

%4 = Macro dimension

%4 = Micro dimension

7.2.1 Macro Dimension

The macro dimension of logistics are categorised as value added role and economic impacts.

Value-added role of logistics

The value-added role of logistics includes the form, place, time and possession utilities.

%4 = Form utility (what)

▼▼ Logistics provides form utility through manufacturing or assembly operations.

▼▼ Logistics provides form utility through its impact on shipment size and packaging.

%4 = Place utility (where)

▼▼ Logistics provides place utility by moving goods from production surplus points to points where demand exists.

▼▼ Reducing logistics costs expands market area for firm.

%4 = Time utility (when)

▼▼ Logistics creates time utility by having goods and services available when demanded.

▼▼ Logistics creates time utility by inventory management, transportation management, and strategic location of goods and services.

%4 = Possession utility (why)

▼▼ Created through the basic marketing activities related to the products and services promotion

%4 = These economic utilities are also referred to as the seven 'R's namely, Right product, Right quantity, Right condition, Right place, Right time, Right customer, and Right cost as shown in fig. 5.3.

Economic impacts of logistics

The economic impacts of logistics include the economic development and specialisation, variety of goods, prices and land values.

%4 = Economic development and specialisation

▼▼ For economic development, investment in transportation is an essential part.

▼▼ The extent of market can be determined by logistics.

%4 = Variety of goods

▼▼ Logistics capabilities enable the ability to provide a wide variety of goods.

%4 = Prices

▼▼ Logistics represents about 10% of gross domestic product.

▼▼ It also represents a much larger percentage of the value of many products and services.

%4 = Land values

▼▼ If there is access to transportation service, it affects the economic potential of land.

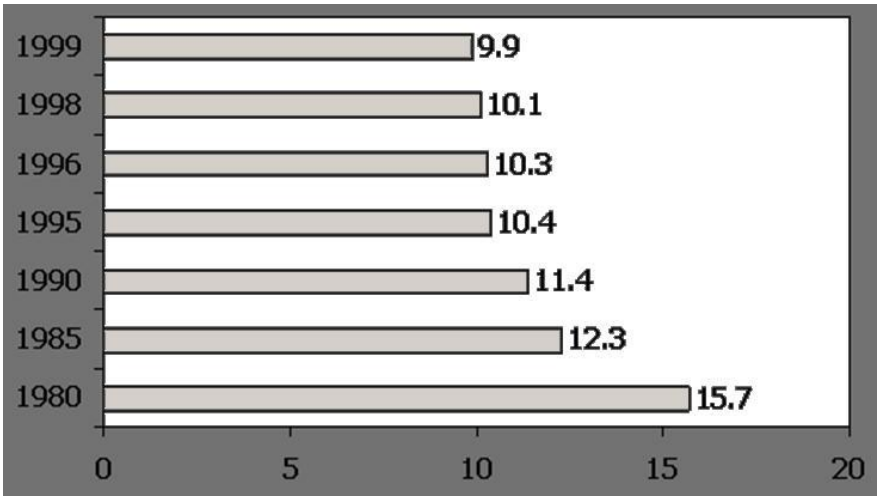


Fig. 7.1 Logistics costs as a percentage of GDP

(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

%4 = As indicated in above figure, logistics costs as a percentage of gross domestic product (GDP) have declined from 16 percent in 1980, to under 10 percent in 1999. Early to mid-1970s saw the figure closer to 20 percent.

%4 = This reflects a serious improvement in the efficiency of logistics systems.

7.2.2 Micro Dimensions

The micro dimensions of logistics are categorised as interfaces with operations or manufacturing and interfaces with marketing.

Logistics interfaces with operations/manufacturing

The logistics interfaces with operations or manufacturing include the length of production run, seasonal demand, supply-side interface and protective packaging.

%4 = Length of production run

▼▼ Previously, the firms sought production economies by producing large volumes each time they had a production line setup or changeover. However, this led to very large inventory levels move to "pull" systems rather than "push" systems.

▼▼ On markets the consumers usually "pulls" the goods or information they demand for their needs, while the offers or suppliers "pushes" them toward the consumers.

▼▼ The push strategy in marketing can be found in the communication (either interactive or non-interactive)

between seller and buyer. For example, if the seller makes his promotion by television or radio, it's not possible for the buyer to interact with. On the other hand, if the communication is made by phone or internet, the buyer has possibilities to interact with the seller.

▼▼ In the first case information is just "pushed" toward the buyer, while in the second case it is possible for the buyer to demand the needed information according to his requirements.

▼▼ In a "pull" system the consumer requests the product and "pulls" it through the delivery channel.

▼▼ For example, a mobile manufacturing company assembles parts to produce mobile phone. The process before production of the phone is push process but the process after production is pull process, as the manufacturer is predicting that the product will be accepted. As the customer orders for mobile phone it will become Pull Process.

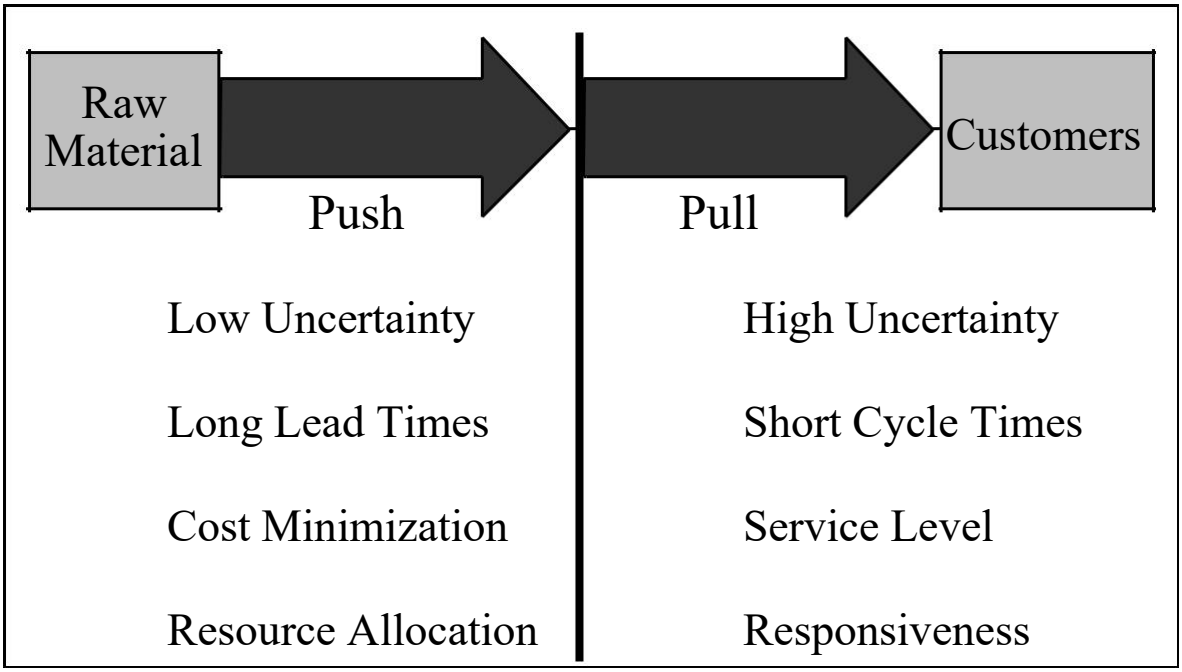


Fig. 7.2 Push and pull systems in supply chain
(Source: http://www.personal.psu.edu/faculty/a/c/acc10/CHAP02.ppt)

%4 = Seasonal demand
▼▼ build-up of seasonal inventories to meet demand and to smooth production

%4 = Supply-side interface
▼▼ materials management
▼▼ supplier relations is critical to efficient production and logistics
▼▼ logisticians involved in production scheduling

%4 = Protective packaging
▼▼ most firms consider this a logistics activity

Logistics interfaces with marketing

The logistics interfaces with marketing include the price, product, promotion, place and customer services.

%4 = Price
▼▼ The product pricing schedule is often tied to transportation pricing schedule (i.e., price discounts occur for product given at volumes where transportation price discounts are present)
▼▼ The logistics costs must be included in the product price.

%4 = Product

▼▼ The size, shape, weight (density), packaging, and other physical characteristics affect logistics. For example, any product size and weight affects transportation and storage.

▼▼ Industrial packaging is done because of product protection and security

%4 = Promotion

▼▼ The promotion campaigns need to be coordinated with logistics staff.

%4 = Place

▼▼ The logistics interfaces with marketing also refers to the distribution channels decisions (e.g., sell through wholesalers or direct to retailers)

%4 = Customer service is the output of logistics. It depends upon following factors: ▼▼ time

▼▼ dependability

▼▼

communications

▼▼ convenience

7.3 Logistics Activities

The logistics activities are listed below:

%4 = Transportation is the physical movement or flow of goods

▼▼ mode and transport service selection ▼▼ carrier routing

▼▼ vehicle scheduling

▼▼ equipment selection ▼▼ claims processing

%4 = Storage includes inventory management and warehousing ▼▼ space determination

▼▼ stock layout and dock design

▼▼ warehouse configuration

▼▼ stock placement

%4 = Packaging is affected by product and transportation

▼▼ design for handling

▼▼ storage

▼▼ protection from loss and damage

%4 = Materials handling in movement, from, and within a warehouse ▼▼ equipment selection

▼▼ equipment replacement policies ▼▼ order picking policies

▼▼ stock storage and retrieval

%4 = Order fulfilment: completing customer orders, affects lead time

%4 = Forecasting: predicting inventory necessary to fulfil customer demand

%4 = Production planning: product necessary to cover market

%4 = Information maintenance

▼▼ information collection, storage, and manipulation

▼▼ data analysis

▼▼ control procedures

%4 = **Purchasing**

▼▼ supply source selection

▼▼ purchase timing

▼▼ purchase quantities

%4 = Inventory management: raw material and finished goods

▼▼ stocking policies

▼▼ short-term sales forecasting

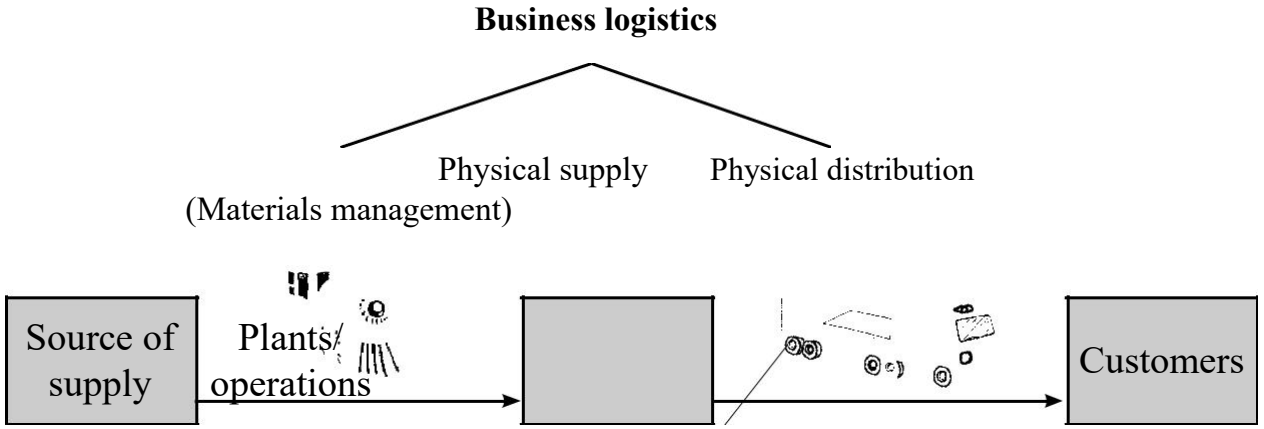
▼▼ product mix at stocking points

▼▼ number, size and location of stocking points

▼▼ just in time, push and pull strategies

%4 = Customer service

%4 = Site location



%4	=	Transportation	%4	=	Transportation
%4	=	Inventory maintenance	%4	=	Inventory maintenance
%4	=	Order processing	%4	=	Order processing
%4	=	Acquisition	%4	=	Product scheduling
%4	=	Protective packaging	%4	=	Protective packaging
%4	=	Warehousing	%4	=	Warehousing
%4	=	Materials handling	%4	=	Materials handling
%4	=	Information maintenance	%4	=	Information maintenance

Fig. 7.3 Logistic activities

(Source: http://info.cba.ksu.edu/ehie/faculty%20site%20templates/mangt%20662/sc-strategy&e-scm.ppt)

%4 = For example, every month the Toyota distribution moves more than 8 million parts and accessories. It is a 30 year old distribution network. This resulted in two distribution centres, one in California, another in Kentucky, feeding nine smaller distribution centres located around the country. Thus, the new network both improved customer service and lowered costs.

