Strategic Supply Chain Management

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Preface

A supply chain is composed of numerous interrelated or interlinked networks and channels which combine to provide products and services to the final consumers. The management of the flow of goods and services is referred to as supply chain management. It includes the movement and storage of raw materials as well as finished goods from point of origin to the point of consumption. Supply chain management also involves the designing, planning, execution, monitoring and control of the activities which take place in the supply chain. It aims to create net value, build a competitive infrastructure, leverage worldwide logistics and synchronize supply with demand. Supply chain management uses tools from various areas such as industrial engineering, marketing, systems engineering, logistics, information technology, operations management, information technology and procurement. This book outlines the processes and applications of supply chain management in detail. Some of the diverse topics covered herein address the varied branches that fall under this category. This textbook will provide comprehensive knowledge to the readers.

A detailed account of the significant topics covered in this book is provided below:

Chapter 1- The system of people, organizations, information, activities and resources which are involved in moving a product or service from supplier to customer is called supply chain. The process which deals with managing the flow of goods and services is termed as supply chain management. This is an introductory chapter which will provide a brief introduction to the significant aspects of supply chain management.

Chapter 2- The detailed organization and implementation of a complex operation is termed as logistics. There are a number of different types of logistics such as global logistics, green logistics, reverse logistics and out-sourced logistics. The topics elaborated in this chapter will help in gaining a better perspective about these types of logistics as well as the logistics information system.

Chapter 3- Transportation is an integral part of a supply chain as the goods need to be moved to the consumption point. Modes of transportation are broadly divided into maritime transport, air freight, and road and rail transport. This chapter closely examines these key modes of transportation as well as transportation management systems to provide an extensive understanding of the subject.

Chapter 4- The process which is involved in determining the ideal quantity as well as timing of inventory in order to align it with production and sales capacity is referred to as inventory planning. Some of the types of inventory which are dealt within it are work in progress inventory and finished goods inventory. The diverse aspects and methods of inventory planning and control have been thoroughly discussed in this chapter.

Chapter 5- A building which is used for storing goods is called a warehouse. Warehouse management refers to the control of the regular operations of a warehouse. Some of the different types of warehouses are private warehouse, public warehouse and bonded warehouse. The topics elaborated in this chapter will help in gaining a better perspective about these types of warehouses and their management.

Chapter 6- The process of a business or organization attempting to acquire goods or services to realize its goals is referred to as purchasing. The management of the process of purchasing and related aspects

in an organization is termed purchasing management. This chapter discusses in detail the objectives and concepts related to purchasing management.

It gives me an immense pleasure to thank our entire team for their efforts. Finally in the end, I would like to thank my family and colleagues who have been a great source of inspiration and support.

Lydia Perry

1

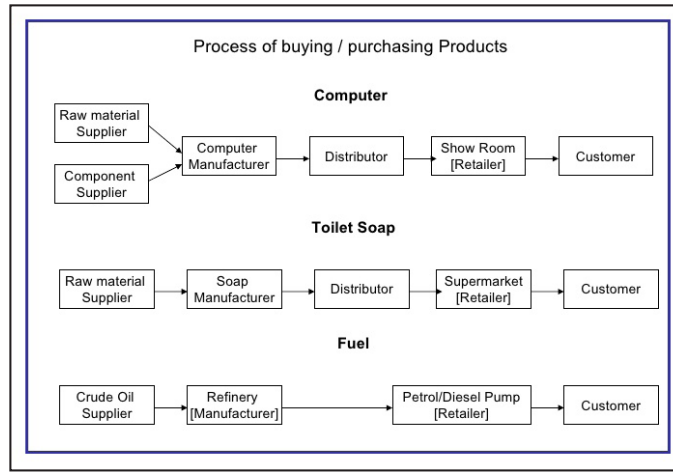
Introduction to Supply Chain Management

The system of people, organizations, information, activities and resources which are involved in moving a product or service from supplier to customer is called supply chain. The process which deals with managing the flow of goods and services is termed as supply chain management. This is an introductory chapter which will provide a brief introduction to the significant aspects of supply chain management.

Supply Chain

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 its original state to the customer.

Supply chains are developed by companies so they can reduce their costs and remain competitive in the business landscape.



A supply chain involves a series of steps involved to get a product or service to the customer. The steps include moving and transforming raw materials into finished products, transporting those products, and distributing them to the end user. The entities involved in the supply chain include producers, vendors, warehouses, transportation companies, distribution centers, and retailers.

The elements of a supply chain include all the functions that start with receiving an order to meeting the customer's request. These functions include product development, marketing, operations, distribution networks, finance, and customer service.

Supply chain management is a very important part of the business process. There are many different

links in this chain that require a lot of skill and expertise. When supply chain management is done effectively, it can lower a company's overall costs and boost profitability. If one link breaks down, it affects the rest of the chain and can be costly to a company.

Flow of Manufacturing Costs

The flow of manufacturing costs refers to the process of using materials and labor to complete a finished product that can be sold to a customer. A supply chain management system can reduce the cost and complexity of the manufacturing process, particularly for a manufacturer who uses many parts.

For example, a clothing manufacturer will first move raw materials into production, such as fabric, zippers, and other pieces used to make clothing. The manufacturer then incurs labor costs to run machinery and perform other work using the materials. Once the items are completed, they must be packaged and stored until they are sold to a customer.

Reliable Suppliers

An efficient supply chain management process requires reliable suppliers. This means they produce a quality product that meets the manufacturer's needs, and the product is delivered on time.

Assume, for example, that XYZ Furniture manufactures high-end furniture, and that a supplier provides metal handles and other attachments. The metal components need to be durable so they can be used on the furniture for years, and the metal parts shipped to XYZ should work as intended. The supplier must be able to fill the manufacturer's orders and ship metal parts to meet XYZ's production needs. These steps are necessary to produce a quality product that is shipped to a customer in a timely manner.

Supply Chain and Deflation

The evolution and increased efficiencies of supply chains have played a significant role in curbing inflation. As efficiencies in moving products from A to B increase, the costs in doing do decrease, which, in turn, lowers the final cost to the consumer. While deflation is often regarded as a negative, supply chain efficiencies are one of the few examples where deflation is a good thing.

Demand Driven Supply Chain

A Demand Driven Supply Chain (DDSC) is a system of coordinated technologies and processes that senses and reacts to real-time demand signals across a network of customers, suppliers, and employees.

Supply and demand are easily matched if demand is steady over time with no change in volume or mix. As soon as demand changes, however, a company must adjust the supply levels accordingly at each step of the supply chain. But given the lag time before changes in demand are detected at various points along the chain, their effects are often amplified when they hit, leading to inventory shortages or pileups. Product promotions—which are becoming increasingly important to retailers—further exacerbate the problem by altering demand. Companies then tend to overcompensate by slowing down or speeding up production lines, which can cause inventory levels to fluctuate wildly. This whipsaw effect is costly and inefficient for all participants.

In the past, matching supply and demand has been extremely difficult given the long reaction time of supply chains and the inherent challenges that arise from communicating across the various IT platforms in a company's extended chain.

A DDSC offers real-time information on current demand and inventory levels to all supply-chain participants so that they can react quickly and effectively—by revising forecasts given to their own suppliers, for instance, or by altering production or distribution plans—when unexpected changes arise. This allows companies to optimize planning, procurement, production, inventory replenishment, and order delivery for better service, higher sales, and lower costs overall.

A DDSC stands on four key pillars:

- Visibility: Demand and inventory levels must be transparent across the supply chain.
- Infrastructure: A robust infrastructure allows supply chain players to adapt quickly to short-term changes in supply and demand.
- Coordination: Tight coordination among all players allows companies to execute flawlessly and cost-effectively.
- Optimization: By optimizing the overall supply-chain performance—and not trying to only reduce costs—companies can deliver the best customer service and still reap major financial benefits.

With a true DDSC, companies can become more responsive to changing market conditions, minimize stockouts and lost sales, maintain lower inventory levels, sharply reduce the costs of expediting orders, and make far better use of their operating assets.

Instead of buying individual suppliers or contract manufacturers, for instance, companies aim for "virtual" integration through a DDSC and gain many of the same benefits. This capability provides even small players with the advantages of vertical integration.

DDSCs are becoming even more critical as supply chains become more global and complex and as new challenges emerge.

Evolving Capabilities

The concept of a DDSC is not new, of course. Toyota's demand-driven kanban system was a key part of its just-in-time (JIT) production system as long ago as the late 1950s and during the 1960s. In the 1970s, the first electronic-data-interchange (EDI) system emerged, allowing multiple companies to connect and share information on a single network. The 1980s saw the first EDI network developed to connect companies in the transportation and financial services industries. By the 1990s, retailers had begun sharing point-of-sale (POS) data on inventory levels with their suppliers. And during the past decade, Procter & Gamble and other leading consumer-products companies raised the bar again by using DDSC strategies—such as actively using POS data in their planning processes—to overcome market challenges, such as SKU proliferation, low-cost competition, and complex global supply chains.

Recent industry and technology changes are driving the DDSC evolution forward. In the past, retailers were reluctant to share real-time POS data with their suppliers.

Now, many companies (including Wal-Mart) provide that information, because they recognize that partnering with suppliers can reduce stockouts, improve service levels, and boost overall sales and customer satisfaction.

Moreover, dramatic improvements in processing speed and computing power can support the rapid, data-intensive processes underlying a DDSC. External storage capabilities—once unavailable or cost-prohibitive—are now virtually unlimited through external platforms and cloud-based systems.

Taken together, these developments are making the DDSC a reality. Now, companies can share information more rapidly and frequently across the entire supply chain—and closely track the ongoing flow of information and products.

Although retailers and consumer products companies are leading the way, other industries with complex products and logistical challenges will likely embrace DDSCs. For instance, manufacturers in the aerospace and defense industry need a high number of very specialized parts at the right time. Since ordering parts in advance and keeping high levels of inventory is costly, the companies must work closely with their suppliers to coordinate deliveries.

