SUPPLY CHAIN MANAGEMENT & LOGISTICS (SCML)

3RD SEMESTER MBA (Subject Code: 18MBA 301 D)

As Per New BPUT Syllabus

Complied By

Er. Manoj kumar Rout

Asst. Professor,

Department of Operation Management

BIITM, BBSR

3rd Semester	18MBA301D	Supply Chain Management & Logistics	L-T-P 3-0-0	3 Credits	35 hrs

COURSE OBJECTIVES

- To analyze the supply chain scenario and to make understand the students the insights on supply chain process from sourcing to distribution
- To enhance the supply chain integration and sustainable supply chain strategic skills among the students

Module I : Supply Chain Foundations: Supply Chain as a network of entities, concept of Value Chain, Impact of Supply Chain Management on Sales, Cost, Profit, Profitability, Profit and Loss Account, and Customer Accounts Profitability. Centralized and Decentralized Supply Chains: their coordination and aligning business activities. Demand forecasting and management: Methods, Bull whip effect, CRM in supply Chain Management.

Module II: Distribution Management: Distribution Channels: Structure and Operation, Distribution Cost Components, Pipe line Inventory and Response Considerations, Hub and Spoke Models, Cross docking, Lots streaming, Container Selection, Vendor Consolidation, Warehousing : Facility location and Network design, Vehicle Loading and Vehicle Routing Methods, Lead time Components and their Compression, Use of IT for tracking in supply chain. Supply chain sustainability in business management.

Module III: Aligning logistics to customer needs: Quick response logistics, Green Logistics, Reverse Logistics, Vendor Managed Inventory, Cross docking, Packaging Innovations, Third Party Logistic and Service concepts and applications. Procurement Logistics: Global Vs. Domestic Sourcing, Landed Cost Computation, Vendor Rating: Contract Negotiation, Consolidation, Self Certified Vendor Management, Individual component Vs. Module Purchases, Vendor Development and Vendor Relationship Management, Vendor Performance Monitoring.

SUPPLY CHAIN MANAGEMENT & LOGISTICS (SCML)

Module - I

Supply Chain Foundations:

Basic of Supply Chain Management:

Definition:

1) A supply chain is the alignment of firms that bring products or services to market.
2) Supply Chain Management can be defined as the management of flow of products and services, which begins from the origin of products and ends at the product's consumption. It also comprises movement and storage of raw materials that are involved in work in progress, inventory and fully furnished goods.
3) The main objective of supply chain management is to monitor and relate production, distribution, and shipment of products and services. This can be done by companies with a very good and tight hold over internal inventories, production, distribution, internal productions and sales.
4) A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves.
5) Supply chain management is the coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served.

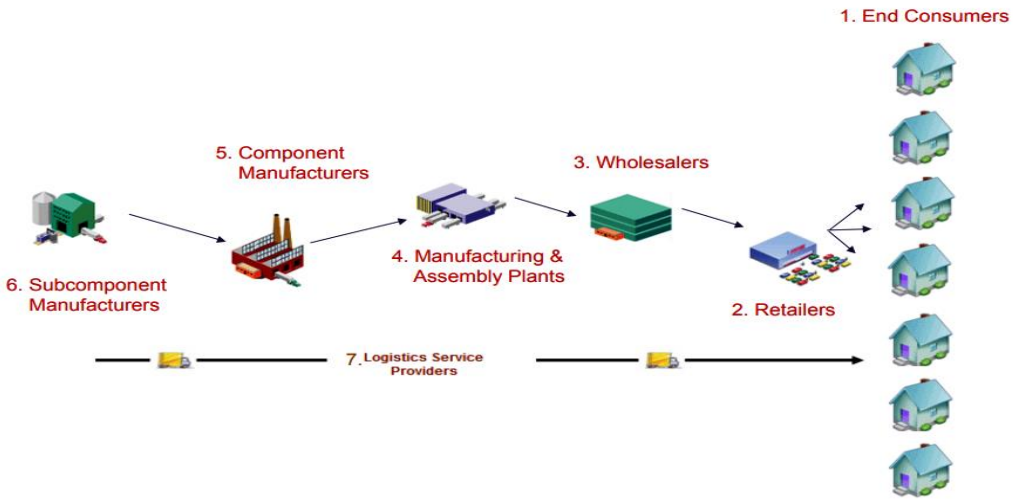


Figure: Supply Chain Management

Goals of Supply Chain Management:

1) Supply chain partners work collaboratively at different levels to maximize resource productivity, construct standardized processes, remove duplicate efforts and minimize inventory levels.
2) Minimization of supply chain expenses is very essential, especially when there are economic uncertainties in companies.

3) Cost efficient and cheap products are necessary, but supply chain managers need to concentrate on value creation for their customers.

4) Exceeding the customers' expectations on a regular basis is the best way to satisfy them.

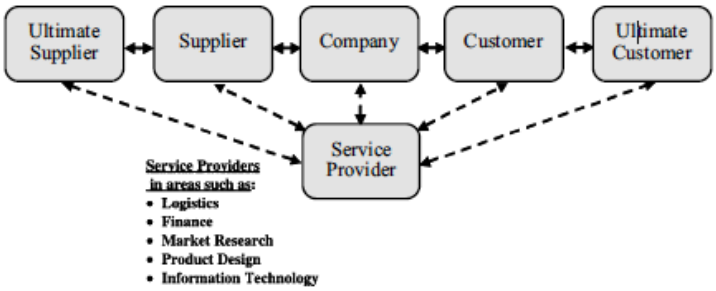
5) Increased expectations of clients for higher product variety, customized goods, off-season availability of inventory and rapid fulfillment.

6) Supply chain management aims at contributing to the financial success of an enterprise.

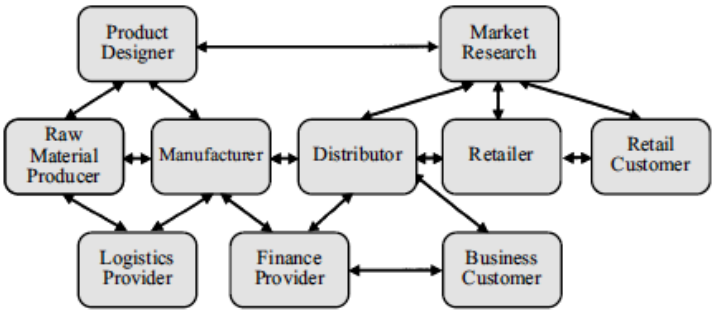
Supply Chain Structure

Simple Supply Chain

Extended Supply Chain



Example of an Extended Supply Chain



Supply Chain Management – Process:

Supply chain management is a process used by companies to ensure that their supply chain is efficient and cost-effective. A supply chain is the collection of steps that a company takes to transform raw materials into a final product. The five basic components of supply chain management are discussed below:

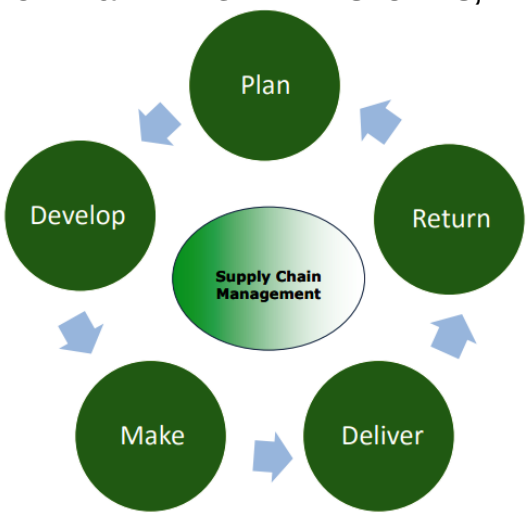


Figure: Supply Chain Management Process

Plan: The initial stage of the supply chain process is the planning stage. We need to develop a plan or strategy in order to address how the products and services will satisfy the demands and necessities of the customers. In this stage, the planning should mainly focus on designing a strategy that yields maximum profit.

Develop (Source): In this stage, we mainly concentrate on building a strong relationship with suppliers of the raw materials required for production. This involves not only identifying dependable suppliers but also determining different planning methods for shipping, delivery, and payment of the product. So in this stage, the supply chain managers need to construct a set of pricing, delivery and payment processes with suppliers and also create the metrics for controlling and improving the relationships.

Make: The third step in the supply chain management process is the manufacturing or making of products that were demanded by the customer. In this stage, the products are designed, produced, tested, packaged, and synchronized for delivery. This stage is considered as the most metric-intensive unit of the supply chain, where firms can gauge the quality levels, production output and worker productivity.

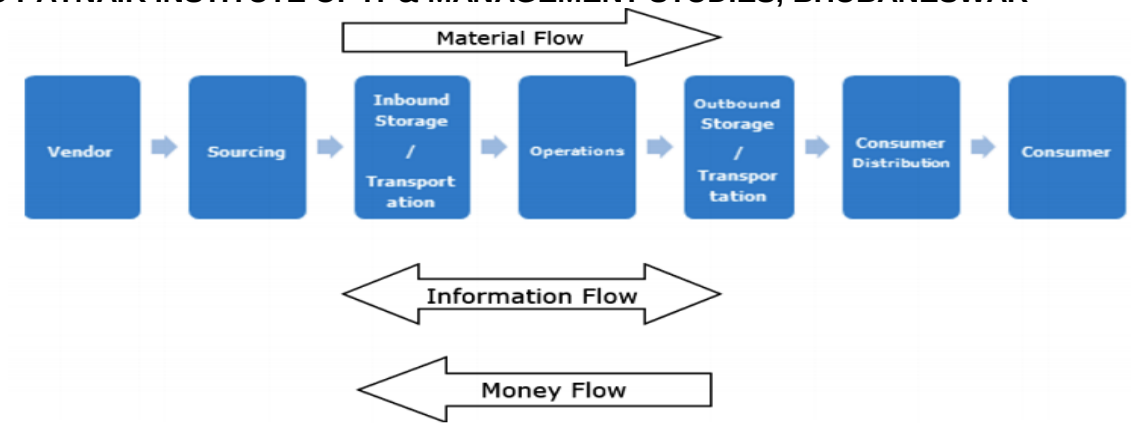
Deliver: The fourth stage is the delivery stage. Here the products are delivered to the customer at the destined location by the supplier. This stage is basically the logistics phase, where customer orders are accepted and delivery of the goods is planned.

Return: The last and final stage of supply chain management is referred as the return. In the stage, defective or damaged goods are returned to the supplier by the customer. Here, the companies need to deal with customer queries and respond to their complaints etc.

Supply Chain Management – Process Flow:

Supply chain management can be defined as a systematic flow of materials, goods, and related information among suppliers, companies, retailers, and consumers. There are three different types of flow in supply chain management:

1) Material flow
2) Information/Data flow
3) Money flow



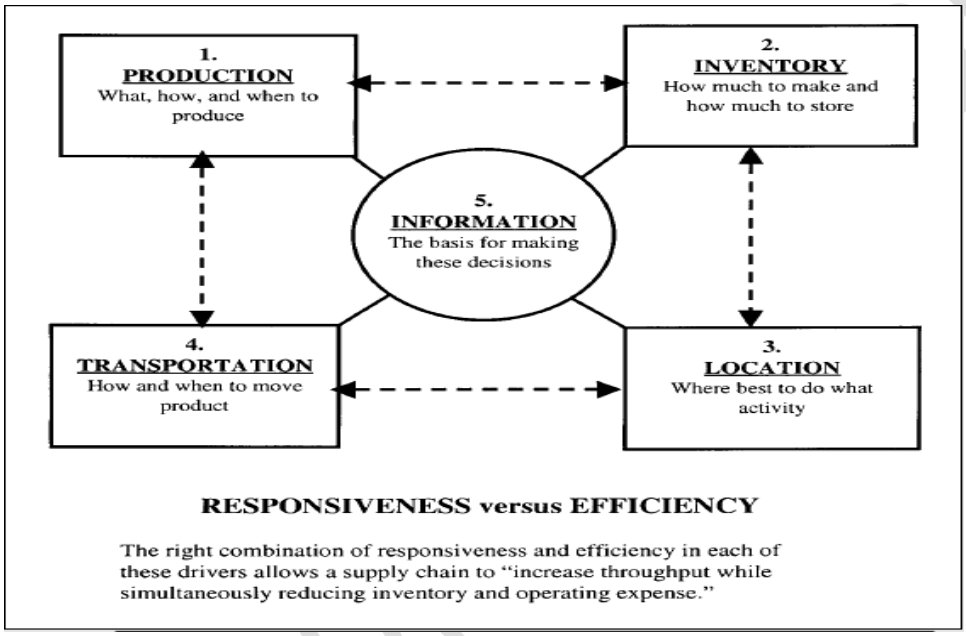


Figure: The Five Major Supply Chain Drivers

Supply Chain Management–Advantages:

1) Develops better customer relationship and service.
2) Creates better delivery mechanisms for products and services in demand with minimum delay.
3) Improvises productivity and business functions.
4) Minimizes warehouse and transportation costs.
5) Minimizes direct and indirect costs.
6) Assists in achieving shipping of right products to the right place at the right time.
7) Enhances inventory management, supporting the successful execution of just-intime stock models.
8) Assists companies in adapting to the challenges of globalization, economic upheaval, expanding consumer expectations, and related differences.
9) Assists companies in minimizing waste, driving out costs, and achieving efficiencies throughout the supply chain process.

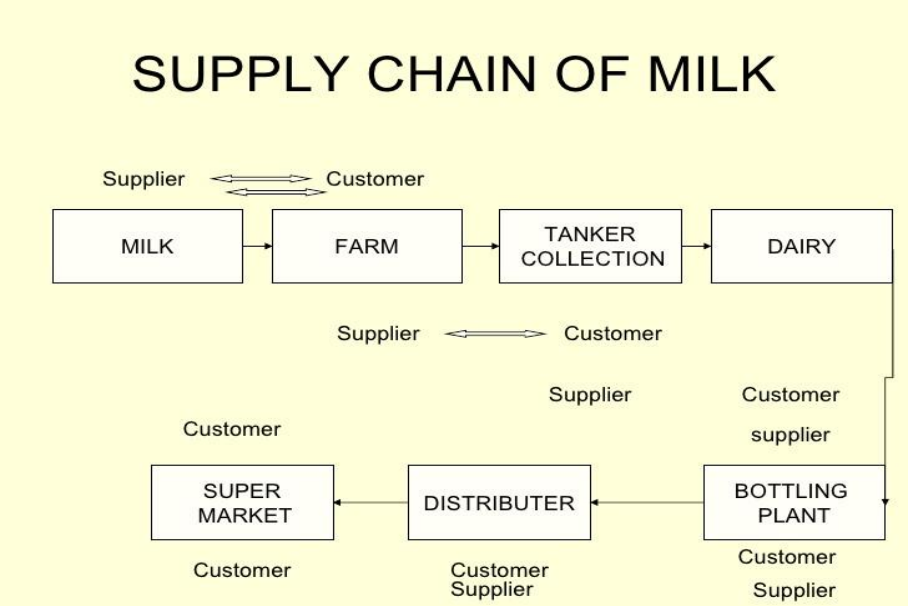
Job responsibilities for a Supply Chain Manager include:

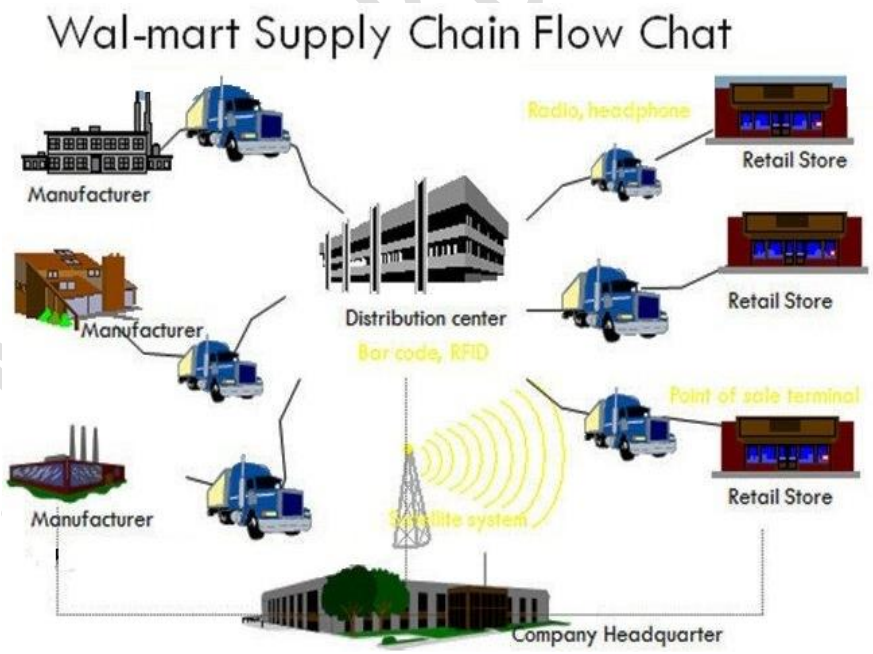
- Overseeing and managing overall supply chain and logistics operations, to maximize efficiency and minimize cost.
- Collaborating with multiple-functional managers to

- plan and execute the development of a
- distribution center operational process to

- enable seamless transfers.
- Managing and monitoring vendors' qualifications and performances to ensure they meet the company's requirements.

Example of Supply Chain Management

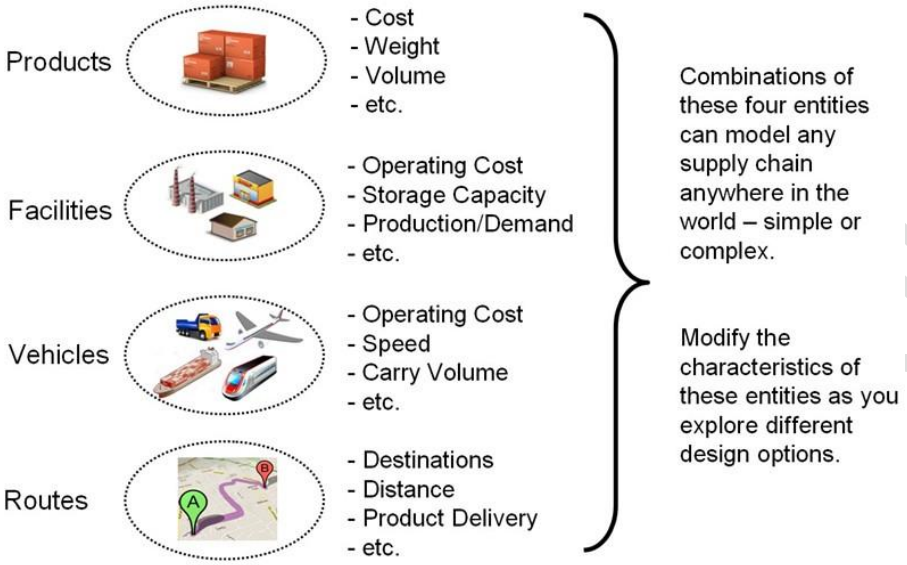




Supply chain as a Network of Entities:

A supply chain is a network between a company and its suppliers to produce and distribute a specific product to the final buyer. This network includes different activities, people, entities, information, and resources. The supply chain also represents the steps it takes to get the product or service from their original state to the customer. The entities in the supply chain include PRODUCTS; FACILITIES; VEHICLES; ROUTES .These entities relate to each other and their interactions are what drive supply operations and produce the simulation results.

1. **PRODUCTS:** things in demand at facilities
2. **FACILITIES:** places where products are made, stored or consumed
3. **VEHICLES:** mechanisms to move products between facilities to meet demand
4. **ROUTES:** paths taken by vehicles to move products between facilities.



Supply chain management is a conscious effort to run supply chains in the most efficient and effective way possible. Such strategies include product development, sourcing, production and logistics, each of which assists in creating quality products and coordinating their flow to the consumer. The supply chain exists in many different forms, but the most common structure contains four separate entities:

1. **Suppliers.** These entities provide the materials needed to create the product, whether they're raw materials or individual parts to a finished product. For example, Apple's iPad comes from a variety of suppliers: Samsung manufactures its processor chips, LG produces the touchscreen display, and Toshiba creates the flash memory.
2. **Manufacturers.** This stage of the supply chain entails bringing together all of the parts provided by suppliers to create the finished product. Apple would take each individual part from the suppliers and put them together to create a finished iPad for distribution.
3. **Distributors.** These entities store and sell the finished product, either at a physical storefront or through an online store. Locations like Apple stores and Walmart provide physical locations where consumers can buy an iPad, whereas online distributors ship the iPad directly to a consumer's door.
4. **Customers.** Consumers create demand for products and ultimately influence the quantity of products and the overall supply chain structure.

Role and Interactions between the Entities:

Effective supply chain management requires simultaneous improvements in both customer service levels and the internal operating efficiencies of the companies in the supply chain. Customer service at its most basic level means consistently high order fill rates, high on-time delivery rates, and a very low rate of products returned by customers for whatever reason. Internal efficiency for organizations in a supply chain means that these organizations get an attractive rate of return on their investments in inventory and other assets and those they find ways to lower their operating and sales expenses. There is a basic pattern to the practice of supply chain management. Each supply chain has its own unique set of market demands and operating challenges and yet the issues remain essentially the same in

every case. Companies in any supply chain must make decisions individually and collectively regarding their actions in four areas:

Product: What products does the market want? How much of which products should be produced and by when? This activity includes the creation of master production schedules that take into account plant capacities, workload balancing, quality control, and equipment maintenance.

Facility: What inventory should be stocked at each stage in a supply chain? How much inventory should be held as raw materials, semi-finished, or finished goods? The primary purpose of inventory is to act as a buffer against uncertainty in the supply chain. However, holding inventory can be expensive, so what are the optimal inventory levels and reorder points?

Vehicle: How should inventory be moved from one supply chain location to another? Air freight and truck delivery are generally fast and reliable but they are expensive. Shipping by sea or rail is much less expensive but usually involves longer transit times and more uncertainty. This uncertainty must be compensated for by stocking higher levels of inventory. When is it better to use which mode of transportation?

Routes: Where should facilities for production and inventory storage be located? Where are the most cost efficient locations for production and for storage of inventory? Should existing facilities be used or new ones built? Once these decisions are made they determine the possible paths available for product to flow through for delivery to the final consumer.

Value Chain Focus of Supply Chain:

1) Supply Chain refers to the integration of all activities involved in the process of sourcing, procurement, conversion and logistics.
2) On the other hand, value chain implies the series of business operations in which utility is added to the goods and services offered by the firm so as to enhance customer value.
3) Supply Chain is the interconnection of all the functions that starts from the manufacturing of raw material into the finished product and ends when the product reaches the final customer.
4) Value Chain, on the other hand, is a set of activities that focuses on creating or adding value to the product.
5) These two networks help to provide quality products to the customer at a reasonable price. Most of the time supply chain is juxtaposed with the value chain.

Value Chain:

1) Value Chain refers to the range of activities that adds value at every single step in designing, producing, and delivering a quality product to the customer. Value Chain Analysis is used to evaluate the activities within and around the organization and relating to its ability to provide value for money, goods, and services.

2) The concept of Value Chain Analysis was first evolved by Michael Porter in 1985 in his renowned book "Competitive Advantage". In his opinion, two major steps involved in the value chain analysis are:
   i. Identification of individual activities
   ii. Analyzing the value added in each activity and relating it to firm's competitive strength.

   Porter split business activities into two main categories, for the purpose of Value Chain Analysis:

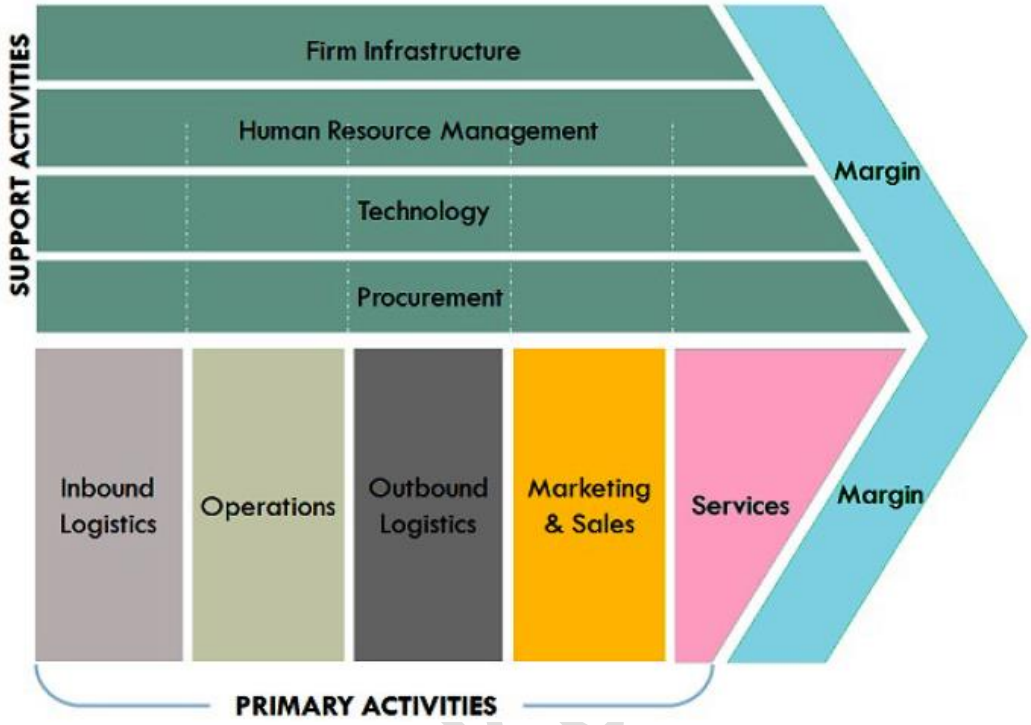
Primary Activities & Support Activities

Primary Activities:

- *Inbound Logistics:* It deals with receiving, storing and distributing of inputs.
- *Manufacturing operations:* Conversion of inputs into finished products.
- *Outbound Logistics:* It is concerned with the collection, storage, and distribution of product or service to customers.

- *Marketing and Sales:* Involve activities that create awareness among the general public regarding the product.
- *Services:* All those activities that increase the value of product or services.

Support Activities: These activities help the primary activities and include procurement, technology development, human resource management and infrastructure.



Difference between Supply Chains vs. Value Chain

Basis for Comparison	Supply chain	Value chain
Meaning	The integration of all the activities involved in the procurement, conversion and logistics of the product is known as Supply Chain.	Value Chain is defined as the series of activities, that adds value to the product.
Originated from	Operation Management	Business Management
Concept	Conveyance	Value Addition
Sequence	Product Request - Supply Chain - Customer	Customer Request - Value Chain – Product
Objective	Customer Satisfaction	Gaining competitive advantage

Impact of Supply Chain Management on Sales:

1) The supply chain process can impact sales, both positively and negatively. If the supply chain process is far enough removed from the sales process the impact is not usually perceived, unless that impact is negative.

2) Failure in the supply chain is noticed, success is not. In distribution, the supply chain process is closely related to the sales process, and the impact is perhaps most quantifiable in that industry, as it involves procuring items for resale.

3) It is easy to see how the supply chain can positively impact sales by negotiated pricing which allows the distributor to sell for less than its competitors.

4) The supply chain can also work to keep sufficient inventory, especially when the demand for "hot" products exceeds the supply in the market, whether the market is regional, national, or international.

5) When it comes to special orders or spot buys, having sources that provide the shortest lead times can make a difference in sales.

6) In manufacturing, the supply chain process is farther removed from the sales process. When it is associated with the sales process it is usually associated with a loss of sales. However, if the supply chain process can negatively affect sales, the opposite must be true, so it can positively affect sales also.

7) An effective supply chain is definitely a component in building a reputation for quality and on time delivery, leading to additional opportunities for sales.

8) So, the supply chain process can impact sales, negatively and positively, and therefore can have a part in increasing sales. That impact is more easily quantified in some industries than others. Generally though, consistent sales are not possible without a consistent supply chain.

Impact of Supply Chain Management on Cost:

1) Supply Chain Management (SCM) can be divided into three main areas: purchasing, manufacturing, and transport. From end to end, this includes decisions about which input materials to use, production quantities, inventory levels, distribution network configuration, and transportation for both the input materials as well as for the finished products.

2) Logistics Management is the component of SCM that focuses on how and when to get raw materials, intermediate products, and finished goods from their respective origins to their destinations. Effective, cost efficient Logistics Management can be a real point of competitive differentiation.

3) To practice effective, cost efficient Logistics Management, an organization must lay the foundation for a responsive, economical transportation network.

4) With a responsive, economical transportation network, an organization is able to implement major strategic changes to reduce costs and increase customer service levels with very little disruption to the overall supply chain flow.

5) An economical transportation network actually begins with a shift in attitude. Businesses are often trapped in the traditional view that transportation is a necessary evil – an inevitable source of cost and risk.

6) In fact, Supply Chain Managers who are outpacing their competition have done so largely by acknowledging transportation as a ready vehicle through which to drive cost savings and create value within the Supply Chain.

How to Reduce Supply Chain Transportation Logistics Costs:

Transportation costs can be a significant part of a company's overall logistics spending. With increases in the price of fuel, the proportion allocated to transportation can be upward of 50 percent. This cost is passed on to the customer and the price of goods continues to rise. Consider a number of transportation strategies that can be used by management to help reduce costs.

Fewer Carriers:

1) The transportation manager should adopt the same strategy when it comes to the number of carriers used.

2) A transport manager spends time finding the best carrier at the best price, but sometimes that leads to a large number of carriers being used, albeit giving excellent service.

3) The multiple carrier approach occurs when the transport manager has negotiated the best deal for each route, but has not looked at the big picture.

4) By reducing the number of carriers, the amount of work offered to the remaining carriers will increase. By offering vendors a larger volume of work, the carrier should be able to offer lower rates across all routes.

Consolidating Shipments:

1) Consolidating shipments means that transportation managers will be moving away from less than truckload (LTL) shipments to truckload (TL) shipments.

2) If a company uses carriers for its deliveries, the rate it pays is negotiated by trip based on weight, distance, and other variables.

3) One strategy that can be used by transportation managers is to consolidate shipments so that fewer trips are made, and the company reaps the benefit of lower rates based on larger shipments.

Single Sourcing:

1) By offering all transportation out to bid, via a request for quotation (RFQ), a company can provide carriers with a detailed explanation of what it requires, which may fall outside of what is normally provided by a common carrier.

2) If the winning bidder fulfills the needs of the company and has been fully evaluated, a company could gain significant transportation savings using a single carrier.

Impact of Supply Chain Management Profit, Profitability:

Businesses that run strong and efficient supply chains tend to generate more revenue and higher profits. In order to increase profitability through supply chain management, you can look at several different areas, including:

1) ***Inventory management*** **–** eg. finding the balance between too much/not enough stock

2) ***Supply and pay agreements*** **–** eg. automating processes, such as order placement, etc.

3) ***Control of operating expenses*** **–** eg. preventing incorrect orders, distribution errors, etc.

4) ***Settlement of payments*** **–** eg. solving late payments, invoicing missing payments, etc.

1. Inventory Management:

Let's say you have just two hours' worth of stock sitting in a car factory, with the aim of keeping the costs of storage low. But what if a certain part, such as a bumper, is delivered half an hour too late? It could result in a standstill of the entire, tightly coupled production line. So what are the costs associated with this? Purely focusing on limiting stock is far too short sighted and, in terms of the bottom line, the result will often be that it costs more than what it yields. Organisations must find the right balance between minimizing their stocks and being able to meet order demands. The threat of a stock shortage must be visible before it actually arises and you have to be ready to give your customer 'no' for an answer if necessary.

2. Supplier Cash Control:

A great deal of insight can be found in the supply and payment agreements with suppliers. There are a number of elements to consider, including how you can avoid purchasing unnecessary stock (through automated order placement), avoidance of costs for corrections in orders and supplies and the optimization of the payment behaviour of suppliers. Ongoing partnerships with vendors often contain a lot of automatic processes that have to be analyzed and optimized critically.

3. Operating Expenses Control:

For many organisations, a great deal can also be improved on the operations side of things. There can be reasons for incorrect supplies occurring and instead of simply correcting the relevant order, it's important to search for the point in the process where the error arose in order to prevent the same mistake from happening again.

4. Customer Cash Control:

When improving the profitability of customer relationships and orders, the measurability of order processing and optimizing settlement of payments is crucial. By continually measuring whether the right product in the right quantity is delivered to the right place at the time required by the client, supply processes can be further optimized and costly errors avoided. However, a factor that is at least as important in order to save costs is the settlement of payments with clients. Reducing the term between ordering and payment, solving late payments, making missing payments visible and invoicing for them can save a great deal.

To make the most of your supply chain, don't focus solely on the logistics. Consider where the cash goes within the processes and identify areas where you may be able to generate savings.

Impact of Supply Chain Management Profit and Loss Account:

1) In traditional accounts, the P&L statement gathers together all the sales-side income and expenditure under sales and administration headings; the supply-side expenditure is grouped under the general heading of 'cost of goods sold' (COGS).
2) Supply chain management and sourcing activities, however, don't always fall into those neat increments. For example, the P&L (Profit and loss account) statement may report revenues from the sale of certain products, but the materials used to make those products may have been purchased several time periods ago.
3) "At any given time, the various goods or services could have been negotiated for cost savings, but each might be in a different spot in the pipeline. The result is a final product comprised of all those total-cost aspects, each of which might have been realized or credited during various time periods.
4) How, then, can supply managers make savings visible to top executives? One way is to take advantage of the three separate opportunities supply chain management has for creating savings:
    - **i.** During contract negotiations,
    - **ii.** When working with a business unit, and
    - **iii.** When resolving problems.
5) Using this approach, it is not immediately evident what the cost are to purchase materials, components and products or payments for service contracts with logistics service providers (LSPs). Consequently, sales revenue continues to take pride of place.
6) An added benefit of implementing the improved structure of P&L (Profit and loss account) statement is that the ratio of VA per full time equivalent employee can be used as an overall performance measure. This provides an ongoing (trend) measure of the capabilities of all employees in the business.

Customer Accounts Profitability in Supply Chain Management:

1) Any supply chain is only as strong as its weakest link. A company can move a product from China to the United States, clear it through Customs, move it to a distribution center, and fulfill it in record time. But if it doesn't deliver the product to consumers quickly enough, they are not happy, and the company's supply chain has failed.
2) Especially in the modern climate, where a customer can blast your company publicly on social media, your brand's reputation is more susceptible to damage from preventable supply chain mistakes than ever before.
3) The supply chain is far and away your most effective customer service tool. It directly dictates the two most vital parts of customer satisfaction: price and delivery.
4) Having an efficient supply chain means you can beat your competitors on retail price and improve your profitability.

5) Having high performing operations also means you'll be able to meet or exceed your customers' expectations on delivery of their product. Giving your customers what they want when they want it and at the cheapest price is key to keeping them satisfied.

6) Effective supply chain management allows you to do just that. By choosing the right systems, approaches, and partners within your supply chain, you're giving your customers, be they individuals or businesses, the great service, transparency, and visibility they crave.

7) The more optimized your supply chain is, the better the customer experience, the happier they'll be, and the more likely they'll be to make a purchase from you again. No other part of your business can come close to matching the supply chain's direct impact on creating return business.

Customer Satisfaction Metrics to Track for Profitability:

While tracking traditional metrics that show supply chain effectiveness will give you a good idea of how well you're treating your customers, you need to go further to continually enhance your customer satisfaction.

i. How many new customers are coming in every day?
ii. How much is every individual customer worth to you?
iii. What are the 5 most common reasons for a customer to leave you?
iv. What areas of your business receive the most complaints?

These metrics will allow you to uncover one of the secrets to business growth: connecting changes in profitability to changes in customer experience and satisfaction.

In order to do this, you need to integrate your analytical and accounting systems to the point that you can clearly view the entire supply chain progression for every client.

i. What step in the lifecycle of that client is causing them to complain most?
ii. Is a part from a specific supplier consistently failing?
iii. Is one of your distribution centers slower than the rest?
iv. Is the last mile responsible for damaging packages?

Fixing any problem areas will keep your customers loyal and allow you to grow. Connecting all the dots can find the areas of your supply chain that cause the highest levels of dissatisfaction amongst your clientele, so that you can optimize it to improve your overall profitability.

Centralized and Decentralized Supply Chain:

Centralize Supply Chain:

1) Centralize Supply Chain Processes are those that can be managed from a remote location, can serve multiple sites, and drive synergy by serving multiple sites.

2) They provide for less duplication of resources and provide efficiency and effectiveness by managing key processes centrally. In some cases it can save money and bring economies of scale. Some examples of centralize supply chain processes that can be managed centrally are shown in below;

i. SIOP (Sales Inventory & Operations Planning) facilitation
ii. Forecasting
iii. Supplier replenishment planning
iv. Master schedule
v. Process design & deployment
vi. Council leadership
vii. Logistics management
viii. Item maintenance

Advantages:

i. Sales Inventory & Operations Planning (SIOP)

ii. Forecasting and Master Scheduling in organisations.
iii. Rough cut capacity planning and materials requirement planning for supply plants or warehouses
iv. By doing demand aggregation there is higher chances to reduce demand variation
v. logistic management & its related spend can be managed centrally on a global level
vi. It also reduces duplication
vii. More spend visibility and the ability to make the most of organizational spend.
viii. Centralize supply chain processes can improve moral in supply chain team and made better use of highly talented supply chain professionals.
ix. There is also a potential to maximize the total cost of ownership
x. The ability to better prepare for new product introduction and development
xi. Information in the items master maintenance should be reliable and up-to-date;
xii. There is huge potential for targeted development of supply chain competencies.

Disadvantages:

i. There's too much reliance on technology as opposed to human capital and skills,
ii. To make it work the organisation requires heavy investment in information technology and systems which could be costly.
iii. This is supposed to reduce paper flow, but policies and procedure to make it work could potentially create more paperwork.

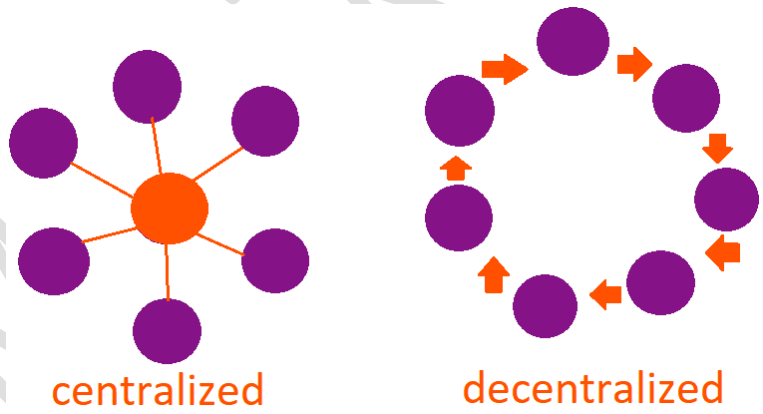


Figure: Centralized and Decentralized Supply Chain Management

Decentralize Supply Chain:

1) Decentralize supply chain processes can be defined as processes that must be performed in the plant because they involve physical interaction with the material.
2) There processes are the ones where the decision-making is 'localized'.
3) It involves supply chain managers, planners, manufacturing teams, health and safety team and possibility trade management folks.
4) Some examples of the example of decentralize supply chain processes that can be managed centrally are shown in below;

i. Receiving/shipping

ii. Assembly
iii. Manufacturing
iv. Material transaction
v. 5S- visual (Sort-Set in order-Shine-Standardize-Sustain)
vi. Plant for every part
vii. Health & safety aspects
viii. Audit & control Process
ix. Trade Management

Advantages:

i. Empowering employees, encouraging creativity and allowing many minds to work on the same problem. Speed of doing this is also a big advantage.
ii. Decision making process can be very quick and reflect local operating dynamics.
iii. For example receiving, shipping and assembly decisions there is shorter approval process when required, faster access to support and speedier replacement of defective material and quality issues, either product or processes quality.
iv. There is no heavy investment is needed up front, managers are able to use first-hand knowledge and experience to improve their areas and there's more accountability.
v. Decentralize supply chain processes provide less bureaucratic with less power vested in one individual.
vi. Errors can be quickly rectified quickly & easily in items master.
vii. There is a reliance on human capital and associated skills as opposed to technical platform.

Disadvantages:

i. In terms of disadvantages decentralize supply chain processes can result in duplication of effort in number of areas, longer planning cycles and create inefficiencies in key process.
ii. There is a danger than local buyers and planner will become paper pushers and/or expeditors with no real commercial or strategic experience & responsibilities.
iii. Another big disadvantage is silo mentality which could become norm. There's also the potential for corruptive practices approach to supply chain processes and mostly commonly master data can be compromised.
iv. There is less preparedness for new product development and less utilization and development of talent pool.