7.4 Approach to Analysing Logistics Systems

%4 = Any system is a set of interacting elements, variables, parts or objects that are functionally related to one another and that form a coherent group. Logistics can be classified into:

▼▼ Materials Management (Inbound Logistics)

▼▼ Physical Distribution (Outbound Logistics)

%4 = Inbound Logistics involves the processes from the purchase of raw material till it reaches manufacturing unit. The departments which are involved in-bound logistics are:

▼▼ purchasing department ▼▼ warehouse ▼▼ manufacturing unit

%4 = Outbound Logistics delivers the finished goods or product to the customer as per their requirement. It is their responsibility to determine the shortest route through which transportation cost is the minimum.

%4 = Usually the movement and storage of raw materials in a company is very different from the movement and storage of finished products. For example, a steel company may move required raw materials of iron ore and coal by large rail carload. Storage may require land where these items can be dumped and piled for future use.

On the other hand, the finished steel will very often be moved by motor carrier, and the storage will require an enclosed facility for protection against the elements and, perhaps, elaborate materials handling equipment.

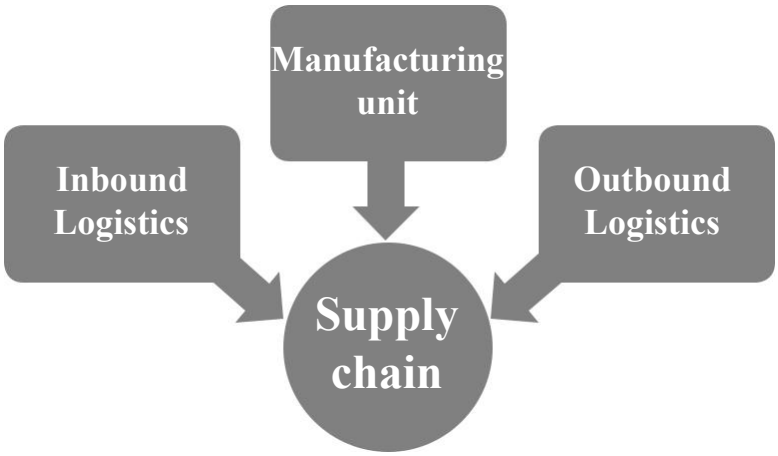


Fig. 7.4 Inbound and outbound logistics

%4 = The movement and storage of raw materials is extremely different from the movement and storage of finished goods.

%4 = This classification is very useful to logistics management.

%4 = From the inbound and outbound requirements perspective, there are four different classifications of logistics system:

▼▼ Balanced system: Companies receive supplies from various vendors in different locations and ship to various customers in different locations, e.g., consumer products.

▼▼ Heavy inbound: The process requires no warehousing, special transportation arrangements, or packaging. In contrast, the inbound side requires detailed scheduling, coordination, and planning to ensure that parts arrive in time. Aircraft companies use thousands of parts manufactured by hundreds of vendors to assemble and produce a finished airplane. Once the airplane is finished and tested, the company simply flies it to the customer e.g. aircraft, construction.

▼▼ Heavy outbound: A wide variety of industrial and consumer products are produced that need storage, packaging, and transportation to the final customer. Therefore, in a company with heavy outbound, the physical distribution side of logistics system is more complex e.g. chemicals companies like Dow.

▼▼ Reverse systems: Some companies have reverse flows on the outbound side of their logistics systems. In the companies producing durable products that the customer may return for trade-in, for repairs, or for disposal. Companies that produce computers, telephone equipment, and copy machines have these characteristics. Increased concern with the environment will require more companies to develop reverse logistics systems to dispose of packaging materials on used products e.g. returnable products.

%4 = Trade-offs

▼▼ To make it easier to study cost trade-offs between the centres, logistics activities are treated as cost centres.

Cost Centers	Rail	Motor
Transportation	$ 3.00	$ 4.20
Inventory	5.00	3.75
Packaging	4.50	3.20
Warehousing	1.50	.75
Cost of Lost Sales	2.00	1.00
Total Cost	$ 15.00	$ 13.00

Table 7.1 Analysis of total logistics cost with a change to higher cost mode of transport
(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

Cost Centers	System 1	System 2
	Three Warehouses	Five Warehouses
Transportation	$ 850,000	$ 500,000
Inventory	1,500,000	2,000,000
Warehousing	600,000	1,000,000
Cost of Lost Sales	350,000	100,000
Total Cost	$ 3,300,000	$ 3,600,000

Table 7.2 Analysis of total logistics cost with a change to more warehouses
(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

%4 = Nodes versus Links

▼▼ Nodes are spatial points (warehouses, plants, etc.)

▼▼ Links are the transportation network (rail, motor, air, pipe and water).

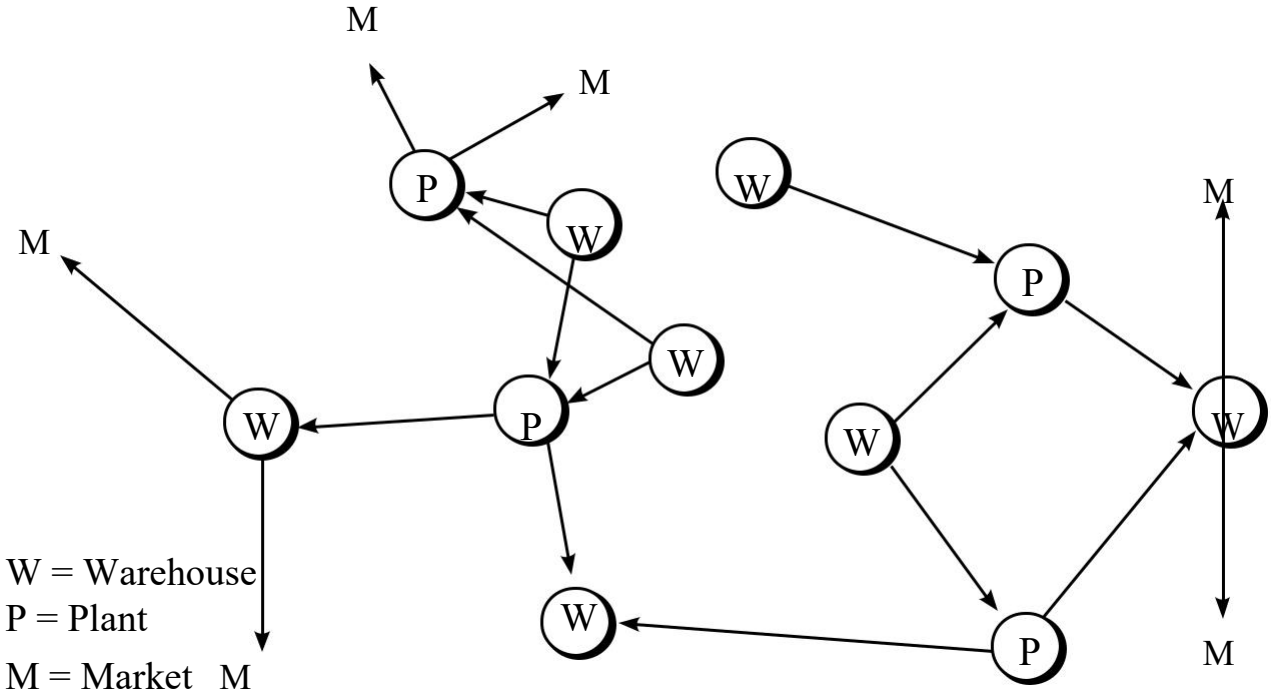


Fig. 7.5 Nodes and links in a logistics system

(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

%4 = Logistics channel

▼▼ The network of intermediaries involved in the logistics system.

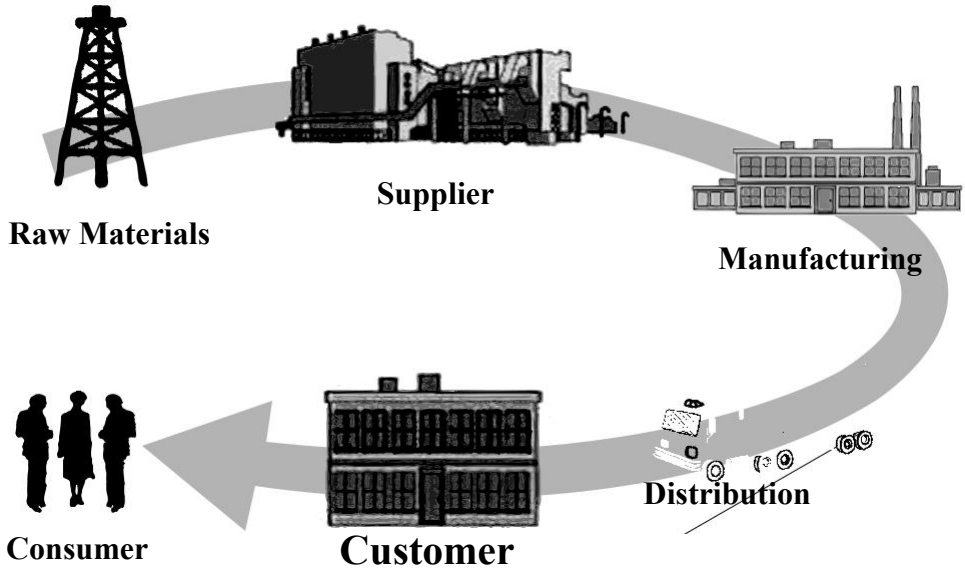


Fig. 7.6 A simple logistics channel

(Source: http://www.necareerguidance.com/category/sub_category.php?cat_id=111)

7.5 Logistics and Systems Analysis

%4 = Optimisation in supply chain is the application of processes and tools to ensure the optimal operation of a manufacturing and distribution supply chain. This includes the optimal placement of inventory within the supply chain, minimising operating costs (including manufacturing costs, transportation costs, and distribution costs). The logistics and system analysis is done in terms of cost and optimality.

%4 = Cost perspective

▼▼ The most efficient systems are not always comprised of each system component operating at its lowest possible cost.

▼▼ The critical concern is to have the entire system operating at its lowest total cost.

%4 = Level of optimality

▼▼ Logistics systems must work in harmony with marketing, finance, production, etc.

▼▼ This may result in sub-optimal logistics performance.

7.6 Techniques of Logistics System Analysis

There are two techniques of total cost analysis for logistics systems.

%4 = Short-run/static analysis

▼▼ The costs associated with various interrelated logistics activities such as transportation, warehousing, inventory, materials handling, and industrial packaging are calculated.

▼▼ This cost information for each system is developed and the one with the lowest overall cost within the constraints of the company's logistics area is found out.