Real-time visibility into demand and supply levels allows for unprecedented supply-chain performance. Inventory can be reduced throughout the system with-out hurting service levels. In fact, by lowering costs and improving forecasting accuracy, DDSCs benefit all supply-chain participants: suppliers, manufacturers, retailers, and consumers.

Six Success Factors

Despite the advances in technology and the growing willingness among supply chain players to share information, creating a DDSC is far from a plug-and-play exercise. Old processes, structures, and behaviors can hinder true change and sharply limit results. Getting all supply-chain participants committed and involved is another challenge. Unfortunately, partial adoption leads to only partial benefits. By evaluating the experiences of leading companies that have implemented true DDSCs—and achieved major benefits—we've identified six critical success factors.

Set up the Right Technology Infrastructure

Information is integral to DDSCs. That's why a fast data-exchange platform that can share inventory data in real time among all participants is the backbone of any implementation. Since sharing real-time data across a supply chain generates a high volume of information, a DDSC requires strong processing capabilities. A trusted source of data storage is the third component. Data must be stored in a common location where it can be analyzed and processed. But since this information is strategically critical to companies, all participants must have confidence in its security and reliability. To this end, mechanisms that restrict access to unauthorized parties must be in place. The system's user interface must allow all participants to easily access and interact with the information. And the system must support operations; close coordination is needed between the IT and supply-chain functions to select and roll out the best tools.

The automation of key supply-chain processes can also help overcome behavioral roadblocks that impede DDSC improvements. For instance, a supplier with a DDSC correctly saw that a major retail

customer was ordering the wrong volume of certain products. But the supplier's order-fulfillment staff either didn't believe the recommendations that the DDSC generated or were too risk-averse to push through product volumes that were different from those the retailer had specified. Automat-ing the manual-fulfillment process allowed the system to bypass these human roadblocks and consistently deliver the optimal volume of products.

Finally, a DDSC requires a scalable architecture that is flexible and robust enough to dynamically incorporate needed changes as they arise. In a world where supply chains are constantly evolving, this feature is critical to keep a network updated and to optimize the contribution of each supply-chain participant.

Revisit Data Collection and Analysis

Most companies trying to implement a DDSC will need to collect and share data on inventory levels more frequently and increase the degree of data granularity they analyze. Effective DDSCs typically require information on levels of finished goods and work-in-process inventory at plants. These systems also require SKU-level detail on items in stores, on warehouse shelves, and in distribution centers. Since the exact volume of on-shelf SKUs are hard to measure in a non-DDSC environment, it may need to be deduced on the basis of shipments to a store minus customer sales. It also may be necessary to remap customer information to make it more usable. A major pain point for many consumer-products companies is that POS data are inconsistent from retailer to retailer. As a result, consumer goods companies may have to create a "shadow" replenishment system that captures and translates retailer data into the required format.

Rethink Operations

The classic elements of flexible manufacturing—such as short changeover times, access to temporary labor and external capacity, and the ability to produce small batches cost-effectively—make it easier to respond quickly to spikes and dips in demand, a key aspect of DDSC success. Companies should analyze their production capabilities and remove any obstacles that hinder agility. Otherwise, they will find it necessary to maintain excess inventory as a cushion—even with perfect supply-chain visibility.

Flexible logistics are also critical. Companies need to rethink delivery planning and scheduling so that trucks can be rerouted quickly as needed and logistics are optimized overall. To lower its transportation costs, a food company switched from trucks to rail for much of its delivery. The increased visibility and lower costs of the DDSC allowed the company to consolidate loads and take a longer path to market. Other companies have found that shrinking loads and reducing truck sizes is the right path to follow. The key is to analyze your specific situation and delivery targets and capitalize on the greater visibility you have into inventory levels throughout the supply chain.

Procurement must change the way it operates, too, by finding flexible, highly responsive suppliers to work with and by rethinking inventory "safety cushions" and ordering habits. To get supplier discounts, for instance, procurement typically buys raw materials in bulk, and transport costs are bundled in the price. As a result, large shipments and high inventory levels are often the norm. Instead, companies should consider unbundling transport costs and assessing the tradeoff between smaller, more frequent just-in-time shipments (so as to lower the carrying costs of inventory) and

the penalty associated with sacrificing the volume discount. Another food company realized that its distributors—often located in the company's own distribution centers—kept excessive safety stock. By integrating this stock into its own inventory and then managing it centrally (on the basis of shared information about stock levels), the company reduced overall finished-goods inventory by ten days, freeing up working capital, cutting warehousing costs, and delivering fresher food to customers.

Align Metrics and Incentives

The ultimate goal of a DDSC is to ensure the best service at the lowest cost. To this end, the performance targets and incentives of all supply-chain players must be aligned so that everyone is marching in the same direction. If retail customers are pushing suppliers to only reduce costs, then that's what they will get. But if incentives to improve service levels are also in place—particularly during promotions—then suppliers will pay greater attention to this area. The most common measurements of DDSC success are reductions in inventory levels and working capital, fewer stockouts, faster and more accurate order fulfillment, and higher rates of customer satisfaction. By working to balance all of these objectives in a coordinated manner, all supply-chain parties can reduce their costs, increase sales, and improve profitability. Negative incentives can also be effective. For instance, retailers that want higher order-fulfillment rates can penalize suppliers that fall short by applying fines and charging for lost margin.

Supplier contracts must be modified to guarantee that decisions made to improve the performance of the supply chain as a whole don't hurt individual parties. For instance, if the demand for widgets exceeds the supply because of a successful promotion, the retailer will want the product manufacturer to boost production. But for the manufacturer, increasing output may not be profitable if it requires extra costs, such as additional labor or overtime. If analysis shows that the total incremental profit of selling more units is greater than the total loss for ramping up production, then producing more products is the right decision. But the manufacturer must somehow be compensated for operating at a loss, either through short-term payments or longer-term rewards. Only with transparency and common incentives can end-to-end economics be optimized.

Manage the Cost and Service Trade-offs

Before getting too lean, companies must be clear on the trade-offs of maintaining lower inventory levels. Stockouts can lead to lost sales—a risk that may be unacceptable when gaining market share is a key strategic objective, when service is an important differentiator, or when the window of opportunity to earn a price premium is limited. High-tech companies with a first-mover advantage and pharmaceutical companies with a new blockbuster drug are examples of the latter.

Segmenting products according to specific characteristics can help companies determine the categories in which the benefits of a DDSC would offset the added costs. These categories typically include high-margin products, high-tech or other products with a high cost of obsolescence, food or other perishables for which fresh-ness is critical, products with highly variable demand (such as consumer durables), and products with rapid inventory turnover (such as fast-moving consumer goods). Segmenting customer accounts on the basis of purchase volume and profitability can also reveal where higher service levels could pay off.

The key is being able to quantify the end-to-end costs and benefits of supply chain decisions. Because companies often lack the ability to perform these complex analytics, many default to pure cost reductions without considering the potentially negative impact on revenue or service. A DDSC promotes greater visibility into the bottom-line impact of higher service levels, greater manufacturing flexibility, and lower inventory levels across the supply chain.

Change the Organization and Employees' Behavior

To work, DDSCs require major organizational and behavioral changes. Most companies are reactive order takers: when a retailer orders five cases of soda, that's what the supplier sends. With a DDSC, the supplier's employees can take a more proactive role, suggesting a larger or smaller order if consumption data show the need—or even contacting the retailer before an order has been placed if POS data show that inventory is getting low. Convincing workers to move from a manual order and delivery management process to an automated one is another challenge. As a transition tool, a consumer products company used "deployment adoption reports" to gauge whether employees were following the guidelines of the new DDSC system that had been put in place. By explicitly measuring adoption rates, the company made it clear that the new system was a priority.

Mitigating the Risks

Many companies often cite the following three risks as the reasons they are reluctant to fully commit to a DDSC. However, these risks can usually be offset.

- When inventory is too lean, we have no safety stock to address supply shortages or unexpected spikes in demand. In fact, when all supply-chain players are connected to the same DDSC, better visibility combined with the network effect can improve overall supply-chain performance.

  The network effect allows you to work with multiple suppliers to address any shortages, and the DDSC gives suppliers greater visibility into your real-time needs, so they can react more quickly. And if your suppliers are all part of the same DDSC, their own suppliers will also see what inventory is needed where, so reaction times throughout the network improve. As a result, the risk of stockouts is greatly mitigated.

- We don't want our proprietary data getting into the wrong hands. Although making sensitive information visible to other nodes on the supply chain can create potential points of vulnerability and conflicts of interest, there are ways to increase security. That's why a trusted source of data storage is critical. Since the information of supply chain participants is often strategic, mechanisms that restrict access to unauthorized parties must be in place. Also important are robust contracts to protect the various participants and discourage wrongdoing.

- If we constantly react to short-term changes in supply and demand, we'll lose our focus and incur added costs. To make a DDSC work, companies need very clear product, marketing, and operational strategies to help establish priorities and provide a compass for making decisions. These guidelines help ensure that employees don't mindlessly fulfill every unexpected customer order no matter what the cost.

The various areas of the company must also communicate and work together to proactively shape

demand instead of simply reacting to changes in the marketplace. For instance, manufacturing and procurement must be notified if a sales campaign is about to be launched. Finally, to truly reap the benefits of a DDSC requires that companies make sure their operational processes are as agile as possible.

A DDSC also requires cross-functional coordination within a company. For instance, to eliminate "hidden" supply-chain costs such as expedited deliveries or excess inventory, various functions such as sales, procurement, manufacturing, and order fulfillment must work together and share responsibility for results. Silo-based decision-making rarely considers the end-to-end impact of various actions. Similarly, financial and performance metrics across the company must be re-aligned to encourage close collaboration across functions.

Perhaps the greatest behavioral challenge for all DDSC participants is learning to trust one another. In the consumer goods industry, for example, retailers must be willing to share their data and trust that suppliers will deliver the right merchandise at the right time. Consumer goods manufacturers must trust that retail buyers will reward their performance—and that closer alignment will lead to greater benefits for all.