Comparison of Centralized Supply Chain Vs. Decentralized Supply Chain:

Centralized Supply Chain	Decentralized Supply Chain
1) Centralize Supply Chain Processes are those that can be managed from a remote location, can serve multiple sites, and drive synergy by serving	1) Decentralize supply chain processes can be defined as processes that must be performed in the plant because they involve physical interaction with the
2) Systematic and consistent reservation of authority.	2) Systematic dispersal of authority.
3) Communication Flow is vertical	3) Open and Free
4) Decision Making is Slow	4) Comparatively faster
5) Proper coordination and Leadership	5) Sharing of burden and responsibility
6) Power of decision making is lies with the top	6) Multiple persons have the power of decision making

management.	
7) Best suited for Small sized organization	**7)** Large sized organization
8) Implemented when inadequate control over the organization	**8)** Considerable control over the organization

Centralized and decentralized supply chain their coordination and aligning business activities:

Centralized and decentralized supply chain coordination for business activities:

1) A supply chain is a network of suppliers, production facilities, warehouses and markets designed to acquire raw materials, manufacture and store and distribute products among the markets. The entire process is driven by the demand generated at the markets.
2) One of the major problems in managing supply chain networks is the lack of collaboration among the different entities including raw material suppliers, production sites, warehouses and retailers.
3) The problem is that the different decision makers do not have access to the information regarding the state of the entire Supply Chain network, and in addition they usually operate under different objective functions.
4) Decision-making in a supply chain network can be performed in a centralized or a decentralized way. In a centralized structure, there exists a central authority responsible for decision-making, whereas in a decentralized structure the individual entities can make their own decisions.
5) In practice no supply chain can be completely centralized or decentralized and both approaches have their advantages and disadvantages. Most commonly the strategic decisions are usually made centrally while operation decisions are decentralized.
6) It is beneficial to adopt centralized control and proposed a mechanism to coordinate the decentralized system so that each player in the chain is benefited.

Centralized and decentralized supply chain aligning for business activities:

1) As far as concern from a strictly cost perspective, the centralization or decentralization of all functions do not result in the lowest cost supply chain.
2) In a centralized structure, transportation costs are typically going to be higher and customer service is going to decrease. In a decentralized structure, raw material and operations costs are typically going to be higher because of redundancy in staffing as well as lower buying power among commodities.
3) A hybrid strategy (aligning) is the balance and combination of both centralization and decentralization within an organization.
4) By centralizing strategic functions such as sourcing and long-term capacity, and decentralizing operations functions such as order fulfillment and shipment handling, global supply chains can maximize customer requirements while lowering total supply chain costs as a percentage of sales.
5) In the marketplace today, we are seeing this hybrid structure come to life where cost and customer service are the driving factors behind consumer purchasing decisions. Now is the time to align your global supply chain into a hybrid structure (is the balance and combination of both centralization and decentralization)and maximize the output of centralized and decentralized functions into a hybrid structure to increase customer service and lower total supply chain costs.

Demand Forecasting and Management:

What is Demand Forecasting?

- Demand Forecasting is predicting the future demand for products/services of an organization.
- Demand forecasting is a combination of two words; the first one is Demand and another forecasting. Demand means outside requirements of a product or service. In general, forecasting means making estimation in the present for a future occurring event. Here we are going to discuss demand forecasting and its usefulness.
- To forecast is to estimate or calculate in advance
- Since forecasts are estimates and involve consideration of so many price and non-price factors, no estimate is necessarily 100% accurate.
- It is a technique for estimation of probable demand for a product or services in the future. It is based on the analysis of past demand for that product or service in the present market condition. Demand forecasting should be done on a scientific basis and facts and events related to forecasting should be considered.
- Therefore, in simple words, we can say that after gathering information about various aspect of the market and demand based on the past, an attempt may be made to estimate future demand. This concept is called forecasting of demand.

Why Demand Forecasting?

- To help decide on facility capacity planning and capital budgeting
- To help evaluate market opportunities worthy of future investments
- To help assess its market share amongst other competitors
- To serve as input to aggregate production planning and materials requirement planning
- To plan for other organizational inputs (like manpower, funds and financing) and setting policies and procedures

Usefulness of Demand Forecasting:

1) Demand plays a vital role in the decision making of a business. In competitive market conditions, there is a need to take correct decision and make planning for future events related to business like a sale, production, etc. The effectiveness of a decision taken by business managers depends upon the accuracy of the decision taken by them.
2) Demand is the most important aspect for business for achieving its objectives. Many decisions of business depend on demand like production, sales, staff requirement, etc. Forecasting is the necessity of business at an international level as well as domestic level.
3) Demand forecasting reduces risk related to business activities and helps it to take efficient decisions. For firms having production at the mass level, the importance of forecasting had increased more. A good forecasting helps a firm in better planning related to business goals.
4) Good forecast helps in appropriate production planning, process selection, capacity planning, facility layout planning, and inventory management, etc. Demand forecasting provides reasonable data for the organization's capital investment and expansion decision. It also provides a way for the formulation of suitable pricing and advertisement strategies.

The significance of Demand Forecasting:

1) Fulfilling objectives of the business

2) Preparing the budget
3) Taking management decision
4) Evaluating performance etc.

Moreover, forecasting is not completely full of proof and correct. It thus helps in evaluating various factors which affect demand and enables management staff to know about various forces relevant to the study of demand behavior.

The Scope of Demand Forecasting:

- The scope of demand forecasting depends upon the operated area of the firm, present as well as what is proposed in the future. Forecasting can be at an international level if the area of operation is international. If the firm supplies its products and services in the local market then forecasting will be at local level.
- The scope should be decided considering the time and cost involved in relation to the benefit of the information acquired through the study of demand. Cost of forecasting and benefit flows from such forecasting should be in a balanced manner.

Types of Forecasting:

There are two types of forecasting: **Based on Economy and Based on the Time Period**

1. Based on Economy: There are three types of forecasting based on the economy:

i. ***Macro-level forecasting:*** It deals with the general economic environment relating to the economy as measured by the Index of Industrial Production(IIP), national income and general level of employment, etc.

ii. ***Industry level forecasting:*** Industry level forecasting deals with the demand for the industry's products as a whole. For example demand for cement in India, demand for clothes in India, etc.

iii. ***Firm-level forecasting:*** It means forecasting the demand for a particular firm's product. For example, demand for Birla cement, demand for Raymond clothes, etc.

2. Based on the Time Period: Forecasting based on time may be short-term forecasting and long-term forecasting

i. ***Short-term forecasting:*** It covers a short period of time, depending upon the nature of the industry. It is done generally for six months or less than one year. Short-term forecasting is generally useful in tactical decisions.

ii. ***Long-term forecasting casting:*** Long-term forecasts are for a longer period of time say, two to five years or more. It gives information for major strategic decisions of the firm. For example, expansion of plant capacity, opening a new unit of business, etc.

What is Demand Management?

- Demand Management is one that takes a complete view of a business
- It means discovering markets, planning products and services for those markets and then fulfilling these customer demands
- It is an integrative set of business processes, across, not just the enterprise, but across all its trading partner network (both customers and suppliers)

What does Demand Management involve?

- Discovering and understanding your market
- Establishing your customers' needs and expectations and what draws them to your business
- Challenge of managing what, when, and how a product/service is designed, made, distributed, displayed , promoted and serviced
- Doing the pricing and inventory optimization at various levels of market and channels segmentation
- Satisfying customers on product, price, delivery and post-sales services

Why is Demand Forecasting important for effective Supply Chain Management?

Demand Forecasting facilitates critical business activities like budgeting, financial planning, sales and marketing plans, raw material planning, production planning, risk assessment and formulating mitigation plans. Outlined below are the impacts of Demand Forecasting on Supply Chain Management:

- **Improved supplier relations and purchasing terms:** Demand Forecasting drives the raw material planning process which facilities the Purchasing Managers to release timely purchase plan to suppliers. Visibility and transparency of raw material demand improve supplier relations and empowers Purchasing Managers to negotiate favorable terms for their companies.

- **Better capacity utilization and allocation of resources:** Based on the current inventory levels, raw material availability and expected customer orders, production can be scheduled effectively. This leads to improved capacity utilization and judicious allocation of manufacturing resources.

- **Optimization of inventory levels:** A proper Demand Forecast provides vital information for driving the desired raw material, WIP and finished goods inventory levels. This reduces the Bullwhip effect across the Supply Chain, leading to optimization of inventory levels and reduction in stock-out or over-stocking situations.

- **Improved distribution planning and logistics:** Apart from small businesses, this is particularly evident in businesses dealing with multiple SKUs and wide distribution networks. Distribution and Logistics Managers are enabled to balance inventory across the network and negotiate favorable terms with Transporters.

- **Increase in customer service levels:** With optimized inventory levels and improved Distribution Planning and Logistics, customer service metrics like on-time delivery (OTD), on-time in-full (OTIF), case-fill/fill-rate, etc. are improved due to right sizing and right positioning of inventory.

- **Better product lifecycle management:** Medium to long range Demand Forecasts provide better visibility of new product launches and old product discontinuations. This drives synchronized raw material, manufacturing and inventory planning to support new product launches and most importantly, reducing the risk of obsolescence of discontinued products.

- **Facilitates performance management:** Management can set KPIs (key performance indicators) and targets for various functions like Sales, Finance, Purchase, Manufacturing, Logistics, etc. based on the medium to long range plans derived from the Demand Forecasting process. Organizational efficiency, effectiveness, and improvement initiatives can be designed for key areas of the company.

Forecasting plays three major roles in effective supply chain management:

1. **Pivotal in strategic planning of Business:** Forecasting is the underlying hypothesis for strategic business activities like expansion planning, budgeting, financial planning, risk assessment, and mitigation. Critical business assumptions like turnover, profit margins, cash flow, capital expenditure, etc. are also dependent on Forecasting.
2. **Initiating all push–processes of Supply Chain:** Forecasting is the starting point for all push-processes of Supply Chain like raw material planning, purchasing, inbound logistics, and manufacturing. Better forecasts help optimize the inventory levels and capacity utilization.
3. **Driving all pull–processes of Supply Chain:** Forecasting drives all pull-process of Supply Chain like order management, packaging, distribution, and outbound logistics. Better forecast improves the distribution and logistics and increases customer service levels.

How does demand forecasting contribute to the success of Supply chain?

Demand forecasting allows a company to take several business decisions, such as planning the production process, purchasing raw materials, managing funds, supply chain and deciding the price of the product. Here are some major advantages of demand forecasting which help supply chain to perform at an optimum level:

Increased customer satisfaction: The demand forecasting will help predict product demand so that enough product is available to fulfill customer orders with short lead times, on-time.

Reducing inventory stock outs: It is vital for organizations to understand the significance of demand forecasting, even if they are working in JIT System or with long lead time suppliers. When buying from long lead time suppliers, all you have to do is to send a demand forecast so that suppliers can arrange raw materials in anticipation of actual customer orders.

Lowering safety stock requirement: With an efficient demand forecasting process, there will be a direct impact in the planning of inventory levels:

a. Developing production requests to manufacturing operations
b. Development for new product launches
c. Preparation for promotional activity
d. Forecasting for seasonal variations in demand

***Preparing the budget*:** Demand forecasting plays a significant role in making budget by estimating costs and expected revenues. Consequently, demand forecasting enables organizations to prepare their budget which leads to a better planning of costs.

Expanding organizations: Demand forecasting helps in the decision about the expansion of a business. It depends on the expected demand; if the demand for products is higher, then the organization may plan to expand further. Then again, if the demand for products is expected to fall, the organization may cut down the investment in the business.

Reducing product obsolescence costs: The volume of inventory on hand can be cut by recognizing, repurposing or eliminating obsolete inventory. In this way, both direct and indirect costs of keeping the obsolete inventory will be

reduced. Through a standardized consistent way of forecasting demand, excess stock is not ordered and this will reduce the chance of obsolete stock.

Corporate training as a mean for building a better forecast: There is no doubt that demand forecasting is highly significant for the success of a business. This is a major reason why companies are increasingly investing in training and development programs to train employees in this area. Nowadays Demand forecasting training can be incorporated within organizations effectively through modern learning solutions such as e-learning, webinars, and simulations. These solutions can prove to be as effective as instructor-led training.

Demand forecasting Methods:

Demand Forecasting methods are of two types which are;

1) Quantitative methods(Time Series Methods)
2) Qualitative Methods(Judgmental Methods)

Quantitative Methods (Time Series Methods)

Time Series Methods

1. Naive approach
2. Moving Average Method
   - **Simple moving average method**
   - **Weighted moving average method**
3. Exponential smoothing method

Causal Method

1. Trend projection
2. Liner regression analysis

Time Series Methods:

Time Series Model:

- Time Series Model use a series of past data to make a forecast for the future.
- It predicts that the future is a projection of the past.
- It observed over a period of time to use a series of data to make a forecast for the future.
- Time series is a time ordered sequence of the observation taken at regular intervals over a period of time.
- Example: hourly, daily, weekly, monthly, quarterly & annually.
- The data may be used for measurement of demand, earning, profits, output, productivity etc.

Decomposition of a Time Series:

- Analysis of time series data requires the analyst to identify the behaviour of the series.(by the help of graph)
- Decomposition of a Time Series are;
  - Trend
  - Seasonality
  - Cycle
  - Random variation (error)

Trend:

1) Trend refers to gradual, long term, upward or down ward movement in the data over time.
2) Example;

- Change in income
- Population
- Age distribution

Seasonality: Seasonality refers to short-term, fairly regular variation related to factor such as weather, holiday, vacation etc. Seasonality variation can be daily, weekly or monthly.

Cycle: Cycles are wavelike variation of more than one year or which occur every several years. They are usually tied with business cycle related to a variety of economic , political conditions etc.

Random Variation (Error): Random Variation are residual which are blips caused by chance and unusual situation which cannot be predicted.(e.g. war, earthquake, flood etc.)

Simple Moving Average:

A simple moving average (SMA) is an arithmetic moving average calculated by adding recent closing prices and then dividing that by the number of time periods in the calculation average.

A simple, or arithmetic, moving average that is calculated by adding the closing price of the security for a number of time periods and then dividing this total by that same number of periods. Short-term averages respond quickly to changes in the price of the underlying, while long-term averages are slow to react.

Simple Moving Average is a method of time series smoothing and is actually a very basic forecasting technique. It does not need estimation of parameters, but rather is based on order selection.

A simple average of demands occurring in all previous time periods is taken as the demand forecast for the next time period in this method.

In this method, the average of the demands from several of the most recent periods is taken as the demand forecast for the next time period. The number of past periods to be used in calculations is selected in the beginning and is kept constant (such as 3-period moving average).

Example: A XYZ refrigerator supplier has experienced the following demand for refrigerator during past five months.

Month	Demand
February	20
March	30
April	40
May	60
June	45

Find out the demand forecast for the month of July using five-period moving average & three-period moving average using simple moving average method.

$$MA_n = \frac{\sum_{i=1}^{n} Di}{n}$$

For five period average (i.e. n = 5)

$$MA_5 = \frac{20+30+40+60+45}{5}$$

$$= 29 \text{ units}$$

For three period average (i.e. n = 3)

$$MA_3 = \frac{40+60+45}{3}$$

$$= 48.33$$

$$\approx 49 \text{ units}$$

Weighted Moving Average:

In this method, unequal weights are assigned to the past demand data while calculating simple moving average as the demand forecast for next time period. Usually most recent data is assigned the highest weight factor.

When using a moving average method described before, each of the observations used to compute the forecasted value is weighted equally. In certain cases, it might be beneficial to put more weight on the observations that are closer to the time period being forecast. When this is done, this is known as a weighted moving average technique. The weights in a weighted Moving Average must sum to 1.

Weighted MA (3) = Ft+1 = wt1(Dt) + wt2(Dt-1) + wt3(Dt-2)

The Weighted Moving Average places more importance on recent price moves; therefore, the Weighted Moving Average reacts more quickly to price changes than the regular Simple Moving Average.

Example: The demand for defense machinery for a certain project is given each month as follows:

Month	1	2	3	4	5	6	7	8	9	10
Demand	120	110	90	115	125	117	121	126	132	128

The defense officer is asked to forecast the demand for the 11th month using three period moving average techniques.

Solution: The defense officer has decided to use a weighting scheme of **0.5, 0.3, 0.2** and calculated the weighted moving average for the 11th month as follows.

Weighted MA (3): F_{11} = 0.5(128) + 0.3(132) + 0.2(126) = 64 + 39.6 + 25.2 = 128.2

Exponential Smoothing Models:

1) In this method, weights are assigned in exponential order. The weights decrease exponentially from most recent demand data to older demand data.
2) Exponential smoothing is a rule of thumb technique for smoothing time series data using the exponential window function (window function is a mathematical function that is zero-valued outside of some chosen interval). Whereas in the simple moving average the past observations are weighted equally, exponential functions are used to assign exponentially decreasing weights over time.
3) It is an easily learned and easily applied procedure for making some determination based on prior assumptions by the user, such as seasonality. Exponential smoothing is often used for analysis of time-series data.
4) Exponential smoothing forecasting methods are similar in that a prediction is a weighted sum of past observations, but the model explicitly uses an exponentially decreasing weight for past observations.

Example :

One of the two wheeler manufacturing company experienced irregular but usually increasing demand for three products. The demand was found to be 420 bikes for June and 440 bikes for July. They use a forecasting method which takes average of past year to forecast future demand. Using the simple average method demand forecast for June is found as 320 bikes (Use a smoothing coefficient 0.7 to weight the recent demand most heavily) and find the demand forecast for August.

$$F_t = \alpha D_{t-1} + (1-\alpha) F_{t-1}$$

where α = Smoothig Coefficient

D_{t-1} = Actual Demand for Recent Period

F_{t-1} = Demand Forecast for Recent Period

F_t = Forecast of Next Period Demand

for July :

$= 0.7(420) + (1-0.7)320$

$= 294 + 96$

$= 390$ units

for August :

$= 0.7(440) + (1-0.7)\,390$

$= 308 + 117$

$= 425$ units

Forecast Errors:

A forecast error is the difference between the actual or real and the predicted or forecast value of a time series or any other phenomenon of interest.

Since the forecast error is derived from the same scale of data, comparisons between the forecast errors of different series can only be made when the series are on the same scale.

Generally a forecast is compared with an outcome at a single time-point and a summary of forecast errors is constructed over a collection of such time-points.

Here the forecast may be assessed using the difference or using a proportional error. By convention, the error is defined using the value of the outcome minus the value of the forecast.

The forecast error is the difference between the observed value and its forecast based on all previous observations. If the error is denoted as e(t) then the forecast error can be written as;

$$\mathbf{e(t) = y(t) - y(t|t-1)}$$

Where,
y(t) = observation;
y(t|t-1)} = denote the forecast of y(t) based on all previous observations

Mean Absolute Deviation (MAD), Mean Absolute Error (MAE):

1) Both the Mean Absolute Deviation (MAD) and the Mean Absolute Error (MAE) refer to the same method for measuring forecast error.

2) MAD is most useful when linked to revenue, APS, COGS or some other independent measure of value. MAD can reveal which high-value forecasts are causing higher error rates.

3) MAD takes the absolute value of forecast errors and averages them over the entirety of the forecast time periods. MAD is obtained by using the following formula:

$$\frac{1}{N}\sum_{k=1}^{N}| F_k - A_k$$

Qualitative or Judgmental Methods:

1. Judgmental forecasting methods incorporate based on Judgement, opinions and subjective probability estimates.
2. Judgmental forecasting is used in cases where there is lack of historical data or during completely new and unique market conditions.
3. Judgmental methods include:
   - **i. Delphi Method**
   - **ii. Market Survey**
   - **iii. Historical Analogy**

Delphi Method:

1) The Delphi method is a forecasting process framework based on the results of several rounds of questionnaires sent to a panel of experts.
2) Several rounds of questionnaires are sent out, and the anonymous responses are aggregated and shared with the group after each round.
3) The experts are allowed to adjust their answers in subsequent rounds. Since multiple rounds of questions are asked and the panel is told what the group thinks as a whole, the Delphi method seeks to reach the correct response through consensus.
4) It is an organized method for collecting views and information concern to a specific area.
5) This method allows dialogue between geographically separated experts while serving an effective means for learning
6) In this method, gathering a group of experts to forecast events and assess complex issues.
7) Its collective representation of human intelligence.
8) The Delphi method is a process of exploring, assessing and evaluating.

Key characteristics of the Delphi method:

1) Structuring of information flow
2) The initial contributions from the experts are collected in the form of answers to questionnaires and their comments to these answers.
3) The panel director controls the interactions among the participants by processing the information and filtering out irrelevant content.
4) This avoids the negative effects of face-to-face panel discussions and solves the usual problems of group dynamics.

How to use Delphi Method:

1) Define the problem
2) Give everyone the problem

3) Collects the response
4) give everyone the collections

5) repeat as necessary

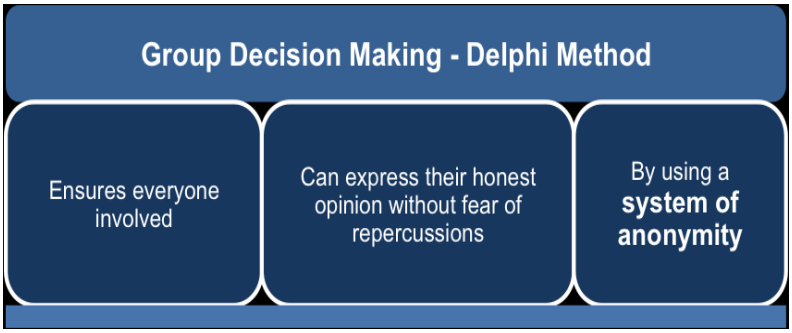


Figure: Delphi Method

Application of the Delphi Method:

1) First applications of the Delphi method were in the field of science and technology forecasting. The objective of the method was to combine export opinions on likelihood and expected development time of the particular technology in a single indicator.
2) Later the Delphi method was applied in other areas, especially those to public policy issues, such as economic trends, health and education. It was also applied successfully and with high accuracy in business forecasting.
3) The Delphi method has also been used as a tool to implement multi stake holder approaches for participate policy making in developing countries.

Benefits of the Delphi Method

The Delphi method seeks to aggregate opinions from a diverse set of experts, and it can be done without having to bring everyone together for a physical meeting. Since the responses of the participants are anonymous, individual panelists don't have to worry about repercussions for their opinions. Consensus can be reached over time as opinions are swayed.

Disadvantages of the Delphi Method

While the Delphi method allows for commentary from a diverse group of participants, it does not result in the same sort of interactions as a live discussion. Response times can be long, which slows the rate of discussion. It is also possible that the information received back from the experts will provide no innate value.

Market Survey:

1) Market Survey an investigation into the state of the market for a particular product or service, including an analysis of consumers' needs and preferences.
2) The study of the spending characteristics and purchasing power of the consumer who are within your business's geographic area of operation; a research method for defining the market parameters of a business.
3) Market survey is the survey research and analysis of the market for a particular product/service which includes the investigation into customer inclinations. A study of various customer capabilities such as investment attributes and buying potential.
4) Market surveys are tools to directly collect feedback from the target audience to understand their characteristics, expectations, and requirements.

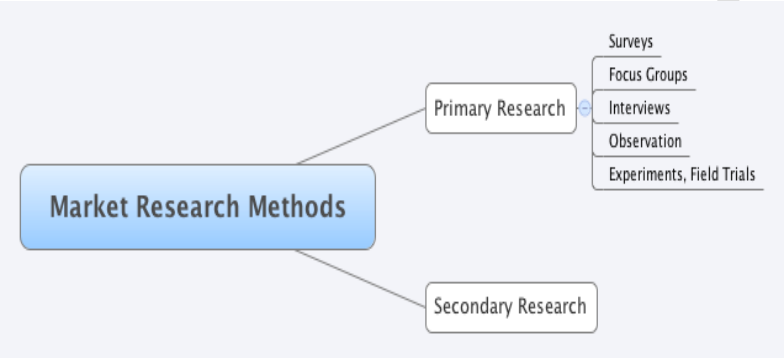


Figure: Market Survey

Market Survey Methods:

1) **Surveys.**
2) **Focus groups.**
3) **Personal interviews**
4) **Observation.**
5) **Field trials**

Surveys: With concise and straightforward questionnaires, you can analyze a sample group that represents your target market. The larger the sample, the more reliable your results will be.

1. In-person surveys are one-on-one interviews typically conducted in high-traffic locations such as shopping malls.
2. Telephone surveys through calls.
3. Mail surveys are a relatively inexpensive way to reach a broad audience.
4. Online surveys usually generate unpredictable response rates and unreliable data, because you have no control over the pool of respondents.

Figure: Market Research

Focus Groups:

- In focus groups, a moderator uses a scripted series of questions or topics to lead a discussion among a group of people.
- These sessions take place at neutral locations, usually at facilities with videotaping equipment and an observation room with one-way mirrors.
- A focus group usually lasts one to two hours, and it takes at least three groups to get balanced results.

Personal Interviews : Like focus groups, personal interviews include unstructured, open-ended questions. They usually last for about an hour and are typically recorded. Focus groups and personal interviews provide more subjective data than surveys.

Observation:

1) Individual responses to surveys and focus groups are sometimes at odds with people's actual behavior.
2) When you observe consumers in action by videotaping them in stores, at work, or at home, you can observe how they buy or use a product.
3) This gives you a more accurate picture of customers' usage habits and shopping patterns.

Field Trials:

- Placing a new product in selected stores to test customer response under real-life selling conditions can help you make product modifications, adjust prices, or improve packaging.
- Small business owners should try to establish rapport with local store owners and Web sites that can help them test their products.

Figure: Difference between Qualitative & Quantitative Market Research

Historical Analogy:

1) Historical Analogy an approach to sales forecasting in which the past sales results of a similar product are used to predict the likely sales of a similar new product.

2) Historical Analogy mainly forecast the demand for a new product, it may be accurate and cheap. It based on forecast and past data of any similar or relevant existing product, then according to the product situation to develop a best fit forecast.

3) A judgmental forecasting technique based on identifying a sales history that is analogous to a present situation, such as the sales history of a similar product, and using that past pattern to predict future sales.

4) This theory is based on a more realistic assumption, that all business cycles are not uniform in amplitude or duration and as such the use of history is made not by projecting any fancied economic into the future, but by selecting some specific previous situation.

5) This theory is based on two assumptions

   i. Every action has a reaction and
   ii. Magnitude of the original action influences the reaction.

Forecast by Historical Analogy:

1) Forecast by analogy is a forecasting method that assumes that two different kinds of phenomena share the same model of behaviour.
2) For example, one way to predict the sales of a new product is to choose an existing product which "looks like" the new product in terms of the expected demand pattern for sales of the product.
3) "Used with care, an analogy is a form of scientific model that can be used to analyze and explain the behavior of other phenomena."
4) According to some experts, research has shown that the careful application of analogies improves the accuracy of the forecast.
5) *Example of Historical Analogy;* Forecasting the demand of iPhone 6 phone cover, can be base on the sales on iPhone 6 phone, forecasting the demand of iPhone 6 will base on the sales of iPhone 5.

Accuracy of Forecasting Methods:

1) Demand forecasting accuracy is a measurement of identifying how close the forecast was comparing to an actual demand.
2) In other words, to make estimates of how the environment differed from the one that was forecasted.
3) The goal of accuracy is to know the error-how much the company missed, of the actual demand for forecasted period.
4) Moreover, forecasting accuracy directly affects profit of the company as well as shareholder value.
5) As a research has shown it should be done by using two or more forecasting models which helps to reduce the variance of forecasting errors.
6) There are many ways of measuring forecasting accuracy which are;
   a) Mean Absolute Deviation – MAD
   b) Mean Squared Error – MSE
   c) Mean Absolute Percent Error

Mean Absolute Deviation – MAD:

This model is calculated by taking the sum of the absolute values of the individual forecast errors and divining by the number of errors (n):

MAD = Absolute Error/n.

- **Error= |Actual – Forecast|**

It shows the average error of each forecast made for specific period.

$$MAD = \Sigma|E|/N$$

Where: |E| = the absolute value of the error (i.e., drop the negative signs)

Mean Squared Error – MSE:

Mean squared error (MSE), which is the average of the squared errors.

MSE = Sum of Squared Errors / n.

It is very helpful where there is a need to cope with high spikes in demand.

$$\text{Mean Squared Error} = MSE = \Sigma E^2/N$$

Where: |E| = the absolute value of the error

Mean Absolute Percent Error – MAPE:

It is the most popular method used for accuracy evaluation. The MAPE is the average of the absolute values of the errors expressed in as percentages of the actual values.

$$\textit{Mean Absolute Percent Error} = MAPE = \Sigma|PE|/N$$

Where: N = the number of periods for which tracks the percent error

|PE| = the absolute value of the percent error (i.e., drop the negative signs)

Solved Questions with Answer

① The table below shows the data of the monthly demand over a six months period. Calculate the forecast of demand for the seventh month using three month moving average method.

Month →	1	2	3	4	5	6
Demand →	120	130	110	140	110	130

Ans $F_7 = \frac{140+110+130}{3} = 126.67$ units.

②

Month	1	2	3	4	5	6	7	8	9	10	11	12
Demand	210	350	240	186	288	300	320	255	275	118	265	?

The table above shows the monthly demand over 11th month period for the product. Determine the forecast of demand for the twelfth month using 5 month moving average method?

Ans $F_{12} = \frac{320+255+275+118+265}{5}$

$= 246.6$ units.

③

Month	Actual demand	forecast by simple average
1	20	
2	30	
3	55	
4	61	
5	37	
6	39	?
7	45	?
8	31	
9	32	
10	26	?
11	15	?
12	57	

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$F_6 = \frac{55+61+37}{3} = 51$

$F_7 = \frac{61+37+39}{3} = 45.67$

$F_8 = \frac{45+31+32}{3} = 36$

$F_{11} = \frac{31+32+26}{3} = 29.67$.

④ In a 3 period, the moving average model the most recent period might be assigned a weight of 0.5 and the second most recent period might be assigned a weight of 0.3 and the third most recent period with a weight of 0.2. Demand are given 20, 30, 40. Calculate the weighted moving average?

Ans $F_{t+1} = \frac{(0.5 \times 20) + (0.3 \times 30) + (0.2 \times 40)}{0.5+0.3+0.2}$

$= \frac{10+9+8}{1} = 27$ units.

⑤ The table below shows the monthly demand over 6 months period for a product →

(1) Determine the forecast of demand for the seventh month using 3 month simple moving method.

(2) If the weightage given for the demand for 6th 5th, 4th month are 0.5, 0.3, 0.2. Determine the forecast of demand for the seventh month using weighted moving average method.

Method	1	2	3	4	5	6
Demand	120	130	110	140	110	130

Ans $F_7 = \frac{140+110+130}{3} = \frac{380}{3} = 126.67$ units

(Simple average method)

$$F_{wa} = \frac{(0.5\times130)+(0.3\times110)+(0.2\times140)}{0.5+0.3+0.2}$$

$$= 65+33+28 = 126 \text{ units.}$$

(6) ABC company predicted the sales of a product as 150 units for the month of February 2015. The actual demand for February 2015 was 158 units. Using a smoothing constant $\alpha = 0.3$, forecast the demand for march 2015?

Ans $F_{march-15} = 150 + 0.3(158-150)$

$= 150 + (0.3\times8)$

$= 150 + 2.4$

$= 152.4$ units.

(7) For mutual fund sales, the table given below shows the 12 months mutual sales

(1) Determine the forecast of demand for 7th, 8th, 9th, 10th and 11th month by using 5 month simple moving method.

(2) The weightage given for the demand for 8th, 7th, 6th and 5th months are 0.1, 0.02, 0.13 and 0.29 respectively. Determine the forecast of demand for 8th month using weighted moving method.

(4)

(SMM)

Month	Demand	Forecast
1	220	
2	240	
3	333	
4	365	
5	115	
6	289	
7	170	268.4
8	189	254.4
9	224	225.6
10	285	197.4
11	301	231.4
12	311	

Any

(1) $F_7 = \frac{365+115+289+240+333}{5} = \frac{1342}{5}$

$= 268.4$ units.

$F_8 = \frac{115+289+170+365+333}{5} = \frac{1272}{5}$

$= 254.4$ units.

$F_9 = \frac{289+170+189+115+365}{5} = \frac{1128}{5} = 225.6$ units

$F_{10} = \frac{170+189+224+289+115}{5} = \frac{987}{5} = 197.4$ units

$F_{11} = \frac{289+170+189+224+285}{5} = \frac{1157}{5} = 231.4$ units

(6)

(2) $F_8 = \frac{(0.02 \times 170) + (0.13 \times 289) + (0.29 \times 115)}{0.02 + 0.13 + 0.29}$

$= \frac{3.4 + 37.57 + 33.35}{0.44} = \frac{74.32}{0.44} = 168.91$

(8)

Month	Sales	W.M.A
1	40	$w_1 = 3/6$
2	50	$w_2 = 02/6$
3	60	$w_3 = 1/6$.
4	?	
5	?	
6	?	
7	?	

Ans

$F_4 = \frac{\left(\frac{3}{6} \times 40\right) + \left(\frac{2}{6} \times 50\right) + \left(\frac{1}{6} \times 60\right)}{3/6 + 2/6 + 1/6}$

$= \frac{\frac{120}{6} + \frac{100}{6} + \frac{60}{6}}{6/6} = \frac{280}{6} = 46.67$

$F_5 = \frac{\left(\frac{3}{6} \times 50\right) + \left(\frac{2}{6} \times 60\right) + \left(\frac{1}{6} \times 46.67\right)}{1}$

$= 25 + 19.8 + 7.93 = 52.73$

$$F_6 = \frac{(0.5 \times 60) + (0.33 \times 46.67) + (0.17 \times 52.73)}{1}$$

$$= 30 + 15.4 + 8.96 = 54.36 \text{ units}$$

$$F_7 = (0.5 \times 46.67) + (0.33 \times 52.73) + (0.17 \times 54.36)$$
$$= 23.335 + 17.39 + 9.24$$
$$= 49.97 \text{ units}.$$

(9)

Week	Demand
1	820
2	775
3	680
4	655
5	750
6	802
7	798
8	689
9	775
10	2

Given, the weekly demand data are the exponential smoothing forecast for period 2-10 using $\alpha = 0.10$ and $\alpha = 0.6$ (consider $F_1 = D_1$).

Ans.

(1)

If $\alpha = 0.1$

Week	Demand	Forecast demand
1	820	820
2	775	$F_2 = 820 + 0.1(820 - 820) = 820$
3	680	$F_3 = 820 + 0.1(775 - 820) = 815.5$
4	655	$F_4 = 815.5 + 0.1(680 - 815.5) = 801.95$
5	750	$F_5 = 801.95 + 0.1(655 - 801.95) = 787.26$
6	802	$F_6 = 787.26 + 0.1(750 - 787.26) = 783.53$
7	798	$F_7 = 783.53 + 0.1(802 - 783.53) = 785.38$
8	689	$F_8 = 785.38 + 0.1(798 - 785.38) = 786.64$
9	775	$F_9 = 786.64 + 0.1(689 - 786.64) = 776.88$
10		$F_{10} = 776.88 + 0.1(775 - 776.88) = 776.69$

Week	error
1	$820 - 820 = 0$
2	$775 - 820 = -45$
3	$680 - 815.5 = -135.5$
4	$655 - 801.95 = -146.95$
5	$750 - 787.26 = -37.26$
6	$802 - 783.53 = 18.47$
7	$798 - 785.38 = 12.62$
8	$689 - 786.64 = -97.64$
9	$775 - 776.88 = -1.88$
10	-776.69

*

Week	demand	Forecast ($\alpha = 0.6$)
1	820	820
2	775	$F_2 = 820 + 0.6(820 - 820) = 820$
3	680	$F_3 = 820 + 0.6(775 - 820) = 793$
4	655	$F_4 = 793 + 0.6(680 - 793) = 725.2$
5	750	$F_5 = 725.2 + 0.6(655 - 725.2) = 683.08$
6	802	$F_6 = 683.08 + 0.6(750 - 683.08) = 723.23$
7	798	$F_7 = 723.23 + 0.6(802 - 723.23) = 770.49$

Week	demand	Forecast
8	689	$F_8 = 770.49 + 0.6(798 - 770.49) = 786.99$
9	775	$F_9 = 786.89 + 0.6(689 - 786.99) = 728.1$
10	-	$F_{10} = 728.1 + 0.6(775 - 728.1) = 756.24$

Week	Error
1	$820 - 820 = 0$
2	$775 - 820 = -45$
3	$680 - 793 = -113$
4	$655 - 725.2 = -70.2$
5	$750 - 683.08 = 66.92$
6	$802 - 723.23 = 78.77$
7	$798 - 770.49 = 27.51$
8	$689 - 786.99 = -97.99$
9	$775 - 728.1 = 46.9$
10	$0 - 756.24 = -756.24$

(10) ABC wishes to forecast the no. of incoming calls it receives in a day from the customer, one of its client XYZ. The ABC schedule, the appropriate no. of telephone operators based on projected call volume. ABC believe that most recent 12 days of call volume are representative of the near future call volume.

Moving average

Days	Calls
1	159
2	217
3	186
4	161
5	173
6	157

Days	Calls
7	203
8	195
9	188
10	168
11	198
12	159

(1) Use the moving average method with 3 days to develop a forecast of call volume in day 13 ?

(2) Use the weighted moving average method with 3 days and the weight of 0.1, 0.3 and 0.6 to develop a forecast of the call volume in day 13.?

(3) If a smoothing constant value is $\alpha = 0.25$, and forecast for day 13 (exponential smoothing forecast of day 11 was 180.76 calls). Calculate ?

Ans

(1) $F_{d-13} = \frac{168 + 198 + 159}{3} = \frac{525}{3} = 175$ calls (SMA)

(2) $F_{d-13} = \frac{(0.1 \times 168) + (0.3 \times 198) + (0.6 \times 159)}{0.1 + 0.3 + 0.6}$ (WMA)

$= 16.8 + 59.4 + 95.4$

$= 171.6$ calls.

(3) $F_{12} = 180.76 + 0.25(198 - 180.76) = 185.07$ calls.

$F_{13} = 185.07 + 0.25(159 - 185.07) = 178.55$ calls.

(10)

(11)

Days	Calls
1	210
2	250
3	222
4	240
5	220
6	180
7	198
8	165
9	105
10	118
11	134
12	189

(i) $\alpha = 0.17$

Day 11 $\Rightarrow$ 172.94 (forecast)

(ii) $w_1 = 0.32$

$w_2 = 0.27$

$w_3 = 0.16$

(i) Find forecast for day 13 by simple moving average method.

(ii) Find forecast for day 13 by weighted moving average method.

(iii) Find forecast for day-13 by exponential smoothing method?

Ans (i) $F_{d-13} = \frac{118 + 134 + 189}{3} = 147$ calls (SMA)

(ii) $F_{d-13} = \frac{(0.32 \times 118) + (0.27 \times 134) + (0.16 \times 189)}{0.32 + 0.27 + 0.16}$

$= \frac{37.76 + 36.18 + 30.24}{0.75}$

$= \frac{104.18}{0.75} \doteq 138.91$ calls.

Teacher's Signature

(iii) $F_{12} = 172.94 + 0.17(134 - 172.94) = 166.32$ calls.

$F_{13} = 166.32 + 0.17(189 - 166.32) = 170.18$ calls.

(12) Calculate the 3yearly and 5 yearly moving average for the following time series →

Year	(in quantity) production	(3yearly) moving average	(5 yearly) moving average
2002	500		
2003	540		
2004	550		
2005	530	530	
2006	520	540	
2007	560	533.33	528
2008	600	536.67	540
2009	640	560	552
2010	620	600	570
2011	610	620	588
2012	640	623.33	606

(13)

Week	Sales
1	39
2	44
3	40
4	45
5	38
6	43
7	39
8	

→ (13) Calculate three weeks moving average, and also compute a moving average forecast error (forecast errors are calculated as actual value)?

Ans:

Week	Sales	Forecast	Error	|Error|	%.Error|
1	39				
2	44				
3	40				
4	45	41	4	4	8.89 %
5	38	43	-5	5	13.15 %
6	43	41	2	2	4.65 %
7	39	42	3	3	7.69 %
8		40			

(14) Mobile shop sales problem (forecast)

Calculate →

(1) Weighted moving average.

~~(2) Compare error~~

Forecast ~~errors~~ sales using 4 weeks weighted moving average with weights 0.4, 0.3, 0.2 and 0.1.

(WMA)

Weeks	Sales	Forecast	Error	|Error|
1	39			
2	44			
3	40			
4	45			
5	38	41.3	-3.3	3.3
6	43	42.4	0.6	0.6
7	39	41.4	-2.4	2.4
8		41.9		

(13)

$$F_5 = \frac{(0.4 \times 39) + (0.3 \times 44) + (0.2 \times 40) + (0.1 \times 45)}{0.4 + 0.3 + 0.2 + 0.1}$$

$$= \frac{15.6 + 13.2 + 8 + 4.5}{1} = 41.3$$

$$F_6 = \frac{(0.4 \times 44) + (0.3 \times 40) + (0.2 \times 45) + (0.1 \times 38)}{1}$$

$$= 17.6 + 12 + 9 + 3.8 = 42.4$$

$$F_7 = (0.4 \times 40) + (0.3 \times 45) + (0.2 \times 38) + (0.1 \times 43)$$

$$= 16 + 13.5 + 7.6 + 4.3$$

$$= 41.4.$$

$$F_8 = \frac{(0.4 \times 45) + (0.3 \times 38) + (0.2 \times 43) + (0.1 \times 39)}{1}$$

$$= 18 + 11.4 + 8.6 + 3.9$$

$$= 41.9.$$

(5)

Month	Units(At)	Forecast (Ft)
May	100	105
June	80	104
July	110	99
Aug.	115	101
Sept.	105	104
Oct.	110	104
Nov.	125	105
Dec.	120	109
Jan.		111

(14)

→ The monthly demand for units by the company is given above.