▼▼ This method is also referred to as static analysis since it analyses costs associated with a logistics system's various components at one point in time or at one output level.

▼▼ This can be illustrated with the help of an example. ABC is a firm which uses first method in which all rail routes from the manufacturing plant and the associated plant warehouse to the customers. At the plant warehouse, the chemicals are bagged and then shipped by rail to the customer. In another method, ABC uses the market oriented warehouse in which the goods would be shipped from the plant to the market warehouse and then packaged and sent to the customer. Thus, instead of shipping all goods by rail, the company would ship them by barge to the warehouse, taking advantage of low bulk rates. Then, after bagging, the chemicals would move by rail from the warehouse for shipping to the customer.

▼▼ Thus, the technique chooses the short run situation and selects the system with the lowest overall cost.

Plant Logistics Costs*	System 1	System 2
Packaging	$ 500	$ 0
Storage and handling	150	50
Inventory carrying	50	25
Administrative	75	25
Fixed cost	4,200	2,400
Transportation Costs*		
To market warehouse	0	150
To customer	800	100
Warehouse Costs*		
Packaging	0	500
Storage and handling	0	150
Inventory carrying	0	75
Administrative	0	75
Fixed cost	0	2,400
Total cost*	$ 5,775	$5,950
*In thousands of dollars.		

Table 7.3 Static analysis of C & B chemical company (50,000 pounds of output)

(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

%4 = **Long-run/dynamic analysis**

▼▼ This is a mathematical method to calculate the point of equality between the two systems.

▼▼ For example, suppose there are two systems1 and 2, equal at about 70,500 pounds of output. If a graph is used to determine the equality point, the accuracy is difficult.

▼▼ The equation for a straight line (y = a + bx) is considered in mathematical solution, where

"a" = fixed costs

"b" = variable cost per unit

" x"= output level

▼▼ Since, the two systems are equal at some point, the two equations are set up as equal and the cost information is used to solve these equations.

▼▼ Known is the fact that at approximately 70,500 pounds, the two systems are equal, and a point of indifference is seen between the two systems.

System 1

If, Total cost = fixed cost + variable cost/unit × number of units

Then, y = 4,200 + 0.0315x ------ equation 1

System 2

▼▼ y = 4,800 + 0.0230x ----------equation 2

▼▼ Trade-off point

▼▼ 4,800 + 0.0230x = 4,200 + 0.0315x (equation 1 = equation 2)

▼▼ 600 = 0.0085x

▼▼ x = 70,588 pounds

7.7 Factors Affecting the Cost and Importance of Logistics

The factors affecting the cost and importance of logistics are:

%4 = Competition via customer service is an important factor affecting logistics. ▼▼ The shorter the order cycle, less inventory is required.

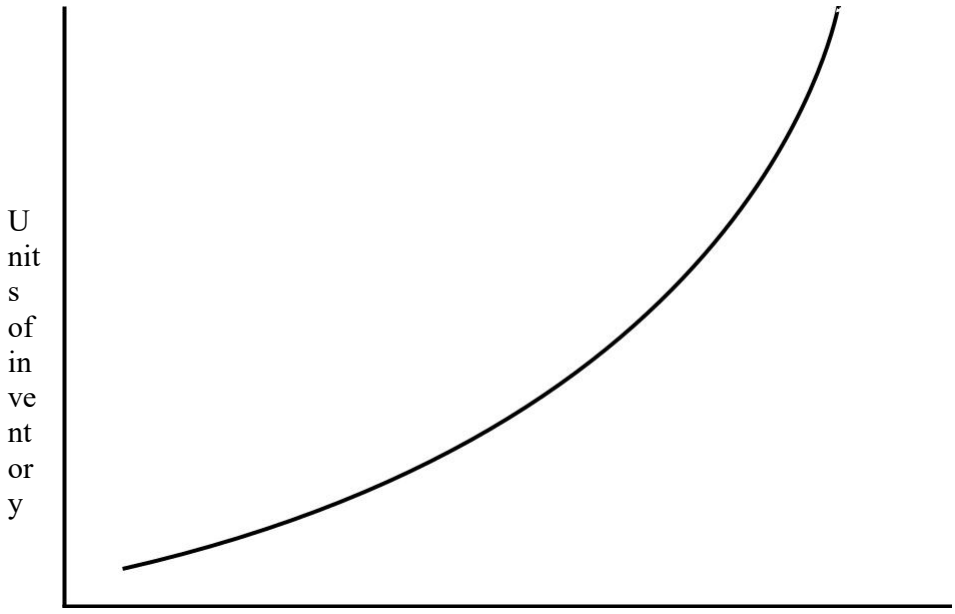


Fig. 7.7 Relationship between required inventory and order cycle length

(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

▼▼ The more substitutable product, the higher customer service level is required.

▼▼ Increase in inventory reduces cost of lost sales.

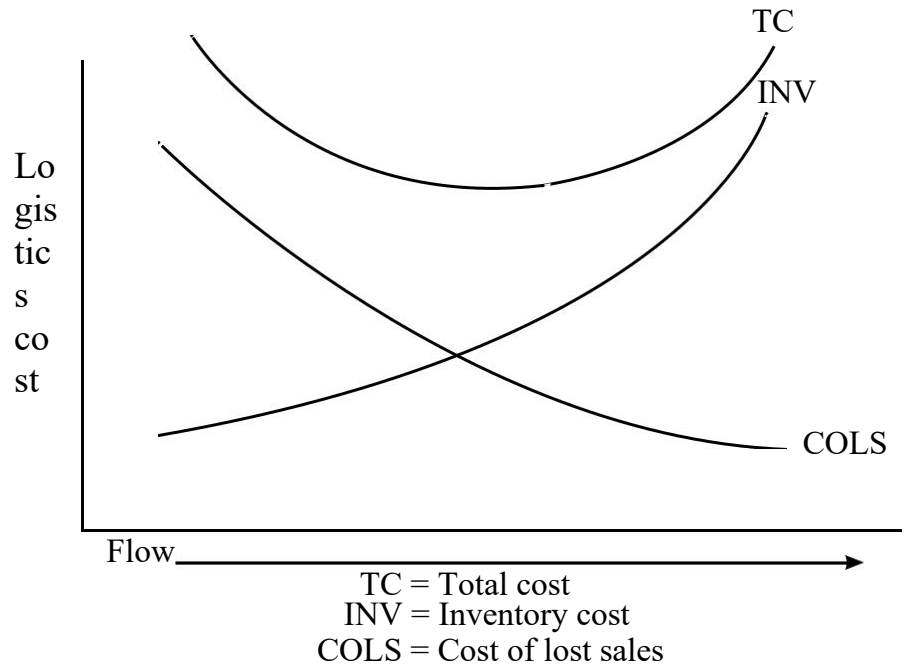


Fig. 7.8 Relationship of the cost of lost sales to inventory cost
(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

▼▼ Increased transportation costs reduces cost of lost sales.

%4 = The final product also affects the logistics.

%4 = As the dollar value goes up, cost of warehousing, transportation and inventory increases.

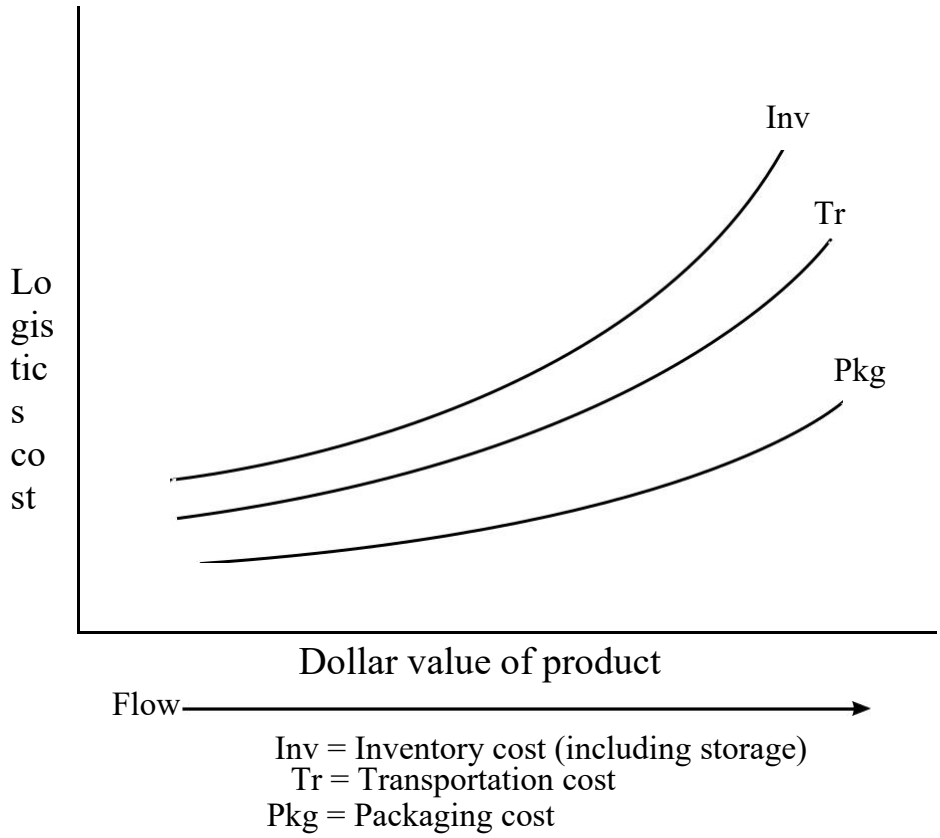


Fig. 7.9 Relationship of product dollar value to various logistics costs
(Source: http://www.swlearning.com/quant/coyle/seventh_edition/powerpoint/ch02.ppt)

%4 = The higher the density, there is more efficient use of warehouse and transportation space.

%4 = If the risk of damage is greater, the transportation and warehousing cost is higher.

%4 = Special handling requirements, spatial relationships and distance are other factors affecting the cost and importance of logistics.

Summary

%4 = Effective logistics system contributes immensely to the achievements of the business and marketing objectives of a firm.

%4 = An efficient system of physical distribution/logistics has a great potential for improving customer service and reducing costs.

%4 = The macro dimension of logistics are categorised as value added role and economic impacts.

%4 = On markets the consumers usually "pulls" the goods or information they demand for their needs, while the offers or suppliers "pushes" them toward the consumers.

%4 = The logistics interfaces with marketing include the price, product, promotion, place and customer services.

%4 = Static analysis method analyses costs associated with a logistics system's various components at one point in time or at one output level.

%4 = Some companies have reverse flows on the outbound side of their logistics systems.

%4 = Companies that produce computers, telephone equipment, and copy machines have these characteristics. Increased concern with the environment will require more companies to develop reverse logistics systems to dispose off packaging materials on used products. e.g., returnable products.

%4 = Optimisation in supply chain is the application of processes and tools to ensure the optimal operation of a manufacturing and distribution supply chain. This includes the optimal placement of inventory within the supply chain, minimising operating costs (including manufacturing costs, transportation costs, and distribution costs).

%4 = The higher the density, there is more efficient use of warehouse and transportation space. If the risk of damage is greater, the transportation and warehousing cost is higher.

%4 = Special handling requirements, spatial relationships and distance are other factors affecting the cost and importance of logistics.

References

%4 = Conrad A., Dimensions of Logistics [Online]. Available at: <http://www.personal.psu.edu/faculty/a/c/acc10/ CHAP02.ppt. [Accessed 15 March 2011].

%4 = Dimensions of Logistics [Online]. Available at: <http://www.scribd.com/doc/7918106/Dimensions-of-Logistics>. [Accessed 14 March 2011].