The Supply Chain Cycle

The processes in a supply chain are divided into a series of cycles, each performed at the interface between two successive stages of a supply chain.

All supply chain processes can be broken down into the following four process cycles:

1. Customer order cycle
2. Replenishment cycle
3. Manufacturing cycle
4. Procurement cycle

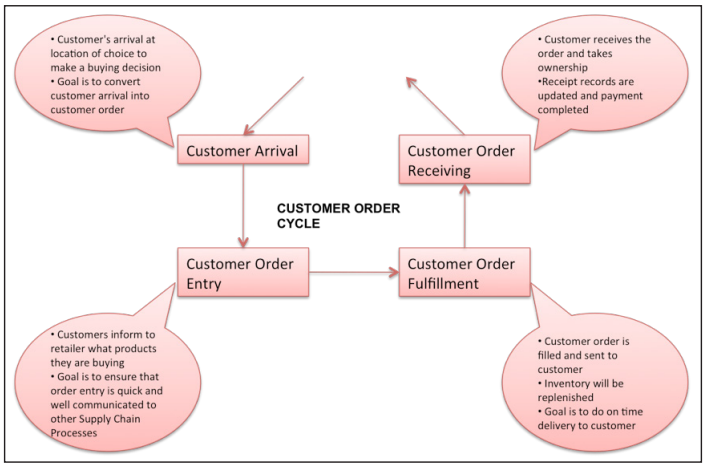
Each cycle occurs at the interface between two successive stages of the supply chain. Not every supply chain will have all four cycles separated. For example, a grocery supply chain in which a retailer stock finished goods inventories and places replenishment orders, which a distributor is likely to have all four cycles separated.

Dell, in contrast, sells directly to customers, thus bypassing the retailer and distributor.

A cycle view of a supply chain is very useful when considering operational decisions because it clearly specifies the rules and responsibilities of each member of the supply chain. The detailed process description of a supply chain in the cycle view forces a supply chain designer to consider the infrastructure required to support these processes.

The cycle view of a supply chain is useful, for example, when setting up information systems to support supply chain operations, as process ownership and objectives are clearly defined.

Customer Order Cycle



The customer order cycle occurs at the customer/retailer interface and includes all processes directly involved in receiving and filling the customer's order.

Typically, the customer initiates this cycle at a retailer site and the cycle primarily involves filling customer demand. The retailer's interaction with the customer starts when the customer arrives or contact is initiated and ends when the customer receives the order.

The processes involved in the customer order cycle include:

- Customer arrival.
- Customer order entry.
- Customer order fulfillment.
- Customer order receiving.

Customer Arrival

The term "customer arrival" refers to the customer's arrival at the location where he or she has access to his or her choice sand makes a decision regarding a purchase. The starting point for any supply chain is the arrival of a customer.

- The customer walks into a supermarket to make a purchase.
- The customer calls a mail order telemarketing center.
- The customer uses the web or an electronic link to a mail order form.

From the supply chain perspective, the key flow in this process is the customer's arrival. The goal is to facilitate the contact between the customer and the appropriate product so that the customer's arrival turns into a customer order.

At a supermarket, facilitating a customer order may involve managing customer flows and product displays. At a telemarketing center, it may mean ensuring that customer does not have to wait on hold for too long.

It may also mean having systems in place so that sales representatives can answer customer queries in a way that turns calls into orders. At a website, a key system may be searched capabilities with tools such as personalization that allow customers to quickly locate and view products that interest them.

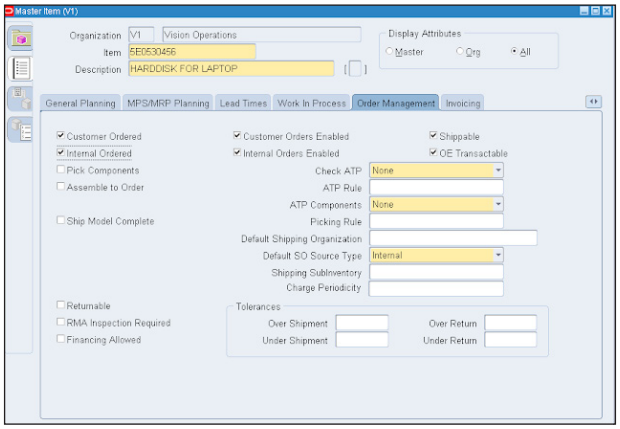
The objective of the customer arrival process is to maximize the conversion of customer arrivals to customer orders.

Customer Order Entry

The term "customer order entry" refers to customers informing the retailer what products they want to purchase and the retailer allocating products to customers. At a supermarket, order entry may take the form of customers loading all items that they intend to purchase onto their carts.

At a mail order firm's telemarketing center or website, order entry involves customers informing the retailer of the items and quantities they selected.

The objective of the customer order entry process is to ensure that the order entry is quick, accurate, and communicated to all other.



Customer Order Fulfillment

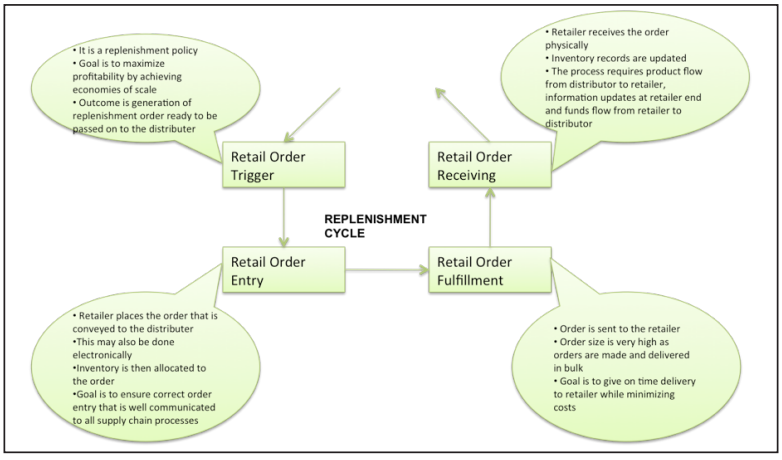
During this process, the customer's order is filled and sent to the customer. At a supermarket, the customer performs this process. At a mail order firm this process includes picking the order from inventory, packaging it, and shipping it to the customer.

All inventories will need to be updated, which may result in the initiation of the replenishment cycle. In general, customer order fulfillment takes place from retailer inventory. In a build-to-order scenario, however, order fulfillment takes place directly from the manufacturer's production line. The objective of the customer order fulfillment process is to get the correct orders to customers by the promised due dates at the lowest possible cost.

Customer Order Receiving

During this process, the customer receives the order and takes ownership. Records of this receipt are updated and payment completed. At a supermarket, receiving occurs at the checkout counter. For a mail order firm, receiving occurs when the product is delivered to the customer.

Replenishment Cycle



The replenishment cycle occurs at the retailer/distributor interface and includes all processes involved in replenishing retailer inventory. It is initiated when a retailer places an order to replenish inventories to meet future demand.

A replenishment cycle may be triggered at a supermarket that is running out of stock of detergent or at a mail order firm that is low in stock of a particular shirt.

The replenishment cycle is similar to the customer order cycle except that the retailer is now the customer. The objective of the replenishment cycle is to replenish inventories at the retailer at minimum cost while providing high product availability.

The processes involved in the replenishment cycle include:

- Retail order trigger
- Retail order entry
- Retail order fulfillment
- Retail order receiving

Retail Order Trigger

As the retailer fills customer demand, inventory is depleted and must be replenished to meet future demand. A key activity the retailer performs during the replenishment cycle is to devise replenishment or ordering policy that triggers an order from the previous stage.

The objective when setting replenishment order triggers is to maximize profitability by ensuring economies of scale and balancing product availability and the cost of holding inventory. The outcome of the retail order trigger process is the generation of a replenishment order that is ready to be passed on to the distributor or manufacturer.

Retail Order Entry

This process is similar to customer order entry at the retailer. The only difference is that the

retailer is now the customer placing the order that is conveyed to the distributor. This may be done electronically or by some other medium. Inventory or production is then allocated to the retail order.

The objective of the retail order entry process is that an order is entered accurately and conveyed quickly to all supply chain processes affected by the order.

Retail Order Fulfillment

This process is very similar to customer order fulfillment except that it takes place at the distributor. A key difference is the size of each order as customer orders tend to be much smaller than replenishment orders.

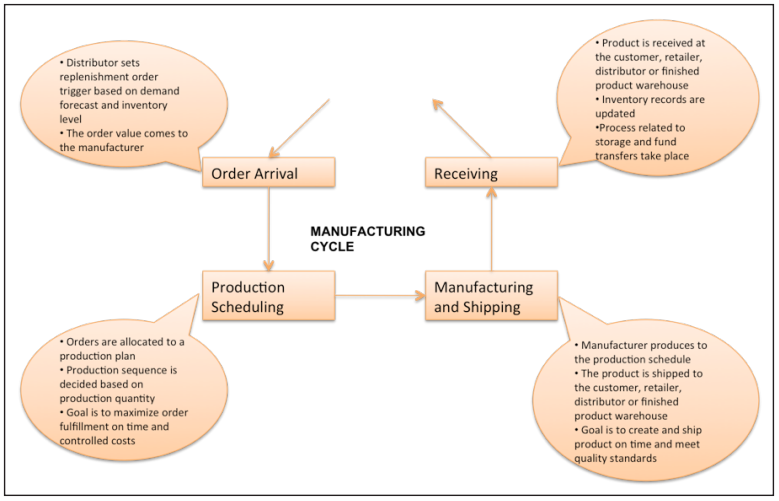
The objectives of the retail order fulfillment are to get the replenishment order to the retailer on time while minimizing costs.

Retail Order Receiving

Once the replenishment order arrives at a retailer, the retailer must receive it physically and update all inventory records. This process involves product flow from the distributor to the retailer as well as information updates at the retailer and the flow of funds from the retailer to the distributor.

The objective of the retail order receiving process is to update inventories and displays quickly and accurately at the lowest possible cost.