(i) Use exponential smoothing method to forecast no of units for June to January

→ The initial forecast for may is 105 units and $\alpha = 0.2$

Ans (i)

$F_{June} = 105 + 0.2(100 - 105) = 104$

$F_{July} = 104 + 0.2(80 - 104) = 99.2$

$F_{Aug.} = 99.2 + 0.2(110 - 99.2) = 101.36$

$F_{Sept.} = 101.36 + 0.2(115 - 101.36) = 104.09$

$F_{Oct.} = 104.09 + 0.2(105 - 104.09) = 104.27$

$F_{Nov.} = 104.27 + 0.2(110 - 104.27) = 105.42$

$F_{Dec.} = 105.42 + 0.2(125 - 105.42) = 109.33$

$F_{Jan.} = 109.33 + 0.2(120 - 109.33) = 111.46$

(15) In a pizza point the manager must forecast the weekly demand for these pizzas, so that he can order the ingredients on weekly basis. The recent demand has been as follows →

Week	Pizzas	(SMA) Forecast	(WMA) Forecast	SMA [Error]	WMA [Error]
June-2	50				
June-3	65				
June-16	52				
June-23	56	55.67	54.9	0.33	1.1
June-30	55	57.67	54.3	0.67	0.7
July-7	60	54.33	53.8	5.67	6.2
July-14	?		56.5		
				6.67	11.6

(16)

(i) Forecast the demand for pizza for June 23rd to July 14th by using the simple average method with n=3. Repeat the forecast by using weighted moving average method, n=3, weights of 0.5, 0.3 and 0.2.

Ans

$$F_{June-23} = \frac{(0.5 \times 50) + (0.3 \times 65) + (0.2 \times 52)}{0.5+0.3+0.2}$$

$$= 25 + 19.5 + 10.4$$

$$= 54.9$$

$$F_{June-30} = (0.5 \times 65) + (0.3 \times 52) + (0.2 \times 56)$$

$$= 32.5 + 15.6 + 11.2$$

$$= 59.3$$

$$F_{July-7} = \frac{(0.5 \times 52) + (0.3 \times 56) + (0.2 \times 55)}{1}$$

$$= 26 + 16.8 + 11 = 53.8$$

$$F_{July-14} = \frac{(0.5 \times 56) + (0.3 \times 55) + (0.2 \times 30)}{1}$$

$$= 28 + 16.5 + 12 = 56.5$$

(17) For a product the forecast and actual sales for August are 40 and 30. If the exponential smoothing factor is 0.5, Calculate the sales for the month of September?

Ans) $F_{September} = 40 + 0.5(30 - 40)$

$= 40 + (-5)$

$= 40 - 5 = 35$

(18) The demand for 2-wheeler was 900 units and 1030 units in april 2015 and may 2015. The forecast for the month of april 2015 was 850 units. Consider the smoothing constant of 0.6. Forecast for month of June 2015?

Ans $F_{may} = 850 + 0.6\,(900 - 850) = 880$.

$F_{June} = 880 + 0.6\,(1030 - 880) = 970$.

(19) For a canteen, the actual demand for disposable cups was 500 units in January and 600 units in febouary. The forecast for month of January was 400 units. Calculate the forecast for month of march considering the α as 0.75.

Ans $F_{february} = 400 + 0.75\,(500 - 400) = 475$.

$F_{march} = 475 + 0.75\,(600 - 475) = 568.75$.

(20) Assume that the demand for a product is fairly stable and the $\alpha = 0.5$. Assume that last month forecast was 1050 units. Actual demand turn out 1000 units. Find the forecast for next period?

Ans $F_{next\ period} = 1050 + 0.5\,(1000 - 1050)$

$= 1025$.

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(21)

Day	Demand	Forecast ($\alpha=0.1$)	Forecast ($\alpha=0.3$)	Forecast ($\alpha=0.5$)
1	10			
2	11			
3	12			
4	13			
5	14			
6	15			
7	16			
8	17			
9	18			
10	19			
11	17			
12	15			
13	13			
14	11			
15	09			

The daily actual demand for data entry operators in a company is given. As a demand planner, what is the value of α you would choose if you are using the simple exponential smoothing method of forecasting.

The three option are 0.1, 0.3 and 0.5.

* Calculate and comment on forecast behavior as compared to the actual demand.

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$\alpha = 0.1$

$F_{d-2} = 10 + 0.1(10-10) = 10$.
$F_{d-3} = 10 + 0.1(11-10) = 10.1$
$F_{d-4} = 10.1 + 0.1(12-10.1) = 10.29$
$F_{d-5} = 10.29 + 0.1(13-10.29) = 10.561$
$F_{d-6} = 10.56 + 0.1(14-10.56) = 10.9$
$F_{d-7} = 10.9 + 0.1(15-10.9) = 11.31$
$F_{d-8} = 11.31 + 0.1(16-11.31) = 11.78$.
$F_{d-9} = 11.78 + 0.1(17-11.78) = 12.302$.
$F_{d-10} = 12.30 + 0.1(18-12.3) = 12.87$.
$F_{d-11} = 12.87 + 0.1(19-12.87) = 13.48$.
$F_{d-12} = 13.48 + 0.1(17-13.48) = 13.83$.
$F_{d-13} = 13.83 + 0.1(15-13.83) = 13.95$.
$F_{d-14} = 13.95 + 0.1(13-13.95) = 13.855$.
$F_{d-15} = 13.86 + 0.1(11-13.86) = 13.57$.

$\alpha = 0.3$

$F_{d-2} = 10 + 0.3(10-10) = 10$.
$F_{d-3} = 10 + 0.3(11-10) = 10.3$
$F_{d-4} = 10.3 + 0.3(12-10.3) = 10.81$
$F_{d-5} = 10.81 + 0.3(13-10.81) = 11.47$.
$F_{d-6} = 11.47 + 0.3(14-11.47) = 12.22$.
$F_{d-7} = 12.22 + 0.3(15-12.22) = 13.05$.
$F_{d-8} = 13.05 + 0.3(16-13.05) = 13.94$.
$F_{d-9} = 13.94 + 0.3(17-13.94) = 14.86$.
$F_{d-10} = 14.86 + 0.3(18-14.86) = 15.8$.
$F_{d-11} = 15.8 + 0.3(19-15.8) = 16.76$.
$F_{d-12} = 16.76 + 0.3(17-16.96) = 16.83$.
$F_{d-13} = 16.83 + 0.3(15-16.83) = 16.28$
$F_{d-14} = 16.28 + 0.3(13-16.28) = 15.3$
$F_{d-15} = 15.3 + 0.3(11-15.3) = 14.01$

(21)

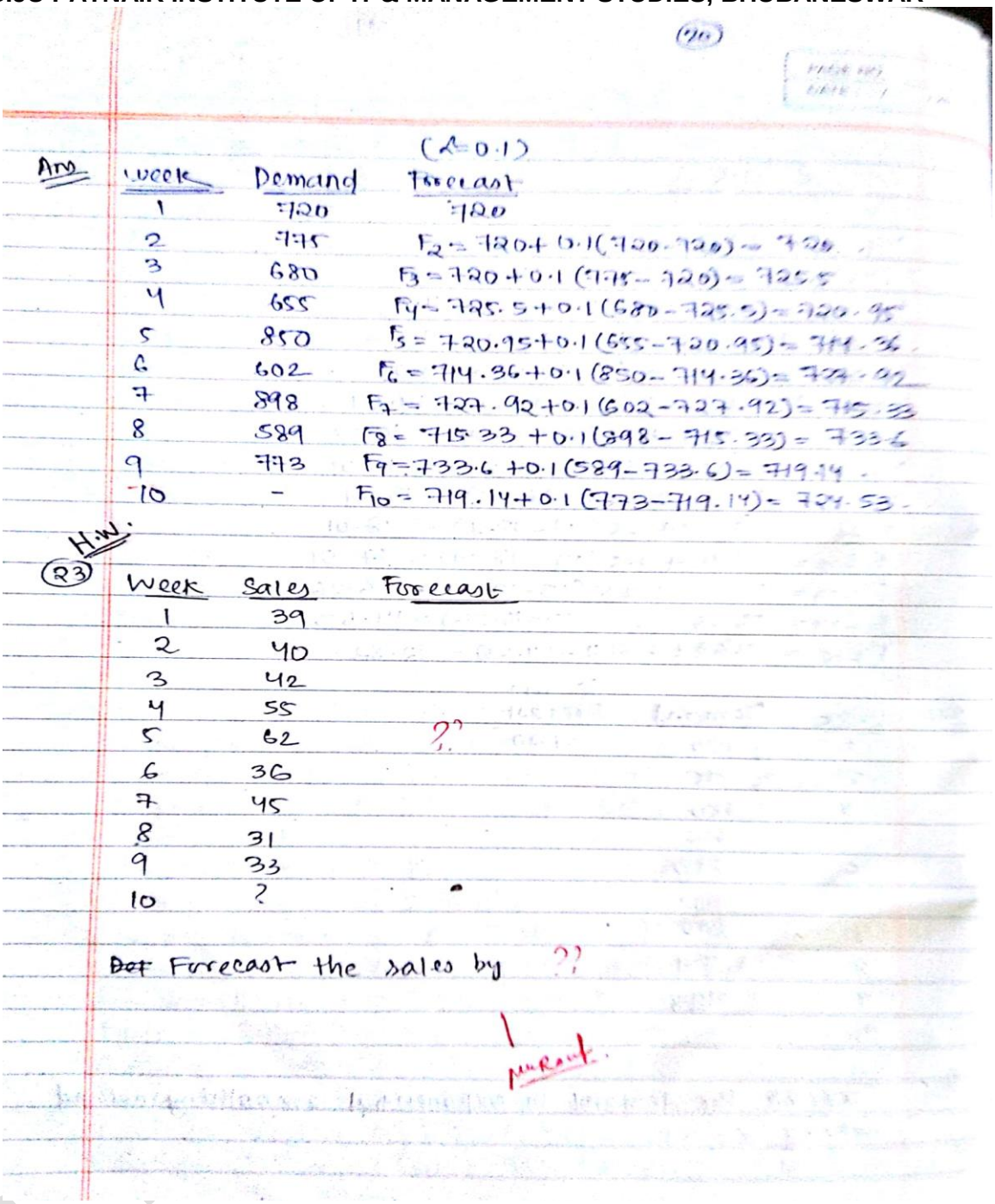
$\alpha = 0.5$

$F_{d-2} = 10 + 0.5(10-10) = 10$.
$F_{d-3} = 10 + 0.5(11-10) = 10.5$.
$F_{d-4} = 10.5 + 0.5(12-10.5) = 11.25$.
$F_{d-5} = 11.25 + 0.5(13-11.25) = 12.13$.
$F_{d-6} = 12.13 + 0.5(14-12.13) = 13.07$.
$F_{d-7} = 13.07 + 0.5(15-13.07) = 14.04$.
$F_{d-8} = 14.04 + 0.5(16-14.04) = 15.02$.
$F_{d-9} = 15.02 + 0.5(17-15.02) = 16.01$
$F_{d-10} = 16.01 + 0.5(18-16.01) = 17.01$
$F_{d-11} = 17.01 + 0.5(19-17.01) = 18.01$
$F_{d-12} = 18.01 + 0.5(17-18.01) = 17.51$
$F_{d-13} = 17.51 + 0.5(15-17.51) = 16.26$.
$F_{d-14} = 16.26 + 0.5(13-16.26) = 14.63$
$F_{d-15} = 14.63 + 0.5(11-14.63) = 12.82$.

(22)

Week	Demand	Forecast ($\alpha = 0.1$)
1	720	720
2	775	
3	680	
4	655	
5	850	
6	602	
7	898	
8	589	
9	773	
10	–	

Q. Forecast the demand in exponential smoothing method taking $\alpha = 0.1$



(20)

Ans (α = 0.1)

week	Demand	Forecast
1	720	720
2	715	$F_2 = 720 + 0.1(720 - 720) = 720$
3	680	$F_3 = 720 + 0.1(715 - 720) = 719.5$
4	655	$F_4 = 719.5 + 0.1(680 - 719.5) = 715.55$
5	850	$F_5 = 715.55 + 0.1(655 - 715.55) = 709.49$
6	602	$F_6 = 709.49 + 0.1(850 - 709.49) = 723.94$
7	898	$F_7 = 723.94 + 0.1(602 - 723.94) = 711.74$
8	589	$F_8 = 711.74 + 0.1(898 - 711.74) = 730.36$
9	773	$F_9 = 730.36 + 0.1(589 - 730.36) = 716.22$
10	-	$F_{10} = 716.22 + 0.1(773 - 716.22) = 721.90$

H.W.

(23)

Week	Sales	Forecast
1	39	
2	40	
3	42	
4	55	
5	62	
6	36	
7	45	
8	31	
9	33	
10	?	

~~Bef~~ Forecast the sales by ??

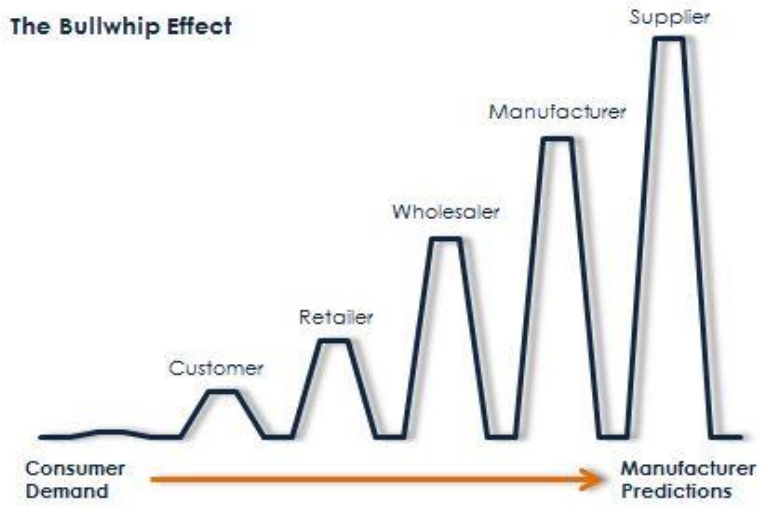
1 Moving.

Bull Whip Effect:

- The bullwhip effect is a supply chain phenomenon describing how small fluctuations in demand at the retail level can cause progressively larger fluctuations in demand at the wholesale, distributor, and manufacturer and raw material supplier levels. The effect is named after the physics involved in cracking a whip. When the person holding the whip snaps their wrist, the relatively small movement causes the whip's wave patterns to increasingly amplify in a chain reaction.
- The bullwhip effect is refers to increasing swings in inventory in response to shifts in customer demand as one moves further up the supply chain. The concept first appeared in Jay Forrester's Industrial Dynamics (1961)

and thus it is also known as the Forrester effect.

- In supply chain management, customers, suppliers, manufacturers and salespeople all have only partial understanding of demand and direct control over only part of the supply chain, but each influences the entire chain with their forecasting inaccuracies (ordering too much or too little). A change in any link along the supply chain can have a profound effect on the rest of the supply chain. Given that, there are many contributors and causes of the bullwhip effect in supply chain management.

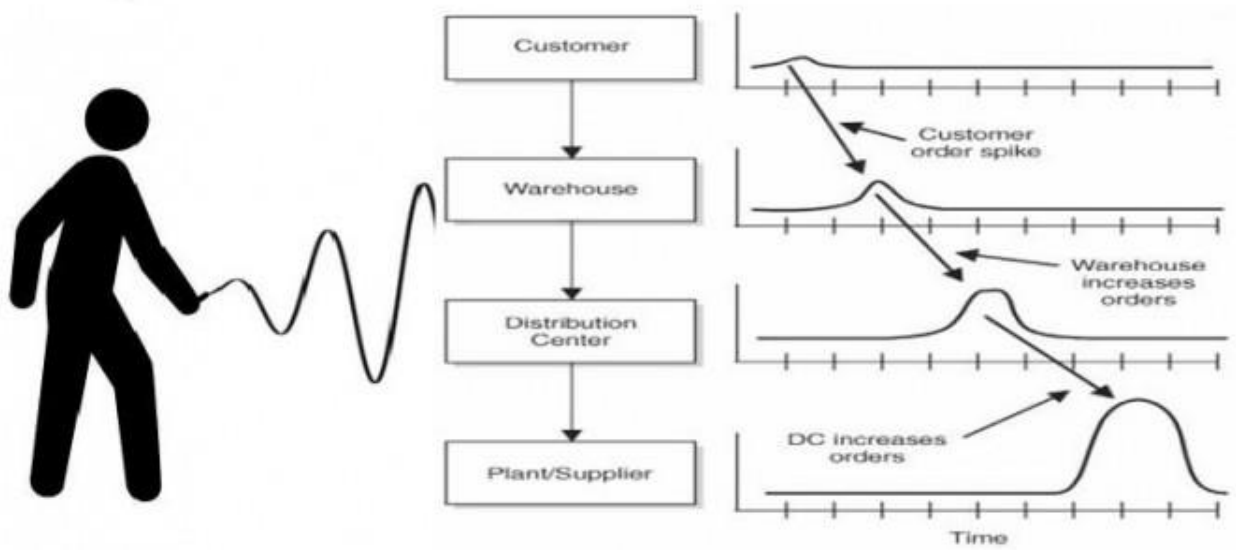


A simplified example of the bullwhip effect

The bullwhip effect often occurs when retailers become highly reactive to demand, and in turn, amplify expectations around it, which causes a domino effect along the supply chain. Suppose, for example, a retailer typically keeps 100 six-packs of one soda brand in stock. If it normally sells 20 six-packs a day, it would order that replacement amount from the distributor. But one day, the retailer sells 70 six-packs and assumes customers will start buying more product, and responds by ordering 100 six-packs to meet this higher forecasted demand.

The distributor may then respond by ordering double, or 200 six-packs, from the manufacturer to ensure they do not run out. The manufacturer then produces 250 six-packs to be on the safe side. In the end, the increased demand has been amplified up the supply chain from to 100 six-packs at the customer level to 250 at the manufacturer.

This example is highly simplified but conveys the sense of exponentially increasing misalignment as actions and reactions continue up and down the chain. The bullwhip effect also occurs as a result of lowered demand at the customer level (which causes shortages when inaccurate) and can be caused at other places along the chain.



Causes of the bullwhip effect

Companies must forecast customer demand based on insufficient information, and try to predict how much product customers will actually want while accounting for the complex factors that enable that amount to be delivered correctly and on time. At every stage of the supply chain there are possible fluctuations and disruptions, which in turn influence the myriad supplier orders. Forecasting demand has always been a difficult endeavor, and the increasing complexity of today's global supply chains intensifies that difficulty, as does increasing consumer preference for Omni channel and e-commerce. A few of the most common dependencies that can cause a bullwhip effect are:

- Lead-time issues such as manufacturing delays
- Less-than-optimal decisions made by supply chain stakeholders at any point along the chain, for example, customer service or shipping
- A lack of communication and alignment between each link or stakeholder organization in the supply chain
- Over- or under-reacting to demand expectations, such as ordering too many units or not enough
- Customer companies, often retailers, waiting until orders build up before placing orders with their suppliers, a practice called order batching
- Discounts, cost changes and other price variations that disrupt regular buying patterns
- Inaccurate forecasts from over-reliance on historical demand to predict future demand

Impact on supply chain management The bullwhip effect can be costly to all the organizations in the supply chain. Excess inventory can result in waste, while insufficient inventory can lead to reduced lead time, poor customer experience and lost business. Most businesses use safety stock (reserve inventory) as a buffer against demand fluctuations. However, safety stock is not a solution to the bullwhip effect, but it provides enough product to fill orders until more arrives from suppliers.

How do you minimize the bullwhip effect?

Every industry has its own unique supply chain, inventory placements, and complexities. Below are some of the methods to minimize the bullwhip effect.

- ***Accept and understand the bullwhip effect:*** The first and the most important step towards improvement is the recognition of the presence of the bullwhip effect. Many companies fail to acknowledge that high buffer inventories exist throughout their supply chain. A detailed stock analysis of the inventory points from stores to raw material suppliers will help uncover idle excess inventories. Supply chain managers can further analyze the reasons for excess inventories, take corrective action and set norms.
- ***Improve the inventory planning process:*** Inventory planning is a careful mix of historical trends for seasonal demand, forward-looking demand, new product launches and discontinuation of older products. Safety stock settings and min-max stock range of each inventory point need to be reviewed and periodically adjusted. Inventories lying in the entire network need to be balanced based on regional demands. Regular reporting and early warning system need to be implemented for major deviations from the set inventory norms.
- ***Improve the raw material planning process:*** Purchase managers generally tend to order in advance and keep high buffers of raw material to avoid disruption in production. Raw material planning needs to be directly linked to the production plan. Production plan needs to be released sufficiently in advance to respect the general purchasing lead times. Consolidation to a smaller vendor base from a larger vendor base, for similar raw material, will improve the flexibility and reliability of the supplies. This, in turn, will result in lower raw material inventories.
- ***Collaboration and information sharing between managers:*** There might be some inter-conflicting targets between purchasing managers, production managers, logistics managers and sales managers. Giving more weight to common company objectives in performance evaluation will improve collaboration between different departments. Also providing regular and structured inter-departmental meetings will improve information sharing and decision-making process.
- ***Optimize the minimum order quantity and offer stable pricing:*** Certain products have high minimum order quantity for end customers resulting in overall high gaps between subsequent orders. Lowering the minimum order quantity to an optimal level will help provide create smoother order patterns. Stable pricing throughout the year instead of frequent promotional offers and discounts may also create stable and predictable demand.

CRM in Supply Chain Management:

Customer Relationship Management (CRM):

- Customer relationship management (CRM) is a model for managing a company's interactions with current and future customers. It involves using technology to organize, automate, and synchronize sales, marketing, customer service, and technical support.
- CRM or Customer Relationship Management is a strategy for managing an organisation's relationships and interactions with customers and potential customers. A CRM system helps companies stay connected to customers, streamline processes, and improve profitability.
- Referring to a CRM system, a tool that is used for contact management, sales management, productivity, and more. The main goal of a CRM system is to improve business relationships.

Purpose of CRM:

- The focus is on creating value for the customer and the company over the longer term.

- When customer value the customer service that they receive from suppliers, they are less likely to look to alternative suppliers for their needs.
- CRM enables organisations to gain 'competitive advantage' over competitors that supply similar products or services.
- The main goal of a CRM system is to improve business relationships.

Benefits of CRM

1) Reduced costs, because the right things are being done (i.e.., effective and efficient operation)
2) Increased customer satisfaction, because they are getting exactly what they want (i.e.. meeting and exceeding expectations)
3) Ensuring that the focus of the organisation is external
4) Growth in numbers of customers
5) Maximization of opportunities (e.g.. increased services, referrals, etc.)
6) Increased access to a source of market and competitor information
7) Highlighting poor operational processes
8) Long term profitability and sustainability

Why is CRM important in supply chain management?

a) The importance of customer relationship management (CRM) within the supply chain is vitally important. The customer and the customer's customer have been a critical part of the supply chain since its inception. The customer is quite clearly what the supply chain is all about. Having procurement, warehousing, manufacturing and distribution in place is all well and good, but without a customer it is academic and lacking in profit.

b) CRM's standard core applications consist of sales force automation, marketing automation, and call center technology. These applications give more attention to customer needs by providing a better handle on the product or products involved the content of the service, and added value.

c) Knowing your customers means knowing who your customers are, what their needs are, and the means by which you communicate with them. When this data becomes a part of your database, there is no reason to research this data again. You can focus instead on updating customer information, processing orders, and extending your knowledge of the customer.

d) Marketing becomes, to a great extent, a function of properly managing critical customer data. It is out of this information that you can target customers and customize communication to meet their needs.

e) Customer relationship management, or CRM, and supply chain management, or SCM, are both software-driven business systems. The primary distinction is that CRM is a marketing process, whereas SCM is a distribution process. With both systems, companies rely on software to facilitate more effective and efficient business activities and gather information to make forecasts.

The Role of CRM in SCM:

The elements of customer relationship management important to supply chain management, performance outcomes associated with customer service activities and their contribution to supply chain objectives, and customer responses to the outcomes of a firm's are described below;

i. To achieve supply chain objectives, customer service activities must be strategic in nature and must be designed based on an understanding of the service levels important to customers.

ii. Important customer segments must be identified and the requirements of those segments understood for both immediate and downstream customers.

iii. The impact of service levels on customers should be understood and internal capabilities designed to deliver service levels that optimize the overall performance of the supply chain.

iv. The quality of the customer interface is likely to influence the level of trust and openness of information exchange between firms, which can contribute to a better understanding of the customer's needs and improved performance of supply chain management activities.

v. It is important to measure customer service outcomes as perceived by the customer and understand which performance outcomes are most valued by customers at various levels of the supply chain.

vi. Customer service requirements and performance, as well as the influence of customer service levels on customer behavior, should be understood and monitored for both immediate and downstream customers in a supply chain.

vii. Customer service is not the ultimate objective of supply chain management but rather an outcome of supply chain management that can create value for customers through improved efficiency or effectiveness.

viii. Creating value for customers superior to that created by competition is expected to result in greater customer satisfaction and competitive advantage and influence customers to behave in ways that improve the performance of the supply chain as a whole.

Module - II

Distribution Management:

Distribution System:

i. In business economics, distributions relates to the allocation of goods to the recipients.

ii. In general, distribution includes all activities that enable the transfer of material and/or economic power over tangible and/or intangible goods from one economic subject to another.

iii. "Distribution encompasses a system of all activities that are related to the transfer of economic goods between manufacturers and consumers. It includes such a coordinated preparation of manufactured goods according to their type and volume, space and time, so that supply deadlines can be met (order fulfillment) or estimated demand can be efficiently satisfied.

iv. Distribution systems are usually divided into:

a) Acquisition distribution system
b) Logistic, i.e. physical distribution system.

Acquisition distribution system management includes the management of distribution routes, i.e. distribution channels. *Logistic distribution system* is focused on bridging the space and time by transportation and storage, as well as order processing and shipment, supply logistics, i.e. the movement of materials.

Distribution Channel:

The term "distribution channels" can at the moment be replaced by the term "marketing channel". "Marketing channel" as a more complex term has been used in the USA since the 1970s, because the intermediaries include not only those who participate in the physical flow of a product from the manufacturer to the end user, but also those that have a role in the transfer of product ownership, as well as other intermediary institutions that participate in the value distribution from production to consumption.

There are three types of marketing channels;

a) Communication channels
b) Distribution channels
c) Service channels

Distribution or marketing channels are systems of mutually dependent organisations included in the process of making goods or services available for use or consumption. Moreover, a marketing channel is "the external contractual organization that management operates to achieve its distribution objectives".

There follow some more recent concepts of the distribution channel:

1) Channel of distribution is the route along which goods and services travel from producer/manufacturer through marketing intermediaries (such as wholesalers, distributors, and retailers) to the final user.
2) Channels of distribution provide downstream value by bringing finished products to end users.
3) This flow may involve the physical movement of the product or simply the transfer of title to it. Also known as a distribution channel, a distribution chain, a distribution pipeline, a supply chain, a marketing channel, a market channel, and a trade channel.
4) Similarly, Distribution channel – one or more companies or individuals who participate in the flow of goods and services from the manufacturer to the final user or consumer.
5) Channel of distribution consist of one or more companies or individuals who participate in the flow of goods, services, information, and finances from the producer to the final user or consumer.
6) These are various routes that products or services use after their production until they are purchased and used by end users. Therefore, marketing channels, i.e. distribution channels are all those organisations that a product has to go through between its production and consumption.

Distribution channels is division is into;

a) **Direct Channels**
b) **Indirect Channels.**

In direct channels, producers/manufacturers sell their goods directly to individual consumers, while indirect channels include a trading company as well. An indirect channel can be both short and long. Only one trading company is included in the short channel (usually, it is a retail company). In the long channel, there are two or more intermediaries (wholesale and retail companies).

Structure and Operation:

Functions of Distribution Channels:

Distribution channels perform a number of functions that make possible the flow of goods from the producer to the customer. These functions must be handled by someone in the channel. Though the type of organization that performs the different functions can vary from channel to channel, the functions themselves cannot be eliminated. Channels provide time, place, and ownership utility. They make products available when, where, and in the sizes and quantities that customers want. Distribution channels provide a number of logistics or physical distribution functions that increase the efficiency of the flow of goods from producer to customer.

Distribution channels create efficiencies by ***reducing the number of transactions*** necessary for goods to flow from many different manufacturers to large numbers of customers. This occurs in two ways. The first is called **breaking bulk.**

Wholesalers and retailers purchase large quantities of goods from manufacturers but sell only one or a few at a time to many different customers. Second, channel intermediaries reduce the number of transactions by **creating assortments** providing a variety of products in one location so that customers can conveniently buy many different items from one seller at one time.

The *transportation and storage of goods* is another type of physical distribution function. Retailers and other channel members move the goods from the production site to other locations where they are held until they are wanted by customers. Channel intermediaries also perform a number of **facilitating functions**, functions that make the purchase process easier for customers and manufacturers. Intermediaries often provide ***customer services*** such as offering credit to buyers and accepting customer returns. Customer services are oftentimes more important in B2B markets in which customers purchase larger quantities of higher-priced products. Distribution channels are not limited to products only even the services provided by a producer may pass through this channel and reach the customer.

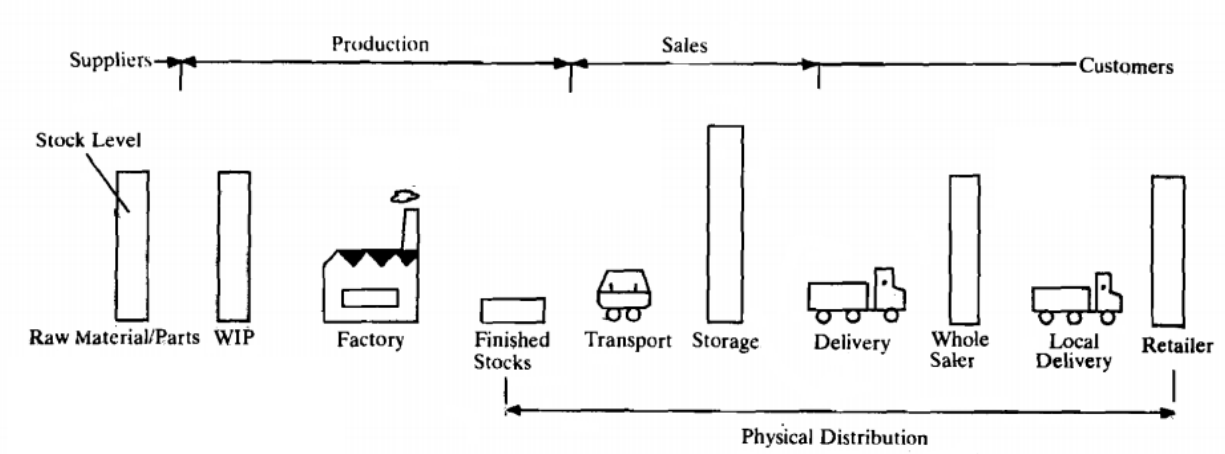


Figure . Physical Distribution Logistics System

Principal Components of the Distribution Process:

This consists of four principal components of PDM:

1) **Order processing;**
2) **Stock levels or inventory;**
3) **Warehousing;**
4) **Transportation.**

Order Processing:

Order processing is the first of the four stages in the logistical process. The efficiency of order processing has a direct effect on lead times. Orders are received from the sales team through the sales department. Many companies establish regular supply routes that remain relatively stable over a period of time providing that the supplier performs satisfactorily. Very often contracts are drawn up and repeat orders (forming part of the initial contract) are made at regular intervals during the contract period.

Inventory:

Inventory, or stock management, is a critical area of PDM because stock levels have a direct effect on levels of service and customer satisfaction. The optimum stock level is a function of the type of market in which the company operates. Few companies can say that they never run out of stock, but if stock-outs happen regularly then market share will be lost to more efficient competitors.

Warehousing:

Currently, many companies function adequately with their own on-site warehouses from where goods are dispatched direct to customers. When a firm markets goods that are ordered regularly, but in small quantities, it becomes more logical to locate warehouses strategically around the country. Transportation can be carried out in bulk from the place of manufacture to respective warehouses where stocks wait ready for further distribution to the customers. This system

is used by large retail chains, except that the warehouses and transportation are owned and operated for them by logistics experts **(e.g. GATI Logistics, Excel Logistics and Kapoor & sons Logistics etc.).**

Transportation:

Transportation usually represents the greatest distribution cost. It is usually easy to calculate because it can be related directly to weight or numbers of units. Costs must be carefully controlled through the mode of transport selected amongst alternatives, and these must be constantly reviewed. During the past 50 years, road transport has become the dominant transportation mode in India. It has the advantage of speed coupled with door-to-door delivery. The patterns of retailing that have developed, and the pressure caused by low stock holding and short lead times, have made road transport indispensable. When the volume of goods being transported reaches a certain level some companies purchases their own vehicles, rather than use the services of haulage contractors.

Objective of Physical Distribution System:

Improving Customer Service: The marketing concept assumes that the sure way to maximise profits in the long run is through maximizing the customer satisfaction. Thus, an important objective of all marketing efforts, including the physical distribution activities, is to improve the customer service. This in turn, produces better sales and profits.

Reduce Distribution Costs: the objective of the firm, should be to reduce 'the total cost of distribution and not just the cost incurred on any one element. n or this purpose, the total cost of alternative distribution systems should be analyzed and the one which has the minimum total distribution cost should be selected.

Generating Additional Sale: the physical distribution system in a firm is to generate ' additional sales. A firm can attract additional customers by offering better services at lower prices through improvements in the physical distribution of the products.

Creating Time and Place Utilities: The physical distribution system also aims at creating time and place utilities in the products. Unless the products are physically moved from the place of their origin to the place where they are required for consumption, they do not serve any purpose to the users. Similarly, the products have to be made available at the time they are needed for consumption.

Price Stabilization: Physical distribution may also aim at achieving stabilization in the prices of the products. It can be achieved by regulating the flow of the products to the market through a judicious use of available transport facilities and compatible warehouse operations.

The Systems or 'Total' Approach to PDM (Physical Distribution Management):

1) Managers have now become more conscious of the potential of PDM, and recognize that logistical systems should be designed with the total function in mind. A fragmented or disjointed approach to PDM (Physical Distribution Management) is a principal cause of failure to provide satisfactory service, and causes excessive costs.

2) Within any PDM structure there is potential for conflict. Individual managers striving to achieve their personal goals can frustrate overall PDM objectives. Sales and marketing management will favour high stock levels, special products and short production runs coupled with frequent deliveries.

3) Production managers will favour long production runs and standard products. It is possible for all these management areas to 'appear' efficient if they succeed in realizing their individual objectives.

4) Senior management must communicate overall distribution objectives to all company management and ensure that they are understood. Ideally, the systems approach to PDM should encompass production and production planning, purchasing and sales forecasting. Included in the systems approach is the concept of total cost, because individual costs are less important than the total cost.

5) The cost of holding high stocks may appear unreasonable, but if high stocks provide a service that leads to higher sales and profits, then the total cost of all the PDM activities will have been effective. Costs are a reflection of distribution strategy, and maximum service cannot be provided at minimum cost.

6) PDM as a cost centre is worth extensive analysis as this function is now recognised as a valuable marketing tool in its own right. In homogeneous product markets, where differences in competitive prices may be negligible, service is often the major competitive weapon. Indeed, many buyers pay a premium for products that are consistently delivered on time. Similarly, the salesperson whose company provides a comprehensive spare parts and service facility, has a valuable negotiating tool when discussing prices.

7) Distribution is not, therefore, an adjunct to marketing; it has a full place in the marketing mix and can be an essential component of marketing strategy. In terms of marketing planning, a well-organized business logistics system can help to identify opportunities as well as supplying quantitative data that can be used to optimize the marketing mix as a whole.

Monitoring and Control of PDM (Physical Distribution Management):

The objective of PDM is **"Getting the right goods to the right place at the right time for the least cost".**
The objective seems reasonable, although it gives little guidance on specific measures of operational effectiveness. Management needs objectives or criteria that, in turn, allow meaningful evaluation of performance. This is the basis of monitoring and control.

Basic Output of Physical Distribution Systems:

The output from any system of physical distribution is the level of customer service. This is a key competitive benefit that companies can offer existing and potential customers to retain or attract business. From a policy point of view, the desired level of service should be at least equivalent to that of major competitors. The level of service is often viewed as the time it takes to deliver an order to a customer or the percentage of orders that can be met from stock. Other service elements include technical assistance, training and after-sales services. The two most important service elements to the majority of firms are:

1) **Delivery - reliability and frequency;**
2) **Stock availability - the ability to meet orders quickly.**

Distribution Strategy:

1) Distribution strategy is influenced by the market structure, the firm's objectives, its resources and of course it's overall marketing strategy. All these factors are addressed in the section on selecting Distribution Channels.

2) The first strategic decision is whether the distribution is to be: Intensive (with mass distribution into all outlets as in the case of confectionery); Selective (with carefully chosen distributors e.g. specialty goods such as car repair kits); or Exclusive (with distribution restricted to upmarket outlets, as in the case of Gucci clothes).

3) The next strategic decision clarifies the number of levels within a channel such as agents, distributors, wholesalers, retailers. In some Japanese markets there are many, many intermediaries involved. Two common strategies are Vertical Marketing Systems and Horizontal Marketing Systems.

4) Vertical Marketing Systems involve suppliers and intermediaries working closely together instead of against each other. They plan production and delivery schedules, quality levels, promotions and sometimes prices. Resources, like information, equipment and expertise, are shared. The system is usually managed by a dominant member, or 'channel captain'. VMS is more flexible than vertical integration where the manufacturer actually owns the distribution channel, for example, Doctor Martens boot manufacturers own their own retail store.

5) Horizontal Marketing Systems occur where organisations operating on the same channel level (e.g. two suppliers or two retailers) co-operate. They then share their distribution expertise and distribution channels. This can speed up the time taken to penetrate the market. There is room for creative alliances here.

6) Resources available affect distribution strategy. Who can handle outbound logistics, marketing and sales, and servicing? Can the supplier afford to deliver small quantities, can it provide more trucks, can its sales force 'push' products into national retail chains? Can the organisation deal with thousands, maybe even millions of customers - can it cope? Does it want to devote huge resources here or would it prefer to utilize someone else's resources in return for a slice of the profits?

Distribution Cost Components:

For any company which is involved in distribution, distribution cost is a major bottleneck. There are many different distribution expenses which must be taken care of. Furthermore, these expenses are not consistent and may change from time to time thereby changing the distribution cost as well. Distribution costs (also known as "Distribution Expenses") are usually defined as the costs incurred to deliver the product from the production unit to the end user.

***Distribution expenses* –** The individual expenses made by the company for various reasons is known as Distribution expenses. These are individual or repeated transactions happening over time. An example may include – Rent, Salaries, Administrative expenses etc. All these are individual transactions or repeat transactions and these transactions can be called distribution expenses.

***Distribution cost* –** The combination of all distribution expenses made by a company is known as Distribution cost. So continuing the above example – the total of rent, salaries, and administrative expenses will be considered as distribution cost. In terms of Formula;

[The sum of all Distribution Expenses] = Distribution cost

It is a broad terminology and it includes several costs. Some of the costs are discussed below.

Direct Selling Expenses: Any expense made towards selling the product to the target customer is a direct selling. Many manufacturers, wholesalers, and distributors carry out direct selling in the regions that they want to expand. They also would like to know the distribution cost of that region. Thus, they consider all direct selling expenses as the primary expense made by the firm. Such Expenses will include Salary of Field Salespeople (only for target customer sales), Travel of salespeople, Entertainment for sub-dealers, Training costs, Postage or office supplies needed for sales etc.

Advertising & Sales Promotion Expenses: If a company wants to establish itself in a new region, it needs to have advertising, it needs to run in-store branding, it needs to run ads in local newspapers or local channels. Thus, the company will be spending a lot towards advertising and promotions which are various forms of distribution expenses.

Product and Packaging Expenses: The product packaging was good but was not strong. As a result, the packaging suffered a huge wear and tear by the time it reached the customer and the customers returned the product. This caused a huge loss to the company and they ultimately came up with a plan to have a different and sturdy form of packaging for Online sales. Such packaging is obviously a cost to the company and should be added as one of the distribution expenses.

Trade Discounts: Besides sales promotion exercises like advertising and marketing, a company launches several trade promotional exercises as well. This includes giving discounts to retailers, distributors, and suppliers on achieving certain targets.