%4 = Push–pull strategy [Online]. Available at: <http://en.wikipedia.org/wiki/Push%E2%80%93pull_strategy>. [Accessed 14 March 2011].

%4 = Supply Chain Strategies & e-Business Supply Chain [Online]. Available at: <http://info.cba.ksu.edu/ehie/ faculty%20site%20templates/mangt%20662/sc-strategy&e-scm.ppt>. [Accessed 14 March 2011].

%4 = Supply chain [Online]. Available at: < http://pradipsuryavanshi.blogspot.com/>. [Accessed 14 March 2011].

%4 = Supply and demand [Online]. Available at: <http://en.wikipedia.org/wiki/Supply_and_demand>. [Accessed 15 March 2011].

%4 = *Logistics* [Online]. Available at: <http://www.stat.mq.edu.au/Stats_docs/stat321/Wk9Handout.pdf>. [Accessed 13 March 2011].

%4 = Coyle J. J., & Langley J.C., 2008. Supply chain management: a logistics perspective, 8th ed., Cengage Learning, pp.47-65.

Recommended Reading

%4 = Christopher M., 2011. *Logistics and Supply Chain Management*, FT Press, 4th ed., p.288.

%4 = Donald C. & Waters J., 2003. *Logistics: an introduction to supply chain management,* Palgrave Macmillan, p.354.
%4 = Rushton A., Croucher P., Baker P., 2006. *The handbook of logistics and distribution management*, Kogan Page Publishers, 3rd ed., p.612.

Self Assessment

%4 = _____in supply chain is the application of processes and tools to ensure the optimal operation of a manufacturing and distribution supply chain.

Optimisation

Forecasting

Collaboration

Planning

%4 = In _____, companies receive supplies from various vendors in different locations and ship to various customers in different locations.

heavy inbound

balanced system

heavy outbound

reverse systems

%4 = To make it easier to study cost trade-offs between the centres, logistics activities are treated as _____.

distribution centres

links

cost-centres

nodes

%4 = Which are the spatial points in logistics system?

Links

Stocks

Nodes

Channels

%4 = _____ involves predicting inventory necessary to fulfill customer demand.

Forecasting

Planning

Collaboration

Order fulfilment

%4 = Which of these is not a factor of customer service?

Time

Promotion

Dependability

Communications

%4 = Which of the following statements is false?

The logistics activities include transportation, warehousing, inventory, materials handling, and industrial packaging.

Order fulfilment in supply chain is the application of processes and tools to ensure the optimal operation of a manufacturing and distribution supply chain.

The most efficient systems are not always comprised of each system component operating at its lowest possible cost.

Logistics systems must work in harmony with marketing, finance, production, etc.

%4 = Which of the following statements is false?

The logistics interfaces with marketing also refer to the distribution channels decisions (e.g., sell through wholesalers or direct to retailers).

The promotion campaigns need to be coordinated with logistics staff.

The logistics costs should never be included in the product price.

Industrial packaging is done because of product protection and security.

%4 = Logistics represents about _____ of gross domestic product.

10%

90%

2%

19%

%4 = The extent of market can be determined by_____.

production costs

logistics

stock-outs

demand

Chapter VIII

Demand Management and Customer Service

Aim

The aim of this chapter is to:

%4 = define demand management

%4 = explain the importance of customer service in competitive market

%4 =understand the concept of collaborative planning, forecasting and replenishment

Objectives

The objectives of this chapter are to:

%4 = describe the concept of forecasting error

%4 = explain the forecasts that may be needed in demand management

%4 = state different steps in demand management

Learning outcome

At the end of this chapter, the students will be able to:

%4 = understand the supply and demand relationship

%4 = explain different channels of distribution of goods

%4 = describe the effective demand management

8.1 Introduction

A market is a group of buyers and sellers of a particular product or service. Supply and demand is the most useful model for a competitive market, and shows how buyers and sellers interact in market. Whatever be the reasons, one element that is always present is price. If the price is too low, sellers will not sell. If the price is too high, buyers will not buy. Prices play a crucial role in our economic system. Demand management activities in any global supply chain consist of three activities: demand management, demand planning, and sales forecasting management. The Law of Demand states that "Quantity demanded varies inversely with (in the opposite direction to) changes in price". Thus, buyers will purchase more of an item at a lower price and less at a higher price.

8.2 Outbound to Customer Logistics Systems

%4 = To increase levels of customer service, significant emphasis is placed on outbound-to-customer logistics systems.

%4 = These systems refer to the set of processes, systems and capabilities that enhance the firm's ability to serve its customers.

%4 = This involves the study of physical distribution, logistics and supply chain management.

8.3 Supply and Demand Relationship

%4 = Demand refers to how much (quantity) of a product or service is desired by buyers. The quantity demanded is the amount of a product, people are willing to buy at a certain price; the relationship between price and quantity demanded is known as the demand relationship.

%4 = Supply represents how much the market can offer. The quantity supplied refers to the amount of a certain good, the producers are willing to supply when receiving a certain price. The correlation between price and how much of a good or service is supplied to the market is known as the supply relationship.

%4 = Price, therefore, is a reflection of supply and demand.

%4 = The determinants of supply are:

▼▼ production costs

▼▼ the technology used in production

▼▼ the price of related goods

▼▼ firm's expectations about future prices

▼▼ number of suppliers

%4 = The determinants of demand are: ▼▼ income

▼▼ tastes and preferences

▼▼ prices of related goods and services

▼▼ buyer's expectations about future prices

▼▼ number of buyers

%4 = Supply and demand determines price in a market.

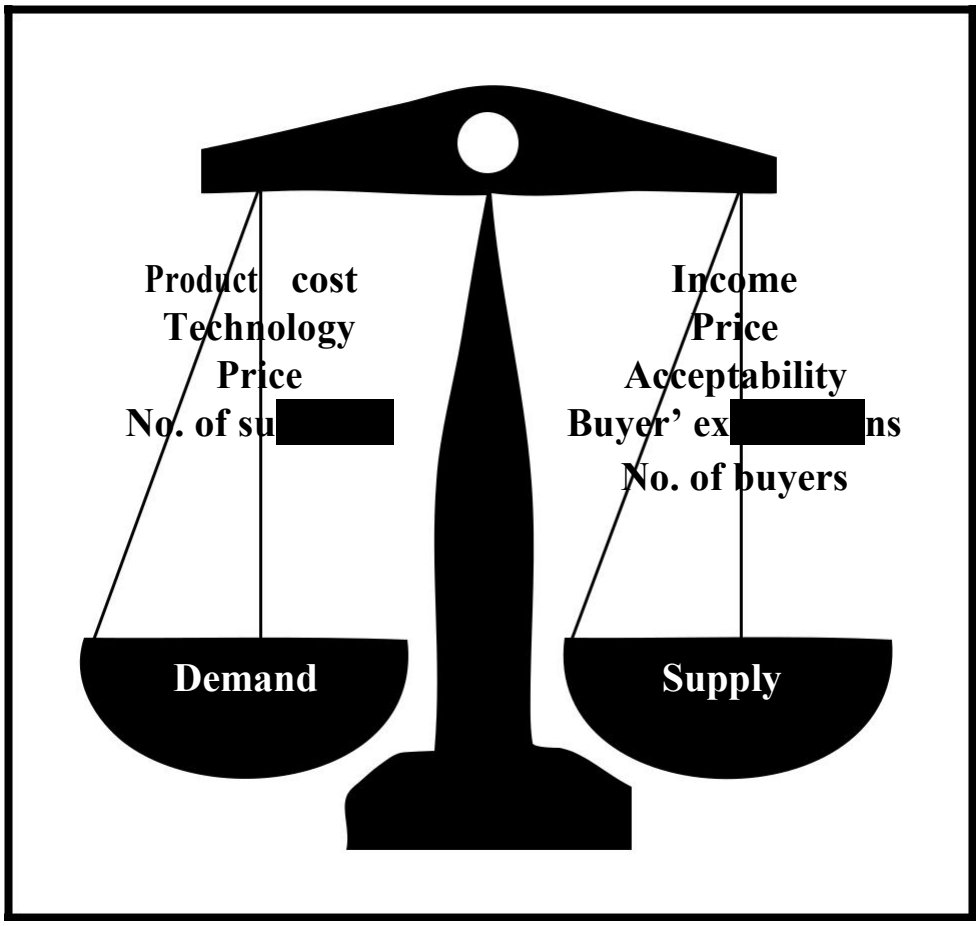


Fig. 8.1 Supply and demand balance
(Source: http://www.therealestatefoundation.com/real-estate-investment-economics/low-prices-and-high-housing-inventory-profit-potential-or-losing-proposition/)

%4 = In a competitive market, the unit price for a particular good varies until it settles at a point where the quantity demanded by consumers (at current price) will equal the quantity supplied by producers (at current price), resulting in an economic equilibrium of price and quantity.

%4 = The four basic laws of supply and demand are:

▼▼ If demand increases and supply remains unchanged, then it leads to higher equilibrium price and quantity.

▼▼ If demand decreases and supply remains unchanged, then it leads to lower equilibrium price and quantity.

▼▼ If supply increases and demand remains unchanged, then it leads to lower equilibrium price and higher quantity.

▼▼ If supply decreases and demand remains unchanged, then it leads to higher price and lower quantity.

8.4 Graphical Representation of Supply and Demand Relationship

%4 = The supply-demand model represents the determination of the price of a particular good and the quantity of that good which is traded.

%4 = The standard graphical representation, usually credited to Alfred Marshall, has price on the vertical axis and quantity on the horizontal axis.

%4 = When supply and demand are equal (i.e., when the supply function and demand function intersect) the economy is said to be at equilibrium.

%4 =At this point of equilibrium, the allocation of goods is at its most efficient because the amount of goods being supplied is exactly the same as the amount of goods being demanded. Thus, everyone (individuals, firms, or

countries) is satisfied with the current economic condition.

%4 = At the given price, suppliers are selling all the goods that they have produced and consumers are getting all the goods that they are demanding.

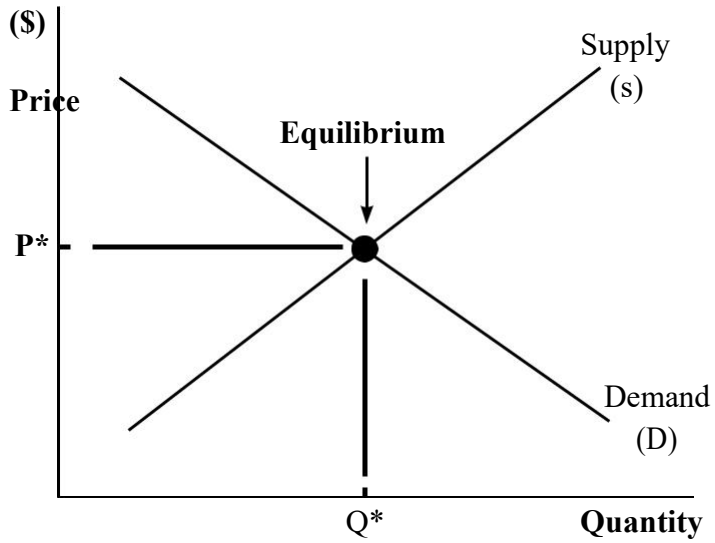


Fig. 8.2 Supply and demand equilibrium
(Source: http://www.investopedia.com/university/economics/economics3.asp)

%4 = Changes in supply and demand can be short run or long run in nature.

%4 = Weather tends to influence market prices generally in the short run. Changes in consumer preferences can have either a short run or long run effect on prices depending upon the goods or services. They are categorised based on importance of product i.e., luxuries or necessities.

%4 = A luxury good may enjoy a short term shift in demand due to changing styles or appeal while necessities tend to have stable or long run demand curves.