Manufacturing Cycle



The manufacturing cycle typically occurs at the distributor/manufacturer (or retailer/manufacturer) interface and includes all processes involved in replenishing distributor (or retailer) inventory.

The manufacturing cycle view of supply chain is triggered by customer orders (as is the case with Dell), replenishment orders from a retailer or distributor (Wal Mart ordering from P&G), or by the forecast of customer demand and current product availability in the manufacturer's finished-goods warehouse.

One extreme in a manufacturing cycle is and integrated steel mill that collects orders that are similar enough to enable the manufacturer to produce in large quantities. In this case, the manufacturing cycle is reacting to customer demand (referred to as a pull process). Another extreme is a consumer products firm that must produce in anticipation of demand.

In this case, the manufacturing cycle is anticipating customer demand (referred to as a push process).

The processes involved in the manufacturing cycle include:

- Order arrival from the finished-goods warehouse, distributor, retailer or customer;
- Production scheduling;
- Manufacturing and shipping;
- Receiving at the distributor, retailer, or customer.

Order Arrival

During this process, a finished-goods warehouse or distributor sets a replenishment order trigger base on the forecast of future demand and current product inventories. The resulting order is then conveyed to the manufacturer.

In some cases, the customer or retailer may be ordering directly from the manufacturer. In other cases, a manufacturer may be producing to stock a finished products warehouse.

In the latter situation, the order is triggered bases on product availability and a forecast of future demand. This process is similar to the retail order trigger process in the replenishment cycle.

Production Scheduling

This process is similar to the order entry process in the replenishment cycle where inventory is allocated to order. During the production scheduling process, orders (or forecasted orders) are allocated to a production plan.

Given the desired production quantities for each product, the manufacturer must decide on the precise production sequence. If there are multiple lines, the manufacturer must also decide which products to allocate to each line.

The objective of the production scheduling process is to maximize the proportion of orders filled on time while keeping costs down.

Manufacturing and Scheduling

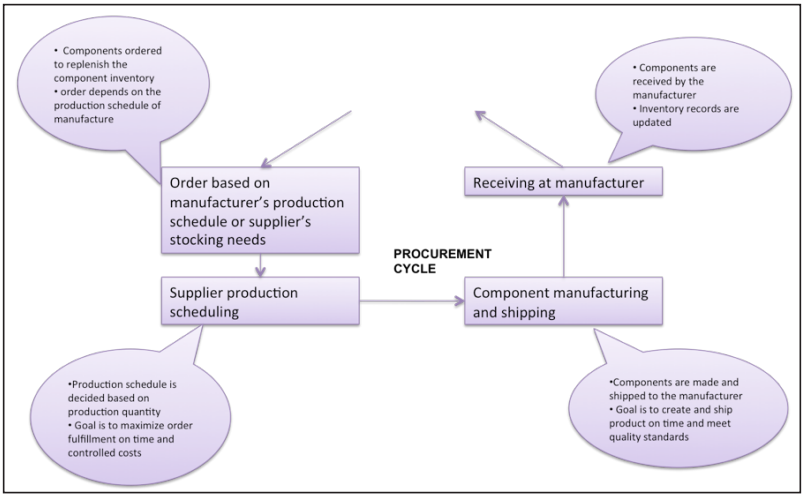
This process is equivalent to the order fulfillment process described in the replenishment cycle. During the manufacturing phase of the process, the manufacturer produces to the production schedule. During the shipping phase of this process, the product is shipped to the customer, retailer, distributor, or finished product warehouse.

The objective of the manufacturing and shipping process is to create and ship the product by the promised due date while meeting quality requirements and keeping costs down.

Receiving

In this process, the product is received at the distributor, finished-goods warehouse, retailer, or customer and inventory records are updated. Other processes related to storage and fund transfers also take place.

Procurement Cycle



The procurement cycle occurs at the manufacturer/supplier interface and includes all processes necessary to ensure that materials are available for manufacturing to occur according to schedule. During the procurement cycle, the manufacturer orders components from suppliers that replenish the component inventories. The relationship is quite similar to that between a distributor and manufacturer with one significant difference.

Whereas retailer/distributor orders are triggered by uncertain customer demand, component orders can be determined precisely once the manufacturer has decided what the production schedule will be. Component orders depend on the production schedule.

Thus, it is important that suppliers be linked to the manufacturer's production schedule. Of course, if a supplier's lead times are long, the supplier has to produce to forecast because the manufacturer's production schedule may not be fixed that far in advance.

In practice, there may be several tiers of suppliers, each producing a component for the next tier. A similar cycle would then flow back from one stage to the next.

Ways to Reduce Total Order Cycle Time

1. Reduce travel time:

> One of the simplest ways that you can shorten your cycle time is to reduce the distance traveled to complete a task. Because time spent walking is time not spent on other, value-adding tasks, simply doing this can have a big impact on your efficiency and productivity. Travel is the largest component in order picking cycle time. If you can cut down on the distance traveled, you can significantly reduce the overall cycle time.

You can accomplish this by establishing more efficient paths and prioritizing early outs. Slotting SKUs based upon picking ability will also reduce idle time, making your workforce more efficient. If you have all of your SKU's being picked from pallets and many are slow movers, you can save space and travel distance with carton flow rack or shelving. Either can face 6-30 SKUs in an eight-foot-wide bay. So in 8 feet of picking travel, you can pass 6-30 SKUs instead of just 2 stored on pallets.

2. Shift resources around the facility to the areas of the most activity:

It makes sense that resources should be placed where they are needed within your facility, but this is often overlooked. By grouping products near the areas with which they will be used, you can cut down on a lot of unnecessary travel time within your facility while also reducing the risk of accidents that can happen during transport.

Resource location can especially be a problem when smaller operations grow and add new processes or departments: As the business grows and new processes are implemented, the placement of resources must also be adjusted to reduce inefficiencies. Whenever a new process, product, or workflow is implemented, it is recommended that you evaluate the placement of your resources to correct issues before they become major headaches.

3. Throttle orders to areas that are underutilized and which have idle resources:

You wouldn't wash your kitchen floor while someone is cooking dinner, right? Not only would it make both jobs more difficult and less efficient, but it also makes it much more likely that mistakes will happen, which you'll then have to go back and correct. This same basic idea can easily be applied to your order fulfillment.

When you are processing your orders, your goal is to make the picking, packing, and shipping as easy as possible. So why would you dump group orders into an area that already has a significant amount of work happening in it? Doing so just increases the chances that orders will be incomplete, damaged, or otherwise mismanaged because you've got too much going on in too small of an area.

By throttling your orders to areas that are underutilized, you can increase the efficiency of all areas by keeping things simpler and more organized. Order management systems can help you identify the areas of your operations that are underutilized at any given time so that you can funnel your orders and resources to them efficiently and seamlessly. Another way to spread the workload across physical areas, and reduce bottlenecks, is to spread faster-moving products across the entire picking area. It should increase the efficiency of the entire picking operation. In order to gain these efficiencies, you need to know if your order profile is right for this type of strategy.

4. Determine and understand order profiles:

If you can understand your order profiles, then you can develop strategies that will allow you to more efficiently fill and ship them. Utilizing wave picking is one way to boost your efficiency, as it will allow you to create a workflow that will better route personnel and resources. By picking groups according to their common packaging characteristics or like products, you can reduce cut down picking travel time.

Of course, every business has its own unique aspects, and its own challenges, which should be evaluated when establishing a picking strategy. For example, if you have many lines in a typical order and a wide array of products (fast and slow movers), you should ask yourself if there is an opportunity to more efficiently route the orders or slot your products. These questions will be specific to your operations and challenges but can go a long way in making your processes more efficient and reducing your total order cycle time.

5. Implement technology that will prevent stock outs and prioritize replenishments before they occur:

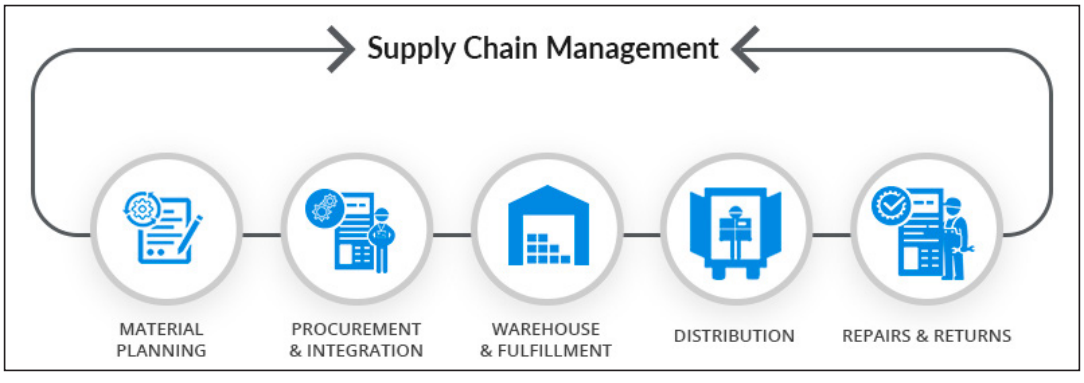
One of the most detrimental setbacks to production (and thus your total order cycle time) is when you run out of stock. In the worst-case scenario, this can completely shut down your operations while you wait for a new shipment of the needed material or product—severely cutting into your overall efficiency and ability to meet your customers' expectations of timely and accurate delivery.

You can avoid stock outs by implementing technologies that automatically track inventory and notify you when a reorder is necessary—before you actually run out. Warehouse control systems or warehouse management systems can prevent the loss of time and productivity that will occur if a forward picking location is empty before it can be restocked. They have configurable minimum and maximum inventory levels so replenishments are automatically scheduled before the picking location is empty.

Supply Chain Management

Supply chain management (SCM) is the process and activity of sourcing the raw materials or components an enterprise needs to create a product or service and deliver that product or service to customers.

The goal of SCM software is to improve supply chain performance. Timely and accurate supply chain information allows manufacturers to make and ship only as much product as can be sold. Effective supply chain systems help both manufacturers and retailers reduce excess inventory. This decreases the cost of producing, shipping, insuring, and storing product that cannot be sold.