Credit, Outstanding and Overdue: A distributor who operates in a regional market needs the huge amount of money to conduct business. To arrange this money, the distributor takes a loan from the banks. This is known as an Overdue account. Hypothetically, If the distributor takes 1 lakh from the bank, within 30 days he should give back 1 lakh + 1% interest. Thus, a dealer suffers a loss when his money does not come back from the market in time. As a result, Overdue accounts, Market outstanding and credit are given in the market to contribute to the distribution cost.

Market Research: When reputed companies like Samsung, LG or Sony want to establish themselves in a new market, they buy market research reports from the likes of IMRB or Nielson. These reports may cost hundreds or thousands of dollars. Not only in a new market, even in an old market, a company might want to conduct a satisfaction survey or a survey of new ideas regarding distribution.

Warehousing and Handling within Warehouse: Warehousing is a major cost of distribution. When a company expands to newer markets, it needs to have new warehouses in each new territory. Domino's or McDonald's practically have warehouses for every 3-4 towns so that they can supply to local retail outlets very fast. Because of Domino's and McDonald's handle frozen goods (burgers or fries), their expenses are even higher because they need cold rooms and cold chains to deliver the products.

Commercials & Accountancy: It is a government requirement to present all your sales and purchases as well as balance and profit sheets to the government to determine profit earned by your firm. The distribution expenses towards commercials and accountancy include Processing of orders and maintaining accounts receivables, sales invoices, payment proof's, clerical jobs, invoicing and accountancy software, printing and stationery expenses, utility expenses. All these expenses together form the distribution cost of commercials and accountancy.

Customer Service: In the industrial segment, there exist industrial distributors who take care of both – Sales and service of the product. In such cases, it is the distributor who must take care of the service of the product as well. As a result, customer service expenses become distribution expenses and contribute to distribution cost.

Sales Returns: If a dealer or a retailer rejects a material, then the material comes back to the manufacturer provided it is in the returns policy of the company. This returned material may have come back due to cosmetic conditions (it was damaged or dented) or it may have come back due to performance issues. In any condition, the returned product is a cost to the company. The distribution expenses of sales returns include freight of bringing damaged products back, repairing of the product, loss due to discounted sale, loss due to recycling of the product, bad inventory in stock, clerical or other administrative expenses towards handling sales return.

Pipe Line Inventory and Response Considerations:

What is Inventory?

Inventory is quantities of goods in stock

• Manufacturing Inventory;

1. **raw materials**
2. **component parts**
3. **work-in-process (WIP)**
4. **finished goods**

• Service Inventory; – involves all activities carried out in advance of the customer's arrival

Reasons for Carrying Inventory:

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

Types of Inventory:

- ***Cycle Stock***
  - inventory for immediate use
  - typically produced in batches (production cycle)
- ***Safety Stock***
  - extra inventory carried for uncertainties in supply and demand
  - also called buffer stock
- ***Anticipation Inventory***
  - inventory carried in anticipation of events
  - smooth out the flow of products in supply chain Pipeline Inventory
  - inventory in transit
  - exists because points of supply and demand are not the same
  - also called transportation inventory
- ***Maintenance, Repair and Operating Items (MRO)***
  - inventories not directly related to product creation
  - also called seasonal or hedge inventory

Inventory is a basic component of any retail or wholesale operation, so inventory management is an essential task. Inventory management includes more than just the items on the shelves. Pipeline inventory consists of items that are in the transit "pipeline" between locations, such as those en route from the warehouse to the retail outlet. Decoupling inventory consists of inventory stock retained to make the independent control of two successive operations possible.

Functions of Pipeline Inventory:

Pipeline inventory refers to those products that are in the company's shipping chain that have yet to reach their ultimate destination. While the items are in transit, they are still considered to be part of the shipper's inventory if the recipient has yet to pay for them. When the recipient pays for the items, even if that recipient has not taken physical custody of the items, that pipeline inventory goes on the recipient's inventory. For example, if a wholesaler buys stock from an overseas manufacturer, that stock is considered pipeline inventory even if it's still in the process of being shipped from the manufacturer. As soon as inventory is paid for, it's considered pipeline inventory until it reaches its final destination i.e. the seller's warehouse. Calculating your pipeline inventory allows you to more accurately track how much cash is tied up in inventory and overheads like carrying costs. Businesses with lead times (like artisan clothing wholesaler Cloth & Co.) need to pay particular attention to pipeline inventory because production can take months and counting stock doesn't accurately reflect inventory levels.

Examples of Pipeline Inventory

In many instances, especially with overseas shipments, inventory can remain in the transit pipeline for days or weeks at a time. For instance, a shipment of video game consoles made in Japan can take several days to arrive by container ship to an American port. If the wholesaler has already purchased the consoles, they are part of that wholesaler's inventory until he sells them to his retail store customers. When the retail store purchases the consoles from the wholesaler, the pipeline inventory goes on their records.

Pipeline Inventory = Lead Time X Demand Rate

Pipeline inventory can be calculated by multiplying your lead time (how long it takes between ordering and receiving stock) by your demand rate (how many units you sell between orders):

Functions of Decoupling Inventory:

A "decoupled" inventory consists of inventory stock set aside in the event of a slowdown or stoppage in production. Decoupling inventory cushions the company's inventory against potential issues in the production line. These issues can occur when one part of the production line works at a different speed than another. When this happens, the production line stalls, and products remain unfinished, which reduces the renewal rate of inventory stocks.

Examples of Decoupling Inventory

The manufacturing of video game consoles requires the assembly of several sensitive parts, such as the central processing units, internal hard drives, motherboards and video connection ports. When the processes involved in building the microchips required to power the central processing units slows down, the entire production line grinds to a halt. A decoupled inventory allows the manufacturer to ship its consoles on time while it resolves the issues with the microchips.

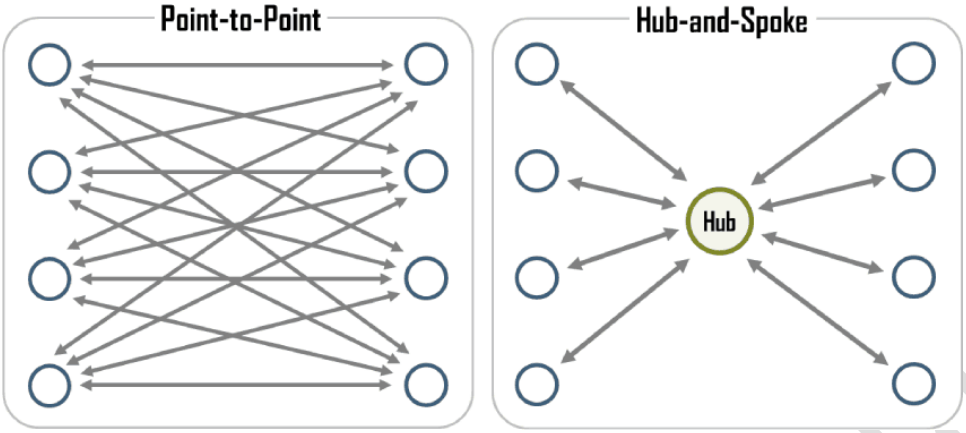
Difference between Pipeline Inventory Vs. Decoupling Inventory:

The major distinction between pipeline inventory and decoupling inventory is that pipeline inventory is a type of inventory, whereas decoupling inventory is a method of managing inventory. Pipeline inventory is also inventory that is at many stages of the production process -- from raw materials on a ship to finished products on the way to the retail seller. Decoupling inventory generally occurs at the factory or business facilities. It generally involves materials that are used during the process of building a finished product. Pipeline inventory is applicable in all industries. Even the smallest business, a local retail gas station, for instance, has pipeline inventory that arrives from a local supplier to its store. Decoupling inventory on the other hand, is mainly relevant in industries where the company is turning raw materials into a finished product.

Hub and Spoke Models:

What is The Hub & Spoke Model?

1. The Hub and Spoke (H&S) model is used when there are multiple locations sourcing, with a central location called the ‘Hub.’ The location provides a single point of contact to the client, whilst the in-country extensions, called ‘Spokes’, which are spread across the globe.
2. The ‘Hub’, as aforementioned is centralized and has responsibilities such as people development, client relationship management and Quality and compliance related matters whilst driving a common delivery standard to its satellite locations.
3. A ‘Spoke’ is a delivery center set up in a country providing services to the client’s customers in a local and customized manner in line with the culture and legislative requirements of the country. The spoke works closely with the client’s local office and reports the performance to them.



4. The key objective of the Hub & Spoke model is to provide greater flexibility to the client in selecting locations out of a portfolio of delivery centers that adequately fulfills all business needs. The Hub & Spoke model is expected to be complimentary to the standard practices followed in the industry at present.

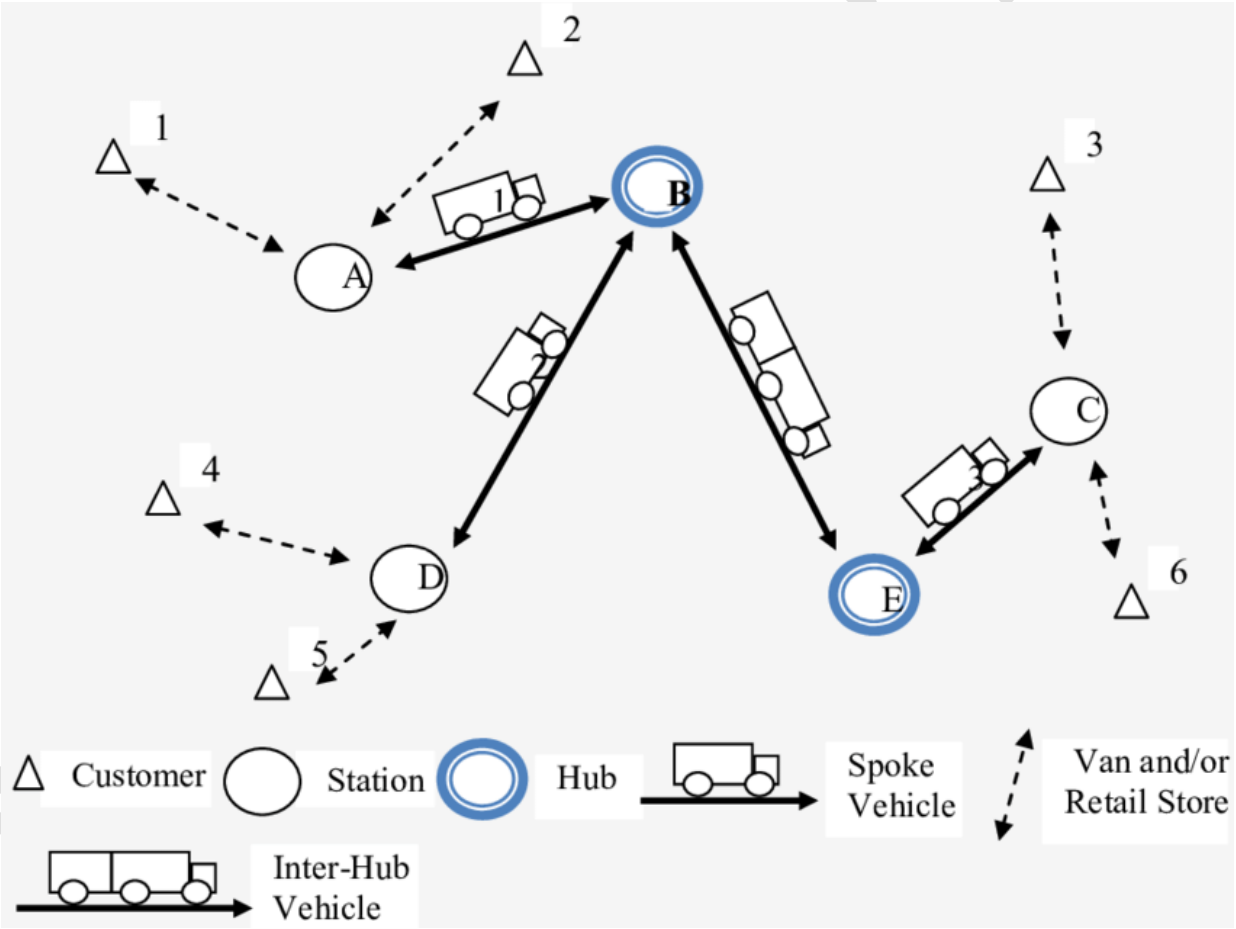


Figure: Hub & Spoke Model

Advantages of H&S Model:

1) ***Capabilities development:*** Enables the use of regional capabilities such as specific skills and languages to develop world class quality of services. Allows centralized control for skill development, resource utilization, operational efficiency and having uniform operational processes across spokes.

2) ***Cost advantage:*** This model ensures higher quality of service at lower costs to service customers by leveraging locally highly skilled resources providing.

3) ***Improved time-to-market:*** Allows delivery centers to locally source talent where the capability is available. This creates a quicker turnaround time.

4) ***Lower cost for deployment of technology:*** This ensures there is little/no incremental investment in technology for every new center that is setup for the same kind of operations.

Key Challenges in deploying the model:

1) ***Differences in culture and time zones:*** With hubs in various parts of the world, there may be cultural differences, time zone etc. challenges that we should be aware of.

2) ***Project management:*** At the time of transition, it is critical to have a Spoke Project Manager taking care of the deployment of the project under the supervision of the overall Program Manager. The project status, milestones and deliverables must be tracked and updated on a regular basis ensuring that updates from all spokes are reported consistently.

3) ***Ensuring data confidentiality and security:*** In a multi-location firm, protecting intellectual property rights and data is critical. It is important to ensure that there is a mechanism for ensuring network security, data security and physical security.

Success Factors of having a H&S model:

- Make the brand stronger and globally recognized using a wide network of delivery centers
- A strong setup of the technology platform which is nimble and accessible across the globe
- A robust governance structure within the organization which is effective remotely
- Quality and Risk Management to ensure consistency across the delivery centers
- Proactive risk mitigation tools and strategies
- Consistent and harmonized operating processes
- Strong global management and local expertise in delivery centers

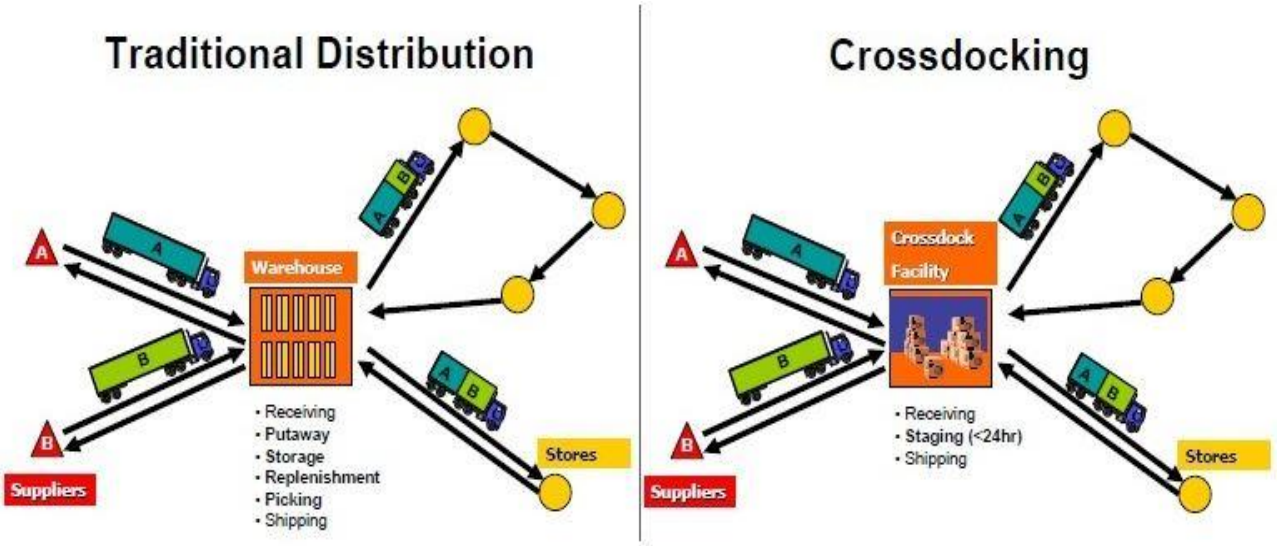
Cross Docking:

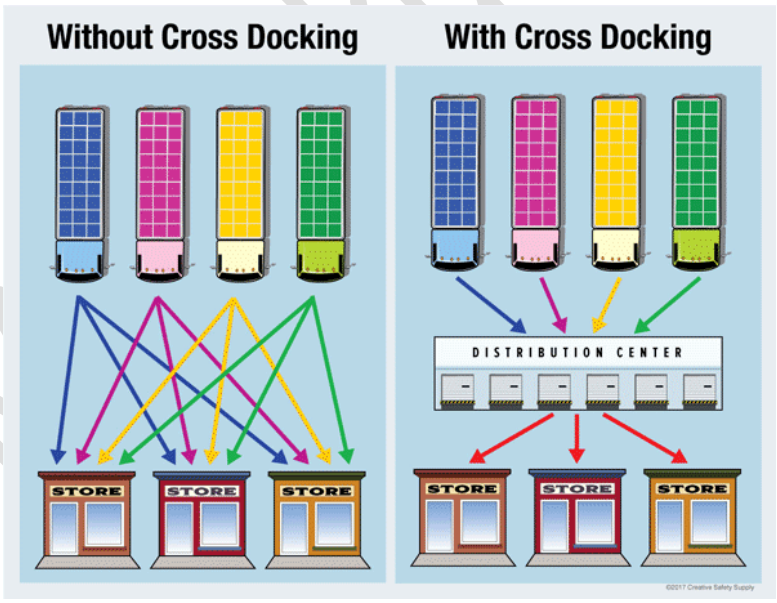
1) Cross-docking is a practice in logistics of unloading materials from an incoming semi-trailer truck or railroad car and loading these materials directly into outbound trucks, trailers, or rail cars, with little or no storage in between. This may be done to change the type of conveyance, to sort material intended for different destinations, or to combine material from different origins into transport vehicles (or containers) with the same or similar destinations.

2) Cross-docking involves delivering products from a manufacturing plant directly to customers with little or no material handling in between.

3) Cross-docking not only reduces material handling but it reduces the need to store the products in the warehouse. In most cases, the products sent from the manufacturing area to the loading dock have been allocated for outbound deliveries.

4) Cross-docking solutions allow companies to expedite shipments to customers, which means that customers often get what they want when they want it the goal of an optimized supply chain.





Types of Cross-Docking

There are a number of cross-docking scenarios that are available to the warehouse management. Companies will use the type of cross-docking that is applicable to the type of products that they are shipping.

1) ***Manufacturing Cross-Docking:*** This procedure involves the receiving of purchased and inbound products that are required by manufacturing. The warehouse may receive the products and prepare sub-assemblies for the production orders.

2) ***Distributor Cross-Docking:*** This process consolidates inbound products from different vendors into a mixed product pallet, which is delivered to the customer when the final item is received. For example, computer parts distributors can source their components from various vendors and combine them into one shipment for the customer.

3) ***Transportation Cross-Docking:*** This operation combines shipments from a number of different carriers in the less-than-truckload (LTL) and small-package industries to gain economies of scale.

4) ***Retail Cross-Docking:*** This process involves the receipt of products from multiple vendors and sorting them onto outbound trucks for a number of retail stores. This method was used by Wal-Mart in the 1980s. They would procure two types of products, items they sell each day of the year, called staple stock, and large quantities of products that are purchased once and not usually stocked again. This second type of procurement is called direct freight, and Wal-Mart minimizes any warehouse costs with direct freight by using cross-docking and keeping it in the warehouse for as little time as possible.

5) ***Opportunistic Cross-Docking:*** This can be used in any warehouse. It involves transferring a product directly from the receiving dock to the outbound shipping dock to meet a customer sales order.

Products Suitable for Cross-Docking:

There are materials that are better suited to cross-docking than others. The list below shows a number of types of material that are more suited to cross-docking.

- Perishable items that require immediate shipment
- High-quality items that do not require quality inspections during goods receipt
- Products that are pre-tagged (barcodes, RFID), pre-ticketed, and ready for sale
- Promotional items and items that are being launched
- Staple retail products with a constant-demand or low-demand variance
- Pre-picked, pre-packaged customer orders from another production plant or warehouse

Advantages of Cross-Docking:

- Streamlines the supply chain, from point of origin to point of sale
- Reduces labor costs through less inventory handling
- Reduces inventory holding costs by reducing storage times and potentially eliminating the need to retain safety stock
- Products reach the distributor, and consequently the customer, faster
- Reduces or eliminates warehousing costs
- May increase available retail sales space
- Less risk of inventory handling

Disadvantages of Cross-Docking:

- Potential partners may not have the necessary storage capacities
- An adequate transport fleet is needed to operate
- A computerized logistics system is needed
- Additional freight handling can lead to product damage
- Labour costs are also incurred in the moving and shipping of stock

Lot Streaming:

1) Lot streaming is a procedure in which a production lot is split into smaller sub-lots and moved to the next processing stage so that operations at successive stages of a multistage manufacturing system can be overlapped in time.

2) Lot streaming reduces the manufacturing lead time and thereby provides an opportunity to lower the costs of holding work-in-process inventories.

3) Lot streaming is the process of splitting a production lot into sublots, and then processing the sublots on different machines in an overlapping manner. We study the use of lot streaming for processing a lot in a two-machine flow shop when a sublot-attached setup time is incurred before the processing of each sublot.

4) The objective is to determine number of sublots and sublot sizes and minimize makespan.

5) An increase in the velocity of material flow from a supplier will result in a shorter makespan for a production lot only if that supplier is currently the slowest among all suppliers.

6) In order to prevent unnecessary expenditure on increased material handling, suppliers must take lot streaming decisions in co-ordination with each other.

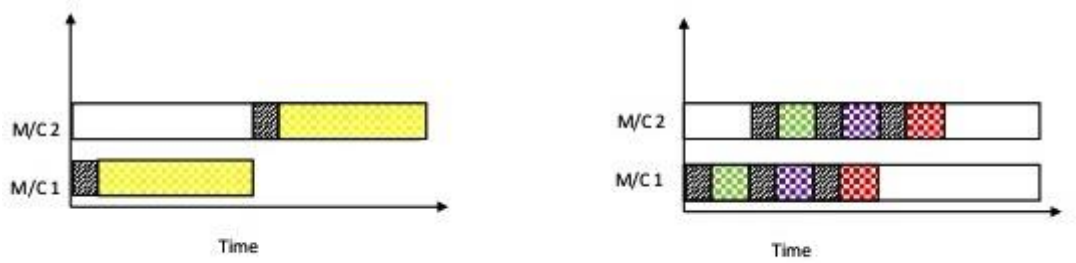


Figure: Lot streaming

Lot streaming has been studied in a variety of production environments. In it, the various features of a lot streaming problem are defined as follows:

{machine configuration}{number of machines}/{number of product types}/{sublot type}/ {idling}/{Number of sublots}/{sublot sizes}/{setups}/{transfer or removal}/{objective function}.

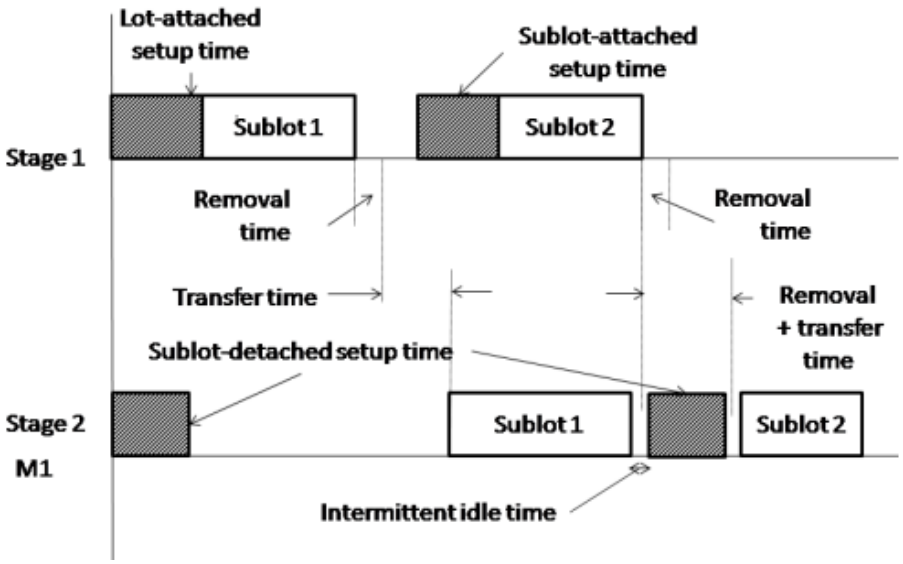


Figure : Lot streaming in a two-machine flow shop

Lot Streaming for Time-based Objective Functions:

A time-based performance measure is especially important for make-to-order environments, which involve objective functions like minimization of makespan, total flow time, cycle time, and meeting due dates. For this class of objective functions, lot streaming has been applied to machine configurations of flow shop, job shop, open shop, parallel machines, hybrid flow shop, and two-stage assembly systems.

Applications of Lot Streaming:

1) The concept of lot streaming is similar to the idea of unit-piece flow in lean manufacturing and in fact it can be considered as a generalization of the lean principles of material flow.
2) Lot streaming helps in reducing makespan, WIP (work-inprocess), and cycle time, among other measures of performance, by increasing the velocity of product flow.
3) Reduces to determining optimal number and sizes of sublots along with the sequence in which to process the batches
4) Lot streaming relates to is material transfer co-ordination.
5) An instance of multiple lot assembly arises in the commercial truck manufacturing industry where customers place orders for small batches of trucks and orders may differ widely from each other.

Carrier/Container Selection:

What Is Carrier Selection?

Carrier selection is an idea made up of two simple words. You need to have multiple carrier options available for selection to keep the price point and shipping cost of your products down. Your transportation costs are roughly equivalent to 5 percent of your total sales, so unless you want to willingly pay 5 percent, you need more options. Fortunately, a broad carrier selection gives you these options.

Use care when comparing and selecting carriers, as many are attached to national networks. Remember, selecting a carrier with a strong regional or national network means that you will work with their other affiliates at some point. When analyzing carriers within these networks, you should also evaluate their network partners. Do they produce the same quality results as the carrier you prefer? If you question network partners' quality control or any facet of their service menu, be sure you receive answers that sufficiently increase your comfort level.

Why Do You Need a Variety of Carriers to Choose From?

There are multiple benefits to working with a variety of carriers. More importantly, you do not have to worry about not getting hold of one carrier for all your needs. Instead, multiple options naturally lead to better service levels and cost savings throughout your business, but some of the additional reasons for expanding your carrier selection include the following:

1) ***Consumers Demand More Choices and Options***. Consumers are not satisfied with standard shipping anymore. They want it today, and they want shipping costs to be ZERO. If you can't meet those demands or be very close to them, they will find what they need from Amazon, Wal-Mart or E-Bay.
2) ***E-Commerce Order Sizes and Delivery Requirements May Vary***. E-commerce varies heavily in size. Although many packages are small parcels, some may be huge. Think of the difference between shipping a 65-inch TV and a bushel of apples. Both may be bulky, but the dimensions can vary dramatically. As a result, you need to have access to multiple types of shipping.
3) ***Different Carriers May Offer Different Service Levels.*** Next-day air service is great, but what if a product takes longer by air than by truck? Different service levels must be available to ensure the fastest mode of transit possible.

4) ***Carriers May Not Provide Open-Ended Services.*** Open-ended services are provided by carriers who work exclusively with other businesses and logistics service providers. In other words, some carriers may not even be available to you without a third-party logistics provider.
5) ***More Carriers Equals More Competitive Rates.*** Carriers have a vested interest in getting your business, so having more carriers will give you access to more rates to choose from.
6) ***Interlining Is Essential to Globalization of E-Commerce.*** Carriers are not necessarily capable of working globally, and some shipments may need to be transferred to another carrier for final or international delivery, otherwise known as interlining. This is critical to making sure you can reach your e-commerce customers from around the globe. Plus, this transfer increases rates, and as mentioned previously, more rates are better.

Benefits of Carrier Selection through 3PLs:

Some additional benefits of using carrier selection through 3PLs include the following:

1) ***Auditing and Order Tracking Tools.*** 3PLs offer an array of auditing services, which can help you isolate errors in your system and processes, which reduce overhead. In addition, you and your customers can take advantage of more order tracking tools to help improve customer service as well.
2) ***Assistance in Preventing Overbilling and Crediting Overpayments.*** Overbilling or double-billing is part of business, and even the most proactive systems will let a few instances slip through the cracks, but a 3PL can work to locate and credit incorrect billing issues.
3) ***Web-Based Applications to Ensure Optimized Routes.*** Optimized routes lead to shorter delivery schedules and better reception by customers, promoting your brand from within.
4) ***Better Alignment of Business Strategy With Goals of E-Commerce.*** Your business must adapt to e-commerce, and 3PLs can provide assistance with aligning your business strategy to the needs of e-commerce.
5) ***Dash boarding Improves Communication in Your Operation.*** Dash boarding is also critical to your success, and your 3PL should offer metrics and dashboards to keep you in the loop and updated on your progress quickly.
6) ***More Shipping Lanes and Availability.*** Having a broad carrier selection through a 3PL also opens up more shipping lanes and helps to prevent delays from unavailable carriers.

Criteria for Selection of Carriers:

Use a supply chain approach to evaluate carriers and companies Choosing a carrier to ship with can be a challenging decision with lasting implications. A shipping partner will have a considerable impact on the day-to-day operations of your business. With so much at stake, it's important you take the time to analyze and evaluate each of your options and select the carrier that will best fulfil your organization's capacity requirements and supply chain needs. To assist you with the evaluation process, we have designed a guide that analyzes several of the most important factors to consider as you select a carrier. Based on your business needs, you will be able to determine the most important factors and criteria to use when evaluating those factors.

1) ***The carriers' financial stability:*** Be sure any recommended carriers are in strong financial condition, since a carrier in economic distress could pose serious problems to your relocation policy.

2) ***Check out the carriers' safety record*** : Your transferees should not have to agonize over the safety of their household goods and personal property. This is more than just an expression of empathy. Their transport safety problems will become your problems.

3) ***Verify that carriers have acceptable insurance coverage:*** This evaluation step is critical. Many carriers carry only minimal insurance coverage, vastly insufficient to cover most normal volume of household goods, or any valuable personal property. Still other carriers have insurance coverage in amounts that even cover property damage disasters.

4) ***If transport timeliness is vital for your company, examine their on-time delivery record:*** When you expect your transferee to report for work at the new location, you expect close to immediate productivity. Delayed household goods deliveries generate concern, apprehension and uncertainty, which could impact your transferees' short term performance.

5) ***Services Offered:*** What services does your business require? What transportation services does the carrier provide? Can one company handle all of your needs, or do you need to work with multiple shippers to move your freight? If your business requires more than one service, working with several companies will increase both your time investment and your cost. It may be beneficial to work with a carrier that offers multiple services, and can meet all of your company's needs.

6) ***Reliability:*** Does the shipper have high level of service (LOS) rates? Your business depends on the timely arrival of your freight to various destinations. A reliable carrier can help to build your company's positive reputation and in turn, grow your business and meet your customer expectations. Imagine shipping with a carrier who has a lower cost, but can never deliver your load on time, causing your freight to miss its inspection window, and not make it to market on time. Sure, you may have saved money in the short term, but in the end, this unreliable carrier will end up costing you more money in late or spoiled loads, and even worse, your company's reputation.

7) ***Asset vs. Non-Asset-Based Carriers:*** Asset-based carriers own all of the equipment needed to transport your freight. Non-asset-based carriers outsource the transportation services to asset-based carriers and do not necessarily own the equipment being used to transport your freight. In a non-asset-based carrier situation, there will be more hands on your freight, leaving more room for error. Asset-based carriers will ship your freight on their trailers, pulled by their own trucks, driven by the carrier's drivers.

8) ***Sustainability:*** Does the carrier follow sustainable practices and are they environmentally conscious when it comes to their transportation solutions? How is the carrier demonstrating their environmental commitments and is it measurable in a way that can be evaluated? Shipping with a carrier that prioritizes sustainability and environmental awareness can help to build your supply chain image and lead to increased sales. Customers pay attention to environmental sustainability and, just like safety, are inclined to buy with companies that have a reputation of being environmentally friendly.

9) ***Capacity:*** Recent trends show the demand for transportation services far outweighs the current supply. Not every carrier will be a good candidate for your business. Some carriers are stronger than others in certain regions. Finding a carrier with a network that includes the lanes your freight will travel on is crucial to establishing a profitable relationship for both parties.

Vendor Consolidation:

What is Vendor Consolidation?

1) Supplier Consolidation, or Vendor Consolidation, is a supply chain management strategy that has increased in popularity over the last decade. Supplier consolidation is the process of reducing suppliers within a specific supply market and focusing on the most successful suppliers within the same supply market.
2) Aimed to reduce supply chain costs and improve efficiency, consolidating suppliers is a strategy that can be implemented by any industry. In addition, supplier consolidation can be implemented on the production and indirect levels. However, manufacturing companies looking to reduce production costs may discover the greatest opportunity of cost savings.

3) Vendor consolidation is a procurement practice that involves lowering the number of vendors your company buys from. Instead of spreading out your spend across a large amount of vendors, you focus your spend on a limited number of select vendors.

4) Part of the process is identifying which supplier relationships are the most profitable for your company. The other part is eliminating the supplier relationships your company no longer needs. This isn't an easy process, but the benefits it can provide for your organization are well worth it.

Vendor Consolidation in Manufacturing:

Purchasing professionals in today's manufacturing industry are strained to find cost-saving initiatives. But as the cost of materials and labor continue to increase, the harder it is to get suppliers to reduce costs. This is where supplier consolidation comes in. A proven strategy for many manufacturers, supplier consolidation reduces purchase prices, reduces process costs, reduces risk and improves supplier relationships.

Reduced Purchasing Costs: As a company reduces its supplier base, purchasing power increases. By allocating more resources to fewer suppliers, companies can receive better prices for a product. Overall freight, handling and other related shipping fees will reduce in cost as well.

Reduced Process Costs: Companies who reduce their supplier base will have lower transactional costs. With fewer suppliers to handle, the costs involved in setting up a supplier in internal systems, completing transactions and managing the relationship significantly decreases. The additional time retained provides more opportunities to focus on other high-priority goals within the company.

Reduced Risk: Relying on fewer suppliers will significantly reduce risk as well. With fewer suppliers to manage, your company can better focus on securing all applicable risks throughout the supply chain. Your company can spend more time improving compliance and other legal policies.

Improved Supplier Relationships: When there are fewer suppliers to manage, the easier it is to focus on building relationships with core suppliers. By consolidating a supplier base, the core suppliers will get a larger piece of your market share. This larger market share for your core suppliers will equal lower prices for your company. Fewer suppliers also allows for more time focusing on improving the quality, efficiency, and overall performance of your core suppliers.

The Sophos Top 10 outstanding benefits of vendor consolidation	
1. COST SAVINGS	• Save thousands of pounds each year • Benefit from reduced product, management and staffing costs
2. TIME SAVINGS	• Save time by implementing just one solution • Fewer employee hours are required to manage fewer tasks • Be proactive rather than reactive
3. RETURN ON INVESTMENT (ROI)	• See a vastly improved ROI and prove your worth • Achieve improved time-to-launch, reduce internal costs (salaries) and external costs (investment)
4. INCREASED BUYING POWER	• Purchase from one vendor and improve economies of scale • Leverage one organisation to supply you with more for less
5. REDUCED TRAINING REQUIREMENTS	• Simple and fast training for new staff • All employees work from the same page, and can work towards common goals and easily transfer knowledge
6. ONE FAMILIAR INTERFACE	• Less stress on teams when colleagues are on holiday or off sick • One single familiar interface increases productivity
7. LESS ADMINISTRATION AND MEETINGS	• Spend less time in multiple vendor meetings, or working on endless paperwork and contracts
8. LESS RISK	• Multiple solutions often require patching to work well together, yet one consolidated solution is designed to cover all risks securely
9. ONE SUPPORT DESK	• One single point of contact reduces time calling for support • Get the answers you need without being passed between departments and third parties
10. COMPETITIVE BUY-BACK SCHEMES	• The days of 'locked in' contracts are long gone. Vendors such as Sophos will work with your incumbent supplier to end your contract ahead of time, without incurring additional costs

Warehousing: Facility location and Network design:

What is Warehousing?

A warehouse may be defined as a place used for the storage or accumulation of goods. The function of storage can be carried out successful with the help of warehouses used for storing the goods.

Warehousing is the act of storing goods that will be sold or distributed later. While a small, home-based business might be warehousing products in a spare room, basement, or garage, larger businesses typically own or rent space in a building that is specifically designed for storage.

"warehouse" and "distribution center" used interchangeably, but technically, a warehouse provides nothing more than storage. A distribution center, on the other hand, stores product but also fulfills orders.

Warehousing can also be defined as assumption of responsibility for the storage of goods. By storing the goods throughout the year and releasing them as and when they are needed, warehousing creates time utility.

Figure: Schematic of Warehousing

Functions of Warehousing:

Storage: This is the basic function of warehousing. Surplus commodities which are not needed immediately can be stored in warehouses. They can be supplied as and when needed by the customers.

Price Stabilization: Warehouses play an important role in the process of price stabilization. It is achieved by the creation of time utility by warehousing. Fall in the prices of goods when their supply is in abundance and rise in their prices during the slack season are avoided.

Risk Bearing: When the goods are stored in warehouses they are exposed to many risks in the form of theft, deterioration, exploration, fire etc. Warehouses are constructed in such a way as to minimise these risks. Contract of bailment operates when the goods are stored in wave-houses. The person keeping the goods in warehouses acts as boiler and warehouse keeper acts as boiler. A warehouse keeper has to take the reasonable care of the goods and safeguard them against various risks. For any loss or damage sustained by goods, warehouse keeper shall be liable to the owner of the goods.

Financing: Loans can be raised from the warehouse keeper against the goods stored by the owner. Goods act as security for the warehouse keeper. Similarly, banks and other financial institutions also advance loans against warehouse receipts. In this manner, warehousing acts as a source of finance for the businessmen for meeting business operations.

Grading and Packing: Warehouses nowadays provide the facilities of packing, processing and grading of goods. Goods can be packed in convenient sizes as per the instructions of the owner.

Type of Warehouses:

There are three types of warehouses as described below:

Private Warehouses: The private warehouses are owned and operated by big manufacturers and merchants to fulfill their own storage needs. The goods manufactured or purchased by the owner of the warehouses have a limited value

or utility as businessmen in general cannot make use of them because of the heavy investment required in the construction of a warehouse, some big business firms which need large storage capacity on a regular basis and who can afford money, construct and maintain their private warehouses. A big manufacturer or wholesaler may have a network of his own warehouses in different parts of the country.

Public Warehouses: A public warehouse is a specialised business establishment that provides storage facilities to the general public for a certain charge. It may be owned and operated by an individual or a cooperative society. It has to work under a license from the government in accordance with the prescribed rules and regulations. Public warehouses are very important in the marketing of agricultural products and therefore the government is encouraging the establishment of public warehouses in the cooperative sector. A public warehouse is also known as duty-paid warehouse.

Public warehouses are very useful to the business community. Most of the business enterprises cannot afford to maintain their own warehouses due to huge capital Investment. In many cases the storage facilities required by a business enterprise do not warrant the maintenance of a private warehouse. Such enterprises can meet their storage needs easily and economically by making use of the public warehouses, without heavy investment.

Public warehouses provide storage facilities to small manufacturers and traders at low cost. These warehouses are well constructed and guarded round the clock to ensure safe custody of goods. Public warehouses are generally located near the junctions of railways, highways and waterways.

They provide, therefore, excellent facilities for the easy receipt, despatch, loading and unloading of goods. They also use mechanical devices for the handling of heavy and bulky goods. A public warehouse enables a businessman to serve his customers quickly and economically by carrying regional stocks near the important trading centres or markets of two countries.

Public warehouses provide facilities for the inspection of goods by prospective buyers. They also permit packaging, grading and grading of goods. The public warehouses receipts are good collateral securities for borrowings.

Bonded Warehouses: Bonded warehouses are licensed by the government to accept imported goods for storage until the payment of custom duty. They are located near the ports. These warehouses are either operated by the government or work under the control of custom authorities. The warehouse is required to give an undertaking or 'Bond' that it will not allow the goods to be removed without the consent of the custom authorities. The goods are held in bond and cannot be withdrawn without paying the custom duty. The goods stored in bonded warehouses cannot be interfered by the owner without the permission of customs authorities. Hence the name bonded warehouse.

Bonded warehouses are very helpful to importers and exporters. If an importer is unable or unwilling to pay customs duty immediately after the arrival of goods he can store the goods in a bonded warehouse. He can withdraw the goods in installments by paying the customs duty proportionately.

Warehousing Elements:

Whether the purpose is strictly storage or storage plus order fulfillment, warehouses use specific elements that help manufacturers, distributors, and retailers monitor inventory and store it safely. An overview of basic elements includes:

- Shelving and rack systems that offer maximum storage capacity and easy product access.
- A climate control system for the product being stored. This is particularly important for frozen products or those requiring refrigeration, including certain pharmaceutical or laboratory products, and others that degrade if exposed to too much heat.
- Inventory control software that tells the product owner – who isn't necessarily the building owner – where all individual units are in the system at all times.