%4 = Another major factor influencing market prices is technology. A major effect of technology in agriculture is to shift out the supply curve rapidly by reducing the costs of production on a per unit basis.

%4 = Here is an example to illustrate the law of supply and demand. For a particular Saturday night, the willingness of particular restaurants to supply a nice dinner for two and the willingness of couples to dine out is observed, depending on the price of the dinner.

%4 = There are five restaurants, each with a seating capacity of 30 couples. One restaurant is willing to supply a nice dinner for $15 a couple, but the others require higher prices. If the price were $15, everyone would show up at the one restaurant, so that it would have a very long line. Only 30 lucky couples would get to eat.

%4 = There are 250 couples willing to go out for dinner, if the price were as low as $12 a couple. Twenty couples would be willing to pay as much as $80, but everyone else requires lower prices. Here is the whole picture.

Price of Dinner for Two	Supply offered by Restaurants	Demand from Consumers
$12	0	250
$15	$30	200
$25	$60	140
$35	$60	60
$45	$90	50
$65	$120	40
$80	$150	20

Table 8.1 Demand fluctuations based on price and supply

%4 = The price P of a product is determined by a balance between production at each price (supply S) and the desires of those with purchasing power at each price (demand D). The diagram shows a positive shift in demand from D1 to D2, resulting in an increase in price (P) and quantity sold (Q) of the product.

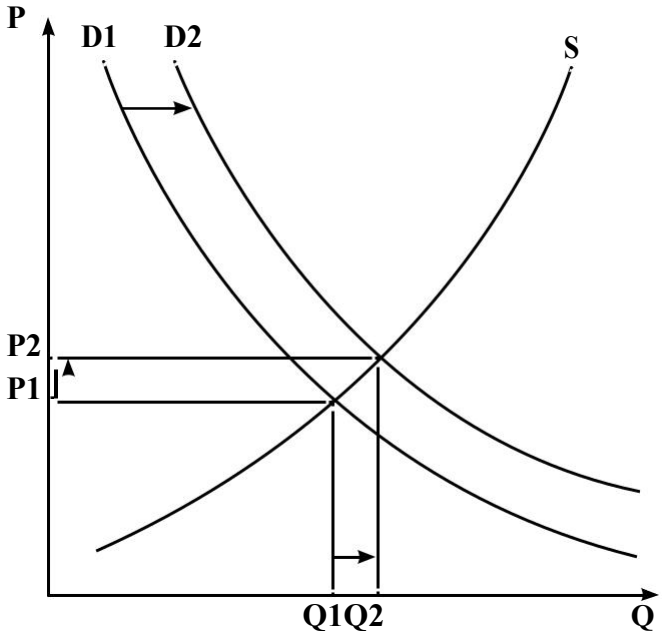


Fig. 8.3 Shift in demand
(Source: http://sustainabilitynz.blogspot.com/2009/05/economicssupply-and-demand.html)

8.5 Demand Management

%4 = Demand management is the supply chain management process that balances the customer's requirements with the capabilities of the supply chain.

%4 = Managing supply with demand factors are essential using the right process, forecasting and executing the plan with minimal disruptions.

%4 = It includes synchronising supply and demand, increasing flexibility and reducing variability.

%4 = Demand chain management is the management of upstream and downstream relationships between suppliers and customers to deliver the best value to the customer at the least cost to the demand chain as a whole.

%4 = The organisation's supply chain processes are managed to deliver best value according to the demand of the customers.

%4 = Successful demand management requires not only to provide more customer services, but also to provide:

▼▼ effective service outcomes to meet identified community needs

▼▼ assess if this need is changing

▼▼ to respond appropriately and within the available resources

%4 = Demand management is a key element of reform in the resource planning and management process.

%4 = Demand can be managed in a variety of ways:

▼▼ Reduction in need for the service. For example, actions to raise awareness of the benefits of pregnant women taking foliate will reduce the need for medical and social support for children with neural tube defects.

▼▼ Alteration of ways to meet the needs to reduce pressure on available resources. For example, trialling different accommodation alternatives to reduce the demand for individual accommodation units.

▼▼ Education and awareness of consumers to limit consumption. For example, educating water users to save water during droughts has led to significant reduction in demand.

▼▼ Mechanisms of pricing. For example, charging consumers a truer price for water encourages more responsible use and may reduce the demand.

▼▼ Service delivery levels revision. For example, the threshold at which benefits become available or the level at which benefits are provided will be changed.

▼▼ Imposing legal penalty. For example, fines can be imposed for use of fixed sprinklers during the evening to reduce demand for additional reservoir pumping capacity.

8.5.1 The Demand Management Process

%4 = Demand management involves a number of key steps within the characteristic phases of any strategic management process which are, preparation, analysis, planning and implementation.

%4 = The preparation phase involves gaining a proper understanding of your clients together with establishing the true costs of providing service.

%4 = This provides the basic information for the analysis and planning phase in which the demand is clearly identified and a response to its management formulated.

%4 = In the implementation phase, a plan is prepared documenting the process stages including procedures for implementation, monitoring and evaluation of the defined Demand Management response.

%4 = The benefits of demand management can be summarised as improving value for money spent on services through:

▼▼ more efficient allocation of resources to programs and projects of greatest need

▼▼ reduced waste and misuse of resources by reducing the provision of unnecessary services by communicating (through charges, education or other means) the true cost of the service

▼▼ deferred capital and recurrent expenditures by reducing excessive consumption

▼▼ greater client participation and control over the cost of the service

%4 = For example, the Sydney harbour tunnel has reduced traffic delays and travel times. It has also provided the opportunity to dedicate one lane of the Harbour Bridge for buses. In the long term, the resulting shorter bus travel times will encourage public transport reducing the demand for further car crossings.

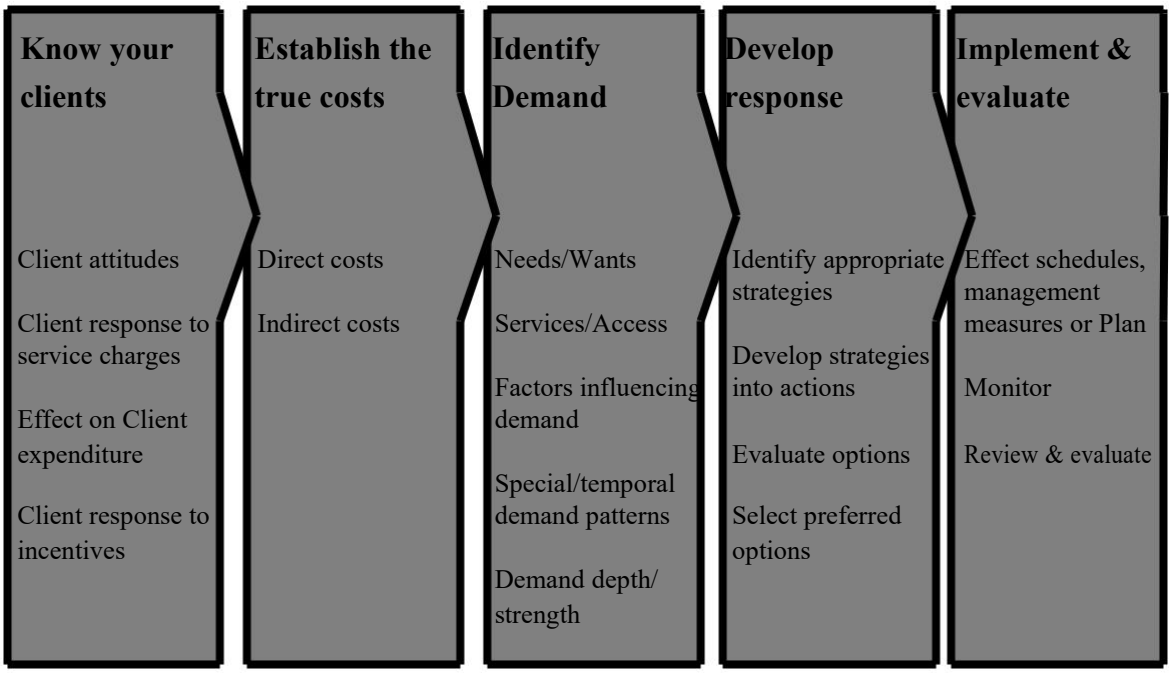


Fig. 8.4 Demand management process
(Source: http://www.treasury.nsw.gov.au/__data/assets/pdf_file/0003/5097/demand_management.pdf)

8.6 Demand Forecasting

%4 = Forecasting the future is a critical element of management decision making.

%4 = The final effectiveness of any decision depends upon the consequence of events following this decision.

%4 = Demand forecasting is the area of predictive analytics dedicated to understanding consumer demand for goods or services.

%4 = If the suppliers know how demand will fluctuate, they can keep the right amount of stock on hand. There can be two consequences.

%4 = If demand is underestimated, sales can be lost due to the lack of supply of goods.

%4 = If demand is overestimated, the supplier is left with a surplus that can also be a financial drain.

%4 = Demand forecasting involves techniques including both informal methods, such as educated guesses, and quantitative methods, such as the use of historical sales data or current data from test markets.

%4 = Demand forecasting may be used in making pricing decisions, in assessing future capacity requirements, or in making decisions on whether to enter a new market.

Necessity for forecasting demand

The need for demand forecast is due to stock and market response effects.

%4 = Stock effects

▼▼ Stock effects are those effects that inventory levels have on sales.

▼▼ Stock-outs are the extreme cases where the demand coming into store is not converted to sales due to a lack of availability. Demand is also untapped when sales for an item are decreased due to a poor display location, or because the desired sizes are no longer available. For example, in fashion retailing, once the stock level of a particular sweater falls to the point where standard sizes are no longer available, sales of that item are diminished.

%4 = **Market response effect**

▼▼ Market response effects are those effects of market events that are within and beyond a retailer's control.

▼▼ Demand for an item will likely rise if a competitor increases the price or if the item is promoted regularly. The resulting sales a change in demand as a result of consumers responding to stimuli that potentially drive additional sales. These forces need to be factored into planning and managed within the demand forecast.

8.7 Demand Planning

%4 = Demand planning improves the accuracy of forecasts.

%4 = The goal of demand planning is to improve production scheduling or inventory stocks, where each party in the supply chain does some processing on the demand signal.

%4 = A demand plan starts with a statistical forecast and adds intelligence through consensus management of the demand information process to develop an accurate demand forecast.

8.8 Demand Forecasting Error

%4 = Forecasting error is defined by The Association for Operations Management (APICS) as "the difference between actual and forecast demand, stated as an absolute value or as a percentage."

%4 = Forecast error is a point of reference of the variance between demand that was projected and actual demand that subsequently occurred.