Extended Supply Chain

The extended supply chain includes all companies that contribute to a product. This means that the extended supply chain includes the suppliers to your suppliers as well as the customers of your customers.

When companies encounter supply chain problems, the initial action is to ask the supplier about the situation. However, organizations that monitor the extended supply chain have the option of reaching back through the primary supplier to the company that supplies components to the primary supplier. As an example, if a popular baseball hat is not available from the manufacturer, the normal reaction of the store manager is to contact the manufacturer. However, if the retailer monitors the extended supply chain, the store manager would know the manufacturer was having trouble getting the brim. If it appears that additional brims will not be available to the manufacturer quickly, the retailer would have time to seek a different supplier.

Planning

This is one of the most important stages. Before the beginning of the entire supply chain, it is essential to finalise the strategies and put them into place. Checking the demand for the product or service, checking the viability, costing, profit, and manpower etc. are vital. Without a proper plan or strategy in place, it will be well-nigh impossible for the business to achieve effective and long term benefits. Therefore, enough time has to be devoted to this phase. Only after the finalisation of the plans and consideration of all pros and cons, can one proceed further. Every business needs a plan or blueprint or a roadmap based on which the strategies are made. Planning helps to identify the demand and supply trends in the market and this, in turn, helps to create a successful supply chain management system.

Information

The world today is dominated by a continuous flow of information. In order to be successful, it is essential that a business stays abreast with all the latest information about the various aspects of its production. The market trends of supply and demand for a particular product can be best understood if the information is properly and timely disseminated through the many levels of the business. Information is crucial in a knowledge-based world economy, and ignorance about any aspect of business may actually spell doom for the prospects of the business.

Source

Suppliers play a very crucial role in supply chain management systems. Products and services sold to the end user are created with the help of different sets of raw materials. It is therefore necessary that suitable quality raw materials are procured at cost effective rates. If a supplier is unable to supply on time, and within the stipulated budget, the business is bound to suffer losses and gain a negative reputation.

It is crucial that a company procures good quality resources so it can create good quality products and maintain its reputation in the market. This necessitates a strong role for suppliers in the supply chain management system.

Inventory

For a highly effective supply chain management system it is essential that an inventory is kept and thoroughly maintained. An inventory means the ready list of items, raw materials and other essentials required for the product or service. This list has to be regularly updated to demarcate available stock and required stock. Inventory management is critical to the function of supply chain management, because without proper inventory management the production, as well as sale of the product, is not possible. Businesses have now started to pay more attention to this component simply because of its impact on the supply chain.

Production

Production is one among the most important aspects of this system. It is only possible when all the other components of the supply chain are in tandem with each other. For the process of production to start it is essential that proper planning and supplies of goods, as well as the inventory, are well maintained. The production of goods is followed by testing, packaging and the final preparation for delivery of the finished product.

Location

Any business, that wants to survive as well as flourish, needs a location which is profitable for the business. Take for example; a carbonated drink factory is set up in an area where water supply is scarce. Water is a basic necessity of such business. The lack of water could hamper the production as well as affect the goodwill of the company. A business cannot survive if it has to share an already scarce raw material with the community. Hence, a suitable location, which is well connected, and very close to the source of essential resources for production is vital to a business' prosperity. The requirement and availability of manpower must also be considered while setting up a business unit.

Transportation

Transportation is vital in terms of carrying raw materials to the manufacturing unit and delivering the final product to the market. At each stage, timely transportation of goods is mandatory to sustain a smooth business process. Any business which pays attention to this component, and takes good care of it, will benefit from the production and transportation of its goods on time.

It is essential that a company works towards a safe and secure transportation process. Be it in-house or a third-party vendor, the transportation management system must ensure zero damage and minimal loss in transit. Well-managed logistics systems along with flawless invoicing are the two pillars of secure transportation.

Return of Goods

Among the various components that create a strong supply chain is the facility for the return of faulty/malfunctioning goods, along with a highly responsive consumer grievance redress unit.

No one is infallible. Even a machine may malfunction once in a million times if not more. As a part of a strong business process, one may expect the return of goods under various circumstances.

Even the best quality control processes may have unavoidable momentary lapses. In the case of such lapses, inevitably followed by consumer complaints, a business must, instinctively, recall the product and issue an apology. This not only creates a good customer bonding, but also maintains goodwill in the long run.

Businesses that have a strong supply chain management system in place always put great emphasis on all the components listed, and also ensure that management, as well as the teams at various levels, play by the rules. Profit is the bottom line and to make sure that the business achieves it, it is essential that the supply chain does not have any gaps. Any snag should be dealt with immediately and the weak links repaired or removed.

Demand and supply are two of the most important aspects of a business. For any business to be successful, trends, with respect to demand and supply, need to be studied carefully while implementing an effective plan of execution. A supply chain management system is required not just for the timely manufacture of goods; it is also a very critical system for ensuring that consumer requirements are met effectively.

Elements of Supply Chain Management

Supply chain management combines supply and demand management. It refers to the planning and managing all activities that are involved in sourcing, procurement, logistics, and conversion. The main elements of supply chain management are:

Demand Management

Demand management is a very important element in supply chain management activities. The company mainly focuses on meeting the needs of the customers more than the production process.

The company that is involved in the supply chain will make the partners aware of the existing customer's needs thereby encouraging the business to increase the quality of the supply thereby adding value to the finished product. The business can improve the competition by having awareness of the customers.

Communication

Communicating effectively is yet another important element of supply chain management. Communication will help to improve its operations effectively which enables all members to share

information regarding demand and operations. Communication will help to keep all members who are involved in the contribution of the supply chain, informed about the development.

This will enable them to adjust their operations that will meet the changing demand. By communicating effectively, all members will be able to respond quickly to the changing business opportunities, get new products to market on the fast track and then increase supply levels after a marketing campaign.

Integration

By integrating the supply chain process, the inventory costs will be reduced. Manufacturers will share the current information that is in high demand and then routes their product to warehouses. This will reduce the company's costs drastically which enables the company to offer feasible pricing to the customers.

In order to achieve proper integration, companies must be able to develop a network that will enable all members to access and share information regarding supply and demand. The networks will be based on Internet so that communication among all members will become easier even though the internal networks are different.

Collaboration

Yet another element in supply chain, collaboration, which will help to strengthen the relation and communication between members, improve teamwork and then help each other to increase their businesses.

Many lead companies run programs and training that focus on the supply chain to improve the partners involved in supply chain market and the product knowledge. They will also start new product development programs with specialized partners who will contribute knowledge of business, materials, and components.

Role of the Supply Chain in Distribution

Companies purchase products from the manufacturer as there is a requirement for routine inflow of products at regular intervals. When a manufacturer of the product is concerned, the factories will manufacture the product or goods and then send it in large quantities.

The manufacturers will not prefer to keep the finished products with them as they will target on selling the product and then go about for manufacturing the next set.

The manufacturers will also not prefer to sell the products to small users or to individual customers who will normally buy less as compared to the distributor. Selling to customers individually also involves in taking orders, shipping, creating invoice, payment collection etc. Hence in order to avoid such issues, organized channels called as individual distributors are set by the production facilities.

Most of the manufacturers will have five to ten production centers and warehouses. A distribution network can contain thousands of locations that will have inventory, staffed people, and product experts. These distribution centers will be close to customers that provide them with the products and services that the customers require.

Hence, when the individual customer places the order with the distributor, a distributor can examine the usage patterns and then recommend products that will last longer which cannot be done by a manufacturer who ships directly. When there is a requirement of service of a product, the manufacturer will cater to the requirement by sending a requirement which will be charged from the customer. When the customer deals with the local distributor, the distributor is well aware of the customer's purchase and usage and will be able to guide the service required.

Buying directly from a manufacturer does not have a lower price or service for an individual customer. An organized supply chain has been created for this reason and it is considered as the most efficient and effective way to get a product from the manufacturer to the customer. By making use of a distributor as much as possible, customers can achieve the lowest cost solution and also meet their needs.

Importance of Supply Chain Management

Boost Customer Service

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

Reduce Operating Costs

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

Improve Financial Position

- Increases Profit Leverage: Firms value supply chain managers because they help control and reduce supply chain costs. This can result in dramatic increases in firm profits. For instance, U.S. consumers eat 2.7 billion packages of cereal annually, so decreasing U.S. cereal supply chain costs just one cent per cereal box would result in $13 million dollars saved industry-wide as 13 billion boxes of cereal flowed through the improved supply chain over a five year period.
- Decreases Fixed Assets: Firms value supply chain managers because they decrease the use of large fixed assets such as plants, warehouses and transportation vehicles in the supply chain. If supply chain experts can redesign the network to properly serve U.S. customers from six warehouses rather than ten, the firm will avoid building four very expensive buildings.
- Increases Cash Flow: Firms value supply chain managers because they speed up product flows to customers. For example, if a firm can make and deliver a product to a customer in 10 days rather than 70 days, it can invoice the customer 60 days sooner.

Supply chain management also plays a critical role in society. SCM knowledge and capabilities can be used to support medical missions, conduct disaster relief operations, and handle other types of emergencies.

Whether dealing with day-to-day product flows or dealing with an unexpected natural disaster, supply chain experts roll up their sleeves and get busy. They diagnose problems, creatively

work around disruptions, and figure out how to move essential products to people in need as efficiently as possible.