- Equipment that can move products from point A to point B – forklifts, pallet jacks, bins that hold products for orders, and conveyor belts, for example.
- Shipping supplies for order fulfillment.
- People who load products into a warehouse and others ("pickers") who fill orders in a true distribution center, plus those who manage the facility and operation.
- Security to protect stored products.
- Access to cost-effective transportation to bring products in or move them out as orders are fulfilled. That often means easy access to interstates, rail lines, or airports.

Benefits from Warehouses:

Regular production: Raw materials need to be stored to enable mass production to be carried on continuously. Sometimes, goods are stored in anticipation of a rise in prices. Warehouses enable manufacturers to produce goods in anticipation of demand in future.

Time utility: A warehouse creates time utility by bringing the time gap between the production and consumption of goods. It helps in making available the goods whenever required or demanded by the customers. Some goods are produced throughout the year but demanded only during particular seasons, e.g., wool, raincoat, umbrella, heater, etc. on the other hand, some products are demanded throughout the year but they are produced in certain region, e.g., wheat, rice, potatoes, etc. Goods like rice, tobacco, liquor and jaggery become more valuable with the passage of time.

Store of surplus goods: Basically, a warehouse acts as a store of surplus goods which are not needed immediately. Goods are often produced in anticipation of demand and need to be preserved properly until they are demanded by the customers. Goods which are not required immediately can be stored in a warehouse to meet the demand in future.

Price stabilization: Warehouses reduce violent fluctuations in prices by storing goods when their supply exceeds demand and by releasing them when the demand is more than immediate productions. Warehouses ensure a regular supply of goods in the market. This matching of supply with demand helps to stabilise prices.

Minimization of risk: Warehouses provide for the safe custody of goods. Perishable products can be preserved in cold storage. By keeping their goods in warehouses, businessmen can minimise the loss from damage, fire, theft etc. The goods kept in the warehouse are generally insured. In case of loss or damage to the goods, the owner of goods can get full compensation from the insurance company.

Packing and grading: Certain products have to be conditioned or processed to make them fit for human use, e.g., coffee, tobacco, etc. A modern warehouse provides facilities for processing, packing, blending, grading etc., of the goods for the purpose of sale. The prospective buyers can inspect the goods kept in a warehouse.

Financing: Warehouses provide a receipt to the owner of goods for the goods kept in the warehouse. The owner can borrow money against the security of goods by making an endorsement on the warehouse receipt. In some countries, warehouse authorities advance money against the goods deposited in the warehouse. By keeping the imported goods in a bonded warehouse, a businessman can pay customs duty in installments.

Factors to Consider when Choosing Warehouse Location:

- ***Desired Consumer Base***: When choosing a location for a warehouse, keep your customers' locations in mind. Determine your customer base and pinpoint the region or regions that you are trying to serve. Having a warehouse location that is in close proximity to your desired consumer base allows for faster deliveries.
- ***Proximity to Carrier Services:*** Consider your warehouse's proximity to carrier services. If your warehouse is located near carrier facilities, it will streamline the process of shipping your product(s) to your customer. Find a good balance -- find a location that offers both convenience and proximity to your customers as well as a

carrier service, making the shipping process easier and faster for both your company and the customers.

- ***Storage Requirements:*** Take account of any special accommodations that you may have to make for your products. Are your products hazardous? Flammable? Fragile? Make sure that the proper accommodations are able to be made at your desired warehouse location.

- ***Workforce Availability:*** The demographics of the warehouse location may be more important that the physical space. Determine your labor needs. Not every geographic location is able to provide the desired workforce with the right skills and right price. Workforce availability can impact overall company costs, therefore doing research on the geographic location is integral.
- ***Longevity:*** Consider the longevity of your warehouse location -- will it be able to accommodate the growth or shrinking of your business? Analyze the potential growth of your company and determine if the warehouse location has room for expansion if needed. If your product is seasonal, consider finding a location that offers seasonal leases or working with companies, such as Flowspace, that offer flexible in storage options.

Vehicle Loading and Vehicle Routing Methods:

Vehicle Loading:

The vehicle loading and unloading were developed to maintain high safety standards, minimize damage or loss, and establish consistent routines. All propane drivers must be trained to follow these procedures. The loading and unloading procedures ensures the security and integrity of your vehicle, and reduces the chance of an accident or product release. The various hazards to employees involved with loading and unloading materials onto vehicles for shipping include, but are not limited to, the following:

- Poor or incorrect hazard identification
- Manual handling
- Operational machinery
- Operator training
- Vehicle safety
- Communications
- Load composition and characteristics
- Weather conditions
- Vehicle and employee interaction
- Lifting equipment
- Equipment and vehicle inspections
- Defective vehicles and mobile equipment
- Designated loading and unloading area
- Vehicle speed

General Requirement of Vehicle Loading:

Job Safety Analysis: All employees involved with loading and unloading material and equipment for any facility will participate in and complete a Job Safety Analysis (JSA), the following documentation will be presented by the shipping company:

- Load composition
- Shipping instructions.
- Relevant dangerous goods and hazardous material certificates.
- Rigging and lifting point certification

Mechanical Lifting Devices: Where ever practicable, mechanical lifting devices should be used for all material. Where appropriate, methods such as pallets, boxes, crates, and containerization should be used. . Mechanical lifting equipment will be made available for identified specific tasks as required. Mechanical lifting devices include, but are not limited to, the following:

- Trolleys
- Hydraulic lifts
- Forklifts
- Cranes
- Vehicle-mounted cranes and/or similarly mounted lifting arms

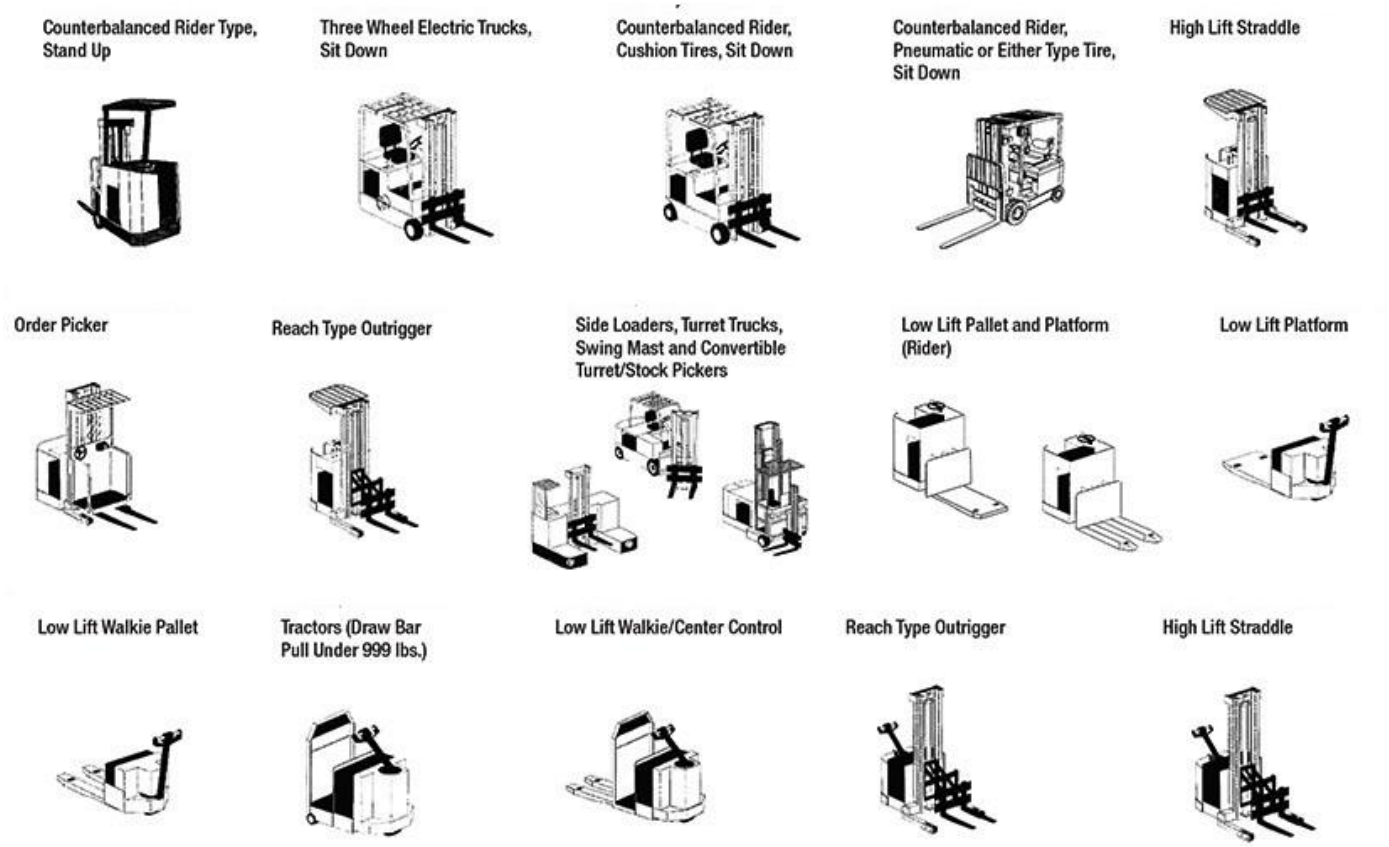


Figure: Different Types of Mechanical Lifting Devices

Equipment and Vehicle Inspections: Vehicles, machinery, and equipment inspections will be conducted in accordance with Practice, including the tag out of defective equipment.

Communications: Wherever possible, communications between parties will be either by clear, precise hand signals or two-way radio. Two-way radio communication channels during loading and unloading will be cleared as much as possible to verify that directions are not misinterpreted.

Load Composition and Characteristics: Where possible, loading and unloading of materials should occur at designated dispatch and receivable points. To provide consistency and continuity throughout the duration of the loading/unloading, a standardized loading/shipping manifest will be used.

Loading/Unloading Area: To conduct loading and unloading operations without interference from adjacent activities, mobile machinery, equipment, and employees, a designated area will be established where practical. The designated area will be clearly marked and sign-posted as a restricted area. All employees operating within the confines of this

area must wear a high-visibility vest or like clothing, which clearly delineates them from other employees during the loading /unloading of very huge consignments.

Role of Shipping (Loading & Unloading) Agent:

The following requirements are to be expected by all transport and shipping agents for transport of material and goods throughout all phases of the project:

1) Unit weight marked on units (individual and collective).
2) Load center of gravity to be marked on each unit.
3) Method of restraining load during transportation.
4) Decide on method of transport and unloading:
    - **i.** Flat racks (where approved lifting equipment is available)
    - **ii.** Cradles (where approved lifting equipment is available)
    - **iii.** Pallets
    - **iv.** Crates
    - **v.** Boxes
    - **vi.** Containers (where approved lifting equipment is available)
    - **vii.** Strapping
    - **viii.** Shrink-wrapping (boxes or pallets) making the small boxes into one unit

- Pre-slings for loading and remain attached as part of the load. They are tied down during transport and are later used to unload, thus eliminating the need for personnel to work at height to attach or remove slings. Pre-slings should be inspected before a lift.

- Use of specialty transport options (such as tilt tray transport and container side loader).

- Verify that the method for unloading identified is compatible with the equipment for unloading, which is at the unloading site.

Vehicle Routing and Scheduling Methods:

Vehicle Routing:

1) Vehicle routing is a branch of operations research that has attracted a great deal of research attention over the years.
2) The scheduling of customer service and the routing of service vehicles are at the heart of many service operations.
3) The design and assignment of routes to specific vehicles according to a defined objective function.
4) Vehicle routing problem (VRP) aims to find a set of routes at a minimal cost (finding the shortest path, minimizing the number of vehicles, etc) beginning and ending the route at the depot, so that the known demand of all nodes are fulfilled. Each node is visited only once, by only one vehicle, and each vehicle has a limited capacity.

Objectives of Routing and Scheduling Problems:

1) The objective of most routing and scheduling problems is to minimize the total cost of providing the service. This includes vehicle capital costs, mileage, and personnel costs. But other objectives also may come into play, particularly in the public sector.

2) For example, in school bus routing and scheduling, a typical objective is to minimize the total number of student-minutes on the bus. This criterion is highly correlated with safety and with parents' approval of the school system.

3) For XYZ-ride services for the handicapped or elderly, an important objective is to minimize the inconvenience for all customers.

4) For the Meals-for-ME program, the meals must be delivered at certain times of the day.

5) For emergency services, such as ambulance, police, and fire, minimizing response time to an incident is of primary importance.

6) Some companies promise package delivery by 10:30 A.M. the next morning. Thus, in the case of both public and private services, an appropriate objective function should consider more than the rupees cost of delivering a service. The "subjective" costs associated with failing to provide adequate service to the customer must be considered as Well.

Vehicle Routing Problem (VRP):

Generally, distribution or collection of goods from customers to depot is called as VRP or Vehicle Scheduling Problem. The distribution of goods concerns the service, in a given time period, to a set of customers by a fleet of vehicles, which are located in one or more depots. These vehicles are operated by a set of crews (drivers), and perform their movements by using an appropriate network. In particular, the solution of a VRP calls for the determination of a set of routes, each performed by a single vehicle that starts and ends at its own depot, such that all the requirements of the customers are fulfilled, with some operational constraints and the global transportation cost is minimized. The operational constraints can be a vehicle capacity, route length, time window, precedence relation between customers, etc.

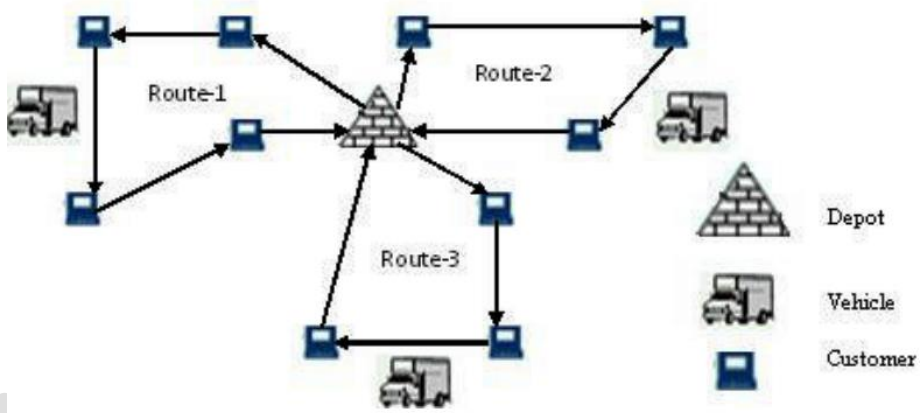
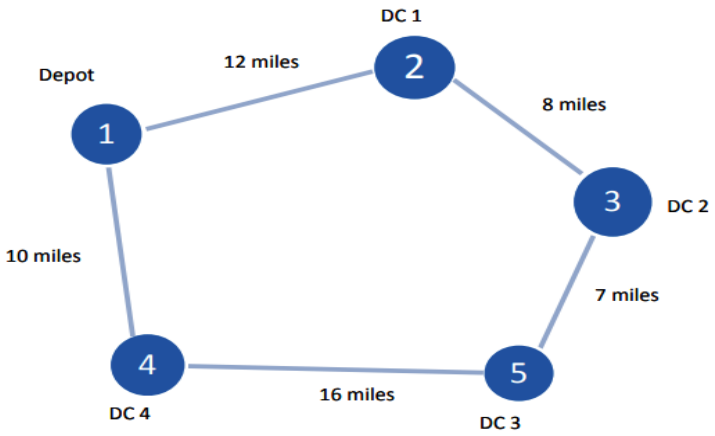


Figure. A VRP with 3 vehicles serving 10 customers forming 3 routes.

The objective of depot is to minimize the total cost of providing the services. This includes the vehicle capital cost, mileage and personnel costs. There can be other service types addressing different objectives as shown in Table.

Service type	Objective
School bus	Minimize student-minutes on the bus
Logistics	Minimize the distance travelled to pick up and/or to deliver parcels following optimum routes
Emergency (ambulance, police, fire)	Minimize response time

Characteristics of Routing and Scheduling:



From above Figure , which is comprised of nodes and arcs. Various such characteristics of routing problems are discussed below.

Nodes: It consists of five circles called nodes. Node 1 is the depot node from which the vehicle starts and ends. Nodes 2, 3, 4 and 5 represent four distribution centers (DC).

Arcs: The line segments connecting the nodes are called as arcs. Arcs may describe the time, cost or distance required to travel from one node to another. In Figure, arcs describe the distance in miles between the DCs. Arcs may be directed (arrows) or undirected (simple line segments). Arrows represent the direction of travel in the case of routing problems (e.g. one-way streets) or precedence relationships in case of scheduling problems.

Tour: Tour is the route for the vehicle. In Figure, travelling nodes in the order as given below

1→2→3→4→5→1

1→5→4→3→2→1

are called tours. The total distance traveled is 53 miles in either case.

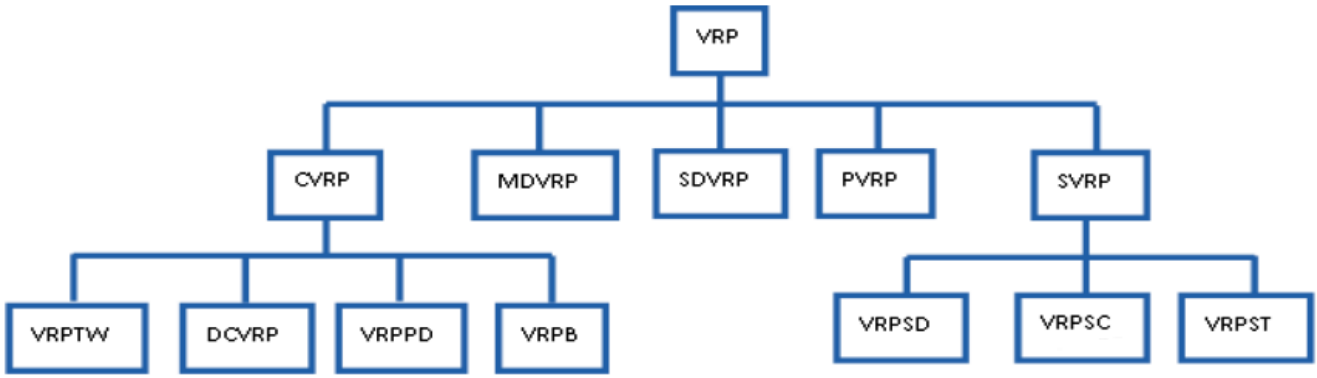
Feasibility: Minimum-cost solution or any other criterion like time or distance traveled is subject to the tour being feasible. Feasibility implies that;

- A tour must include all nodes
- A node must be visited only once
- A tour must begin and end at a depot.

Route: Sequence in which the nodes (or) arcs are to be visited.

Schedule: Specifies when each node has to be visited

Classification of Routing and Scheduling Problems:



Classification of Vehicle Routing and Scheduling

Capacitated VRP (CVRP) - CVRP is a Vehicle Routing Problem (VRP) in which a fixed fleet of delivery vehicles of uniform capacity must provide service to known customer demands for a single commodity from a common depot at minimum transit cost. That is, CVRP is like VRP with the additional constraint that every vehicle must have uniform capacity of a single commodity.

VRP with Time Windows (VRPTW) - The VRPTW is the VRP with the additional restriction that is, a time window is associated with each customer, defining an interval $[e_0, l_0]$ wherein the customer has to be supplied where e_0 and l_0 represents the early and late time. The interval $[e_0, l_0]$ at the depot is called the scheduling horizon.

VRP with Backhauls (VRPB) - The VRPB is the extension of the VRP in which the customer set is partitioned into two subsets. One contains customers that require a given quantity of product to be delivered and the second contains customers where a given quantity of inbound products must be picked up.

Distance-Constrained VRP (DCVRP) – In DCVRP, each route has a maximum length (or time) constraint instead of capacity constraint.

Multi-Depot VRP (MDVRP) - A company may have several depots from which it can serve its customers. If the customers are clustered around depots, then the distribution problem should be modeled as a set of independent VRPs. However, if the customers and the depots are intermingled, then a MDVRP should be solved. A MDVRP requires the assignment of customers to depots. A fleet of vehicles is based at each depot. Each vehicle originates from one depot, provide service to the customers assigned to that depot, and return to the same depot. The objective of the problem is to service all customers while minimizing the number of vehicles and travel distance compared assigning of customers to depot using six heuristic for multi-depot VRPTW.

VRP with Pick-Up and Delivering (VRPPD) - The Vehicle Routing Problem with Pick-up and Delivering (VRPPD) is a VRP in which the possibility that customers return some commodities is contemplated. So in VRPPD, it should be taken into account that the goods returned by customers to the delivery vehicle must fit into it. These restrictions make the planning problem more difficult and can lead to bad utilization of the vehicles capacities, increased travel distances or a need for more vehicles. Hence, it is usual to consider restricted situations where all delivery demands start from the depot and all pick-up demands shall be brought back to the depot, so there are no interchanges of goods between the customers.

Split Delivery VRP (SDVRP) - SDVRP is a relaxation of the VRP wherein it is allowed that the same customer can be served by different vehicles if it reduces overall costs. This relaxation is very important if the sizes of the customer orders are as big as the capacity of a vehicle.

Stochastic VRP (SVRP) - Some values (like number of customers, their demands, serve time or travel time) are random. Stochastic VRP (SVRP) is a VRP where one or several components of the problem are random. Three different kinds of SVRP are:

i. *Stochastic customers:* Each customer $\mathbf{v_i}$ is present with probability $\mathbf{p_i}$ and absent with probability $\mathbf{1-p_i}$.
ii. *Stochastic demands:* The demand di of each customer is a random variable.
iii. *Stochastic times:* Service times and travel times $\mathbf{t_{ij}}$ are random variables.

In SVRP, two stages are made for getting a solution. A first solution is determined before knowing the realizations of the random variables. In the second stage, a recourse or corrective action can be taken when the values of the random variables are known (Steward and Golden 1980; Jaillet 1987).

Periodic VRP (PVRP) - In classical VRPs, typically the planning period is a single day. In the case of the Period Vehicle Routing Problem (PVRP), the classical VRP is generalized by extending the planning period to a specified number of days.

Applications of VRP:

There are several important problems that must be solved in real time. The main applications that motivate the research in the field of the real time VRPs are listed below;

i. Dynamic fleet management: Several large scale trucking operations require real-time dispatching of vehicles for the purpose of collecting or delivering shipments. Important savings can be achieved by optimizing these operations.

ii. Vendor-managed distribution systems: In vendor-managed distribution systems, distribution companies estimate customer inventory level in such a way to replenish them before they run out of stock. Hence, demands are known beforehand in principle and all customers are static. However, because demand is uncertain at some time, some customers (usually a small percentage) may run out of stock and have to be serviced urgently.

iii. Couriers: Long-distance courier need to collect locally outbound parcels before sending them to a remote terminal to consolidate loads. Also, loads coming from remote terminals have to be distributed locally. Most pick-up requests are dynamic and have to be serviced the same day if possible.

iv. Rescue and repair service companies: There are several companies providing rescue or repair services (broken car rescue, appliance repair, etc.).

v. Dial-a-ride systems: Dial-a-ride systems provide transportation services to people between given origin–destination pairs. Customers can book a trip one day in advance (static customers) or make a request at short notice (dynamic customers).

vi. Emergency services: Emergency services comprise of police, fire fighting and ambulance services. By definition, all customers are dynamic. Moreover, the demand rate is usually low so that vehicles become idle from time to time. In this context, relocating idle vehicles in order to anticipate future demands or to escape from downtown rush hour traffic jam is a major issue.

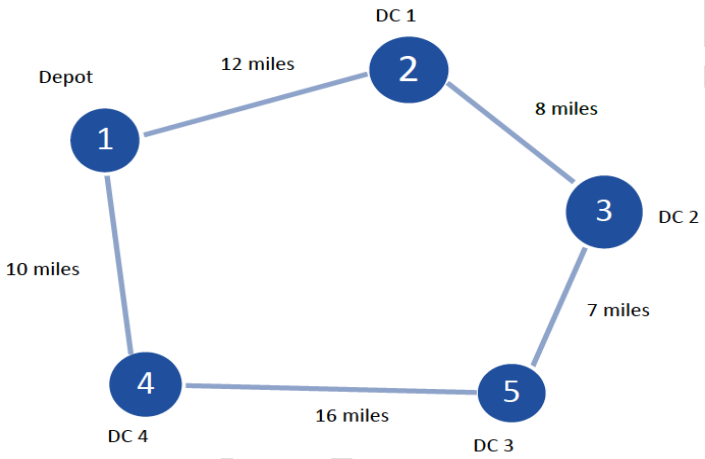
vii. Taxi cab services: In taxi cab services, almost every customer is dynamic. As in emergency services, relocating temporary idle vehicles is an issue.

viii. Refuse collection: It is an activity rendering used products or wastes and moving them to some points where further treatment is taken care. In real life waste collection vehicle routing problem with time windows (VRPTW), with consideration of multiple disposal trips and drivers', with workload balancing and compact route of each vehicle need to be found.

ix. Newspaper distribution: Distribution of newspaper is similar to VRP, where it is to improve the distribution activity. Distribution activity is a part of the strategic planning of the company which aims to reduce number of staff members and to reduce the cost occurred in the distribution process.

Solution Approach to Routing and Scheduling Problems:

Consider a milk van delivering milk to four distribution centers (DC) every day morning as shown in the Figure below.



Consider the delivery of milk cans to DCs as described in above figure. Suppose there are 10 DCs, we can have 10^2 or 1024 possible routings. Realistic problems may be of greater size making the solution to become expensive to solve optimally. Hence heuristic solution techniques have been developed to yield good solutions if not optimal solutions to these problems.

Two commonly used heuristics for the traveling salesman problem are the **nearest neighbor procedure (NNP)** and the **Clark and Wright savings heuristic (C-W) algorithm).**

Nearest Neighbor Procedure (NNP):

Nearest Neighbor Procedure (NNP) builds a tour based on the cost or distance of traveling from the last-visited node to the closest node in the network. The steps in NNP are:

1) Start with a node at the beginning of the tour (say depot node)
2) Find the node closest to the last node and add to the tour. If the closest node is already in the tour or already there in the path then select next closest node.
3) Go to step 2 until all nodes have been added
4) Connect the first and the last node to form a complete tour.

Example

Collect the data of distance or cost of traveling for milk cans delivery example from every node in the network to every other node in the network with undirected arcs and present it in a distance matrix as shown below. The distance from node, i, to node, j, will be the same as the distance from j to i, provided $i \neq j$. Such a network is said to be symmetrical.

Table: Distance Matrix

From Node	To Node (distances in miles)				
	1	2	3	4	5
1	-	6	3	12	10
2	6	-	5	10	4
3	3	5	-	8	6
4	11	10	8	-	5
5	4	9	3	10	-

Procedure:

Step 1: Start with depot node (node 1). Examine the distances between node 1 and every other node. Closest node is node. So fix the partial tour or path as **1→3**

Step 2: Find the closest node to the last node added (node 3) that is not currently in the path. This is node 2. Connect it to the path to yield **1→3→2**

Step 3: The node closest to node 2 is node 5. Connect it to yield **1→3→2→5**

Step 4: Connect the last node i.e. node 4 to the path and complete the tour by connecting node 4 to the depot. The complete tour formed is **1→3→2→5→4→1** as shown in Figure . The length of the tour is 33 miles

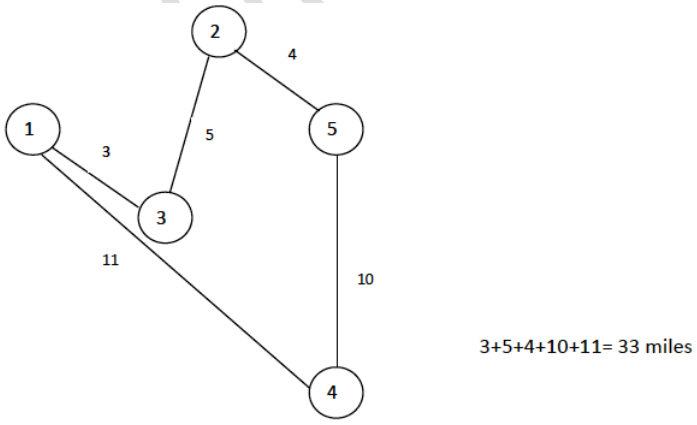
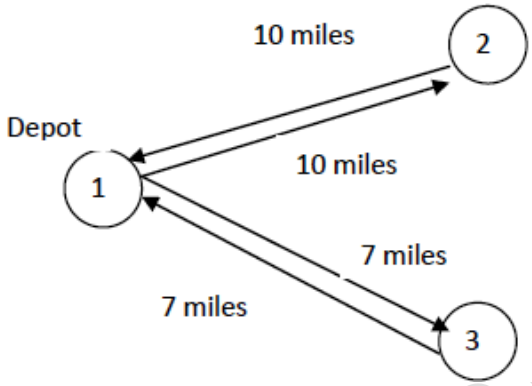


Figure: The final tour for milk can delivery problem

This final tour determined by nearest neighbor procedure may not be the best-possible route. As the alternative path, **1→2→5→4→3→1** has the total distance of 6+4+10+8+3 = 31 miles. This shows the limitation of the heuristics for not resulting in optimality. Enumeration is possible for this small network. But for large problems with 100 or 200 nodes, enumeration becomes very difficult.

Clark and Wright Savings Heuristic (C-W):

Clark and Wright (C-W) algorithm was developed by Enter G Clarke and J. W. Wright. The basis for C-W algorithm is savings concept where these savings are realized by linking pairs of delivery points served by a single depot in the network. First step in C & W heuristic is to select a node as depot node and label as node 1. To understand the savings concept, assume n-1 vehicles are available where n is the number of nodes. Each vehicle travels from the depot directly to the node and return to the depot. As we can see in the network below for milk delivery example, one vehicle goes from depot to node 2 and come back and other vehicle goes from depot to node 3 and comes back to depot (node 1).



The total distance traveled by two vehicles is 34 miles (2*10 + 2*7 =34). This is not a feasible solution if all nodes in TSP should be visited by one vehicle.

We know that the distance from node 2 to node 3 is 5 miles. If we select the tour starting from depot (node 1) to be **1→2→3→1**that is linking node 2 and 3 before returning to node 1 we can achieve savings of 12 mile.

These savings can be computed as follows. Let, D_{ij}, presented the distance between node i and node j. Suppose a vehicle travels from depot (node 1) to DC node 2 and comes back and again make tour to other DC node 3 and finally return to node 1. The total cost of such tour will be as given below.

$$\textbf{Total cost 1= } 2D_{12} + 2D_{13}$$

The cost for following 1→2→3→1 tour will be

$$\textbf{Total cost 2=} D12 + D_{23} + D_{31}$$

The difference between total cost 2 and total cost 1 will give us savings, S23, by pairing up nodes 2 and 3 as given below.

$$S_{23} = 2D_{12} + 2D_{13} - (D_{12} + D_{23} + D_{31})$$

$$\textbf{Or } S_{23} = D_{12} + D_{13} - D_{23}$$

Hence savings is computed as a measure of how much the tour length or cost can be reduced by 'hooking up' a pair of nodes (nodes 2 and 3).Steps in the C & W savings heuristic for networks with n nodes is as follows.

Steps in C-W Algorithm:

Step 1: Construct a shortest distance half matrix comprised of shortest distance or least time between each pair of nodes including starting node.
Step 2: Develop an initial allocation of one round-trip from starting node to each destination.
Step 3: Calculate the net savings for each pair of nodes (excluding starting node) and construct net savings half-matrix. Net savings are the savings achieved by pairing nodes relative to the cost of making round trip to each paired node from depot or node1.
Step 4: Introduce a special indicator, I, into appropriate cells of the net savings half-matrix. This indicator will tell if the two nodes in question are directly linked. The link can be from either node 1 to any other node j or it can be between any pair of nodes, i and j when ($i \neq 1$ and $i \neq j$). This trip indicator, I may have one of three values.

- **Step 4.1:** when a vehicle travels from point of origin (node 1) to node j (other than node 1) and then returns to point of origin then, I=2. That is, a round trip will have I=2. In the matrix we can write the value of indicator that is I1j = 2 (where j≠1). This value will appear only in the first row of the net-savings half matrix.
- **Step 4.2:** When a vehicle travels one way directly between two nodes, the Iij=1.
- **Step 4.3:** The value of trip indicator Iij=0, if a vehicle does not travel directly between two particular nodes that is no trip between a pair of nodes.

Step 5: Select the (i,j) cell in the net savings half matrix having maximum net savings and link i and j. But before linking the pair of nodes, following conditions should be fulfilled to link i and j.

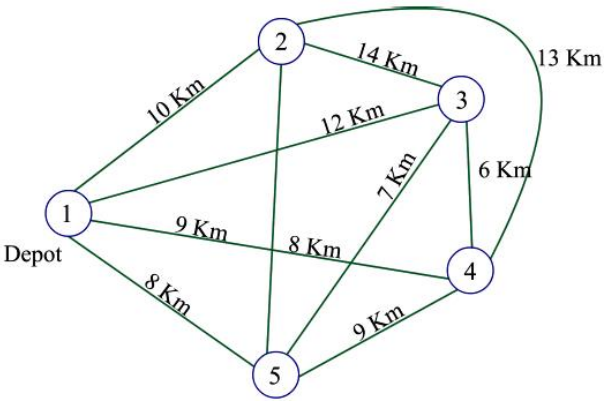
- **Step 5.1:** I1i and I1j must be greater than 0.
- **Step 5.2:** Nodes i and j are not already on the same route or loop.
- **Step 5.3:** There is no violation of constraint in linking i and j. (There can be some constraints like one way route is only permissible between two streets, there is not a proper road between two nodes, the vehicle has limited capacity etc.)

If the cell meets all the above conditions they assign Iij=1 otherwise assign zero and select the cell with next highest net savings and check for the conditions stated in 5.1, 5.2 and 5.3.

Step 6: When all nodes are linked on a single route and no other cell meets the conditions in step 5, stop the algorithm. Otherwise go to step 5

Example

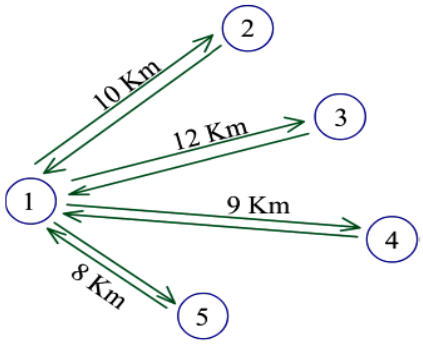
We will solve the milk delivery problem from depot to four distribution centers in figure below using C-W algorithm. The arcs between all the nodes present the distance.



Step 1: Construct shortest distance half matrix as given below.

	2	3	4	5
1	10	12	9	8
2	8	13	9	
	3	6	7	
		4	7	

Step 2: Develop an initial trip allocation



Step 3: Calculate net savings for each pair of nodes as given below.

Paired Nodes	Savings sij
2,3	$S_{23} = 10 + 12 - 14 = 8$
2,4	$S_{24} = 10 + 9 - 13 = 6$
2,5	$S_{25} = 10 + 8 - 8 = 10$
3,4	$S_{34} = 12 + 9 - 6 = 15$
3,5	$S_{35} = 12 + 8 - 7 = 13$
4,5	$S_{45} = 9 + 8 - 9 = 8$

Construct net savings half matrix

	2	3	4	5
1	-	-	-	-
2	8	6	10	
3	15	13		
4	8			

Step 4: Introduce indicator I for initial round tripe allocation

	2	3	4	5
1	$I_{12} = 2$ -	$I_{13} = 2$ -	$I_{14} = 2$ -	$I_{15} = 2$ -
2	8	6	10	
3	15	13		
4	8			

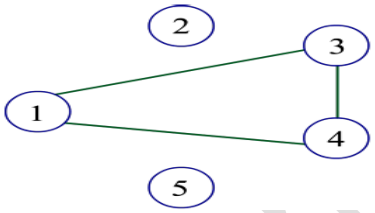
Step 5: Select the cell with maximum net savings

	2	3	4	5
1	$I_{12} = 2$ -	$I_{13} = 2$ -	$I_{14} = 2$ -	$I_{15} = 2$ -
2	2	8	6	10
3		3	15	13
4			4	8

We can see that cell (3,4) has maximum savings so we will link (3,4) after checking conditions 5.1, 5.2 and 5.3 given in step 5 of C-W algorithm.

- **I_{13}** and **I_{14}** are greater than 0 and both have value equal to 2.
- Node 3 and node 4 are not already on the same node.
- No constraints are mentioned for this problem.

Hence, we will link nodes 3 and 4 which will change the indicator values in the net savings matrix as given below.

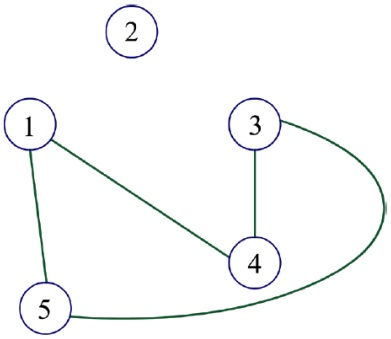


	2	3	4	5
1	$I_{12} = 2$	$I_{13} = 1$	$I_{14} = 1$	$I_{15} = 2$
2	2	8	6	10
3		3	$I_{34}=1$ 15	13
4			4	8

The value of indicator in the cell (3,4) will become 1. The values for I13 and I14 will also change from 2 to 1. Now look for next highest savings in the matrix, which is cell (3, 5) that is with the value of 13. Check the conditions of step 5.

- **I_{13}** and **I_{15}** are greater than 0
- Node 3 and node 5 are not already on the route

So, we will link nodes 3 and 5 with following route and update in net savings matrix.



	2	3	4	5
1	$I_{12}=2$ -	$I_{13}=0$ -	$I_{14}=1$ -	$I_{15}=1$ -
2		8	6	9
3			$I_{34}=1$ 15	$I_{35}=1$ 13
4				8

The indicator $\mathbf{I_{15}}$ will take value of 1 and $\mathbf{I_{35}=1}$ will be introduced in cell (3,5). Look now **I13=0**, hence we cannot link node 3 with any other node except 4 and 5. Look for next highest savings, which are in cell (2,5).

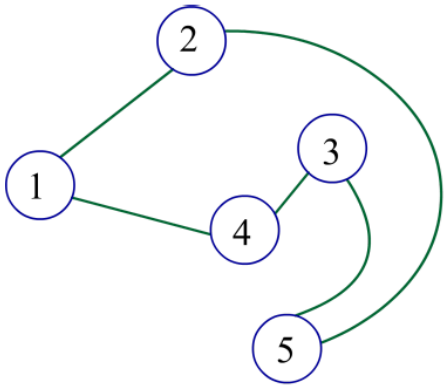
	2	3	4	5
1	$I_{12}=2$ -	$I_{13}=0$ -	$I_{14}=1$ -	$I_{15}=1$ -
2		8	6	9
3			$I_{34}=1$ 15	$I_{35}=1$ 13
4				8

Check for the conditions in step 5.

- $\mathbf{I_{12}}$ and $\mathbf{I_{15}}$ are greater than 0
- Node 2 and node 5 are not on the route.

So, pair up node 2 and node 5 and update the network and the matrix as given below.

	2	3	4	5
1	$I_{12}=1$	$I_{13}=0$	$I_{14}=1$	$I_{15}=0$
2		8	6	$I_{25}=1$ 9
3			$I_{34}=1$ 15	$I_{35}=1$ 13
4				$I_{45}=1$ 8



Selected path or route is

$$1 \longrightarrow 4 \longrightarrow 3 \longrightarrow 5 \longrightarrow 2 \longrightarrow 1$$

or

$$1 \longrightarrow 2 \longrightarrow 5 \longrightarrow 3 \longrightarrow 4 \longrightarrow 1$$

With distance of 10 + 8 + 7 + 6 + 9 = 40Km

For the multiple vehicles routing problem, there can be some constraints regarding the limited capacity of vehicle. In such case introduce this constraint in the condition number 5.3 of step 5 in C-W algorithm. One should have data on the demand at each node. Then apply C-W algorithm and keep on linking nodes until the demand at linked nodes reach capacity of vehicle. Stop further linking of nodes and introduce second vehicle.

Lead Time Components and their Compression:

What Is Lead Time?

1) Lead time is the amount of time that passes from the start of a process until its conclusion. Companies review lead time in manufacturing, supply chain management, and project management during pre-processing, processing, and post-processing stages. By comparing results against established benchmarks, they can determine where inefficiencies exist.
2) Reducing lead time can streamline operations and improve productivity, increasing output and revenue. By contrast, longer lead times negatively affect sales and manufacturing processes.
3) In Supply Chain Management, Lead time is the duration from when the order is received till goods are delivered to the customer.
4) In New Product development, Lead time is the time taken for a product to reach the market.
5) In HRD (Human Resources Development), there is a lead time for recruitment of resources to the organization.
6) Lead time is very critical because:
   i. Higher Lead time leads to increase in inventory
   ii. Lead time has an important role in Demand forecast
   iii. Lead time has a direct impact on customer Satisfaction; it makes your clients look for alternatives.
   iv. Lead time provides a competitive edge for Product Manufacturing companies.