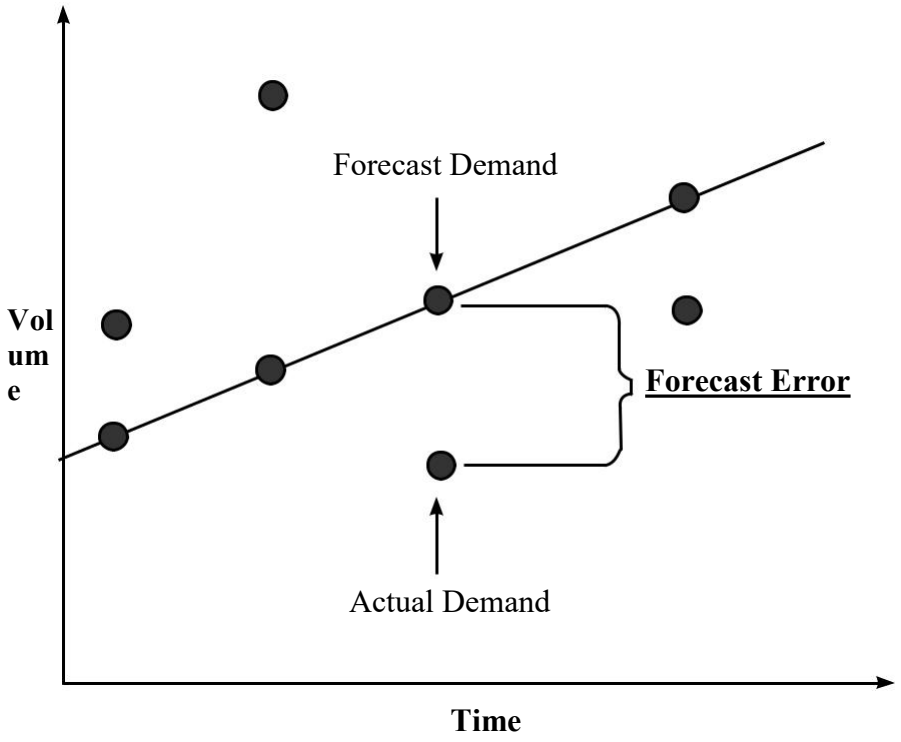


Fig. 8.5 Demand forecasting error

(Source: http://www.sdcexec.com/web/online/Demand-Management-Trends/Forecast-Fit-vs-Forecast-Error--Clarifying-the-Concepts--Understanding-the-Value/22$9933)

8.9 CPFR

%4 = Collaborative Planning, Forecasting and Replenishment (CPFR) is a concept that aims to enhance supply chain integration by supporting and assisting joint practices.

%4 = CPFR was launched in 1995 by Wal-Mart with the pharmaceutical group Warner Lambert. It seeks cooperative management of inventory through joint visibility and replenishment of products throughout the supply chain.

%4 = Planning and satisfying customer demands occur through a supportive system of shared information between

suppliers and retailers.

%4 = Continuous updating of inventory and upcoming requirements is possible, making the end-to-end supply chain process more efficient.

%4 = The CPFR process is divided into four steps:

▼▼ Strategy and planning: The ground rules for the collaborative relationship are established. Collaboration arrangement is the process of setting the business goals for the relationship, defining the scope of collaboration and assigning roles, responsibilities, checkpoints and growth procedures. The joint business plan identifies the significant events that affect supply and demand in the planning period, such as promotions, inventory policy changes, store openings or closings, and product introductions.

▼▼ Demand and supply management: Sales forecasting projects consumer demand at the point of sale. Order planning or forecasting determines future product ordering and delivery requirements based upon the sales forecast, inventory positions and transit lead times.

▼▼ Execution: Order generation includes transitions forecasts to firm demand. Order fulfilment is the process of producing, shipping, delivering, and stocking products for consumer purchase. The sales transactions are recorded and payments are made.

▼▼ Analysis: Monitor planning and execution activities for exception conditions i.e. exceptions management. Aggregate results are calculated. The active monitoring of planning and operations and performance assessment are the tasks included. For continuously improved results, plans are analysed.

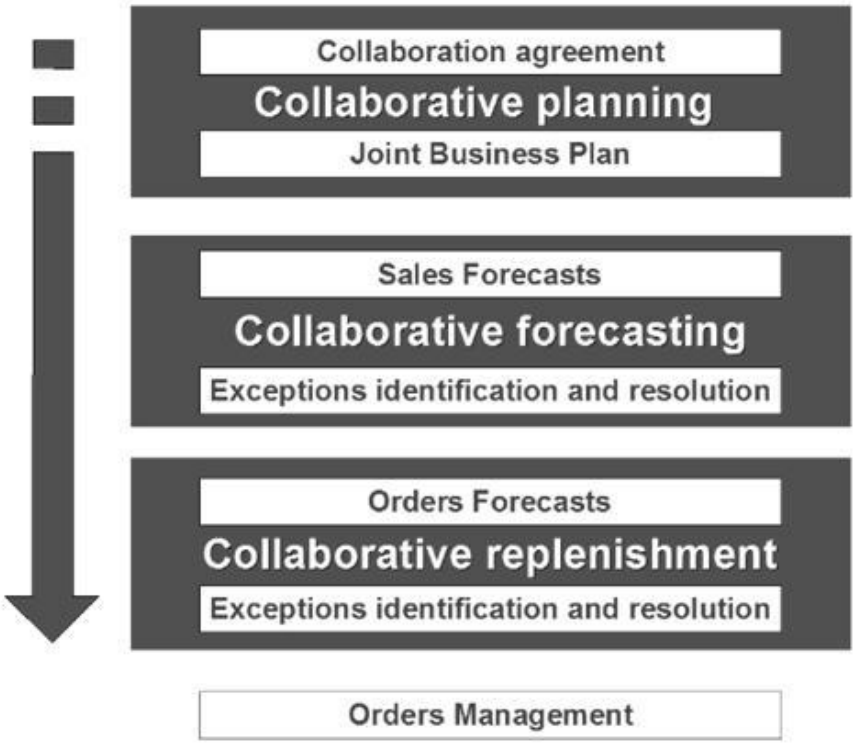


Fig. 8.6 Collaborative planning, forecasting and replenishment process (Source: http://www.free-logistics.com/index.php/Spec-Sheets/Forecasts-Supply-and-Inventory/CPFR-Collaborative-Planning-Forecasting-and-Replenishment.html)

8.10 Customer Service

%4 = Customer service is the provision of service to customers before, during and after a purchase.

%4 = According to Turban *et al.* (2002), "Customer service is a series of activities designed to enhance the level of customer satisfaction, i.e., the feeling that a product or service has met the customer expectation."

%4 = Customer service is an integral part of a company's customer value proposition.

%4 = Good customer service is the lifeblood of any business. It can bring back the customers.

%4 = The importance of customer service varies by product, industry and customer.

%4 = Customer service can be illustrated with the help of an example, such as defective or broken products can be **exchanged, often only with a receipt and within a specified time frame.**

%4 = Retail stores often have a desk or counters devoted to dealing with returns, exchanges and complaints, or perform related functions at the point of sale.

%4 = Customer service plays an important role to generate income and revenue of an organisation.

%4 = A customer service experience can change the entire perception a customer has of the organisation.

%4 = Customer relationship management (CRM) is a widely-implemented strategy for managing a company's interactions with customers, clients and sales prospects. It involves using technology to organise, automate, and synchronise business processes such as sales activities, marketing, customer service and technical support.

%4 = The overall goals are to:

▼▼ **find, attract and win new clients**

▼▼ take care and retain those clients that the company already has

▼▼ persuade former clients back

▼▼ reduce the costs of marketing and client service

%4 = Thus, the use of a CRM system grant several advantages to a company:

▼▼ **quality and efficiency**

▼▼ decreased costs

▼▼ decision

support ▼▼

enterprise agility

%4 = The high-quality customer service in the help desk is provided which requires much more than just technical troubleshooting skills. Employees must have excellent listening and communication skills, telephone skills, writing skills and they must be able to solve and prevent problems in the help desk. They should have the **ability to handle difficult customers and minimise stress during the workday besides increasing the level of** customer service they provide. These soft skills are often more important in ensuring a high level of customer satisfaction.

Fig. 8.7 Customer service strategy
(Source: http://www.nlighten.co.za/customer-service-strategy/)

8.11 Cost of Stock-outs

%4 = Stock-out is a situation where the demand or requirement for an item cannot be fulfilled from the current (on hand) inventory.

%4 = Stock-out costs are the costs associated with being unable to draw on a stock of raw material, work-in-progress or finished goods inventory (loss of sales, profits and goodwill, production dislocation).

%4 = The cost of a stock out is a critical to the implementation of any retail inventory model. Unless these costs are known, retailers cannot balance the costs (and risk) of holding inventory with the inevitable profits when an item is out of stock.

8.12 Channels of Distribution

%4 = Product distribution is one of the four elements of the marketing mix.

%4 = Distribution in supply chain management refers to the distribution of goods from one business to another. It can be factory to supplier, supplier to retailer, or retailer to end customer.

%4 = Distribution channel is the path through which the goods and services flow in a direction.

%4 = Each of the intermediaries is passing the product down the chain to the next. organisation, before it finally reaches the consumer or end-user.

%4 = Each of the elements in these distribution chains will have their own specific needs, which the producer must take into account, along with those of the all-important end-user.

%4 = A distribution channel can be as short as being direct from the vendor to the consumer or may include several inter-connected (usually independent but mutually dependent) intermediaries such as wholesalers, distributors, agents, retailers.

%4 = Each intermediary receives the item at one pricing point and moves it to the next higher pricing point until it reaches the final buyer.

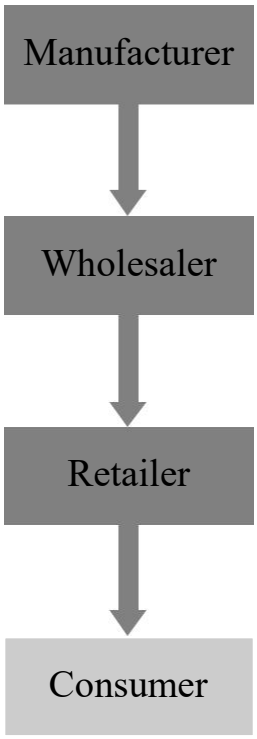


Fig. 8.8 Channels of distribution

(Source: http://www.mbaknol.com/marketing-management/concept-of-distribution-channels-in-marketing/)

%4 = Therefore, the channel serves to bridge the gap between the point of production and the point of consumption thereby creating time, place and possession utilities.

%4 = A channel of distribution consists of three types of flows:

▼▼ Downward flow of goods from producers to consumers

▼▼ Upward flow of cash payments for goods from consumers to producers

▼▼ Flow of marketing information in both downward and upward direction i.e.,

%4 = flow of information on new products, new uses of existing products, etc from producers to consumers

%4 = flow of information in the form of feedback on the wants, suggestions, complaints, etc. from consumers to producers

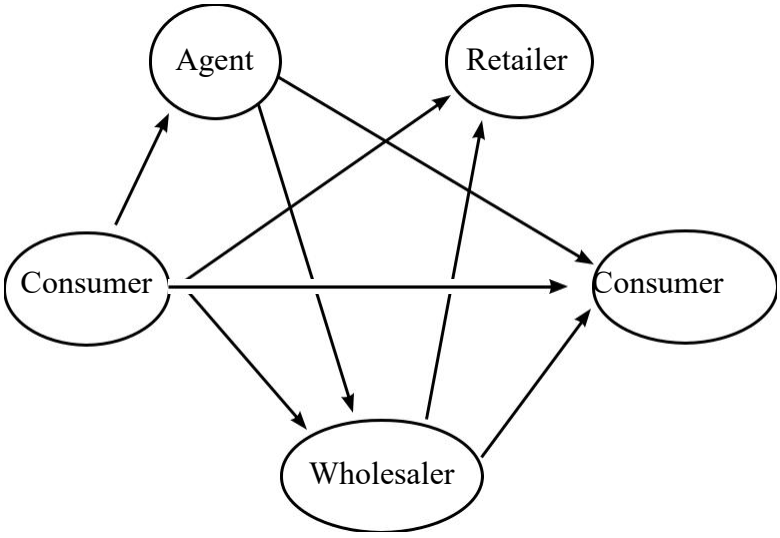


Fig. 8.9 Distribution network

(Source: http://www.nios.ac.in/Secbuscour/20.pdf)

Summary

%4 = The Law of Demand states that "Quantity demanded varies inversely with (in the opposite direction to) changes in price". Thus, buyers will purchase more of an item at a lower price and less at a higher price.