Societal Roles of SCM

Ensure Human Survival

- SCM Helps Sustains Human Life: Humans depend on supply chains to deliver basic necessities such as food and water. Any breakdown of these delivery pipelines quickly threatens human life. For example, in 2005, Hurricane Katrina flooded New Orleans, LA leaving the residents without a way to get food or clean water. As a result, a massive rescue of the inhabitants had to be made. During the first weekend of the rescue effort, 1.9 million meals and 6.7 million liters of water were delivered.
- SCM Improves Human Healthcare: Humans depend on supply chains to deliver medicines and healthcare. During a medical emergency, supply chain performance can be the difference between life and death. For example, medical rescue helicopters can save lives by quickly transporting accident victims to hospitals for emergency medical treatment. In addition, the medicines and equipment necessary for treatment will be available at the hospital as a result of excellent supply chain execution.
- SCM Protects Humans from Climate Extremes: Humans depend on an energy supply chain to deliver electrical energy to homes and businesses for light, heat, refrigeration and air conditioning. Logistical failure (a power blackout) can quickly result in a threat to human life. For example, during a massive East Coast ice storm in January 1998, 80,000 miles of electrical power lines fell resulting in no electricity for 3,200,000 Montreal, Quebec residents. Due to extreme cold, 30 died and 25% of all Quebec residents left home to seek heated shelter. In addition, economic costs included $3 billion in lost business, $1 billion in home damage and $1 billion in government expenditures.

Improve Quality of Life

- Foundation for Economic Growth: Societies with a highly developed supply chain infrastructure (modern interstate highway system, vast railroad network, numerous modern ports and airports) are able to exchange many goods between businesses and consumers quickly and at low cost. As a result, the economy grows. In fact, the one thing that most poor nations have in common is no or a very poorly developed supply chain infrastructure.
- Improves Standard of Living: Societies with a highly developed supply chain infrastructure (modern interstate highway system, vast railroad network, numerous modern ports and airports) are able to exchange many goods between businesses and consumers quickly and at low cost. As a result, consumers can afford to buy more products with their income thereby raising the standard of living in the society. For instance, it is estimated that supply chain costs make up 20% of a product's cost in the U.S. but 40% of a product's cost in China. If transport damage is added in, these costs make up 60% of a product's cost in China. The high Chinese supply chain cost is a major impediment to improving the standard of living for Chinese citizens. Consequently, China has embarked on a massive effort to develop its infrastructure.

- Job Creation: Supply chain professionals design and operate all of the supply chains in a society and manage transportation, warehousing, inventory management, packaging and logistics information. As a result, there are many jobs in the supply chain field. For example, in the U.S. logistics activities represent 9.9% of all dollars spent on goods and services in 2006. This translates into 10,000,000 U.S. logistics jobs.
- Opportunity to Decrease Pollution: Supply chain activities require packaging and product transportation. As a by-product of these activities, some unwanted environmental pollutants such as cardboard waste and carbon dioxide fuel emissions are generated. For example, paper and paperboard accounted for 34% of U.S. landfill waste in 2005. Only 50% of the 84 million tons of paper and paperboard waste were recycled. Also, carbon dioxide emissions from transportation accounted for 33% of total U.S. CO_2 emissions in 2005. As designers of the network, supply chain professionals are in a key position to develop more sustainable processes and methods.
- Opportunity to Decrease Energy Use: Supply chain activities involve both human and product transportation. As a by-product of these activities, scarce energy is depleted. For example, currently transportation accounts for 30% of world energy use and 95% of global oil consumption. As designers of the network, supply chain professionals have the role of developing energy-efficient supply chains that use fewer resources.

Protect Cultural Freedom and Development

- Defending Human Freedom: Citizens of a country depend on military logistics to defend their way of life from those who seek to end it. Military logisticians strategically locate aircraft, ships, tanks, missiles and other weapons in positions that provide maximum security to soldiers and other citizens. Also, superior logistics performance yields military victory. For example, the B-2 Stealth Bomber is able to deliver bombs to target without being detected by enemy radar.
- Protects Delivery of Necessities: Citizens of a country depend on supply chain managers to design and operate food, medicine and water supply chains that protect products from tampering. Sophisticated packaging techniques, state of the art surveillance cameras, global positioning systems and RFID inventory tracking are some of the methods used to deter terrorists from accessing these vital logistics systems.

Supply Chain Strategy

Supply Chain Strategy or Strategic Supply Chain Management is defined as: “A strategy for how the supply chain will function in its environment to meet the goals of the organization’s business and organization strategies”.

The strategic supply chain processes that management has to decide upon will cover the breadth of the supply chain. These include product development, customers, manufacturing, vendors, and logistics.

Product Development

Senior management has to define a strategic direction when considering the products that the company should manufacture and offer to their customers.

As product cycles mature or products sales decline, management has to make strategic decisions to develop and introduce new versions of existing products into the marketplace, rationalize the current product offering, or developing a new range of products and services.

These strategic decisions may include the need to acquire another company or sell existing businesses. When making these strategic product development decisions, the overall objectives of the firm should be the determining factor.

Customers

At the strategic level, a company has to identify the customers for its products and services. When company management makes strategic decisions on the products to manufacture, they need to then identify the key customer segments where company marketing and advertising will be targeted.

Manufacturing

At the strategic level, manufacturing decisions define the manufacturing infrastructure and technology that is required. Based on high-level forecasting and sales estimates, company management has to make strategic decisions on how products will be manufactured.

The decisions can require new manufacturing facilities to be built or to increase production at existing facilities. However, if the overall company objectives include moving manufacturing overseas, then the decisions may lean towards using subcontracting and third-party logistics.

As environmental issues influence corporate policy to a greater extent, this may influence strategic supply chain decisions with regards to manufacturing.

Suppliers

Company management has to decide on the strategic supply chain policies with regards to suppliers. Reducing the purchasing spends for a company can directly relate to an increase in profit and strategically there are a number of decisions that can be made to obtain that result.

Leveraging the total company's purchases over many businesses can allow company management to select strategic global suppliers who offer the greatest discounts. But these decisions have to correspond with the overall company objectives.

If a company has adopted policies on quality, then strategic decisions on suppliers will have to fall within the overall company objective.

Logistics

As well as strategic decisions on manufacturing locations, the logistics function is key to the success of the supply chain. Order fulfillment is an important part of the supply chain and company management needs to make strategic decisions on the logistics network.

The design and operation of the network have a significant influence on the performance of the supply chain. Strategic decisions are required in warehouses, distribution centers which transportation modes should be used. If the overall company objectives identify the use of more third-party subcontracting, the company may strategically decide to use third-party logistics companies in the supply chain.

Strategic decisions determine the overall direction of the company's supply chain. They should be made in conjunction with the company's overall objectives and not biased towards any particular product or regional location.

These high-level decisions can be refined, as required, to the specific needs of the company at the lower levels which allow for tactical and operational supply chain decisions to be made.

Elements of a Supply Chain Strategy

Inventory Management Demand and Supply Planning

In an extended network across the product life cycle, there are different types of inventory, including work in progress, finished goods in bulk state, packaged, and saleable units.

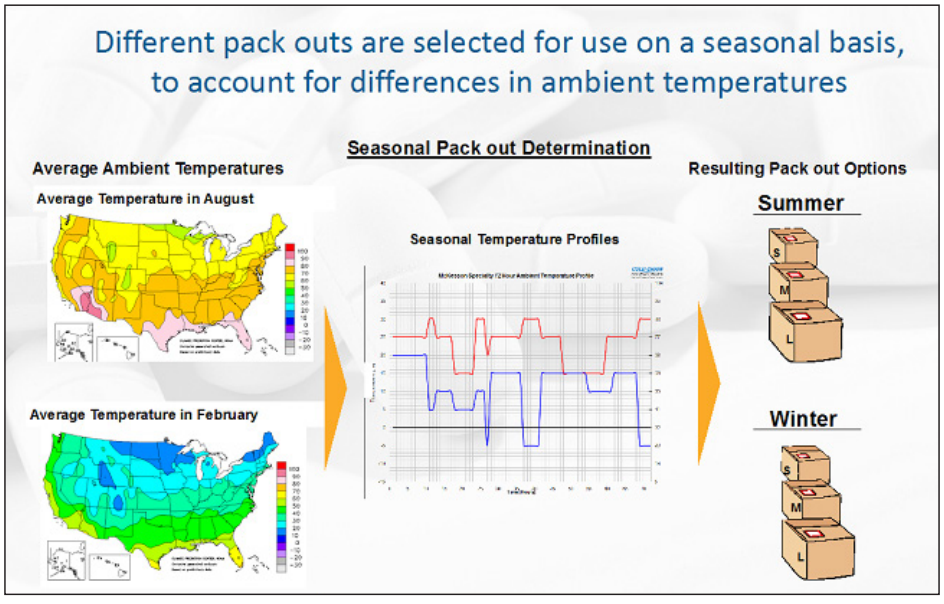
For new products where the demand is relatively unknown—or unpredictable—maintaining a balance between supply and demand requires close collaboration between all participants in the chain of care. It is important to define functional requirements to enable collaboration across a network of partners.

Managing the disposition of inventory to support different packaging, labeling, or material handling requirements requires an understanding of the nuances of risks and constraints within the operational environments of these stakeholders. Different fulfillment models should be reviewed with stakeholders, ensuring ease of access to product. This can be facilitated through a combination of inventory management strategies, including—but not limited to—provider managed inventory and consignment inventory.

Capabilities required for inventory management and control should be clearly defined in user requirements specifications (URSs) across the value chain from production of the drug substance to drug product filling and packaging operations (unit of use) through final packaging, labeling, and delivery to the clinical setting and point of patient.

Packaging Strategy

The packaging strategy is a subset of the overall business and operations policy and the related supply chain strategy. Packaging is an integral part of each product and, in addition to aesthetics, marketing functions, and brand awareness, should preserve the stability and integrity of the packaged unit. In addition, in the case of products that are susceptible to environmental conditions, packaging should include additional controls to ensure product integrity.



Development and implementation of the packaging strategy should integrate best practices for supply chain, one of which is postponement at the packaging level. An example of this is the shipment and storage of product in a work in process state, with final packaging (unit, composite, or other package configuration) taking place at time of order fulfillment. The advantage of such a strategy is that it provides a higher degree of flexibility, enabling pack to market or pack to patient, including any special labeling or package inserts.

A consideration of different alternatives for postponement at the final packaging level includes (but is not limited to):

- Regulatory restrictions,
- Inventory management and valuation,
- Product risk during handling.