Components of Lead Time:

To manage Lead time in a beneficial way, one needs to understand the components of Lead time. The components of Lead Time are an accumulation of all the Cycle Time (also referred as Lead Time in some industry) in each department. For E.g., Customer Service – receiving requests from customers at a call center or a branch and then followed by other subsequent departments receiving the request and processing the request in a pre-defined forecasted time (Cycle Time). For calculating Lead time the following formula is required;

Lead Time = Preprocessing Time + Processing time + Waiting time + Transportation time + Storage time + Inspection time

1) ***Preprocessing time:*** Time taken for receiving the Request, understanding the request and creating a Purchase order
2) ***Processing Time:*** Time taken to produce or procure the item
3) ***Waiting Time:*** Amount of time the item is in queue waiting for production
4) ***Transportation Time:*** Time the item is in transit to reach the customer
5) ***Storage Time:*** Time the item is waiting at warehouse or factory
6) ***Inspection Time:*** Time taken for checking the product for any non-conformity

While calculating the lead time, one must assume that there is zero inventory/WIP and include the time taken for replenishment of Inventory in Lead time duration. While practically this may not be visible to customer's eyes, it is useful to forecast the demand, help to reduce WIP and move towards JIT (Just in Time Manufacturing).

Lead Time Reduction/ Lead Time Compression:

1) **Reduce Non-Value Added Activities:** Perform a Value Stream Mapping to identify the list of Non-value added activities that can be ***eliminated or reduced***.
2) **Simplification of Parts:** Simplification of sub parts that can be used for multiple parts will ***reduce the complexity*** and hence reduce lead time.
3) **Machine Layout:** Arranging or ordering the machinery in a way such that ***transportation and movement of processed goods is reduced***.
4) **Standard Operations:** Standardizing the operational procedures and documenting will help ***reduce confusion among staff*** and help easy learning and ***improve consistency***in production.
5) **Set up time Reduction:** Set up time of machinery is one of the crucial tasks, which delays the subsequent tasks. Reduction of this task, helps in reducing the processing time
6) **Total Planned Maintenance:** Unpredictable down-time is a huge disaster, no matter how efficient the operations are. Therefore ***frequent planned maintenance*** of machinery helps in avoiding this risk.
7) **Supplier Relationship and Performance Management:** Identifying a pool of suppliers with back up ***arrangements***, ***scoring*** them, and ***providing feedback*** at appropriate intervals is an important task.

Many leading manufacturers ***treat suppliers as their extended organization*** and ***educate suppliers*** on key processes, so that they get to know the importance of their product in the value flow. Customers are more inclined towards any Product or Service which has lesser Lead Time. It is therefore ***imperative*** for any industry to keep improving their Lead Time to **stay in LEAD in the market**.

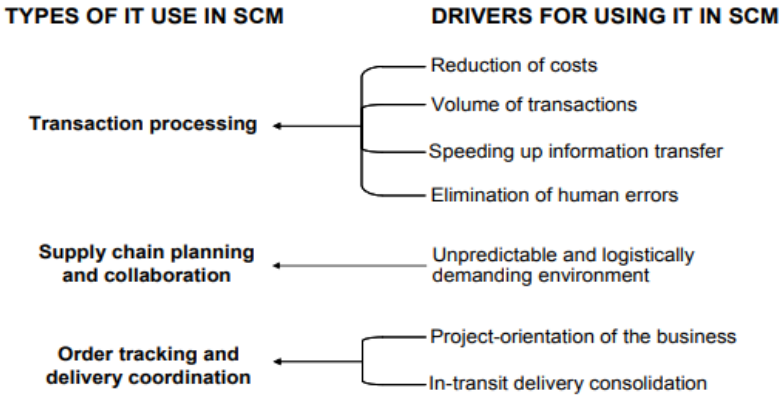
Use of IT for tracking in Supply Chain:

The use of information technology (IT) is considered a prerequisite for the effective control of today's complex supply chains. The objectives of IT in SCM are :

- providing information availability and visibility;
- enabling a single point of contact for data;

- allowing decisions based on total supply chain information; and
- enabling collaboration with partners

The use of IT for SCM purposes can be divided into 1) transaction processing, 2) supply chain planning and collaboration, and 3) order tracking and delivery coordination.



The first type of IT use, **transaction processing** stands for the use of IT for increasing the efficiency of repetitive information exchanges between supply chain partners. In this type of IT use the exchanged information is typically related to such tasks as order processing, billing, delivery verification, generating and sending dispatch advices, and producing order quotes.

The second type of IT use, **supply chain planning and collaboration**, represents the use of IT for sharing planning-related information such as demand forecasts and other demand information, inventory information, and production capacity information, with the intention of increasing the effectiveness of the supply chain.

Finally, the third type of IT use in SCM, **order tracking and delivery coordination**, refers to the monitoring of individual orders or shipments, which may consist of components or final products, with the aim of coordinating their delivery or conveying timely information of their location.

Information sharing between partners in the supply chain is also crucial and these integration attempts are accompanied by IT initiatives. Such IT initiatives include:

- Use of bar-coding in logistics systems
- Use of EDI (Electronic Data Interchange) to communicate between branches
- Use of Material Requirements Planning (MRP)
- Enterprise Solutions like ERP
- Internet and Web Services for communication between partners

Logistics Traceability/Tracking:

- Tracking and tracing is usually associated with logistics as the process of determining the location of goods which are delivered from an origin to a destination.
- If tracking is the ability to determine the current state of a product in the real time, tracing means the ability to remember the past states and the origins (raw materials, subparts, components) of the product as well.
- "Tracking and Tracing may be subdivided into a tracking part and a forward and backward traceability. The tracking part consists of the determination of the ongoing location of items during their way through the supply chain. The forward traceability part refers to the determination of the location of items in the supply chain, which were produced together. Backward tracing is used to determine the source of the problem of a defective item".

- Thus, the term of logistics traceability is related to the order-delivery processes and can be understood as an ability to retrace steps and events, referring to logistical activities such as transportation, distribution or warehousing.
- Traceability refers to the completeness of the information about all the states of entity and their changes during their product lifecycle, including manufacturing, removing, maintaining, repairing, storing and delivering processes.
- For Example, the Air Transport Association (ATA) defines traceability as "the ability to show where a part has been since it was manufactured or last certified"

Benefits:

- Currently, traceability is one of the bases of supply chain management approach. Such functions as current status, expected delivery time and information about delays allow coordination between companies involved in a supply chain.
- Numerous benefits from improved T&T system (Traffic & Transportation) could be identified in the fields of operational performance, risk and safety as well as in the legislation.
- Traceability helps companies to use their assets in a more efficient way and to achieve a competitive advantage through a better customization and faster deliveries of ordered goods.
- A number of incorrect deliveries and costs caused by them can also be significantly decreased thanks to the better quality control.
- Tracking is also useful for aftermarket logistics, especially within relative long-lifecycle goods, such as vehicles or aircrafts. Traceability through the maintenance, repair and overhaul (MRO) processes enables new efficiencies in these operations as well as increases visibility at the logistics level.
- Traceability also permits a precise, purposeful and possibly cheap reaction to customers' claims, which is a significant improvement both for clients and manufacturers.

Supply Chain Sustainability in Business Management:

Supply-chain sustainability is a business issue affecting an organization's supply chain or logistics network in terms of environmental, risk, and waste costs. There is a growing need for integrating environmentally sound choices into supply-chain management. Sustainability in the supply chain is increasingly seen among high-level executives as essential to deliver profitability and has replaced monetary cost, value, and speed as the dominant topic of discussion among purchasing and supply professionals. A sustainable supply chain seizes value creation opportunities and offers significant competitive advantages for early adopters and process innovators.

Why Sustainable Supply Chains Matter???

Environmental managers and chief sustainability officers are increasingly looking to their supply chains to conserve natural resources and reduce carbon emissions. Considering supply chains are responsible for up to four times the greenhouse gas emissions of a company's direct operations and many suppliers operate in water-stressed areas of the globe, this makes sense from an environmental savings standpoint. To this end, the corporations like **Apple** push for more rigorous environmental standards and renewable energy use across its supply chain and publish regular supply chain audit reports detailing suppliers' progress and **Nike** creating an entirely new apparel supply chain company that will "embed sustainability and transparency into the business."

Climate-related regulations, the cost and availability of materials and human resources are all supply chain risks. Working with suppliers to improve sustainability can help mitigate these, as well as reputational risks. As transparency and accountability become increasingly important to investors, consumers and other shareholders, sustainable supply chain shortcomings can also be a blow to a corporation's sustainability cred. This is something **Disney** found out in recent weeks with environmental protection groups accusing **Disney** of using polluting suppliers in China and it's actually what spurred **Apple** to monitor its suppliers' environmental, health and safety performance in the first place.

As a result, companies are increasingly recognizing that they need to invest in sustainability beyond their direct operations and create resilient and responsible supply chains to be successful in a globalized, fast-changing world. Sustainability leaders also recognize that sustainable supply chains can offer competitive advantages such as improved efficiency, innovation and market differentiation."

Three Tiers of Sustainability in SCM

Tier 1: Getting the basics right:

This is the base level and is the stage in which the majority of organizations are at. Companies employ simple measures such as switching lights and PCs off when left idle, recycling paper, and using greener forms of travel with the purpose of reducing the day-to-day carbon footprint. Some companies also employ self-service technologies such as centralized procurement and teleconferencing.

Tier 2: Learning to think sustainably:

This is the second level, where companies begin to realize the need to embed sustainability into supply chain operations. Companies tend to achieve this level when they assess their impact across a local range of operations. In terms of the supply chain, this could involve supplier management, product design, manufacturing rationalization, and distribution optimization.

Tier 3: The science of sustainability:

The third tier of supply chain sustainability uses auditing and benchmarks to provide a framework for governing sustainable supply chain operations. This gives clarity around the environmental impact of adjustments to supply chain agility, flexibility, and cost in the supply chain network. Moving towards this level means being driven by the current climate (in which companies recognize cost savings through green operations as being significant) as well as pushing emerging regulations and standards at both an industry and governmental level.

Application of sustainability in SCM

Companies looking to implement sustainable strategies down its supply chain should also look upstream. To elaborate, if a company is able to choose between various suppliers, it can for example use its purchasing power to get its suppliers in compliance with its green supply chain standards. In managing suppliers, companies must measure that inputs from suppliers are of high quality, and the usage of water and energy is minimized leading to less pollution, defects and over production. They also must audit their supplier base and make sure that they are improving the supply chain metrics.

Creating a Sustainable Supply Chain – Best Practices and Business Drivers:

While the concept of a "sustainable supply chain" is still relatively new, there is a budding consensus over best practices to follow when building a more sustainable supply chain. The National Bureau of Sustainability, in conjunction with various corporations, summarized these best practices (which have been modified slightly):

Define Company Objective:

- Define ways management will communicate sustainable initiatives internally and externally
- Develop a business case that illustrates the costs and payback period. Highlight all benefits, even those where

- the financial benefit is less obvious but the sustainability value is clear.

Create Meaningful Expectations:

- Interview and leverage experience and opinions of all stakeholders to create relevant documents to enhance the applicability, legitimacy and efficacy of policies.
- Conduct appropriate environmental research, in the context of international supply chains, to better anticipate challenges and to allow for organization to pro-actively manage supply chains.
- Search for and assess the applicability of pre-existing standards that the company might adopt, thus improving efficiency and avoiding audit fatigue.

Select Suppliers and Agree to Targets:

- Create an interview process with qualitative measures to select and develop a supplier base, relying less on the traditional "tick box" selection scenario.
- Create a safe and open environment that allows for and promotes supplier-led solutions. This includes developing key performance indicators (KPIs) with suppliers, benchmarking KPIs across suppliers to guarantee that standards and metrics will stand up to external inspection and creating a set of clear and systematic processes to obtain performance data.

Evaluate and Develop Suppliers:

- Communicate effectively with suppliers regarding performance in relation to sustainability targets. Advise suppliers early if performance is not meeting goals.
- Create a development a program for suppliers as a means to understand supply chain failures and as a way to support and improve future performance.

Build on Past Successes:

- Cultivate and prioritize a culture of learning, highlighting the importance of transparency and accountability as imperative for success and persistent growth.
- Measure continuously the company's performance against KPIs and metrics developed above.

What is difference between green supply chain management and sustainable supply chain management?

Sl. No.	Green Supply Chain Management	Sustainable Supply Chain Management
1	Green supply chain management can be defined as integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product as well as end-of-life management of the product after its useful life.	Sustainability Supply Chain Management can be maximized throughout the supply chain, beginning with concept and development then continuing through all phases of production and final customer distribution. These increased sustainability efforts are made to decrease the impact of the supply chain on future generations.
2	Green supply chain management remodeling from current business.	The growth dimension adds aspirations and expectations of various stakeholders of the chain.
3	Green supply chain focus on an environmental issue with considering to an economic result.	sustainable supply chain is built on three dimensions: social, economical, and environmental
4	Green Supply Chain Management is a sustainable way to increase efficiency as well as a cost lowering	It gives a unique chance to run latest technologies.

	method for any kinds of term.	
5	GSCM consider environmental issues inclusion during business	Sustainability deals with environmental as well as social issues during business conduct

Module - III

Aligning Logistics to Customer Needs

Customer Requirements Analysis:

1) The term customer requirement analysis in the supply chain is considerably used to describe both marketing and substantial distribution activities aimed at enhancing the product offering or facilitating the exchange process between the supplier and the customer.
2) But it has been manifested that an institutional client in the supply chain has much greater and often different requirements than the end consumer, at the same time appearing in a dual role of the supplier and the customer; and the first and foremost, firms should take an active part in creating and implementing a supply chain strategy.
3) This must be based upon cooperation among the supply chain participants, aimed at generating value for the end customer. Therefore, the marketing perspective of customer service include the elements of product design and maintenance, training, salesperson attitude and responsiveness, ease of customer interface with the firm, guarantees, and price, in addition to the element of supply chain management.
4) Since supply chain management is a subset of overall customer service, includes elements associated with the handling, warehousing and delivery of products to meet customer‘s needs.
5) Moreover customer service is the unifying factor for integrating marketing and logistics, which result in customer service of the firm. Thus, customer service can be thought of as an integrative activity between two firms and within the channel of distribution.

Customer Satisfaction: The degree to which customers are satisfied with the product and/or service received, and may apply to internal customers or external customers. Customer satisfaction is comprised of three elements:

i. ***Pre-Transaction Satisfaction:*** satisfaction associated with service elements occurring prior to product purchase.
ii. ***Transaction Satisfaction:*** satisfaction associated with service elements directly involved in the physical distribution of products.
iii. ***Post-Transaction Satisfaction:*** satisfaction associated with support provided for products while in use.

Customer requirements analysis in Supply Chain:

Usually refers to internal customers only:

- ***Fill Rate Maximization:*** Maximize the fraction of customer orders filled on time.
- ***Product Lateness Minimization:*** Minimize the amount of time between the promised product delivery date and the actual product delivery date.
- ***Customer Response Time Minimization:*** Minimize the amount of time required from the time an order is placed until the time the order is received by the customer.

Usually refers to external customers only:

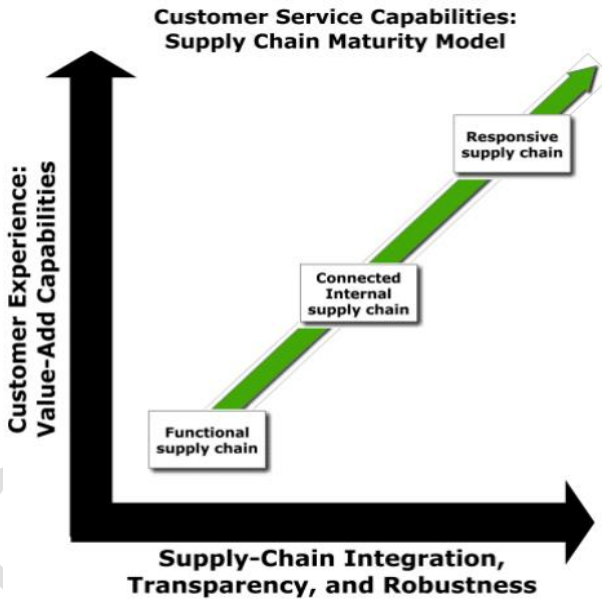
- ***Lead Time Minimization:*** Minimize the amount of time required from the time a product has begun its manufacture until the time it is completely processed.
- ***Function Duplication Minimization:*** Minimize the number of business functions that are provided by more than one business entity.

Measuring Customer Requirement with the Supply Chain:

In effect, the Supply Chain Maturity Model shows how the structure of a company's supply chain and decision-making models affect its capability to deliver a lasting customer experience. Specifically, enhancements to supply chain integration, transparency, and robustness (the quality or condition of being strong and in good condition.) lead to corresponding improvements in customer service capabilities.

Supply chain enhancements and corresponding customer experience capabilities - are, in part, defined by the collection of people, processes, and technologies that support the organization.

"Supply Chain", which include inbound and outbound logistics of physical goods, as well as the informational and financial processes related to the procurement, manufacture and distribution of those goods.



Aligning Supply Chain to Customer Needs:

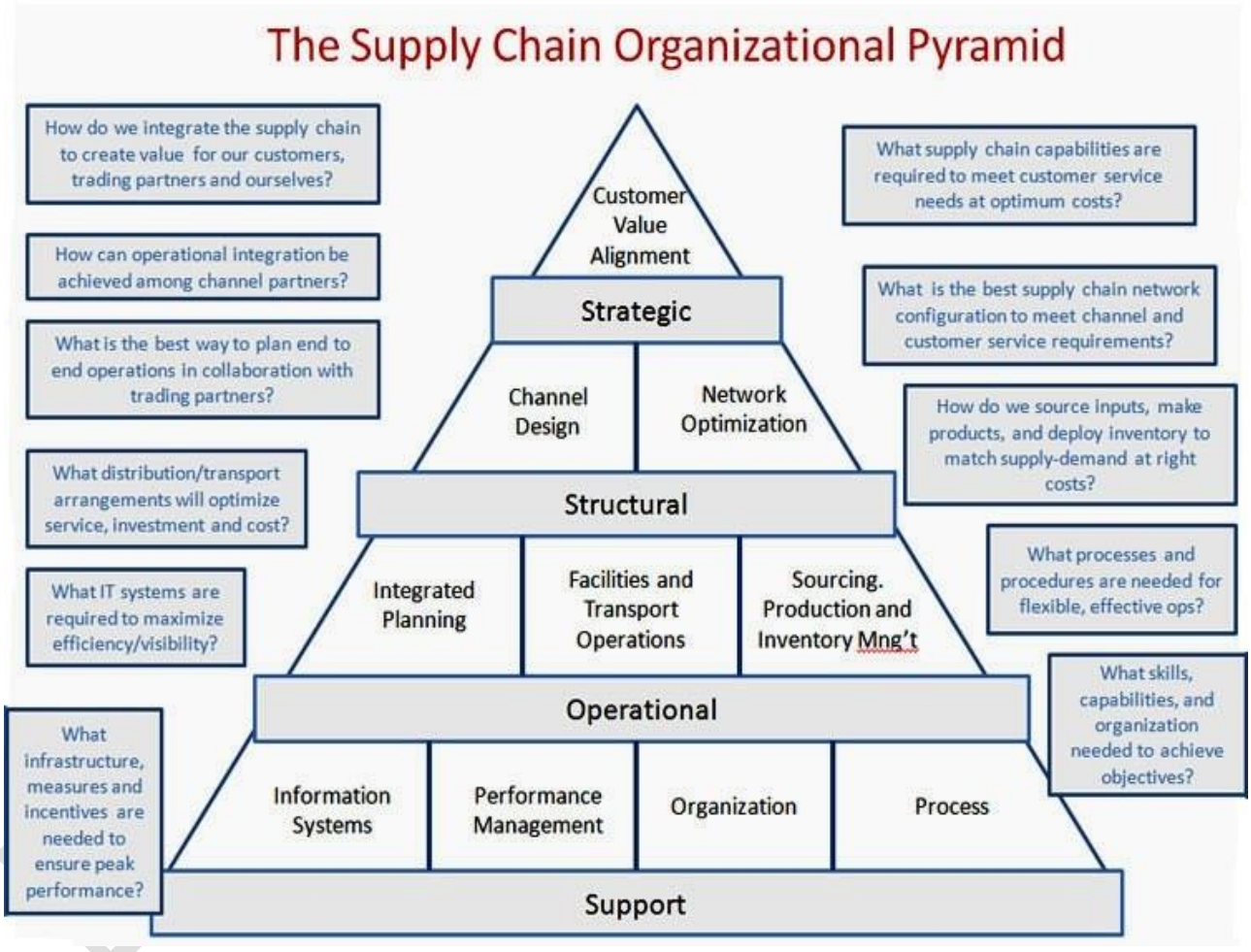
1) Supply chain triangle is Alignment. It seems simple, but in practice there are few supply chains that consistently align themselves with that most important element, the end customer.
2) In most companies this alignment gap is a result of good intentions, usually based around solving the challenges of cost, quality and inventory. But along the way, service to the customer suffers.
3) Late deliveries, out of stock and lost sales are the symptoms, swiftly followed by the sound of customers heading towards the competition. How do you avoid this?
4) The solution lies in designing and optimizing your supply chain for the customers you serve, through fully understanding what they need from your product and service.
5) It sounds deceptively straight-forward, but most supply chains are designed around the 'things' in the supply-chain. Some organisations will concentrate on optimizing warehouse utilization and truck capacity, and at others they are focused on the manufacturing facility productivity.

6) On top of these physical structures, we layer on any number of different process optimization tools to make these 'things' as productive and efficient as possible. The net result is often a highly cost-effective supply chain that is inflexible to customer needs.

7) In contrast, companies with Triple-A (Agility, Adaptability and Alignment) supply chains have re-designed them around their customers. They recognize that their customers may require for different products, and can offer a variety of service options with differing replenishment times and inventory levels to support them.

8) Crucially, the piece that makes the biggest difference is that everyone involved in the supply chain is organized around meeting customer expectations, and they know which behaviours to use to achieve them.

9) This includes suppliers, trading partners, logistics providers and manufacturers, as well as their own associates. Their reward systems are also based on customer service, so that bonuses are paid on meeting the targets, and costs are incurred if they do not. These companies revolve around incentivizing the people in the supply chain to deliver service to their customers.



Quick Response Logistics:

What is Logistics?

1) Logistics is used more broadly to refer to the process of coordinating and moving resources – people, materials, inventory, and equipment – from one location to storage at the desired destination. The term logistics originated in the military, referring to the movement of equipment and supplies to troops in the field.

2) Logistics is generally the detailed organization and implementation of a complex operation. In a general business sense, logistics is the management of the flow of things between the point of origin and the point of consumption in order to meet requirements of customers or corporations.

3) The resources managed in logistics can include physical items such as food, materials, animals, equipment, and liquids; as well as intangible items, such as time and information. The logistics of physical items usually involves the integration of information flow, materials handling, production, packaging, inventory, transportation, warehousing, and often security.

Logistics Management:

The management process which integrates the movement of goods, services, information and capital, right from the sourcing of raw material, till it reaches its end consumer is known as Logistics Management. The objective behind this process is to provide the right product with the right quality at the right time in the right place at the right price to the ultimate customer. The logistic activities are divided into two broad categories they are:

Inbound Logistics: The activities which are concerned with procurement of material, handling, storage and transportation.

Outbound Logistics: The activities which are concerned with the collection, maintenance and distribution or delivery to the final consumer.

Apart from these, other activities are warehousing, protective packing, order fulfillment, stock control, maintaining equilibrium between demand and supply, stock management. This will result in savings in cost and time, high quality products etc.

Logistics vs. Supply Chain Management:

Basis For Comparison	Logistics Management	Supply Chain Management
Meaning	The process of integrating the movement and maintenance of goods in and out the organization is Logistics.	The coordination and management of the supply chain activities are known as Supply Chain Management.
Objective	Customer Satisfaction	Competitive Advantage
Evolution	The concept of Logistics has been evolved earlier.	Supply Chain Management is a modern concept
How many organizations are involved?	Single	Multiple
One in another	Logistics Management is a fraction (activity) of Supply Chain Management.	Supply Chain Management is the new version of Logistics Management.
Technology	Transportation Management System (TMS), Warehouse Management System (WMS)	Customer Relationship Management (CRM), Enterprise Resource Planning (ERP)

Key Differences between Logistics and Supply Chain Management:

The following are the major differences between logistics and supply chain management:

- The flow and storage of goods inside and outside the firm is known as Logistics. The movement and integration of supply chain activities is known as Supply Chain Management.
- The main aim of Logistics is full customer satisfaction. Conversely, the main aim behind Supply chain Management is to gain substantial competitive advantage.
- There is only one organization involved in Logistics while a number of organizations are involved in Supply Chain Management.

- Supply Chain Management is a new concept as compared to Logistics.
- Logistics is only an activity of Supply Chain Management.

Logistics Components:

The management of logistics can involve some or all of the following business functions, including:

- Inbound transportation
- Outbound transportation
- Fleet management
- Warehousing
- Materials handling
- Order fulfillment
- Inventory management
- Demand planning

Why Logistics is Important?:

Although many small businesses focus on the design and production of their products and services to best meet customer needs, if those products cannot reach customers, the business will fail. That's the major role that logistics plays. But logistics also impacts other aspects of the business, too.

The more efficiently raw materials can be purchased, transported, and stored until used, the more profitable the business can be. Coordinating resources to allow for timely delivery and use of materials can make or break a company. And on the customer side, if products cannot be produced and shipped in a timely manner, customer satisfaction can decline, also negatively impacting a company's profitability and long-term viability.

Types of logistics:

1) ***Procurement logistics*–** the process of providing the enterprise with material resources, the allocation of resources in the warehouses of the enterprise, storage and delivery into production.

2) ***Industrial Logistics*** – Materials Management, while passing through its production units, moving from the primary source of raw materials to finished products.

3) ***Distribution logistics*** – a complex of interrelated functions included in the distribution of material flow between the various wholesale purchases, ie in the wholesale trade.

4) ***Transport logistics*** – management of cargo transportation.

5) ***Information logistics*** – the part of logistics, which is the link between supply, production and marketing of products and organizes the data flow, which accompany the material flow in the process of being relocate

Job Responsibilities for a Logistics Manager include:

- Managing and planning for logistics policies, objectives, and initiatives
- Creating procedures for logistics management to optimize product workflow and minimize cost.
- Monitoring vendor selection and negotiation, distribution, transportation, and inventory control.
- Strategically plan and manage logistics, warehouse, transportation and customer services
- Direct, optimize and coordinate full order cycle
- Liaise and negotiate with suppliers, manufacturers, retailers and consumers
- Keep track of quality, quantity, stock levels, delivery times, transport costs and efficiency
- Arrange warehouse, catalog goods, plan routes and process shipments
- Resolve any arising problems or complaints

- Supervise, coach and train warehouse workforce
- Meet cost, productivity, accuracy and timeliness targets

- Maintain metrics and analyze data to assess performance and implement improvements
- Comply with laws, regulations and ISO requirements.

Quick Response Logistics (QRL):

1) Quick Response Logistics is one of the most debated topics in logistics studies over the years because of its increasing role in reducing operational expenses. It is a supply chain management strategy that has been used by manufacturers, soft lines retailers, and general merchandise to minimize operating expenses, forced markdowns, and retail out-of-stocks all achieved by reduced response time.

2) Most of the retailers and suppliers work together to respond quickly to the consumers' needs as they are able to share point-of-scale scan data thus in a potential point to forecast the needs of their consumers now and in the future and more rapidly.

3) Quick Response Logistics has proven advantageous in most of the industries across the globe for instance, in the apparel industries because they are able to achieve efficient consumer response.

4) The concept of quick response logistics integrates inventory deployment, production scheduling, and demand management thus helping firms to make better use of the available information, inventory, and production resources for competitive advantage.

5) Quick Response Logistics is, therefore, a management concept that has been used by several firms including the fast food companies so as to enhance customer satisfaction while at the same time remain competitive in the market.

6) The main argument of quick response logistics is that it shortens the lead time (from the time an order has been received to the time when the product is delivered to the consumer) thus increasing the cash flow.

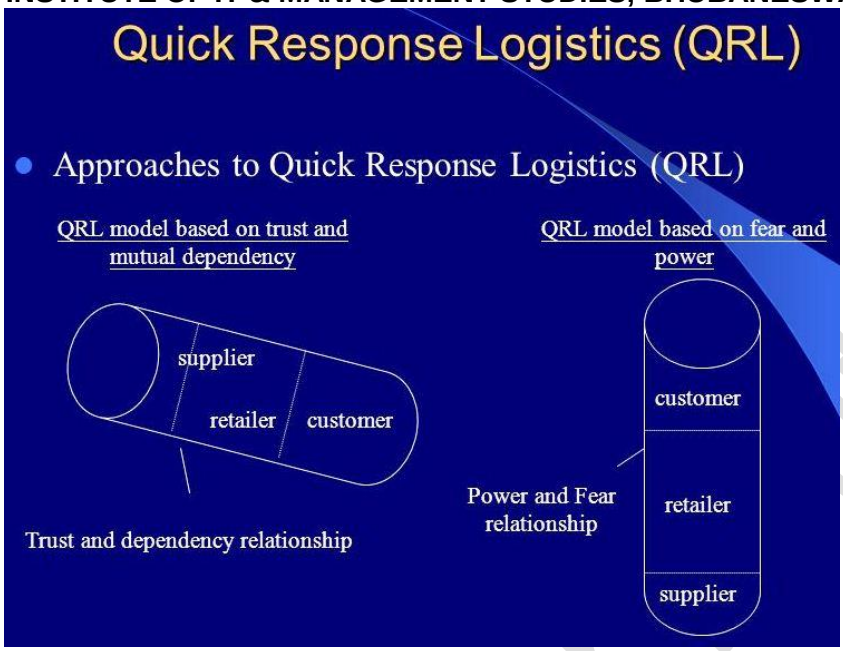
7) The concept of quick response logistics is similar to the concept of Efficient Customer Response System (ECR) as they work to respond more rapidly to consumer demands for competitive advantage.

8) The changes in technology and the globalization process have altered consumer's needs and beliefs thus transforming the whole logistic system.

9) Consumers across the globe expect instant product availability in the market with much of the supply or logistics system changing from physical distribution to logistics management.

10) The logistics transformation has been linked with retail and consumer changes, service requirements, and cost of the service in the market.

11) Quick response on products is, therefore, highly appreciated because holding stock or inventory at one time is one of the costly activities in a firm and it can result into a competitive disadvantage for the firm. Holding stock is expensive and in many cases it becomes obsolete.



Example of Quick Response Logistics:

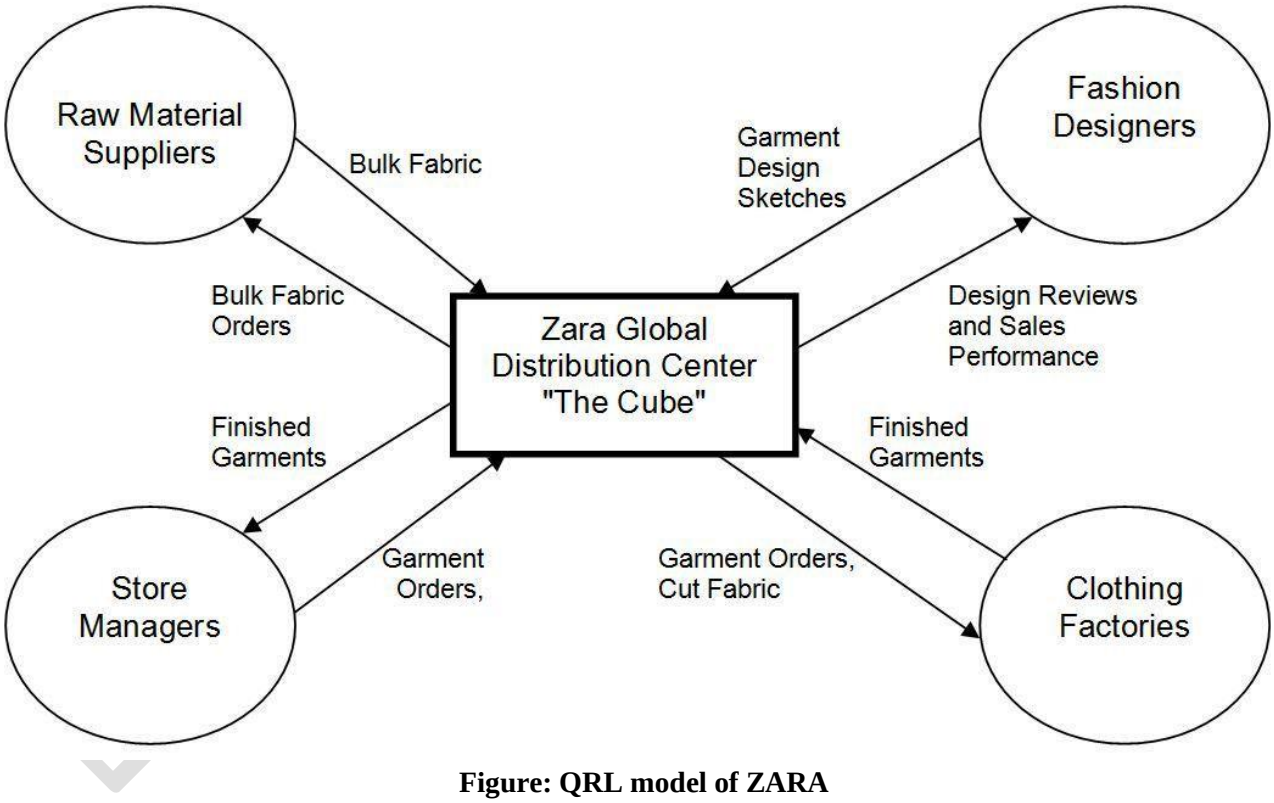


Figure: QRL model of ZARA

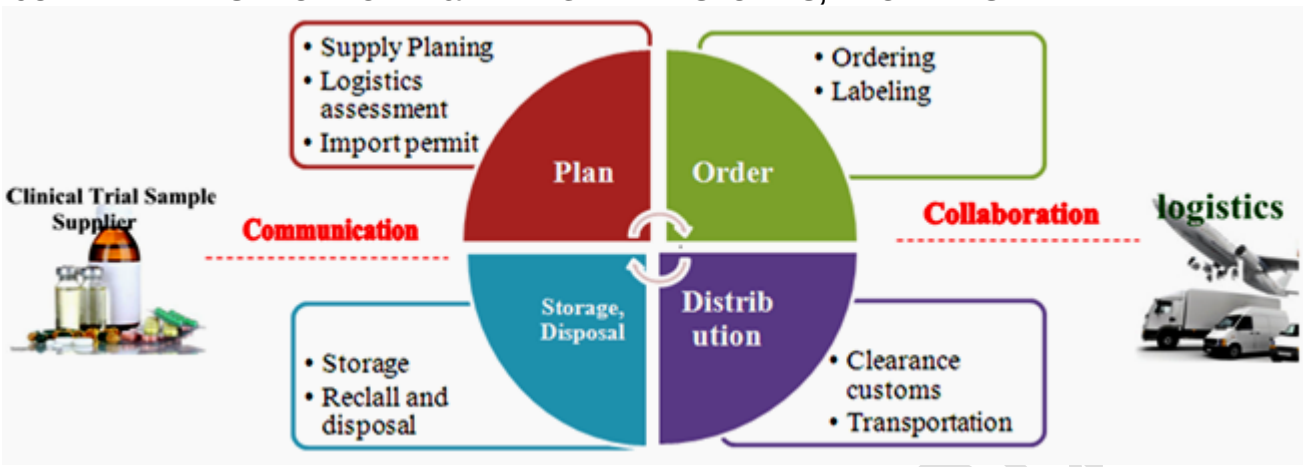


Figure: QRL model of Clinical Unit (Health Care)

Green Logistics:

- Green Logistics is defined as "efforts to measure and minimize the environmental impact of logistics activities, these activities include a proactive design for disassembly".
- Green logistics is a form of logistics which is calculated to be environmentally and often socially friendly in addition to economically functional. It describes all attempts to measure and minimize the ecological impact of logistics activities. This includes all activities of the forward and reverse flows of products, information and services between the point of origin and the point of consumption. It is the aim to create a sustainable company value using a balance of economic and environmental efficiency.

- Green logistics describes all attempts to measure and minimize the ecological impact of logistics activities. This includes all activities of the forward and reverse flows of products, information and services between the point of origin and the point of consumption. It is the aim to create a sustainable company value using a balance of economic and environmental efficiency. Green logistics has its origin in the mid 1980s and was a concept to characterize logistics systems and approaches that use advanced technology and equipment to minimize environmental damage during operations.
- Green logistics is the process of minimizing damage to the environment due to the logistics operations of an organization. Logistics includes transportation and resource intensive processes such as procurement,

inventory management, warehousing, order fulfillment and distribution. It also includes processes such as reverse logistics and disposal logistics that concern reuse, recycling and waste disposal. The following are common examples of green logistics.

Transport: Minimizing the emissions and energy consumption of transportation. For example, a telecom company that moves to electric vehicles for field service.

Reuse: Reuse such as a process of reusing durable packaging in your supply chain.

Efficiency: Reducing waste to improve operational efficiency. For example, an ecommerce company that fits each order into a reasonable size of box without wasted space.

Design for Logistics: Designing things to be easier to transport. For example, furniture that requires minor assembly but fits into an efficient standard size box.

Proximity: Reducing transport by doing things closer to the customer. For example, local sourcing of parts.

Sourcing: Sourcing from environmental responsible partners and implementing controls and audits to continually validate their environmental practices.

Reverse Logistics: Reselling, refurbishing, remanufacturing, reusing and recycling items that are returned by the customer.

Returns Avoidance: Preventing returns with techniques such as digital tools to make sure clothing fits the customer before shipping it.

Quality of Life: Working to improve quality of life in the communities where you operate. For example, improving the safety of transport.

Waste is Food: The principle that business processes don't release anything into the environment that couldn't be safely consumed by an organism. For example, a hydrogen powered vehicle that emits water as a waste product. Related to the idea of a circular economy.

Importance of Green Logistics

Logistics are an important function of modern transport systems. While traditional logistics seeks to organize forward distribution, that is the transport, warehousing, packaging and inventory management from the producer to the consumer, environmental considerations opened up markets for recycling and disposal, and led to an entire new sub-sector: green logistics.

Inserting logistics into recycling and the disposal of waste materials of all kinds, including toxic and hazardous goods, has become a major new market. Reverse distribution is a continuous embedded process in which the organization (manufacturer or distributor) takes responsibility for the delivery of new products as well as their take-back. This would mean environmental considerations through the whole life-cycle of a product (production, distribution, consumption and disposal). For example, BMW is designing a vehicle whose parts will be entirely recyclable.

A business gain can gain the following benefits from getting into ‘green logistics’ -

- Reduction in CO2 emissions
- Unlocking significant cost savings
- Heightened supply chain optimization
- Boosted business performance

Paradoxes of Green Logistics

When adapting green logistics there could be some inconsistencies that might arise. The issue is that green logistics is

supposed to be environmental friendly, but logistics in itself is not very green because of pollution and waste that it creates. So when adapting green logistics there are some paradoxes that arise as given below:

Cost: Companies wants to get the cheapest way to do things but at the same time they should choose options that are green, which sometimes are more costly to the company. The purpose of logistics is to minimize costs, notably transport costs. The cost-saving strategies that are pursued by logistics operators are often at variance with environmental considerations.

Time/Flexibility : The modern integrated supply chains and JIT provide adjustable and competent physical distribution systems but on the other hand extended production, distribution and retailing models are consuming more space, energy and generate more emissions (CO2, particulates, NOx, etc.).

Reliability: At the heart of logistics is the overriding importance of service reliability. Its success is based upon the ability to deliver freight on time with the least threat of breakage or damage while the least polluting modes are generally regarded as being the least reliable in terms of on-time delivery, lack of breakage and safety. Ships and railways have inherited a reputation for poor customer satisfaction, and the logistics industry is built around air and truck shipments... the two least environmentally-friendly modes.

Warehousing: A reduction in warehousing demands is one of the advantages of logistics. This means however, that inventories have been transferred to a certain degree to the transport system, especially the roads. Inventories are actually in transit, contributing still further to congestion and pollution. The environment and society, not the logistical operators, are assuming the external costs.

E-commerce: The explosion of the information technology has led to new dimensions in retailing - e-commerce. However, changes in physical distribution systems by e-commerce have led to higher levels of energy consumption.