%4 = Demand refers to how much (quantity) of a product or service is desired by buyers. The quantity demanded is the amount of a product, people are willing to buy at a certain price; the relationship between price and quantity demanded is known as the demand relationship.

%4 = Demand management is the supply chain management process that balances the customers' requirements with the capabilities of the supply chain.

%4 = Managing supply with demand factors are essential using the right process, forecasting and executing the plan with minimal disruptions. It includes synchronizing supply and demand, increasing flexibility and reducing variability.

%4 = Demand chain management is the management of upstream and downstream relationships between suppliers and customers to deliver the best value to the customer at the least cost to the demand chain as a whole.

%4 = In a competitive market, the unit price for a particular good varies until it settles at a point where the quantity demanded by consumers (at current price) will equal the quantity supplied by producers (at current price), resulting in an economic equilibrium of price and quantity.

%4 = Demand for an item will likely rise if a competitor increases the price or if the item is promoted regularly. The resulting sales a change in demand as a result of consumers responding to stimuli that potentially drive additional sales. These forces need to be factored into planning and managed within the demand forecast.

%4 = Demand forecasting is the area of predictive analytics dedicated to understanding consumer demand for goods or services.

%4 = A distribution channel can be as short as being direct from the vendor to the consumer or may include several inter-connected (usually independent but mutually dependent) intermediaries such as wholesalers, distributors, agents, retailers.

References

%4 =Supply and demand [Online]. Available at: <http://en.wikipedia.org/wiki/Supply_and_demand>. [Accessed 18 March 2011].

%4 = Economics Basics: Demand and Supply [Online]. Available at: <http://www.investopedia.com/university/ economics/economics3.asp>. [Accessed 17 March 2011].

%4 = How Supply and Demand Determine Commodities Market Prices [Online]. Available at: <http://futures. tradingcharts.com/learning/supply_and_demand.html>. Accessed 18 March 2011].

%4 = Demand Management Guideline [Online]. Available at: <http://www.treasury.nsw.gov.au/__data/assets/pdf_ file/0003/5097/demand_management.pdf>. [Accessed 17 March 2011].

Recommended Reading

%4 = Crum, C. & Palmatier G. E., 2003. *Demand management best practices: process, principles, and collaboration,* Integrated business management series*,* J. Ross Publishing, ISBN 1932159010, p.239.

%4 = Mentzer, J. T. & Moon, M. A., 2005. *Sales forecasting management: a demand management approach,* SAGE publications, 2nd ed., p.347.

%4 = Ling L., 2007. *Supply chain management: concepts, techniques and practices enhancing the value through collaboration*, World Scientific, p.347.

Self Assessment

%4 = The Law of Demand states that "Quantity demanded varies inversely with (in the opposite direction to) changes in _____.

price

quality

supply

income

%4 = Which of these is not the determinant of demand?

Income

Tastes and preferences

Prices of related goods and services

Production costs

%4 = Which of these is not the determinant of supply?

The price of related goods

Firm's expectations about future prices

Income

Number of suppliers

%4 = Which of the following statements is false?

If demand increases and supply remains unchanged, then it leads to higher equilibrium price and quantity.

If demand decreases and supply changes, then it leads to lower equilibrium price and quantity.

If supply increases and demand remains unchanged, then it leads to lower equilibrium price and higher quantity.

If supply decreases and demand remains unchanged, then it leads to higher price and lower quantity.

%4 = The standard graphical representation, usually credited to_____, has price on the vertical axis and quantity on the horizontal axis.

Ling Li

John T. Mentzer

Alfred Marshall

C. Crum

%4 = A channel of distribution consists of _____ types of flows.

two

three

four

six

%4 = _____is a situation where the demand cannot be fulfilled from the current (on hand) inventory.

Stock-out

Collaboration

Stock costs

Forecasting error

%4 =Which of these play an important role to generate income and revenue of an organisation?
Demand management
Revenue management
Demand forecasting
Customer service

%4 = _____ includes transitions forecasts to firm demand.
Order fulfilment
Order generation
Demand planning
Joint business plan

%4 = Who launched CPFR in 1995?
APICS
Hewlett-Packard
Wal-Mart
Procter & Gamble

Case Study I

Procter & Gamble: Third-Party Logistics Management Supply Chain

Procter & Gamble (P&G) is the world's largest consumer goods manufacturers. In 1992, Procter & Gamble entered the Chinese market and established large-scale production base. In order to save transport costs, railway as transport and logistics service was used.

P&G's logistics services follow the response time, service reliability and high quality requirements of the protection system. The logistics industry occupies the leading position of state-owned enterprises and private storage enterprise. But, after investigation, it was found that it lacks many things such as perfect quality protection, transport, information technology, lack of awareness of service staff etc. So, P&G required private storage enterprise.

Using third-party 3PL logistics companies, P&G used rail freight transfer stations in order to "quality first, customer first, 24-hour service" feature, to provide "door to door" service. For the establishment of the logistics network across the country, 3PL was used. The aim of the whole process was to provide value-added services to ensure the delivery of goods to the destination. The storage and transportation trainings were given to staffs for receiving, unloading, delivery services. It maintained strict good manufacturing practices (GMP) quality management standards. P&G's products were quickly, accurately and timely delivered to sales outlets across the country.
With P&G business growth in China, there was a significant increase in demand for warehouse storage. The planning, design and implementation of logistics management systems efficiently optimised business processes. High standards for the information technology systems were established to manage and provide comprehensive and effective information platform storage, transportation and other logistics information in real time. The electronic data began to be used for the effective integration of processes and information. As a result, the logistics became more efficient, rationalised and systematic. It greatly reduced the cost of P&G's logistics and shortened the order cycle and delivery times, improved customer service levels. Thus, P&G successfully applied third party logistics.

Concluding, businesses choose the right third-party logistics service providers, first to accurately define their logistics needs, and then choose to meet the business needs and goals of the provider.

Questions

%4 = P&G's focus on supply chain management is responsible for its leadership in the consumer goods manufacture. Discuss the need for third party logistics by P&G.

Answer

Even after good logistics services such as the response time, service reliability and high quality requirements of the protection system, it was found that it lacks many things such as perfect quality protection, transport, information technology, lack of awareness of service staff etc. So, P & G required the third party logistics to accurately define their logistics needs, and to meet the business needs and goals.

%4 = P&G has always used innovative information technology tools to supplement its supply chain. In a few words, explain how use of IT benefited P&G.

Answer

High standards for the information technology systems were established to manage and provide comprehensive and effective information platform storage, transportation and other logistics information in real time. The electronic data began to be used for the effective integration of processes and information. As a result, the logistics became more efficient, rationalised and systematic. It greatly reduced the cost of P&G's logistics and shortened the order cycle and delivery times, improved customer service levels.

%4 = Price is an important factor in the supply and demand relationship. How the cost of logistics in P&G was reduced?

Answer

Using third-party 3PL logistics companies, P&G's products were quickly, accurately and timely delivered to sales outlets across the country. The planning, design and implementation of logistics management systems efficiently optimised business processes. High standards for the information technology systems were established to manage and provide comprehensive and effective information platform storage, transportation and other logistics information in real time. The electronic data began to be used for the effective integration of processes and information. As a result, the logistics became more efficient, rationalized and systematic. It greatly reduced the cost of P&G's logistics and shortened the order cycle and delivery times, improved customer service levels.

Case Study II

McDonald's Food Chain

McDonald's is a fast food chain with restaurants all over the world. It serves burgers and other fast food. It remains consistent in terms of cost and quality of burgers. To meet such high standards, it was essential to have an excellent supply chain management system.

McDonald's was started as a drive-in restaurant by two brothers, Richard and Maurice McDonald in California, US in the year 1937. The business, which was generating $200,000 per annum in the 1940s, got a further boost with the emergence of a revolutionary concept called 'self-service.' Prices were kept low. Speed, service and cleanliness became the critical success factors of the business. By mid-1950s, the restaurant's revenues had reached $350,000. As a result, franchisees started showing interest. However, the franchising system failed because the McDonald brothers observed very transparent business practices. As a consequence, imitators copied their business practices and emerged as competitors.

In 1996, when McDonald's entered India, Mumbai-based Radhakrishna Foodland Private Limited (RFPL) was chosen as a distribution agent who would act as a hub for all its vendors. RFPL stored the products in controlled conditions in Mumbai and New Delhi and supplied them to McDonald's outlets on a daily basis. By transporting the semi-finished products at a particular temperature, the cold chain ensured freshness and adequate moisture content of the food. The specially designed trucks maintained the temperature in the storage chamber throughout the journey. From its experience in other countries, McDonald's was aware that supply chain management was undoubtedly the most important factor for running its restaurants successfully.

In India as in other parts of the world, McDonald's had a very well orchestrated supply chain, called the 'cold chain'. Around the world (including India), approx. 85% of McDonald's restaurants were owned and operated by independent franchisees. Yet, McDonald's was able to run by outsourcing nine different ingredients used in making a burger from over 35 suppliers spread all over India through a massive value chain. McDonald's sourced its ingredients from all parts of India. For example, the iceberg lettuce was specially developed for India using a new culture farming technique.

Thus, US-based fast food giant, McDonald's success in India had been built on four pillars: limited menu, fresh food, fast service and affordable price. Intense competition and demands for a wider menu drive-through and sit-down meals - encouraged the fast food giant to customize product variety without hampering the efficacy of its supply chain.

Questions

%4 = What business strategies were used in McDonald's food supply chain?
%4 = What was the role of outsourcing in SCM?
%4 = How McDonald's continues to be the fast food giant?

Case Study III

Dell's Direct Selling Model

US based computer hardware manufacturer Dell Inc. (Dell) aims to integrate its supply chain and achieve higher efficiency and quality. It is a leading direct computer systems manufacturing company. Earlier, all Dell's factories had been managed regionally, and procurement functioned as a separate division. Dell had been the top PC manufacturer till the second quarter of 2006. But in the third quarter of 2006, HP overtook Dell for worldwide PC shipments.

To rank first among PC manufacturers, Dell used direct selling method. The Dell's direct selling model had the idea of selling computers directly to the consumer eliminating the need for middlemen and distributors. Dell sold its computer systems directly to end customers, bypassing distributors and retailers (resellers). Thus, Dell's supply chain consisted of only three stages: the suppliers, the manufacturer (Dell), and end users.

By selling PCs directly to the consumers, the company was better able to understand the needs of its customers. Its direct contact with customers allowed it to identify market segments, analyze the requirements and profitability of each segment and develop more accurate demand forecasts. . The company's procurement decisions were based on four criteria - quality, cost, delivery and technology.

The first computer Turbo PC was introduced in 1985. The launch was advertised in computer magazines and sold directly to customers. Dell also began employing computer literate sales personnel to guide consumers in their choice of systems. Each system was assembled according to the preferences of the customers. This option helped customers to get computers at a price lower than other brands.

Dell matched supply and demand because its customers ordered the computer configurations over the phone or online. Dell received orders via the telephone, internet, e-mail, etc. With advancement in technologies, the choices available for the consumers also widened. Customers could use Dell's website www.dell.com, to configure their customised computer and place an order for it and choose from a variety of products ranging from desktops, notebooks, servers, printers, etc. The website catered to different segments of customers like individuals, home office customers, small businesses, medium businesses, large businesses and public sector customers like Government departments, educational institutions and healthcare institutions. Thus, it got popular amongst all.

Dell's strategy was to provide customised, low cost, and quality computers delivered on time. Dell reduced the cost of intermediaries that would otherwise add up to the total cost of PC for the customer. The time on processing orders was saved that other companies normally incur in their sales and distribution system. Moreover, the company got a clearer indication of market trends. This helped to plan for future besides better managing its supply chain.