A further consideration is the requirement for item-level serialization in compliance with regulations within the U.S. EU, and other countries. A holistic approach, including definition in terms

of package inserts required, labeling for market, serialization for compliance, and any product protective measures, such as tamper-evident seals and sensors, should be taken. The packaging strategy should be addressed by a cross functional team that includes sales/marketing, quality, regulatory, logistics, and customer advocates. Evaluation of requirements should include:

- Product level packaging, labeling: Single unit package as well as bulk packaging requirements.
- Shipment packaging: Transportation-related requirements based on product profile, risk assessment, and time and temperature restrictions/risk factors.

Shipment packaging evaluation and specification should take place during development of the packaging strategy, identifying hazards that should be planned for at both a regional, global, and seasonal level. This will provide detail that should be integrated into standard operating procedures and controls for shipment planning and execution.

Storage and Delivery Strategy

Mature products with known patient populations and related demographic profiles are relatively simple to plan for. In the case of new products, in particular novel therapies with small patient populations, limited point of care locations, and an evolving patient standard of care, it is critical to ensure that the distribution strategy supports the overall market message and patient experience. Different demand models should be considered to establish the most efficient and cost-effective network design for product storage and distribution.

In an outsourced model where the order fulfillment takes place within the distribution network, there are many considerations. This is an area that has grown in importance and is currently the focus of Guidance for Good Distribution Practices (GDP). These guidelines, which extend the controls of GMP into the distribution environment, include approaches that should be adhered to.

A key element of this is trading partner and shipment qualification, including:

- Supplier qualification: During the product life cycle, there are a variety of suppliers of raw materials and packaging components, as well as contract research and manufacturing organizations that contribute to the overall composition and configuration of the final drug product. During the scale up to commercial production, it is necessary to re-evaluate the current supplier landscape and identify any risk factors as well as additional requirements. In many cases, there will be sole and single source suppliers that may not be able to support the projected growth for commercialization. When evaluating alternative suppliers, it is appropriate to establish required service levels based on projected demand and associated supply patterns.
- Customer qualification: During the establishment of the commercial supply chain structure, it is necessary to establish customer master files with associated authorities and credit arrangements. Additional requirements for supply chain security include the qualification and authentication of all entities procuring pharmaceutical and biopharmaceutical products.

- Carrier qualification: Additional security requirements, in addition to service level agreements established to ensure shipment integrity, should be complied with. This will ensure that all carriers that are engaged in the transportation of pharmaceutical products are authorized and legitimate. Based on the nature of the products, for example, controlled substances—additional screening and qualification may apply for carriers.
- Shipment planning and packaging qualification/stability studies: For every shipment where there is a variation from existing shipping lanes, modes of transportation, or product profiles, it is necessary to perform a risk assessment as part of the shipment planning process. Factors for evaluation and qualification include shipment packaging, labeling, time and temperature management, and alerting.

Regulatory Compliance

The life sciences industry is highly regulated, with close cooperation between regulatory bodies and inspectors at a global level. The increase in biological drug substances and products, many of which are derived from a combination of human and animal cells, blood products, and other biological elements, has its own special challenges. Many of these materials are regulated by agencies and regional entities. When developing the supply chain strategy, it is important to consider any local or regional regulations that need to be complied with—and any global differences in associated product descriptions with related literature and support materials.

This is especially important when crossing geographical boundaries where there are compliance requirements beyond healthcare regulators. Vigilance across the extended pharmaceutical supply chain, in response to an increase in product adulteration, counterfeiting, and diversion, has resulted in a variety of regulations that need to be complied with. One of the key requirements is additional information to facilitate authentication across the chain of custody, using a combination of serialized labels and track and trace technology.

Regulators provide guidance and oversight to ensure the safe and secure production, packaging, storage, and distribution of life sciences products. However, the ultimate responsibility is on the marketing authorization holder.

Supply Chain Safety and Security

One of the major concerns for both life sciences industry regulatory bodies and customs and border protection agencies is the quality and efficacy of the drug materials and products that are manufactured and delivered to patients.

In addition to the complex environment for storage, distribution, and, ultimately, reimbursement, there are additional challenges for both pharmaceutical and biotech products. Increasing concerns related to counterfeiting, adulteration, and diversion have resulted in additional regulations that must be complied with.

Financial Models

The flow of materials is related to the flow of cash and change of ownership across the extended chain of custody from shipment of product to delivery to final point of care. Supply chain-related

events and associated transactions should be mapped out to identify specific triggers and information requirements across the overall distribution network.

Supply chain models should be developed to identify any risks, constraints, or areas of opportunity for the flow of cash in support of the order-to-cash cycle. It is recommended that this activity include a cross functional team of stakeholders and subject matter experts, to include, but not limited to:

- Finance,
- Information technology,
- Sales and marketing,
- Legal,
- Quality,
- Supply chain and manufacturing operations.

Further considerations for different ownership and distribution models should be evaluated, always ensuring that the key objectives of the business strategy are in alignment with these financial models.

Data Integrity and Control

There are many challenges in a multidimensional and multi-echelon supply chain, not the least of which is the exchange and retention of timely and accurate information. In common with the flow of goods and cash, the flow and sharing of both transactional and event-level data are key functions of an effective supply chain. From initiation of the shipment plan to each of the process steps across the chain of custody, there are incremental references and time stamps that should be captured, retained, and shared. Data sources, as well as the timeliness and accuracy of data, should be included in a detailed end-to-end process review. Although ideally the generation of data should be an automated process, the reality is that there will be a variety of data that is shared using EDI transaction-level files and event and exception data generated by data loggers and tracking devices, as well as data that is captured in the field using handheld devices, log books, or manual data entry.

Data integrity is an area of concern for regulators, and diligence in data management is critical. In addition to the legacy systems within the ecosystem across the supply chain, there are specialized applications that are available to integrate data across the shipment and product life cycle. Known as orchestration platforms, these independent applications provide enhanced capabilities for command and control at the execution level—while capturing additional data points for operational analysis and review.

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2

Logistics: An Integrated Study

The detailed organization and implementation of a complex operation is termed as logistics. There are a number of different types of logistics such as global logistics, green logistics, reverse logistics and out-sourced logistics. The topics elaborated in this chapter will help in gaining a better perspective about these types of logistics as well as the logistics information system.

Logistics refer to the overall process of managing how resources are acquired, stored, and transported to their final destination. Logistics management involves identifying prospective distributors and suppliers and determining their effectiveness and accessibility. Logistics managers are referred to as logisticians.

"Logistics" was initially a military-based term used in reference to how military personnel obtained, stored and moved equipment and supplies. The term is now used widely in the business sector, particularly by companies in the manufacturing sectors, to refer to how resources are handled and moved along the supply chain.

Logistics in Management and Business

In simple terms, the goal of logistics management is to have the right amount of a resource or input at the right time, getting it to the appropriate location in proper condition and delivering it to the correct internal or external customer.

For example, in the natural gas industry, logistics involves managing the pipelines, trucks, storage facilities and distribution centers that handle oil as it is transformed along the supply chain. An efficient supply chain and effective logistical procedures are essential to reduce costs and to maintain and increase efficiency. Poor logistics leads to untimely deliveries, failure to meet the needs of clientele, and ultimately causes the business to suffer.

The concept of business logistics has been transformed since the 1960s. The increasing intricacy of supplying companies with the materials and resources they need and the global expansion of supply chains has led to a need for specialists known as supply chain logisticians.

Special Considerations

The tasks for which a logistician is responsible vary depending on the business. Primary responsibilities include overseeing and managing inventory by arranging for appropriate transportation and adequate storage for the inventory.

A qualified logistician plans out these and other aspects of the logistics process, coordinating the steps as inventory and resources move along the supply chain.

Types of Logistics

Global Logistics

Global logistics refers to the flow of resources and information between a business or source and the consumer. It is a management process that analyzes how resources are acquired, stored and transported. To be effective, the process requires detailed analysis of a company's entire supply chain.

Global logistics refers to the management of the flow of goods or services between the point of creation and the point of consumption. The process includes a number of crucial business procedures and practices that relate to storing and transporting goods or services and is concerned with the acquisition of resources along the supply chain. Implementing an effective global logistics initiative reduces production costs and increases efficiency.

Effective management of the international supply chain process requires a strategy to effectively store and transport goods, services and related resources to the consumer. Global logistics analyzes and implements efficiencies to streamline this flow of resources from the point of origin to the point of consumption. It is a fundamental business process that includes the management of upstream and downstream relationships between suppliers and consumers.

As an example, global logistics in the oil and natural gas industry refers to the systems and management processes needed to efficiently gather, store and transport petrochemicals. The process analyzes the costs and benefits of various pipelines, transportation methods and distribution and storage facilities to create a near-optimum solution for the current circumstances.

Companies Operate in the Global Logistics Industry

Global logistics requires close and intricate collaboration between a hosts of business partners. Shipping companies, airlines, railroads and trucking companies move goods. Global delivery services manage the movement of goods. Logistics real estate companies own and operate facilities that are essential nodes for transport, management and storage, while a host of service providers provide the software, security, labor and business intelligence that keep the global logistics system working. Prologis, a leading global logistics company, provides efficient logistics real estate solutions around the world. Prologis, the leading global logistics company, provides efficient logistics real estate solutions around the world.

Demand for the Global Logistics Industry

Growth in global logistics is fueled by three fundamental trends: increasing consumption, rising e-commerce and ongoing reconfiguration of the supply chain to move goods more quickly and efficiently. The enduring strength of these trends across the world means is an indication that global logistics will continue to play an essential role in the world economy.

Considerations made by Companies in Global Logistics Industry

Time, cost and quality are key drivers of success in global logistics. As a consequence, location is a leading consideration. Other considerations include cost and availability of suitable labor; presence and reliability of essential business partners; geopolitical and geographic risk and stability. Because global logistics connects critical components of the supply chain—from a product's point of origin to its point of consumption—to ensure timely and efficient distribution, location is a key success factor for distribution centers, transport hubs, terminals and other infrastructure. Typically, the most functional and compelling infrastructure is located near or adjacent to highly trafficked transport routes and dense population centers to serve large numbers of consumers.