Green Logistics in Application- Case Study

IKEA Model

IKEA is a global furniture store that provides “cheap furniture that as many as possible can afford”. Ikeas company view of green logistics is firstly to remove the wooden pallets from the entire supply chain. Instead of wooden pallets they are using Paper/cardboard pallets and so called ledges. Underneath these ledges there are a plastic leg underneath the goods. Because of this approach they are dramatically decreasing transportation, Co2 emissions, PP/LL can be packed with less space than with normal wooden pallets. Also IKEAs Iway monitoring system steer transport partners to use low Co2 equipments. The Iway monitoring system is IKEAS own measuring system. The goals for IKEA within green logistics are as the following:

- 2012 60% total flow integrated to non-wooden pallets
- 2014 100% of total flow integrated to non-wooden pallets
- 2015 all transport partners are fulfilling the Iway standards (IKEA sets a standard for Corporate Social Responsibility.)

DHL – Go Green Solutions

- DHL Global Forwarding solutions provide a reliable way of accounting for and managing your supply chain CO2 emissions, with best-in-class carbon reporting and all-inclusive carbon offsetting services.
- DHL Global Forwarding has developed a carbon reporting methodology with precision and reliability in mind. Over a number of years, our experience in carbon reporting has provided us with the expertise to produce accurate CO2 calculations for our customers.
- By considering each individual shipment, actual operational data (mode, fleet, age, trade lane, weight/volume, actual distance travelled) and credible sources for emission factors, DHL is able to give the best-in-class CO2 calculation.
- Their methodology follows the principles of the Greenhouse Gas Protocol and the World Economic Forum (WEF) Guideline for Consignment-level Carbon Report
- They will create a carbon report that provides you with the confidence to design your own carbon reduction strategy

Figure: DHL – Go Green Solutions

Reverse Logistics:

Definition:

- Reverse logistics refers to all procedures associated to product returns, repairs, maintenance, recycling and dismantling for products and materials. Overall it incorporates running products in reverse through the supply

chain to gain maximum value.

- Reverse logistics is for all operations related to the reuse of products and materials. It is "the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal. Remanufacturing and refurbishing activities also may be included in the definition of reverse logistics.
- Logistics is defined by The Council of Logistics Management as the process of planning, implementing and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements.
- Reverse logistics includes all of the activities that are mentioned in the definition above. The difference is that reverse logistics encompasses all of these activities because they operate in reverse. Therefore, reverse logistics is the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or for proper disposal.

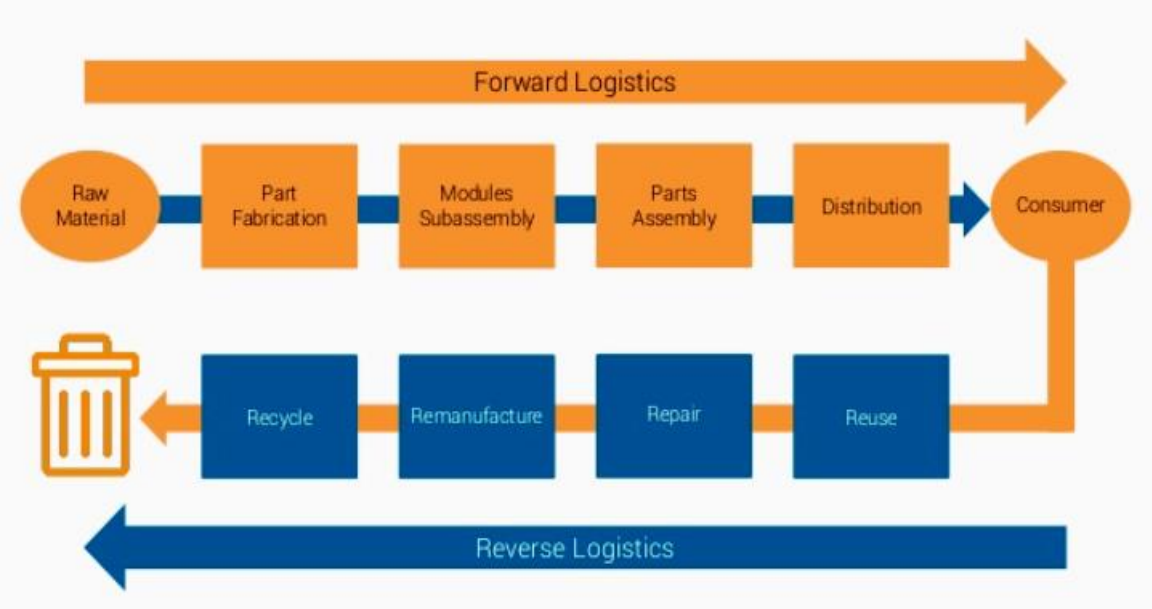
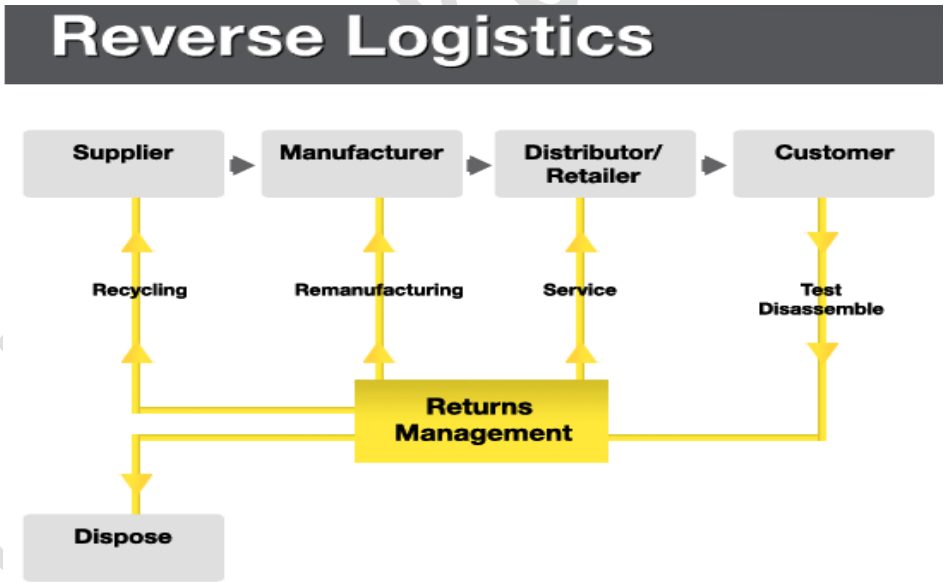


Figure: Concept of Reverse Logistics

Why is it important to deal with organisations who implement reverse logistics?

Organisations that implement reverse logistics are able to improve customer service and response times; reduce environmental impact by reducing waste and improve overall corporate citizenship.



For example; a manufacturer produces product A which moves through the supply chain network reaching the distributor or customer. Any process or management after the sale of product A involves Reverse Logistics. If product A happened to be defective the customer would return the product. The manufacturing firm would then have to organize shipping of the defective product, testing the product, dismantling, repairing, recycling or disposing the product. Product A will travel in reverse through the supply chain network in order to retain any use from the defective product. This is what reverse logistics is about.

Importance of Reverse Logistics:

- Reverse logistics is only seen as an expense to an organisation. But it can be profitable; reusing and recycling can often reduce costs.
- Reverse costs are less clearly visible and therefore not looked upon as a priority; often organisations avoid difficult problems.
- It is difficult to forecast for reverse flow of the product and to know exactly what and how much merchandise will be returned by the customer, therefore return flow needs to be recorded and planned so it can be estimated and managed effectively.
- Organisations only look at faulty customer returns, not the total volume of returned products such as end-of-life strategies for products that are perfectly functional but replaced with newer versions of the product. Therefore these organisations miss the total volume of reverse flow which if managed properly can lead to large gains.
- Many organisations do not have the expertise, manpower or infrastructure for processing returns and expanding to start up a new operating system of returns. These organisations should consider outsourcing to a qualified third party logistics organisation (3PL).
- Reverse logistics is often seen as more complicated and less structured than the normal supply chains due to variation in product quality, defect rates and maximum life span. This doesn't mean organisations shouldn't try and tackle the challenge. By creating structured flow path ways for different product scenarios most of these problems can be handled.

Reverse logistics component of environmental sustainability:

There are three main principles in sustainable development:

- ***Environmental Sustainability,*** ensuring a tolerable development for all essential ecological processes, especially the diversity of biological resources
- ***Social and Cultural Sustainability,*** which guarantees a favorable economic development, members of society, culture and values compatible with the existing culture and civilization, to preserve community identities
- ***Economic Sustainability,*** having a role in ensuring efficient economic development, resources are handled so that it also will exist in the future.

Reverse Logistics is the process of disposing of used products or a new initial point of the supply chain, such as the customer returns, overstock, expired food, also redistributing them using specific rules to collect their management. Reverse logistics refers to recoverable material components after consumption, waste and packaging, which go on backward, from the consumer production that is incorporated into a new economic cycle.

Threats for reverse logistics due to global instability

The network of facilities, processes and people involved in procurement of raw materials, production, distribution and related information flow are integrated in one complex chain. However, the consumer is not always the end of the chain and, a return flow of products should be added to forward flow into a closed loop supply chain. Products that have failed, recalled products or obsolete ones, spare parts that still have some value, waste that must be disposed of and even unsold products become subject of take bake system, as the responsibility for them shifts back to the producer. Suppliers and producers are facing new and complex challenges determined by several factors:

- Increasing competition in a global environment. Companies adopt more flexible sales policies and agree to take back unsold products from retailers.
- Consumer awareness on companies and their products environmental footprint.
- Legal constraints. Original manufacturer is now responsible for final disposal of the product.
- Shortening product life cycles. Products become obsolete more quickly and returns increase.

There are important characteristics that need to be managed in order to ensure an economically viable reverse supply chain, listed as: uncertain flow of materials, diversity of returned products depending on the specific customer, time, value improvement, flexibility of the supply chain, coordination between multiple parties involved into the returning process.

Implement of Reverse Logistics Strategies in an organisations:

- Allows a trader to receive products back from the consumer or send unsold merchandise back to the manufacturer to be taken apart, sorted, reassembled or recycled; minimising overall costs for an organisation.
- Reverse logistics can be valuable in increasing product lifecycles, supply chain complexity, maintainable practices and consumer preferences; which have to be improved on to maintain productivity and growth.
- Gains can include; increasing speed of production, reducing costs (transportation, administrative, and aftermarket maintenance, repair and replacement), retaining customers by improving service goals and meeting sustainability goals.
- More value can be extracted from used/returned goods instead of wasting manpower, time and costs of raw materials involved in the original supply chain.
- Improved customer satisfaction and loyalty by paying more attention to faulty goods, and repairs of merchandise. Reverse logistics can include gaining feedback to make improvements and to improve the understanding of real reasons for product returns.

Benefits of Reverse Logistics:

- Reduced administrative, transportation and aftermarket support costs.
- Increased velocity.
- Increased service market share.
- Higher achievement of sustainability goals.
- Greater customer service and higher retention levels.
- Improved reverse supply chain visibility, increased productivity, and greater responsiveness to customers.
- A synchronized supply chain to now include forward traditional logistics, inbound logistics, and reverse logistics.
- Transparency in supply chain operations across your network.
- Automatic consolidation of data from partners and systems.
- Transparency into the entire product life-cycle.
- Distribution and refurbishment center management.

Vendor Managed Inventory (VMI):

- The goal of Vendor Managed Inventory is to provide a mutually beneficial relationship where both sides will be able to more smoothly and accurately control the availability and flow of goods.

- Vendor Managed Inventory (VMI) is a streamlined approach to inventory management and order fulfillment. VMI involves collaboration between suppliers and their customers (e.g., distributor, retailer, OEM, or product end user) which changes the traditional ordering process.

- The goal of VMI is to align business objectives and streamline supply chain operations for both suppliers and their customers. The business value is a direct result of increased information flow:

  i. Improved Inventory Turns
  ii. Improved Service
  iii. Increased Sales

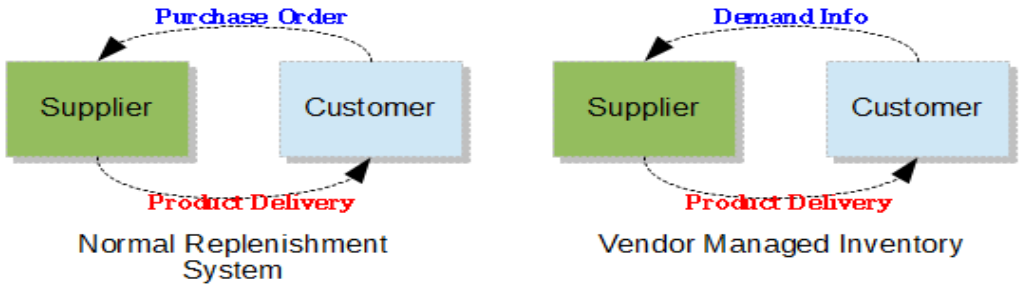
- In VMI a manufacturer or distributor assumes the role of inventory planning for the customer. Extensive information sharing is required so that the manufacturer/distributor can maintain a high degree of visibility of its goods at the customer's location. Instead of the customer reordering when its supply has been exhausted, the supplier is responsible for replenishing and stocking the customer at appropriate levels.

Customer Benefits:

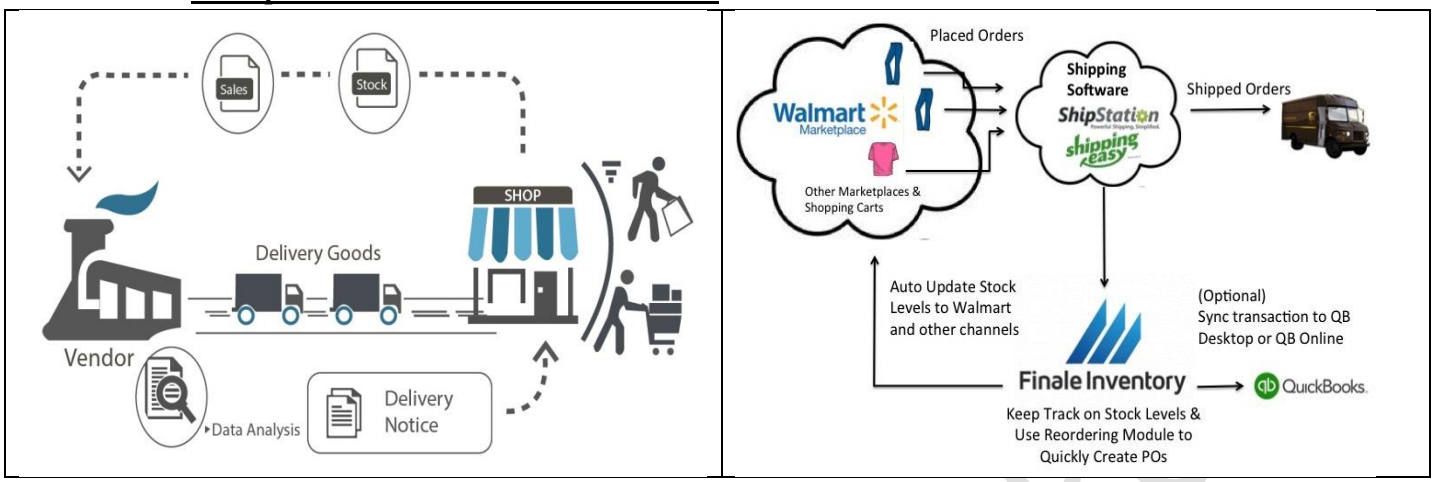
When the supplier can see that its customer is about to exhaust its inventory, the supplier can better prepare to replenish the customer because the supplier can then better schedule its own production/distribution. Customers will reduce/eliminate stockouts because they will not have to reorder goods at the last minute without knowing whether the supplier has the ability to restock without interrupting the customer's operations. Therefore, part of VMI's goal is to reduce uncertainty that arises when the supplier is blind to the customer's inventory status.

Supplier Benefits:

As long as the supplier carries out its task of maintaining predetermined inventory and avoiding stockouts, it will be able to lock in a VMI-supported customer for the long term with or without a contract. This will produce a steady and predictable flow of income for the supplier and reduce the risk that the customer will switch suppliers (Switching would be too costly for the customer). A VMI arrangement will allow the supplier to schedule its operations more productively because it is now monitoring its customer's inventory on a regular basis. Furthermore, reductions in inventory will be achieved once the supplier develops a better understanding of how the customer uses its goods over the course of a year.



Example of Wal-Mart has mastered VMI:



Vendor Managed Inventory (VMI) Process:

The basic Vendor Managed Inventory (VMI) process can be described in terms of the following steps: data communications, calculations, monitoring and reporting.

Figure: Vendor Managed Inventory (VMI) Process

How to make VMI work:

a. ***Clarify expectations.*** There needs to be thorough discussion about how the system will benefit both organizations in the long term or one of the parties, particularly the supplier, is prone to disappointment with some of the short-term results. If these items are not addressed the program will likely be terminated quickly with neither side gaining any of the benefits expected from the program. The objective is clear and constant communication between the supplier and customer. When the two parties work in conjunction they can be assured that the planning function, for both sides, will begin to smooth over time.

b. ***Agree on how to share information***. If the supplier and customer can agree to share information vital to restocking in a timely manner, then the odds of a synchronized system will dramatically improve. Proprietary information would not have to be shared between the supplier and customer, but enough information to maintain a steady flow of goods is necessary. The customer should be willing to share production schedules and/or forecasts to provide some visibility for the supplier.

c. ***Keep communication channels open.*** When the two parties set out to implement a VMI program, they need to meet and discuss their goals and how they need to proceed in order to realize those goals. Once a VMI program has been activated, each side needs to understand that there are going to be some miscues. These miscues need to be studied as opportunities for learning and then used to avoid repetitive problems in the future.

Cross Docking:

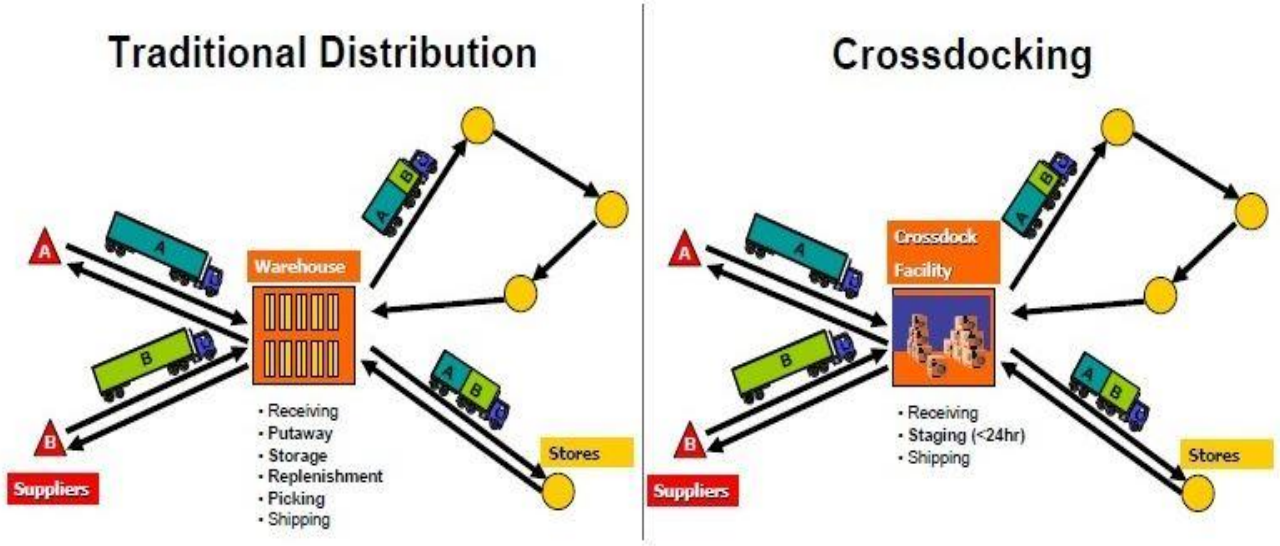
1) Cross-docking is a practice in logistics of unloading materials from an incoming semi-trailer truck or railroad car and loading these materials directly into outbound trucks, trailers, or rail cars, with little or no storage in between. This may be done to change the type of conveyance, to sort material intended for different destinations, or to combine material from different origins into transport vehicles (or containers) with the same or similar destinations.

2) Cross-docking involves delivering products from a manufacturing plant directly to customers with little or no material handling in between.

3) Cross-docking not only reduces material handling but it reduces the need to store the products in the warehouse. In most cases, the products sent from the manufacturing area to the loading dock have been allocated for outbound deliveries.

4) Cross-docking solutions allow companies to expedite shipments to customers, which means that customers often get what they want when they want it the goal of an optimized supply chain.

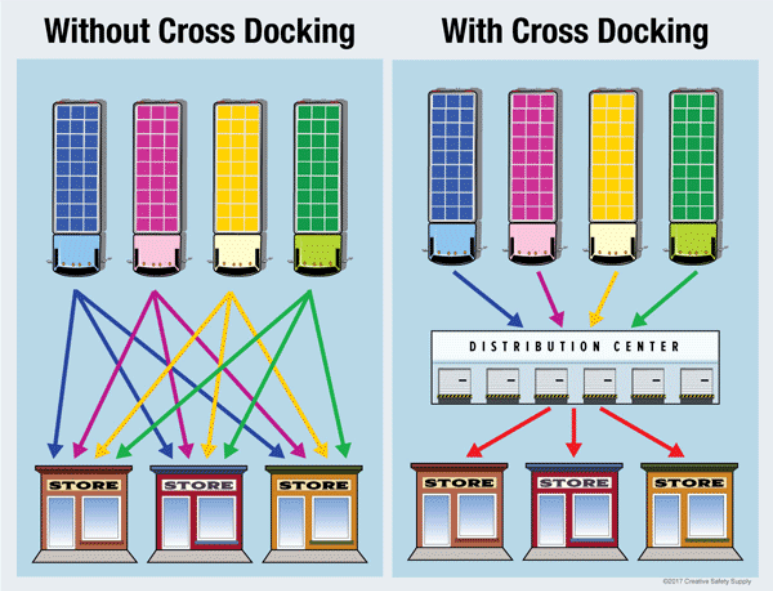
5) But cross-docking solutions also come with risks that companies should consider before implementing them into standard operating procedures.



Benefits:

Many companies have benefitted from using cross-docking. Some of the benefits include;

1) Reduction in labor costs, as the products no longer require picking and putting away in the warehouse
2) Reduction in the time from production to the customer, which helps improve customer satisfaction
3) Reduction in the need for warehouse space, as there is no requirement to store the products



Types of Cross-Docking

There are a number of cross-docking scenarios that are available to the warehouse management. Companies will use the type of cross-docking that is applicable to the type of products that they are shipping.

6) ***Manufacturing Cross-Docking:*** This procedure involves the receiving of purchased and inbound products that are required by manufacturing. The warehouse may receive the products and prepare sub-assemblies for the production orders.

7) ***Distributor Cross-Docking:*** This process consolidates inbound products from different vendors into a mixed product pallet, which is delivered to the customer when the final item is received. For example, computer parts distributors can source their components from various vendors and combine them into one shipment for the customer.

8) ***Transportation Cross-Docking:*** This operation combines shipments from a number of different carriers in the less-than-truckload (LTL) and small-package industries to gain economies of scale.

9) ***Retail Cross-Docking:*** This process involves the receipt of products from multiple vendors and sorting them onto outbound trucks for a number of retail stores. This method was used by Wal-Mart in the 1980s. They would procure two types of products, items they sell each day of the year, called staple stock, and large quantities of products that are purchased once and not usually stocked again. This second type of procurement is called direct freight, and Wal-Mart minimizes any warehouse costs with direct freight by using cross-docking and keeping it in the warehouse for as little time as possible.

10) ***Opportunistic Cross-Docking:*** This can be used in any warehouse. It involves transferring a product directly from the receiving dock to the outbound shipping dock to meet a customer sales order.

Products Suitable for Cross-Docking

There are materials that are better suited to cross-docking than others. The list below shows a number of types of material that are more suited to cross-docking.

- Perishable items that require immediate shipment
- High-quality items that do not require quality inspections during goods receipt
- Products that are pre-tagged (barcodes, RFID), pre-ticketed, and ready for sale

- Promotional items and items that are being launched
- Staple retail products with a constant-demand or low-demand variance

- Pre-picked, pre-packaged customer orders from another production plant or warehouse

Risks Associated with Cross-Docking:

- Because products aren't put away in the company's prescribed fashion during cross-docking, there's an increased risk related to loss of inventory control by using the method the long term.
- To implement cost-docking effectively, warehouse and supply chain managers should put into place robust inventory control processes and train warehouse employees on those processes.
- Even though cross-docked items are not put away in the company's prescribed fashion, that does not lessen the need to account for those goods while accounting for stock and reconciling supplier and customer invoices.

Advantages of Cross-Docking:

- Streamlines the supply chain, from point of origin to point of sale
- Reduces labor costs through less inventory handling
- Reduces inventory holding costs by reducing storage times and potentially eliminating the need to retain safety stock
- Products reach the distributor, and consequently the customer, faster
- Reduces or eliminates warehousing costs
- May increase available retail sales space
- Less risk of inventory handling

Disadvantages of Cross-Docking:

- Potential partners may not have the necessary storage capacities
- An adequate transport fleet is needed to operate
- A computerized logistics system is needed
- Additional freight handling can lead to product damage
- Labour costs are also incurred in the moving and shipping of stock

Packaging Innovation:

- As we all know, right packaging is essential for a product to be successful, as it is the first thing that is noticed by a customer.
- Therefore innovation should be a priority when it comes to product packaging, as consumers' needs and wants are always changing.
- Packaging Innovation. Turning new concepts into packaging that consumers use, trust, and love.
- Innovation in packaging gives you an opportunity to appeal to people's feelings and emotions that lead to more impulsive buying decisions, as well as creates brand loyalty for existing customers.

Production Packaging Innovations:

Production Packaging Innovations (PPI) is geared towards providing solutions for your packaging needs. PPI focuses on meeting customer needs and offering solutions in efficient and affordable ways. Every organization commitment to innovation with expertise, manufacturing ability and materials, aim to provide designs that deliver in every way.

Enhancing your product's appeal:

When your new product is ready to take on the competition, you need packaging which makes that possible. That's where we come in. We help boost your product's appeal with packaging which;

- Distinguishes your product
- Promotes branding
- Protects your product
- Advertises your range
- Improves and increases transport options
- Displays assembly instructions efficiently

The packaging which performs these functions doesn't appear from nowhere, that's why Production Packaging Innovations' experience is vital. These stages include;

- Conceptual sketches / discussions
- Technical drawings
- Samples and adjustments
- Approval
- Package production

Logistics packaging solutions across industries:

The design engineers work towards producing safe, attractive and environmentally-friendly results for clients. So the designer uses a range of materials to create the best packages for customer requirements. To give an idea of what company provide, here are a few of logistics packaging solutions:

- Shipper cartons
- Protective packaging / inserts
- Customized solutions
- Heavy duty packaging
- Mailing packs
- Wine bottle shippers
- Timber products
- Moisture protection

Marketing through packaging – creating impressions:

At PPI, it recognize how important marketing is. In many ways it's the most vital function of commercial packaging, so we know how crucial this is to success. You get one chance to make that first impression, so we'll help make it count. Packaging that strive to create promotes corporate values through graphics. It reflects the product's positioning through design. Types of marketing packaging which include:

- Display stands
- Counter displays
- Brochure stands
- Sample packaging
- Gift boxes
- Wine gift packs
- Window displays
- Polypropylene

Design facilities and a process that delivers:

The motto is 'design that delivers'. To back this, company's CAD design equipment, coupled with expertise, to help create designs which make a difference. From sketched idea to cardboard sample. Packaging options are endless, but time and money aren't, so the aim to create a solution which does what customer need. When in production, it consider the following:

- Item quantities to be manufactured
- Budgets
- Product endurance
- The best manufacturing route
- Alternatives and style

Modern Packaging Innovation:

Asceptic Packaging:

Process in which a food product, such as ultra high temperature (UHT) milk and its package is sterilized separately and then combined and sealed under sterilized atmosphere. It increases the shelf-life.

Vacuum Packaging:

It is a procedure in which air is drawn out of the package prior to sealing but no other gases are introduced. This technique has been used for many years for products such as cured meats and cheese.

Modified atmosphere packaging (MAP) :

Modified atmosphere packaging (MAP) is a procedure which involves replacing air inside a package with a predetermined mixture of gases prior to sealing it. The gases involved in modified atmosphere packaging, as applied commercially today, are carbon dioxide, nitrogen and oxygen.

- Carbon dioxide reacts with water in the product to form carbonic acid which lowers the pH of the food. It also inhibits the growth of certain microorganisms, mainly moulds and some aerobic bacteria.
- Nitrogen inhibits the oxidation of fats.

- Oxygen is included in MAP packages of red meat to maintain the red colour, which is due to the oxygenation of the myoglobin pigments.

Active packaging :

Active packaging is an innovative concept that can be defined as a mode of packaging in which the package, the product and the environment interact to prolong shelf-life or enhance safety or sensory properties, while maintaining the quality of the product. It allows the active preservation of foods, according to their needs, by modification of the environment inside the package by removing undesired gases or by regulating the composition of the gas in the package headspace. Active systems can be classified according to their functionality as scavengers, regulators and emitters, and their action can be specific for several substances (O2 , CO2 , ethylene etc.). The internal atmosphere may be regulated by substances that absorb (scavenge) or release (emit) gases or vapors.

Edible Packaging:

Edible packaging is defined as a thin layer of edible material formed on a food as a coating or placed (preformed) on or between food components. Natural polymers have been studied extensively for the development of edible packaging. A variety of polysaccharides (starch and hydrocolloids), proteins (whey proteins, soybean proteins and fish proteins) and lipids have been used, either individually or in mixtures, to produce edible films.

Intelligent or Smart Packaging:

Intelligent or smart packaging is basically designed to monitor and communicate information about food quality. It is essentially an integrating method that deals with mechanical, chemical, electrical and/or electronically driven functions that enhance the usability or effectiveness of the food product in a proven way. Some common examples of intelligent packaging are Time–Temperature Indicators (TTIs), ripeness indicators, biosensors and radio frequency identification.

Packaging Materials:

The major categories of materials used for food packaging are glass, metals, paper and paperboard, and plastics. There are many multilayered packaging materials containing either layers of different plastics or combinations of plastics with paper/board, metal or glass. In many cases, a packaging material with two layers is chosen.

Types of packaging materials:

Paper:

Paper and paperboard are sheet materials produced from an interlinked network of cellulose fibers derived from wood by using sulphate and sulphite. The fibers are then pulped, bleached, and treated with chemicals and strengthening agents to produce the paper product. Example: Kraft paper, sulphite paper, grease proof paper.

Paperboard :

Paperboard is thicker than paper, with a higher weight per unit area, and is often made in multiple layers. It is commonly used to make containers for shipping, such as boxes, cartons and trays and is used for direct food contact. There are several different types of paperboard, including white board, solid board, fiber board and chipboard. Carton boxes, trays, egg tray , tetra pack.

Glass:

The production of glass containers involves heating a mixture of silica (the glass former), sodium carbonate (the melting agent), limestone or calcium carbonate and alumina (stabilizers) to high temperatures until the materials melt into a thick liquid mass, which is then transferred to molds.

Advantages: Glass possesses very good barrier properties, so it maintains product freshness for a long period of time without impairing the taste or flavor, visibility of product, the ability to withstand high processing temperatures.

Disadvantages: Brittle, heavy and non-degradable.

Plastics :

Plastics are synthesized by condensation, addition or crosslinking polymerization of monomer units. In condensation polymerization, the polymer chain grows by condensation reactions between molecules and is accompanied by the formation of water or alcohol. The thermal and mechanical properties can be partially modified in order to manufacture retortable packages with plastics that have a high melting point, or thermosealable packages making use of plastics with a low melting point and to develop very flexible structures (sachets and wrappings), semirigid structures (trays and tubs) and rigid structures (bottles, closures and tanks). Polypropylene, polyethene, polyesters, polyethylene terephthalate, polycarbonate, poly ethylene naphthalate.

Metals :

Metals are the most versatile of all forms of packaging. They offer the combination of excellent physical protection and barrier properties, formability, decorative potential, recyclability, and consumer acceptance. Metal containers are vacuum-sealed and thermally sterilized under low oxygen pressure. The decomposition of nutrients is kept to a minimum in metal containers, since metals are a perfect barrier to oxygen, light and moisture. The major limitations of metal containers are cost, the weight of the containers and the fact that they are difficult to crush. Aluminum and steel are the most predominantly used metals in food packaging. Example: Aluminium, tin etc.

Functions of Packaging Materials:

Packaging materials have the four basic functions of providing protection, communication, convenience and containment. Traceability and tamper indication are said to be the secondary functions of increasing importance.

- ***Protection:*** One of the main objectives of the packaging of food is to protect it against spoilage or deterioration due to physical damage, chemical changes or biological damage.
- ***Communication:*** Any special instructions or information.
- ***Convenience:*** Ease of access, handling, and disposal; product visibility; reseal ability.
- ***Containment:*** Hold the contents and keep them secure until they are used.
- ***Traceability:*** Ability to track any food through all stages of production, processing and distribution.
- ***Tamper indication:*** Food tampering is the intentional contamination of a food product, with intent to cause harm to the consumer or to a private company. There are several measures to detect tampering, including banding, special membranes, breakaway closures, special printing on bottle liners or composite cans such as graphics or text that irreversibly changes upon opening and special printing that cannot be easily duplicated.

Third Party Logistic and Service Concept Applications:

Third Party Logistic:

1) Third-party logistics (abbreviated as 3PL, or TPL) in logistics and supply chain management is a company's use of third-party businesses to outsource elements of its distribution, warehousing, and fulfillment services.
2) Third-party logistics providers typically specialize in integrated operations of warehousing and transportation services that can be scaled and customized to customers' needs, based on market conditions, to meet the demands and delivery service requirements for their products.
3) Often, services exceed logistics to include value-added services related to the production or procurement of goods, such as services that integrate parts of the supply chain.
4) A provider of such integrated services is referenced as a third-party supply chain management provider (3PSCM), or as a supply chain management service provider (SCMSP).
5) 3PL targets particular functions within supply management, such as warehousing, transportation, or raw material provision.
6) A 3PL (third-party logistics) provider offers outsourced logistics services, which encompass anything that involves management of one or more facets of procurement and fulfillment activities. In business, 3PL has a broad meaning that applies to any service contract that involves storing or shipping items. A 3PL service may be a single provider, such as transportation or warehouse storage, or it can be a system wide bundle of services capable of handling supply chain management.

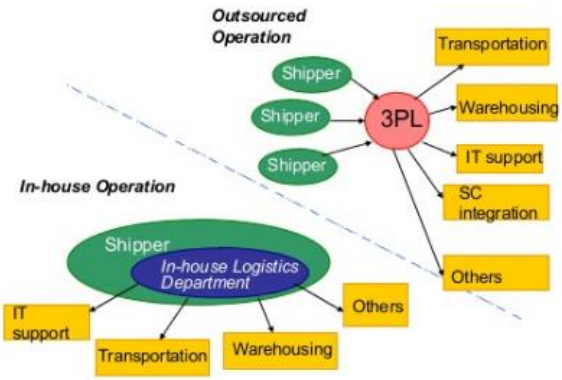


Figure: Third party Logistics

Types of Third party logistic:

Third-party logistics providers include freight forwarders, courier companies, as well as other companies integrating & offering subcontracted logistics and transportation services. There are four categories of 3PL providers:

Standard 3PL Provider: this is the most basic of form of a 3PL provider. They would perform activities such as, pick and pack, warehousing, and distribution (business), the most basic functions of logistics. For a majority of these firms, the 3PL function is not their main activity.

Service Developer: this type of 3PL provider will offer their customers advanced value-added services such as: tracking and tracing, cross-docking, specific packaging, or providing a unique security system. A solid IT foundation and a focus on economies of scale and scope will enable this type of 3PL provider to perform these types of tasks.

The Customer Adapter: this type of 3PL provider comes in at the request of the customer and essentially takes over complete control of the company's logistics activities. The 3PL provider improves the logistics dramatically, but does not develop a new service. The customer base for this type of 3PL provider is typically quite small.

The Customer Developer: this is the highest level that a 3PL provider can attain with respect to its processes and activities. This occurs when the 3PL provider integrates itself with the customer and takes over their entire logistics function. These providers will have few customers, but will perform extensive and detailed tasks for them.

How Third-Party Logistics Work:

Here is an example of how 3PL arrangements operate: A book publisher hires writers, editors and graphic designers to produce publications, but it may not want to handle the consumer ordering process or transportation of book shipments. Instead, the book publisher uses a fulfillment center to process its online orders and hires a trucking carrier to haul its freight. The fulfillment center and carrier both act as 3PL providers. It's possible for a single 3PL provider to fulfill and ship book orders, too. By contracting with a 3PL provider, the book company can use supply and distribution services only when needed, thus controlling costs more effectively while focusing on its core competency of producing books.

Figure: How the 3PL works

Many 3PL companies focus on procurement processes and can help you develop, manufacture, and source ready-made goods to sell. These services include:

- Product development — a 3PL can help you design and engineer an item and even secure patents
- Raw materials sourcing — 3PLs can help you identify the best materials and configure a sustainable, cost-effective sourcing plan
- Production facilities scouting — 3PLs work with an array of production facilities and can match the right factory to your product
- Manufacturing scheduling — 3PLs can develop cost-effective production plans and schedule manufacturing runs based on forecasted demand
- Finished goods sourcing — 3PLs keep up with who is making what and can source or help customize ready-made good to meet your needs.

What Kind of Value Do Third Party Logistics Companies Offer?

A third party logistics firm can offer your company a number of key services, including:

- Logistics expertise
- Network analysis
- Mode and load network optimization
- Cost containment strategization
- Managing vendor compliance
- Systems support
- Customized Services

The expertise in supply chain management, warehousing, and other operations that a third party logistics firm can offer is of substantial value to companies. Third party logistics can also be of benefit to shipping and carrying companies. A third party logistics firm will help a company to maximize efficiency, eliminate weak points that result in lost profits or revenue, and otherwise ensure maximal success and profitability.

3PL vs. 4PL:

The term 4PL (fourth-party logistics) often pops up in discussions about 3PL. In brief, when 3PL providers outsource any of their own contracted services, they become a 4PL provider. In the example of a book publisher, if the fulfillment center subcontracts out its shrink-wrapping and freight weighing to other companies, then the center acts a 4PL provider. Some observers view 3PLs providers as managers of a particular outsourced service, while 4PL providers oversee services across an entire supply chain. Another way to look at a 4PL service is as a provider that acts as a client company's single point of contact in the supply chain; the 4PL provider selects and manages various 3PL activities 4PL is also known as lead logistics providers (LLP).

Key Advantages of Third Party Logistics:

- ***Cost Savings:*** Clients of third party logistics firms nearly always save money overall.
- ***Low Capital Commitment:*** When a company outsources logistics functions to a third party logistics firm, that company no longer needs to worry about maintaining and managing their own warehouses and transportation systems.
- ***Freedom to Focus on Core Competencies:*** A third party logistics company specializes in logistics issues and operations. Business is complex, and it is difficult or impossible for a company to have expertise in every single sector or division.
- ***Benefit from Professional Supply Chain Expertise:*** An experience 3PL provider is a knowledgeable source of industry best practices. Such companies stay current with the latest advancements and developments in logistics technology, manufacturing processes, and overall logistics.
- ***Leverage a Stronger Resource Network:*** Most 3PL companies offer a vast resource network that lends to significant advantages over in-house supply chains. By leveraging the resource network of 3PL provider, steps in the supply chain can be optimized and executed in a more efficient and cost-effective manner.

- ***Free-up Valuable Time & Capital:*** Outsourcing your logistics services can free-up a wealth of money and time for your business. A 3PL company can help eliminate the need to invest in transportation, warehouse space, technology, and staff to execute essential supply chain management processes.
- ***Utilize Flexible & Scalable of Services:*** A major advantage of investing in a 3PL provider is the ability to effectively scale transportation, labor, and space according to your company's unique inventory management requirements.
- ***Continuously Improve & Optimize Your Supply Chain:*** 3PL providers like United Facilities have the resources to make adjustments and continuous improvements to each link in their clients' supply chains. Logistics professionals will ensure your company's needs are met by leveraging highly-efficient and cost-effective strategies and systems.