It was also able to get the customers requirements regarding software to be loaded. Dell loaded the ordered software in its plant itself before dispatching it. By eliminating the need of a PC support engineer to load software, the customers gained both in time and cost. Dell collaborated closely with its suppliers in order to manage its operations with low inventory levels.

Demand forecasting with 75% accuracy was done as it maintained a database to track the purchasing patterns of corporate customers and their budget cycles. It also maintained a similar database for indi-vidual customers in order to cater to their future requirements for PCs. The changing demand patterns were communicated to the major suppliers frequently.

Questions

%4 = How direct contact with the customers helped Dell to rank first among PC manufacturers?

%4 = Dell has always use innovative information technology tools to supplement its supply chain. In a few words, explain how the use of IT tools has benefited Dell.

%4 = Which databases were created in order to cater to the customer's future requirements for PCs?

Bibliography

References

%4 = Andam Z. R., 2003. e-Commerce and e-business [Online]. Available at: < http://www.apdip.net/publications/ iespprimers/eprimer-ecom.pdf>. [Accessed 18 March 2011].

%4 = Chopra, S., & Meindl P., 2001. *Supply Chain Management: Strategy, Planning, Operation.* Prentice Hall, New Jersey, 3rd ed., 636 pages

%4 = Conrad A., Dimensions of Logistics [Online]. Available at: <http://www.personal.psu.edu/faculty/a/c/acc10/ CHAP02.ppt. [Accessed 15 March 2011].

%4 = Continuous Replenishment Program (CRP) and Vendor Managed Inventory [Online]. Available at: <http://swe. lawson.com/www/resource.nsf/pub/CRP_VMI.pdf/$FILE/CRP_VMI.pdf>. [Accessed 16 March 2011].

%4 = Coordination in the Supply Chain [Online]. Available at: <http://www.clt.astate.edu/asyamil/SCM_Chopra/ chopra3_ppt_ch17.ppt>. [Accessed 14 March 2011].

%4 = Coyle J. J., & Langley J.C., 2008. Supply chain management: a logistics perspective, 8th ed., Cengage Learning, pp.47-65.

%4 = Creaney, N., 2008. Legal Issues for IT Professionals [Online]. Available at: <http://knol.google.com/k/n-/- /1hzaxtdr9c09g/7>. [Accessed 13 March 2011].

%4 = Customer relationship management [Online]. Available at: <http://searchcrm.techtarget.com/definition/CRM>. [Accessed 18 March 2011].

%4 = Decision Craft Inc, 2000. Variability and Supply Chain [Online]. Available at: <http://www.decisioncraft.com/ dmdirect/variability.htm>. [Accessed 14 March 2011].

%4 = Decision Phases in a Supply Chain [Online]. Available at: <http://www.sbaer.uca.edu/publications/supply_ chain_management/pdf/03.pdf>. [Accessed 14 March 2011].

%4 = Demand Management Guideline [Online]. Available at: <http://www.treasury.nsw.gov.au/__data/assets/pdf_ file/0003/5097/demand_management.pdf>. [Accessed 17 March 2011].

%4 = Dimensions of Logistics [Online]. Available at: <http://www.scribd.com/doc/7918106/Dimensions-of-Logistics>. [Accessed 14 March 2011].

%4 = Economics Basics: Demand and Supply [Online]. Available at: <http://www.investopedia.com/university/ economics/economics3.asp>. [Accessed 17 March 2011].

%4 = Enterprise resource planning [Online]. Available at: <http://en.wikipedia.org/wiki/Enterprise_resource_planning>. [Accessed 19 March 2011].

%4 = Gupta, Y., Sundararaghavan P. S., & Ahmed M., 2003. Ordering policies for items with seasonal demand, International Journal of Physical Distribution & Logistics Management, Vol. 33, pp.500 – 518. Available at: <http://www.emeraldinsight.com/journals.htm?articleid=846884&show=html>. [Accessed 18 March 2011].

%4 = How Supply and Demand Determine Commodities Market Prices [Online]. Available at: <http://futures. tradingcharts.com/learning/supply_and_demand.html>. [Accessed 18 March 2011].

%4 = Importance of Supply Chain Management - SCM, a set of critically important functions [Online]. Available at: <http://www.supplychainmanagement.in/scm/importance-of-supply-chain.htm>. [Accessed 13 March 2011].

%4 = Information Technology and the Supply Chain [Online]. Available at: <http://www.clt.astate.edu/asyamil/ SCM_Chopra/chopra3_ppt_ch16.ppt>. [Accessed 19 March 2011].

%4 = Logistics [Online]. Available at: <http://www.stat.mq.edu.au/Stats_docs/stat321/Wk9Handout.pdf>. [Accessed 13 March 2011].

%4 = Need for supplier chain relationship management [Online]. Available at: <http http://bimtech-retail.com/ blog/2010/need-for-supplier-relationship-management-in-retail/>. [Accessed 19 March 2011].
%4 = Objectives of supply chain management [Online]. Available at: <http://wiki.answers.com/Q/What_are_ objectives_of_supply_chain_management#ixzz1Fyi6LwK4>. [Accessed 14 March 2011].
%4 = Pricing and Revenue Management in the Supply Chain [Online]. Available at: < http://www.clt.astate.edu/

asyamil/SCM_Chopra/chopra3_ppt_ch15.ppt> 2007, Pearson Education. [Accessed 18 March 2011].

%4 = Push–pull strategy [Online]. Available at: <http://en.wikipedia.org/wiki/Push%E2%80%93pull_strategy>. [Accessed 14 March 2011].

%4 = Resource Manager's Role in Transactions [Online]. Available at: <http://msdn.microsoft.com/en-us/library/ ms679472%28v=vs.85%29.aspx>. [Accessed on 16 March 2011].

%4 = Slack B., Rodrigue J. P., & Comtois C. Transportation Modes: An Overview [Online]. Available at: <http:// people.hofstra.edu/geotrans/eng/ch3en/conc3en/ch3c1en.html>. [Accessed 17 March 2011].

%4 = Supplier Scoring – The Importance of Ranking Your Suppliers [Online]. Available at: <http://supplychain-mechanic.com/?p=104>. [Accessed 18 March 2011].

%4 =Supply and demand [Online]. Available at: <http://en.wikipedia.org/wiki/Supply_and_demand>. [Accessed 15 March 2011].

%4 =Supply and demand [Online]. Available at: <http://en.wikipedia.org/wiki/Supply_and_demand>. [Accessed 18 March 2011].

%4 = Supply chain [Online]. Available at: < http://pradipsuryavanshi.blogspot.com/>. [Accessed 14 March 2011].

%4 =Supply Chain Coordination [Online]. Available at: <http://www2.isye.gatech.edu/~spyros/courses/IE3103/SC-Coordination.ppt>. [Accessed 16 March 2011].

%4 =Supply Chain Edge: 15 Key Factors That Impact Your Distribution Network Effectiveness [Online]. Available at <http://www.investorwords.com/1498/distribution_network.html#ixzz1G0TR7yBo>. [Accessed 15 March 2011].

%4 = Supply Chain Management [Online]. Available at: <http://www.slideshare.net/thadeshvar/supply-chain-management-presentation-731970>. [Accessed 16 March 2011].

%4 = Supply Chain Resource Cooperative [Online]. Available at: <http://scm.ncsu.edu/public/terms/s.html>. [Accessed on 18 March 2011].

%4 = Supply Chain Strategies & e-Business Supply Chain [Online]. Available at: <http://info.cba.ksu.edu/ehie/ faculty%20site%20templates/mangt%20662/sc-strategy&e-scm.ppt>. [Accessed 14 March 2011].

%4 =The Bullwhip Effect in Supply Chain [Online]. Available at: <http://www.ehow.com/about_5230010_bullwhip-effect-supply-chain.html#ixzz1GeqgM5QD>. [Accessed 17 March 2011].

%4 = The objective of a supply chain [Online]. Available at: < http://mba-lectures.com/supply-chain/1113/the-objective-of-a-supply-chain.html>. [Accessed 13 March 2011].

%4 = Transportation in the Supply Chain [Online]. Available at: <http://www.clt.astate.edu/asyamil/scm_chopra/ chopra3_ppt_ch13.ppt>. [Accessed 18 March 2011].

%4 =Transportation: An Important Tool in Supply Chain Management [Online]. Available at: <http://www.xomba.com/transportation_important_tool_supply_chain_management>. [Accessed 18 March 2011].

%4 = Xu L., Beamon, Benita M., 2006. Supply chain coordination and cooperation mechanisms: an attribute-based approach. Journal of Supply Chain Management [Online]. Available at: http://www.highbeam.com/doc/1G1-143011706.html>. [Accessed 16 March 2011].

Recommended Reading

%4 = Chase, 2006. *Operations Management for Competitive Advantage*, Tata McGraw-Hill Education, 11th ed., p.875.

%4 = Chopra S., 2010. *Supply Chain Management*, Pearson Education India, 4th ed., p.578.

%4 = Chopra, S., & Meindl P., 2003. *Supply Chain Management: Strategy, Planning, and Operations*, Prentice Hall, 2nd ed., p.592.

%4 = Chopra, S., & Meindl P., 2006. *Supply Chain Management*, Pearson Education India, 3rd ed., p.636.

%4 = Christopher M., 2011. *Logistics and Supply Chain Management*, FT Press, 4th ed., p.288.

%4 =Crum, C. & Palmatier G. E., 2003. *Demand management best practices: process, principles, and collaboration,*

Integrated business management series, J. Ross Publishing, ISBN 1932159010, p.239.

%4 = Donald C. & Waters J., 2003. *Logistics: an introduction to supply chain management,* Palgrave Macmillan, p.354.

%4 = Hugos M. H., 2006. *Essentials of supply chain management: Essentials (John Wiley) Series*, John Wiley and Sons, 2nd ed., p.290.

%4 = John J. C., John J., C., Langley C., Bardi E. J., Gibson B. J., Novack R. A., 2008. *Supply chain management: a logistics perspective,* Cengage Learning 8th ed., p.705.

%4 = Joris J. A. Leeman, 2010. *Supply Chain Management*, BoD – Books on Demand, ISBN 3839137918, 9783839137918, p.250.

%4 = Ling L., 2007. *Supply chain management: concepts, techniques and practices enhancing the value through collaboration*, World Scientific, p.347.

%4 = Mahadevan B., 2010.*Operations Management: Theory and Practice*, Pearson Education India, 2nd ed., p.672.

%4 = Mentzer J. T., 2001. *Supply chain management*, Sage Publications, 2nd ed., p.512.

%4 = Mentzer J. T., 2004. *Fundamentals of supply chain management: twelve drivers of competitive advantage,* Sage Publications, p.293.

%4 = Mentzer, J. T. & Moon, M. A., 2005. *Sales forecasting management: a demand management approach,* SAGE publications, 2nd ed., p.347.

%4 = Meredith, J.R., & Shafer, S.M., 2007. *Operations Management for MBAs.* John Wiley and Sons, New York, 3rd ed., p.445.

%4 = Mohanty R.P., & Deshmukh S.G., 2005. *Supply Chain Management (Theories & Practices)*, Dreamtech Press, p.376.

%4 = Rushton A., Croucher P., Baker P., 2006. *The handbook of logistics and distribution management*, Kogan Page Publishers, 3rd ed., p.612.

- Shah J., 2009. *Supply Chain Management: Text and Cases,* Pearson Education India, ISBN 8131715175, 9788131715178, p.472.

%4 = Tyndall, G., 1998. *Supercharging Supply Chains: New Ways to Increase Value Through Global Operational Excellence.* John Wiley and Sons, New York, p.269.

Self Assessment Answers

Chapter I

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Chapter II

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