Procurement Logistics:

1) Procurement Logistics is a key activity in the supply chain. It can significantly influence the overall success of a company depending on how it is managed.
2) The goal of procurement logistics is the control of the supply in order to meet the needs of operational processes. Quantities to be supplied and supply frequency, impact on supply chain inventory, demand forecasting, quality of service delivery, vendor selection, compliance dates and the types of packing and loading units used by suppliers are all factors to consider in procurement logistics.
3) The systematic coordination of all aspects of the procurement process including bids, price negotiations, assuring proper quantities and specifications, shipping and delivery. The goal is to obtain materials, services or products at the best possible cost which meet the needs and time constraints of the organization.
4) Procurement logistics achieves a high level of complexity in different situations:
    - Management of a large number of products (retail sector is a case in point).
    - Logistics networks with many interacting agents.
    - Global sourcing, with extended replenishment periods

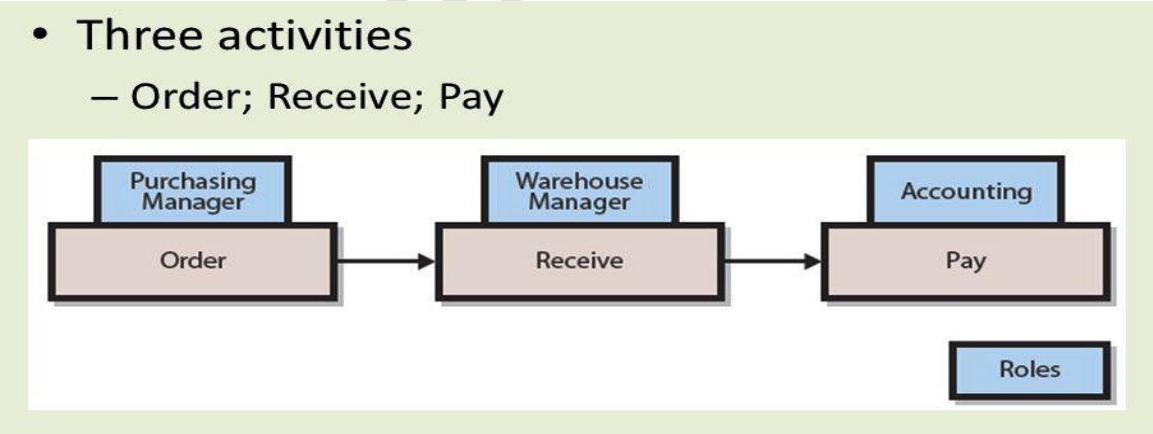


Figure: Fundamental Procurement Process and activities

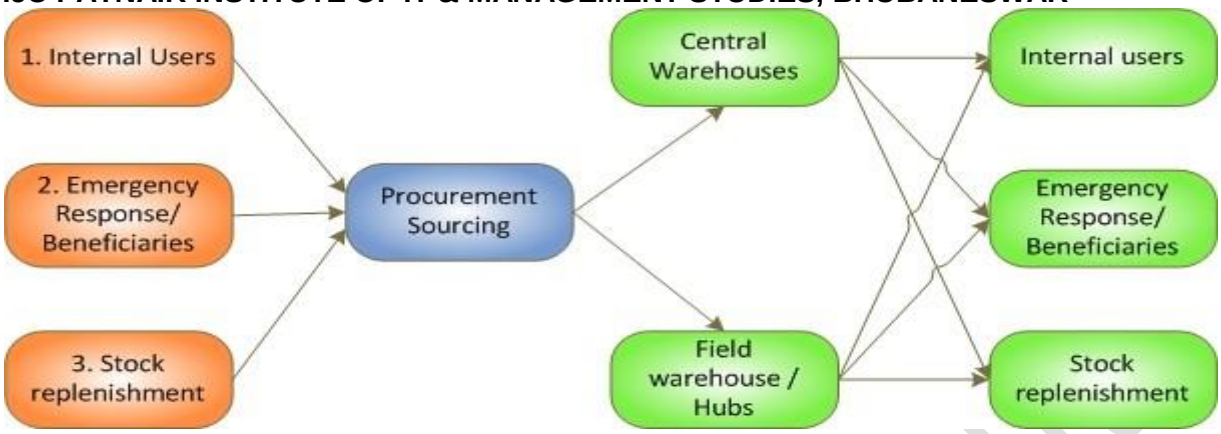


Figure: Procurement - Logistics Operational Activities

What Is Procurement Management?

Procurement management is all of the processes that go into managing a company's incoming material needs for manufacturing. This may include obtaining bids from third-party logistics (3PLs) providers, the creation and negotiation of contracts with such providers, the hiring of employees and drivers, and marketing and business professionals. Each job plays a critical role in ensuring the costs associated with manufacturing do not exceed the company's expectations. Often, a whole procurement management team may be hired for large organizations or corporations. But, small-business owners may lack the resources to hire all of these professional at the onset of manufacturing. As a result, working with a 3PL directly may be the best way for a new or growing organization to gain access to all of the resources necessary to build a successful enterprise.

Logistics Vs. Procurement In Your Supply Chain:

1) A procurement supply chain person is directly responsible for the purchasing or procurement of any product (i.e. raw materials, components in manufacturing), services (logistics or otherwise). A logistics supply chain person is focused on the logistical cost and efficiencies within the supply chain of an organization.
2) As soon as I see "procurement," I immediately think "purchasing". This excludes selling, operations, management, and finance. As soon as I see "logistics" I see a coordinating role that involves operations and possibly marketing, finance, and management.
3) A procurement supply chain person would be focused on the purchase of supply chain services. A logistics supply chain person would have a more holistic approach which would encompass purchasing as well as planning, implementation, operations, budgeting and optimization.
4) The procurement supply chain person needs the logistics supply chain person to organize to a full "journey" from beginning to final end, including all other tools needed to make a sound and safe adventure.
5) The term "logistics supply chain" encompasses the planning and management of all logistics activities across the supply chain, the activities that add value globally across the supply chain – from procurement end to final distribution of finished goods. Procurement supply chain focuses on the earlier part of logistics within a supply chain, not suggesting a relation to the activities that stem from work-in-progress and finished goods inventory and distribution.
6) Procurement is the buying or purchasing of goods or services. Logistics is the movement, storage, and operations around whatever the business is in.

Service overview of Procurement Logistics:

The processes and propose new strategies for procurement logistics in order to Improve Supply Chain Performance. The following tasks should be considered;

- Improving accuracy of demand forecasting by means of advanced methods.
- Selection of appropriate inventory models through simulation and optimization.
- Analysis of impact of different inventory policies on supply chain processes.
- Selection of type of supply (centralized / decentralized).
- Choice of supply strategies (direct replenishment, stocked flow, cross docking).
- Replenishment policy taking into account considerations of retail such as order days management (Shelf connected supply chain).

Advantages of Procurement Logistics:

1) Procurement process if well followed gives the buyer advantage to select the best suppliers for the job
2) Opened of the market for the buyer to get best quality at reduced price
3) It saves time and money
4) An effective plan of procurement serves as a conduit to achieving entity's objectives
5) It provides a framework to guide procurement officers in the achievement of their tasks and duties.
6) Choose the right suppliers with the right skill on the job with latest technology.
7) An effective plan ensures compliance with regulatory policies.

Source identification:

The business needs to determine where to obtain the product. The company might have an approved vendor list. If not, the business will need to search for a supplier using purchase orders or research a variety of other sources such as magazines, the Internet or sales representatives. The company will qualify the suppliers to determine the best product for the business.

Supplier identification includes identifying particular suppliers that can provide the required product or services. There are many sources to search for potential suppliers. One good source is trade shows. Modern procurement software often incorporates a supplier catalog for standardized goods and services.

Sourcing:

1. Sourcing is defined as a technical activity with the purpose of identifying existing suitable products and services on the market and qualified suppliers available to provide those products and services.

2. Sourcing also aims at collecting and analyzing information about capabilities within the market to satisfy the organization's requirements, such as obtaining updated cost information, determining the appropriate technology and alternative products, as well as identifying appropriate supplier qualification criteria.

3. Sourcing process, leading to identification and invitation of relevant suppliers, ensures maximised competition, by allowing the most relevant and suitable companies to compete. Sourcing also leads to a better understanding of the market. This knowledge helps to:

i. Assist in a make or buy or lease decision
ii. Determine when to buy
iii. Establish realistic delivery schedules
iv. Review sole/single source justifications
v. Identify price and non price evaluation factors

vi. Identify special terms and conditions for the solicitation and resulting contract that are customary in special markets

vii. Establish realistic budgets, pricing arrangements and economic ordering quantities.

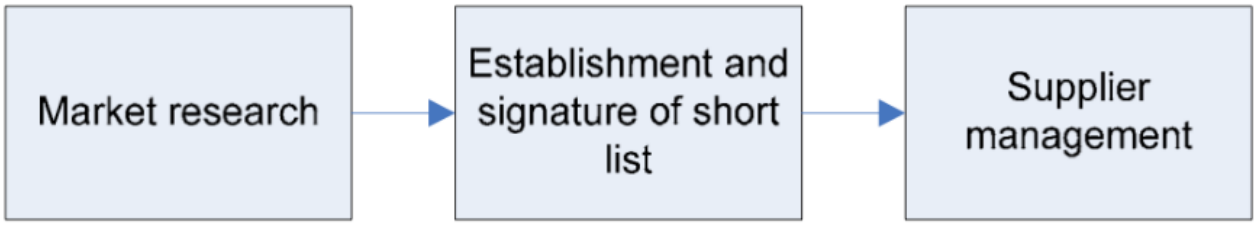
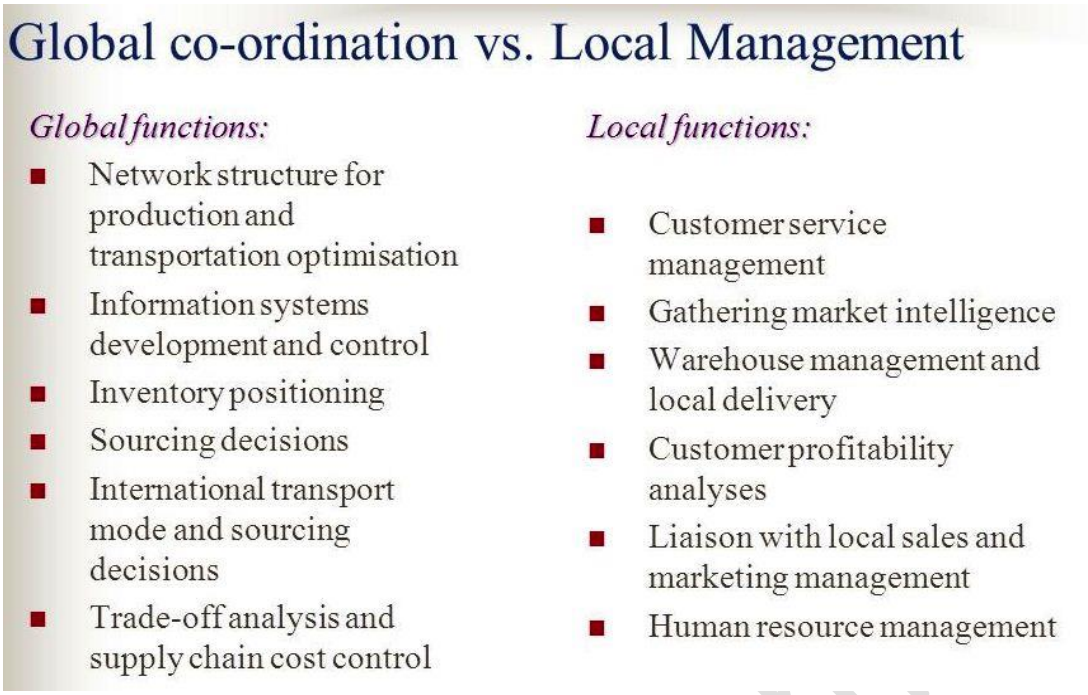


Figure: Sourcing Process

Procurement officials increasingly realize that their make-buy supplier decisions fall along a continuum from simple buying transactions to more complex, strategic buyer-supplier collaborations. It is important for procurement officials to use the right sourcing business model that fits each buyer-seller situation. There are seven models along the sourcing continuum: basic provider, approved provider, preferred provider, performance-based/managed services model, Vested business model, shared services model and equity partnerships.

- ***A basic provider model is transaction-based;*** it usually has a set price for individual products and services for which there are a wide range of standard market options. Typically these products or services are readily available, with little differentiation in what is offered.
- ***An approved provider model uses a transaction-based*** approach where goods and services are purchased from prequalified suppliers that meet certain performance or other selection criteria.
- The preferred provider model also uses ***a transaction-based economic model***, but a key difference between the preferred provider and the other transaction-based models is that the buyer has chosen to move to a supplier relationship where there is an opportunity for the supplier to add incremental value to the buyer's business to meet strategic objectives.
- A performance-based (or ***managed services model***) is generally a formal, longer-term supplier agreement that combines a relational contracting model with an output-based economic model. It seeks to drive supplier accountability for output-based service-level agreements (SLAs) and/or cost reduction targets.
- ***A vested sourcing business model*** is a hybrid relationship that combines an outcome-based economic model with a relational contracting model. Companies enter into highly collaborative arrangements designed to create and share value for buyers and suppliers above and beyond.
- ***A shared services model*** is typically an internal organization based on an arm's-length outsourcing arrangement. Using this approach, processes are often centralized into an SSO that charges business units or users for the services they use.
- ***An equity partnership creates a legally binding entity;*** it can take different legal forms, from buying a supplier (an acquisition), to creating a subsidiary, to equity-sharing joint ventures or entering into cooperative (co-op) arrangements.

Global Vs. Domestic Sourcing:



Landed Cost Computation:

What is Landed Cost?

Landed cost is an essential way to calculate your company's bottom line by representing the total cost of a product on its journey from the factory floor to your buyer's door. It includes the price of goods, shipment costs, insurance fees, customs duties, and any other charges incurred along the way. Not only does know how to calculate landed cost important, it is necessary to running a successful business.

Why is Landed Cost Necessary?

1. There are obvious and hidden costs associated with getting any product to your customers. But knowing your landed cost can bring clarity, allowing you to assess how your business is performing, maximize your pricing, and ensure that you know exactly how much you are paying for your inventory.
2. It also provides you the opportunity to analyze your supply chain and determine where it might be worth cutting costs.
3. This information enables you to calculate whether or not you will be able to make a profit on your products or even if your business model is sustainable.
4. But calculating landed cost can be difficult if you do not yet know your full expenses or lack the experience to anticipate how high the additional fees that often come up in shipping will be.

The landed cost analysis is important for the following reasons:

1) Ensure estimated profit on the product by marking the price such that you can sell it with attractive discounts. When total landed cost is accurately known, the profit margin per article is optimum.
2) When the supply chain of the product and expenses at all the stages is broken-down to calculate landed costs, it is easier to figure out the steps at which you can cut yourself some slack. This way savings can be done where possible.

3) Precise data on landed cost can make you far-sighted, and therefore you take decisions not solely on the purchasing price of a specific product but other factors as well.

Calculating Landed Cost:

This is the basic equation that you will be calculating:
Landed Cost = Shipping + Customs + Risk + Overhead

- ***Shipping:*** There is more to shipping than boxing your goods and putting them on a boat (or plane, truck, train, etc.). There are costs associated with every aspect of the process, including crating, packing, handling, and freight.
- ***Customs:*** Every country has its own authority for monitoring the flow of goods into and out of its borders. These agencies are also responsible for collecting any duties, tariffs, value-added tax (VAT), brokers fees, harbor fees.
- ***Risk:*** The costs of avoiding risk can add up, but not covering them can be even most costly. Insurance, compliance, quality, and safety stock inventory are all vital considerations.
- Overhead: Operating costs are the final part of the landed cost equation. Purchasing staff, due diligence cost, travel, and exchange rates are included in overhead.

Example-1:
Consider that you are looking to import 100 units of a product from Bhubaneswar to Sambalpur. The per-unit cost is Rs. 50. The freight cost for the shipment is Rs. 1000 and it represents one-quarter of the shipment. The duty charge is set at 5%.

Per Unit Cost + Freight Cost + Duty Charge = Landed Cost Per Unit
Rs. 50 + ((1000 * 25%) / 100) + (5% * Rs. 50) = Rs. 55 Per Unit
Let's say your goods are held at customs for three days and you are charged Rs. 100 for each day:
Per Unit Cost + Freight Cost + Duty Charge + Additional Charge = Landed Cost Per Unit
Rs. 50 + ((1000 * 25%) / 100) + (5% * Rs. 50) + ((Rs. 100 * 3) / 100) = Rs. 58 Per Unit
The unforeseen cost added an additional Rs. 3 to your landed cost per unit. With this information in mind, you may choose to adjust your pricing model.

Example-2:
Suppose the shipment of 100 units of a particular product arrives

- Supplier cost: Rs. 20 per unit
- Duty applicable at 4%
- Freight cost for the entire shipment was Rs. 200 – and the specific product represents one-quarter of the shipment (1/4th of the total shipment)

Total Landed Cost = **Supplier Cost** + (**Duty charges**) + (**Shipment charges specific to this product/total units) .**
Total Landed Cost = Rs. 20 + (4% x 20) + ((200 x 25%)/100) = 20+ 0.8 + .5 = Rs. 21.3 per unit

Vender Rating:

What is Vender Rating?

1) A vendor is any person or company that sells goods or services to someone else in the economic production chain.
2) Vendors or suppliers are given standing, status, or title according to their attainment of some level of performance, such as delivery, lead time, quality, price, or some combination of variables.

3) It may take the form of a hierarchical ranking from poor to excellent and whatever rankings the firm chooses to insert in between the two.

4) For some firms, it may come in the form of some sort of award system or as some variation of certification.

5) It is a direct result of the widespread implementation of the just-in-time concept.

Objectives of Vender Rating:

- To help the buyer in future selection
- To provide buyer with the information helpful in subsequent negotiation
- To provide the buyer with the important information which he can act upon any corrective measures.

Benefits of Vendor Rating:

1) Helping minimize subjectivity in judgment and make it possible to consider all relevant criteria in assessing suppliers.

2) Providing feedback from all areas in one package.

3) Facilitating better communication with vendors.

4) Providing overall control of the vendor base.

5) Requiring specific action to correct identified performance weaknesses.

6) Establishing continuous review standards for vendors, thus ensuring continuous improvement of vendor performance.

7) Building vendor partnerships, especially with suppliers having strategic links.

8) Developing a performance-based culture.

Demerits of Vendor Rating:

1) Inexperience with Products and Services

2) Unfamiliarity With Corporate Operations

3) Resistance Within Company

4) Threat to Security

How the Vendors are rated?

Vendors are rated on the basis of various characteristics:

- Time delivery
- Quality
- Price
- Others actors (such as Supplying useful market information & Meet emergency order).

Vendor Rating Methods:

Categorical plan:

This is a very subjective method.

Mangers from concerned department prepare list of factors important from their views.

Each of the major supplier is evaluated against each evaluator's list of factors evaluation is done in the terms of

- Good
- Satisfactory
- poor

Weighted point plan:

The buyer decides on;

- Factor important form evaluation
- Weightages for each factor
- The vendor performance in respect of each factor

Cost ratio plan:

Under this method, the vendor rating is done on the basis of various costs incurred for procuring the materials from various suppliers. The cost ratios are ascertained for the different rating variables such as quality, price, timely delivery etc. The cost ratio is calculated in percentage on the basis of total individual cost and total value of purchase

Example: The total delivery cost is Rs5000 and the total purchases are Rs 1,00,000 then delivery cost ratio will be 5,000 / 1,00,000 x 100 = 10%

Contract Negotiation:

What Is Contract Negotiation?

Contract negotiations are a process that involves discussing and compromising on contract terms in order to reach a final agreement between two or more parties involved in a transaction. In most contract negotiations, each party tries to negotiate for the best interest of themselves or their business. There is a lot of back and forth communication, but most contract factors boil down to risks and revenues.Contracts that are negotiable can include real estate leases, manufacturer warranties, employment contract, business deals, and financial contracts. The negotiation aspect of a transaction is very important because once the contract is final, all parties are legally bound to the terms of the contract terms and cannot overlook these terms without being liable.

What Is the Best Approach to Contract Negotiations?

In typical contract negotiations, each party involved in the contract must compromise on each in order to get what they really want out of the transaction. The best way to approach contract negotiations is the following:

1. ***Identify the objective for entering the contract****:* Every party to the contract must have a specific idea of what they want to gain from the transaction. Before attempting to negotiate a contract, make a lost of things you will compromise and a list of terms that you will not negotiate or give up.
2. ***Research contract laws****:* Contracts are legally binding agreements, which are regulated by the courts. Before attempting to negotiate a deal, search online or get expert advice to determine whether the terms of the contract you are trying to form is legally allowed.
3. ***Prepare for negotiations****:* Gather all facts, figures, financial statements, and documents for the negotiation process in case you need to show proof of anything that you may need to back up your negotiation points.
4. ***Prepare a backup plan****:* Create a plan for the possibility that the contract fails to form and that both side cannot agree on the terms after negotiation.
5. ***List your priorities****:* It is important to know the difference between what you need out of the transaction and what you want.
6. ***Set a goal****:* Know your bottom line so you can determine when to accept a deal and when to walk away.
7. ***Know the difference between what you need and what you want****:* Review your priorities and ask yourself if the term that you are chasing for is worth negotiating

Contract Negotiation Process:

When it comes to a contract negotiation process, the most difficult part may be to actually forget what you have been told about traditional negotiations processes, strategies & techniques.

Step 1 of Contract Negotiation Process: Prepare, Prepare, Prepare.:

his is the most important step of the whole contract negotiation process. Understand that contract negotiation is not about who's the better negotiator. Below are some other things that you need to prepare during this step: Issue Identification, Issue Information, Classify the Issues, Prepare the meeting agenda, Get ready to Negotiate.

Step 2 of Contract Negotiation Process: Negotiation Meeting:

This is the meeting proper where you (and your team if there's one) will sit down with the supplier. Important here is that this meeting most of the time is not called negotiation meeting – but any time you meet with a supplier to discuss their offer it means you are negotiating.

Step 3 of Contract Negotiation Process: Summarise all points:

This is very important, as you need to get the other party's agreement to all the points that you discussed. You can simply divide this into two categories:

a) Points that you have already agreed; and

b) Points that you or the other side would need to get back to each other.

When Is There an Enforceable Contract?

- Under contract law, there is no enforceable contract until all of the material elements of the transaction have been negotiated and agreed upon by both sides. All the contract terms and conditions must be legal in order for them to be enforceable or that term or condition is void. Some contracts must fall within the statute of limitations, meaning that the contract must be in writing and signed by the parties.

- If the parties have agreed to the terms of the deal and want to move forward with the contract and legal details, they can draft a contract that lists all the terms and both sign the contract as the final agreement.

- Is it when the parties agree on the business terms or when the legal terms are finalized? Under contract law, there is no contract until all of the material elements of the deal have been negotiated and agreed upon. So, a legal dispute over whether and when a contract exists will boil down to whether any of the outstanding legal issues are material elements of the deal.

- Back to Ram the landlord and Krishna the prospective tenant. Let's say that Ram refuses to budge on any of the terms of his standard lease, but Krishna has already given notice at her current apartment because she believed her handshake with Sam created a contract. Whether she has a legal right to force Ram to go through with the agreement or pay her damages depends on whether the attorney fee and insurance provisions are material elements of the deal.

- If the parties have agreed to the business terms of the deal and want to proceed before hammering out the legal details, they can use an escrow account or condition the release of funds on the execution of a written agreement. This avoids the problem of having to chase after money you laid out if the deal never materializes. If the negotiations fall apart, everyone gets back what they put in and moves on.

Consolidation:

In business, consolidation or amalgamation is the merger and acquisition of many smaller companies into a few much larger ones. In the context of financial accounting, consolidation refers to the aggregation of financial statements of a group company as consolidated financial statements.

Business consolidation is the combination of several business units or several different companies into a larger organization. Business consolidation is used to improve operational efficiency by reducing redundant personnel and processes. Also known as an amalgamation, a business consolidation is most often associated with mergers and acquisitions in which several similar, smaller businesses are combined into a new legal entity and the original entities cease to exist. Business consolidation can result in long-term cost savings and a concentration of market share, but in the short-term can be expensive and complex.

Business consolidations fit into a few categories. They include:

- Statutory consolidation: When businesses are combined into a new entity and the original companies cease to exist.
- Statutory merger: When an acquiring company liquidates the assets of a company it buys, incorporating or dismantling its operations.
- Stock acquisition: A combination that sees an acquiring company buy a majority share (more than 50% or common stock) of a company and both companies survive.
- Variable interest entity: When an acquiring entity owns a controlling interest in a company that is not based on a majority of voting rights.

Consolidation Accounting:

Consolidation accounting is the process of combining the financial results of several subsidiary companies into the combined financial results of the parent company. This method is typically used when a parent entity owns more than 50% of the shares of another entity. The following steps document the consolidation accounting process flow:

- *Record intercompany loans.*
- *Charge corporate overhead.*
- *Charge payables.*
- *Complete adjusting entries.*
- *Investigate asset, liability, and equity account balances.*
- *Review subsidiary financial statements.*
- *Eliminate intercompany transactions..*
- *Review parent financial statements.*
- *Record income tax liability.*
- *Close subsidiary books.*
- *Close parent company books.*
- *Issue financial statements.*

Self-Certified Vendor Management:

Vendor:

A vendor is a person or organization that vends or sells contingent labor. Specifically a vendor can be an independent consultant, a consulting company, or staffing company (who can also be called a supplier – because they supply the labor or expertise rather than selling it directly).

Vendor Management:

The term vendor management is used when describing the activities included in researching and sourcing vendors, obtaining quotes with pricing, capabilities, turnaround times, and quality of work, negotiating contracts, managing relationships, assigning jobs, evaluating performance, and ensuring payments are made. It requires a lot of skills, resources, and time.

Though many business owners believe that vendor management is simply about finding the supplier with the cheapest price for a product or service, it's about more than that. It's about streamlining the process for heightened efficiencies and managing vendor relationships to ensure that the agreements made are mutually beneficial for both parties. Typical Vendor Management activities can include:

1) Vendor sourcing, appraisal and negotiations
2) Contract creation and agreement

3) Reporting and KPI(Key Performance Indicator) tracking
4) Arranging and conducting QBRs (Quarterly Business Reviews)
5) Compliance monitoring and security testing
6) Recording escalation processes and key contacts
7) Resolving disputes

Vendor Management Processes:

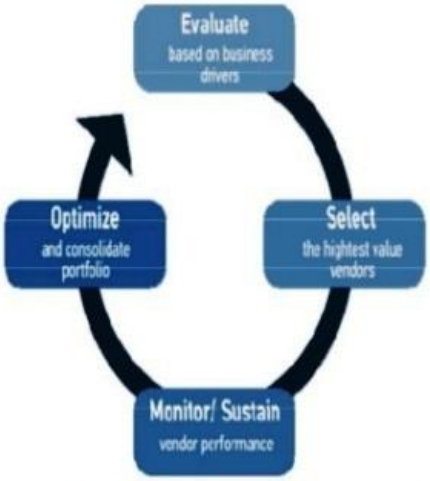
With effective vendor management processes in place, you can properly establish service, quality, cost, and satisfaction goals and choose and manage third-party suppliers that help you achieve those business goals. Vendor management is typically broken down into four steps.

- The first is the establishment of the business goals mentioned above. It's much easier to select and manage vendors when you have clearly defined performance parameters to compare and contrast.

- The second part of the process is to select the best vendors that will be able to match your company's performance characteristics. Every vendor will have its strengths and weaknesses, and choosing the right one is a very critical task to optimizing operational results.

- Third is managing your suppliers. On a daily basis, your vendor managers will need to monitor performance and output, ensure contract terms are being followed, approve or disapprove changes, provide feedback, and develop relationships through effective communication, honesty, and integrity.

- Finally, the fourth aspect of vendor management is meeting your goals on a consistent basis. This requires continuous work in influencing vendors to meet performance objectives to ensure profitability.



Life Cycle Of Vendor Management

Manage and Measure

- Centralize vendor information.
- Track and monitor vendor commitments — contractual or otherwise .
- Establish alerts to ensure commitments are met, issues addressed, and renewals tackled.

Application Area of Vendor management:

Vendor management typically delivers value to a business across several different areas, including:

- ***Cost control,*** either through identification of opportunities for consolidation or through timely renegotiation around renewals
- ***Benefits realization*** **-** proactive Vendor Management and continuous contact mean that the original terms of a contract can always be kept front of mind. By pushing vendors to deliver, and smoothing the way internally as well, VM helps get businesses towards their goals faster.
- ***Supply chain resilience and continuity*** **-** by maintaining a constant dialogue with key vendors, your business can assess any ongoing risks to supply and make alternative plans in a timely fashion if required.
- ***Compliance*** **-** periodic assessment of compliance becomes easier and this ensures that any risk associated with legislation or industry standards is minimized.
- ***Innovation*** **-** most, if not all, businesses are looking to grow and develop new technologies, and your vendors are no different. By having close relationships with them and managing them well, good vendor management can place your business in pole position to take advantage of advancements in their products or services.

Vendor Certification Procedure:

Supplier / vendor certification is an important component of our total quality management system that assures that a supplier's product is produced, packaged, and shipped under a controlled process that results in consistent conformance to our requirements. The primary objective of the certification process is to assure consistent high quality as demonstrated by predictable conformance to our requirements. The basic premise is that want to identify suppliers that have adequate process controls in place and they provide legitimate proof that their products are consistently fit for use, authentic, and meet 100% requirements. The procedure are given below;

1) Initiate a Quality audit of the supplier.
2) Liaise with supplier to enhance their understanding of company requirements.
3) Create or review and update the relevant Raw Material Control Test Methods to reflect required testing terminology, requirements and methods.
4) Together with Procurement, present a report to the Management Certification Committee requesting certification of the supplier. The report is composed of typically the following; quality supply history, delivery performance, Project plan, Change Control request, audit information, Supply agreement, a Certificate of Analysis from the vendor, supplier inspection planning requirements, matrix.
5) Produce a Certificate to be presented to the successful vendor

Individual Component Vs. Module Purchases:

Purchase Module:

The Purchase module provides an easy way for businesses to order and purchase products for use in production and for sale. Some of the great features are:

i. Easy to use database management tools for all your supplier and production information
ii. The ability to send purchase orders directly from company via email
iii. Handy data entry (Simple)

The Purchase module enables you to start your inventory management process. From this module, it has the ability to:

- record stock coming in
- edit supplier details

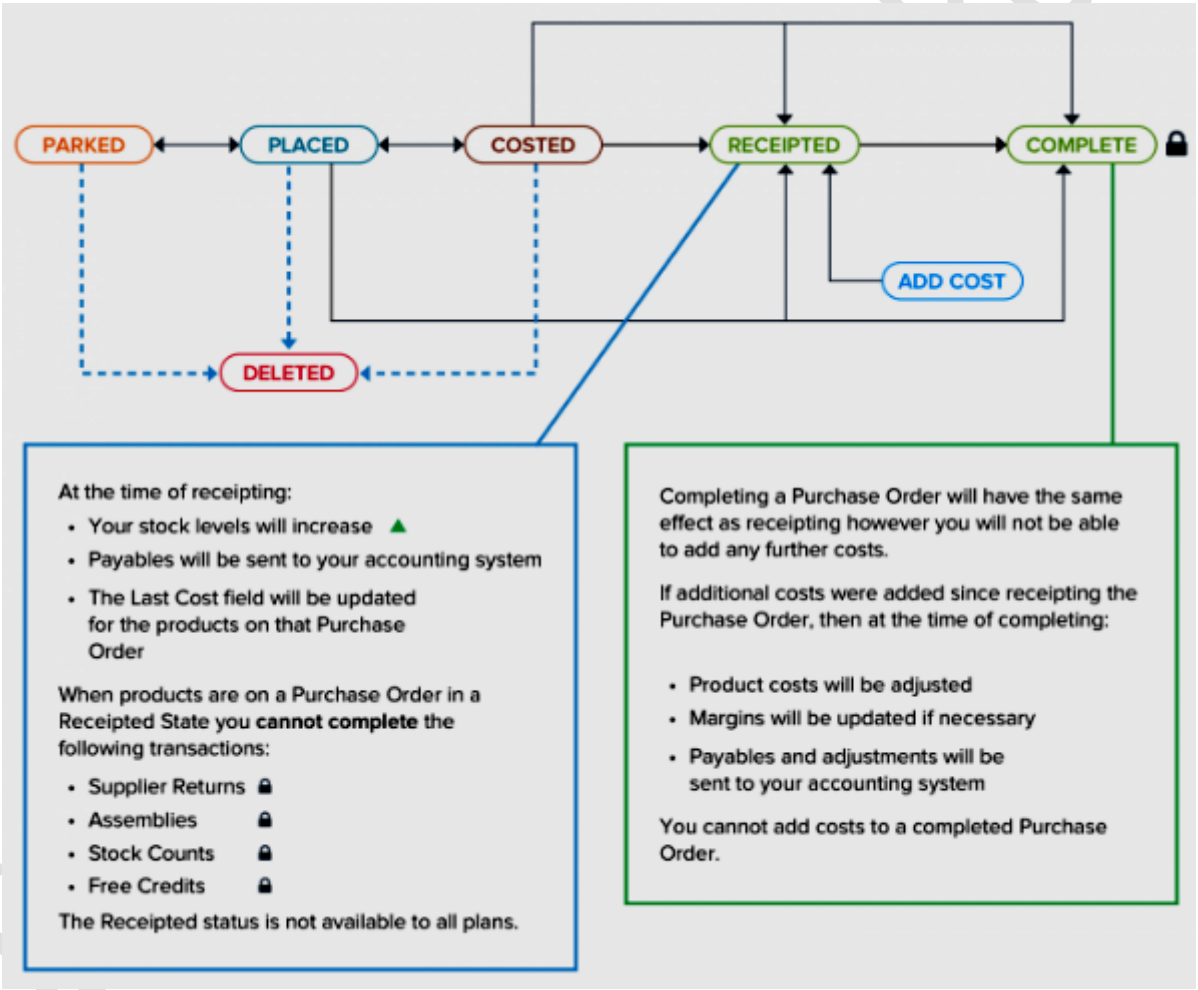


Figure: Workflow diagram demonstrates a typical use case example of how you can use the purchases module in a company

Individual Component Purchases:

1) Component purchases means purchases of the component parts of an item that in normal purchasing practices would be purchased in one purchase.

2) Component purchases means uniquely identifiable input, part, piece, assembly or subassembly, system or subsystem, that;

- Is required to complete or finish an activity, item, or job,
- Performs a distinctive and necessary function in the operation of a system, or
- Is intended to be included as a part of a finished, packaged, and labeled item.

3) Example: Upon purchasing the small building block toy set, Patsy spread out all the component and made sure each piece was present before beginning to build the toy.

Vendor development and vendor relationship management:

What is Vendor Development?

Vendor development is one of the popular techniques of strategic sourcing, which improves the value receive from suppliers. Vendor Development can be defined as any activity that a Buying Firm undertakes to improve a Supplier's performance and capabilities to meet the Buying Firms' supply needs.

Buying Firms use a variety of activities to improve vendor performance, which includes,

* Assessing Suppliers' operations
* Providing incentives to improve performance
* Instigating competition among Suppliers
* Working directly with Suppliers either through training or other activities etc.,

Best Practices in Vendor development

Following are few of the Best Practices in Vendor development if adopted successfully would enable World Class Supply Chain Management (WCSCM).

* Creating dedicated supply developments teams…
* Teaching a supplier on the tactics of self-development, after initial guidance from the supplier development team…
* Focusing on underlying causes of long cycle times…
* Involving suppliers in new product and process development at the buying firm…
* Providing on-line training programs and off-line education programs to suppliers…
* Conducting frequent improvement-focused seminars for suppliers…
* Creating supplier support centers at their locations itself…
* Loaning-out process engineers and quality managers to share their expertise with suppliers…
* Setting 'stretch goals' to encourage radical change as well as continuous improvement schemes for suppliers…
* Improving proper metrics for supplier development improvements…
* Sharing the savings from supplier development activities with suppliers…
* Last, but not the least, Improving the supplier's supply management system…

Building Relationships with Vendors:

To get the most success out of your vendor management process, you need to take a strategic approach to building and maintaining relationships with your best vendors. Good suppliers are hard to come by, so it's important to nurture your relationships with the suppliers you don't want to lose.

Share information and priorities: For your vendors to effectively meet your needs to the best of their ability, it's important for you to provide the necessary information in a timely manner. This might include launch dates, changes in design, forecast information, and other pertinent information that might affect quality or service.

Allow strategy and innovation: When you and your vendors work together on strategy, you can get the best value for your money. Invite the vendor to meetings that involve the product he is working on. You hired him because he's an

expert in that area so he could provide valuable insights or innovative suggestions that make the product better or even cheaper, which could give you a competitive advantage.

Look to the future: Short-term relationships with vendors will only lead to short-term gains and marginal cost savings. The real value comes from building partnerships for the long terms. Doing so will enable trust and commitment from your vendors, which could lead to discounts, preferential treatment, and access to expert knowledge.

Focus on win-win agreements: You won't be able to build relationships with strong-arm negotiation tactics. Instead, you'll create resentment that can lead to further problems down the road. Focus on negotiating agreements in good faith that allow both parties to walk away feeling good about the deal.

Vendor Performance Monitoring:

The term 'suppliers' includes contractors for works and services as well as supplies; the term 'performance monitoring' means measuring a supplier's ability to comply with, and preferably exceed, their contractual obligations i.e. monitoring post contract. CIPS (CIPS - Leading global excellence in procurement and supply) recognizes this is sometimes referred to as 'vendor rating' especially where specific measures are used. CIPS believes that performance monitoring is a fundamental element within contract management and supplier development (the broader subject is covered in a separate CIPS practice document). It can also be argued that monitoring the performance of suppliers can be;

i. An aspect of supplier appraisal (i.e. the process of evaluating potential suppliers) and can be extended to supplier selection criteria during tendering; and
ii. An aspect of the management of approved supplier lists.

There are many contractual relationships with suppliers where it is more important to agree joint goals and jointly measure performance against these goals - rather than the buyer simply monitoring the supplier's performance. This requires transparency and a sharing, as appropriate, of business goals. This type of relationship allows for the supplier to monitor performance provided a suitable process of validation is in place. Relationship management is part of the performance monitoring process. It is a key skill for the buyer and can be summarised as the proactive development of particular relationships with suppliers.

Assessment of Supplier Performance:

There are a number of key themes which might be used to assess supplier performance and which might be used as a yardstick for determining whether good practice is being achieved in specific situations. Some examples of such themes (together with their sub-categories) are as follows:

- Product Quality
- MTBF (Mean Time Between Failure)
- Percentage of incoming rejects (delivery accuracy)
- Warranty claims
- Service Quality (against agreed SLAs)
- Call-out time
- Customer service response time
- Performance against agreed delivery lead times
- Relationship/Account Management
- Accessibility and responsiveness of account management
- Commercial
- Costs are maintained or reduced

Monitoring Performance of the Vendor:

As outlined in the Vendor Management, one of the key performance criteria is a process to monitor the performance of the vendor. To do this, it is necessary to have a vendor management scorecard. Regardless of the size of the business, a vendor management scorecard should address the following criteria:

1) The scorecard should measure the key performance indicators (KPI) that the vendor is bound to. An easy way to develop this list is to use the vendor's contract terms as the list of measured items. In other words, build on the effort that was used to develop the terms of the contract to create a list of the most important items to measure with the scorecard.
2) The scorecard should be easy to use by all employees that need to interact with this tool. It does not matter how comprehensive the list of performance indicators is if the tool is too cumbersome and user-unfriendly. Although the scorecard will be complete in its definition of what should be measured, if it is not intuitive, nobody will use it – which defeats the purpose of having a scorecard.
3) The scorecard should have a corresponding timeline and set of milestones that are in sync with the performance indicators. That is, performance is a function of both times as well as quality. The two are not mutually exclusive, and the scorecard should be time, as well as quality performance based.
4) The scorecard should not be a surprise that a business suddenly decides to use with a vendor if they find that the vendor is under-performing. Ideally, the vendor has been made aware that their performance will be monitored and measured throughout the term of the contract. The measurement will be based on consistent and regularly scheduled audits or evaluations that are agreed to by both sides. This awareness should be created during the contract negotiation phase of the vendor relationship.
5) The data that is collected and analyzed by the scorecard should be used to follow up with the vendor. What good is accurate data about the vendors' performance if the business does not take action with the vendor based on the conclusions about vendor performance that the scorecard made visible?

Benefits of Vendor Performance Monitoring:

1) ***Avoid supply chain risk and disruptions*** **–** Vendor performance management provides in-depth visibility into the risk a supplier may pose so you can put measures in place to reduce or eliminate that risk as it relates to your supply chain.
2) ***Protect and improve brand/reputation*** **–** A number of corporate brands have been tarnished by the actions of their suppliers. Vendor performance management can help you track supplier performance against these KPIs which will enable you to enact corrective actions early and keep your brand and reputation strong in the eyes of your customers and partners.
3) ***Avoid costs and achieve savings*** **–** There are a variety of cost factors tracked using Vendor performance management which affect both hard and soft costs. Lack of timely and accurate vendor information can have huge impact on costs and can prevent you from capturing savings.
4) ***Segment and rank vendors*** –Vendor performance management is useful gives procurement groups visibility into specific groups of suppliers and their overall ability to meet your organizations expectations and requirements.
5) ***Collaborate with suppliers*** **–** When you collaborate closely with suppliers you create new value for your business. The data collected through a vendor performance management solution can help to start these conversations because it provides the supplier with a view of what is important to your organization. The results are numerous: continuous improvement of the supply base, creation of realistic contracts based on past performance, more communication with suppliers, formation of common goals, and the establishment of trust.

6) ***Improve internal processes*** **–** Creating a Vendor performance management process is a great step towards optimizing your supplier management program. By utilizing a technology-based solution for Vendor performance management, organizations can achieve a standardized and automated approach for creating scorecards, issuing and tracking scorecards for completion, and in-depth reporting and analysis.