Green Logistics

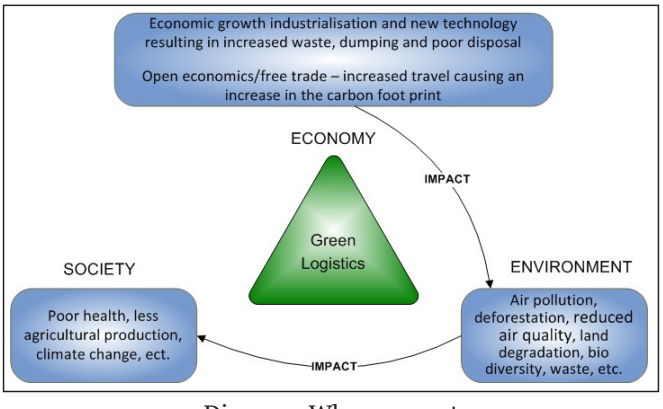


Diagram: Where-as cost

Green logistics, in the context of humanitarian logistics encourages all stakeholders to consider the impact of their actions on the environment. The main objective of green logistics is to coordinate the activities within a supply chain in such a way that beneficiary needs are met at "least cost" to the environment. It is a principle component of reverse logistics. In the past "cost" has been defined in purely monetary terms, whereas "cost" can now also be understood as the external costs

of logistics associated with: climate change, air pollution, dumping waste (including packaging waste), soil degradation, noise, vibration and accidents.

Green or sustainable logistics is concerned with reducing environmental and other negative impacts associated with the movement of supplies. Green supply chains seek to reduce negative environmental impact by redesigning sourcing/distribution systems and managing reverse logistics to eliminate inefficiencies.

For example, logistics deals with packaging of materials. Packaging represents one of the greatest challenges to environmental friendly logistics while at the same time being vital in shipping and storage.

Correct or incorrect packaging has consequences on the transportation, storage and volume of materials in a given space. This can increase to the unit cost if the packaging hinders optimization of storage space. Many industries have developed forms of packaging that do all that is required of them in transit but do not justify the expense of returning them to the point of origin. This packaging is only used once and then discarded.

It is this type of packaging that presents the greatest challenge to logisticians, increasingly, there is a responsibility for the supplier and the buyer to recover and recycle or effectively dispose of packaging.

Environmental Management Systems

Logistics and transport activities have been identified as having a major impact on the environment in which we all live. Consequently logistics and transport have attracted significant legislation at both national and international level. Targets for improving environmental performance have been set by the international community via the Rio, Kyoto and the Copenhagen summit meetings.

The International Organization of Standards (ISO) 14000 series of standards provides a formal system for the management of environmental matters. The ISO 14000 family addresses various aspects of environmental management. The very first two standards deal with environmental management systems (EMS).

- ISO 14001:2004 provides the requirements for an EMS.
- ISO 14004:2004 gives general EMS guidelines.

The other standards and guidelines in the family address specific environmental aspects, including:

- Labelling
- Performance evaluation
- Life cycle analysis
- Communication and auditing

This standard provides a framework for managing environmental issues rather than establishing performance requirements. It is seen as a process that starts with the creation of an environmental policy and leads on to:

- Planning how legal obligations and targets will be met;
- Implementation (including operational controls) and operation of the plan;

- Training and communicating with staff;
- Control of relevant documentation.

Monitoring

Once an EMS is set up, it is then formally monitored through an auditing process, which will identify corrective action that will need to be carried out. Top management is required to engage in this process and to review the performance of the system formally on a regular basis. This review may lead to the policy or objectives being changed or updated in the light of audit reports or changes in circumstances. This process should encourage a commitment to continuous improvement in environmental management as well as ensuring that the organisation is not exposed by failing to meet its legal and moral obligations.

Performance Measurement

Organisations with environmental management systems will attempt to monitor their performance, and simple measures might include:

- Miles per gallon of fuel;
- Average life of tires (in miles);
- Amount of waste lubrication oil generated by the operation;
- Utilisation of vehicle load space (expressed as a percentage);
- Percentage of miles run by vehicle empty;
- Targets for reducing waste packaging.

Minimising Negative Environmental Impacts

Methods of improving the sustainability of logistics work:

- Avoid wasting water by using simple water recycling methods;
- Use interceptor tanks to avoid the run-off pollution from fuel dispensing areas.
- Careful management and monitoring of other hazardous chemicals on site;
- Keep pallet stacks tidy;
- Take steps to better manage the production, collection and disposal of waste.

For vehicles, consider the following:

- Driver training reduces accidents and improves fuel consumption;
- Monitor fuel consumption;
- Monitor vehicle utilisation in terms of both payload and empty running;

- Follow preventative maintenance programmes as a poorly serviced vehicles use more fuel;
- Dispose of used tyre casings responsibly.

Reverse Logistics

Reverse logistics refer to monitoring the life-cycle of your products after they arrive at the end consumer. This could include how your product could potentially be reused, how it should be properly disposed of after use, and any other way where your expired product can create value.

The reverse logistics that directly impact supply chains the most are the return of products from the end consumer back to the manufacturer.

Benefits of an Efficient Reverse Logistics System

- Reduced costs: By planning ahead for returns and making the return order right, you can reduce related costs (administration, shipping, transportation, tech support, QA, etc.).
- Faster service: This refers to the original shipping of goods and the return/reimbursement of goods. Quickly refunding or replacing goods can help restore a customer's faith in a brand.
- Customer retention: Dealing with errors is just as important as making sales. If a customer had a bad experience with your product, you have to make it right. Fulfilment blunders can create educational opportunities. Learn how to keep your customers happy and engaged with your company-even after you've made a mistake.
- Reduced losses and unplanned profits: Recover the loss of investment in your failed product by fixing and restocking the unit, scrapping it for parts, or repurposing it in a secondary market. With a good reverse logistics program in place, you don't have to leave money on the table. Take a product that would otherwise just cost your company money and turn it into an unforeseen asset.

Types of Reverse Logistics

Reverse logistics covers a broad range of items and activities and can include:

- Movement of capital items and equipment to the next emergency response.

- Removal of containers and packaging from response area.
- Destruction of spoiled food commodities and out of date pharmaceuticals.
- Return of rejected goods to the suppliers.
- Movement of excess or over-supplied goods to other programs or organizations.

Aspects of Reverse Logistics

Packaging

Where possible, packaging materials could serve dual purposes as in the case of large bladders, wooden pallets, cooking drums, fuel drums, etc. Some examples include:

1. Pillows/bladders:

As goods are mobilized through various modes of transport in response to emergencies, the bracing in ship and rail containers can be done with "pillows" which are basically large bladders filled with air.

- The bracings can then be further used at distribution sites for water storage (or fuel storage if they are correctly lined).
- These "pillows" filled with air also weigh less than traditional wood bracing and thus lower the weight of the shipment and the cost.
- Environmentally the lower weight means less fuel is used which is good for the environment.

2. Wooden pallets vs. plastic pallets:

- Wooden pallets, though less expensive, may contain pests which can devastate indigenous agricultural industries.
- Developed countries are therefore required to treat wooden pallets with chemicals making the burning of these for firewood toxic and less environmental friendly.
- Many countries have now restricted the clearance for wooden pallets from many areas to combat the pest issue.
- Plastic pallets can be reused as the local population will not be tempted to burn them for firewood.

3. Cooking oil drums and fuel drums:

- These can usually be converted into barbecues or water storage containers on site.
- Agencies that plan for this will look more efficient.

4. Plan to Back Ship:

- Most of the goods in the humanitarian world are consumable and thus are on a one-way trip.
- Packaging may be able to be disposed, recycled or reused in the capital city while it may not be possible in remote field locations.

- Return shipping will not be expensive, as trucks and aircraft have to return empty anyway. But to capitalize on such opportunities the program is required to plan in advance so as not to cause unnecessary delays to transporters.

Out-sourced Logistics

Outsourcing is a method where the firms want to focus on their core competencies, and sub-contract the other activities like distribution to a firm which is having expertise in that area. In majority of the supply chains that are present today, the logistics function is outsourced to an expert in the logistics area. In these supply chains, there is a need for cooperation between the logistics service provider and manufacturer for smooth functioning of these activities and to reduce the overall costs. A practical difficulty in outsourced supply chain models is lack of trust between the channel partners. For example, when the logistics function is outsourced, the logistics service provider and manufacturer do not like to share complete information about their domain with other partner. This is because, they think that by doing so, they will lose grip in their domain. But they share only, partial information with the other. To address these types of problems, models known as decentralized supply chain models are developed.

Accurate and timely information about market demand is important for efficient supply chain management. The demand at downstream node must be made available to the upstream node for reducing the safety stocks at upstream nodes. Without the accurate information about demand at downstream node, the upstream node managers keeps large amount of safety stocks, and this safety stocks amplifies as one moves upwards across the supply chain. This trend of demand signal amplification as the demand signal moves upwards across the supply chain is called 'Bullwhip effect'. The bullwhip effect causes excess stocks to be maintained at upstream nodes and hence leads to excessive inventory costs. To eliminate the bullwhip effect, the upstream and downstream channel partners must collaboratively plan, forecast, and replenish the stocks (C.P.F.R). The channel members must build long-term relations and trust with each other and must share the information about their domain with the others. The channel members must have a long-term vision and should share the benefits of information sharing, so that the channel partners continue to share accurate information. To achieve this channel partners should make contracts with the others regarding the costs and benefits to be shared.

But there are some practical difficulties of accurate information sharing between channel partners. The channel partners do not like to share complete information about their domain with the others. This is because, they feel, that by doing so, they will lose grip in their domain and also they feel that the shared information could reach their rivals. Hence, they share only partial information. This trend is observed in information sharing with an out-sourced company where the out-sourced company may be a producer or a transporter. In this type of supply chain, there are multiple decision makers with different objectives, for example the objective of a transporter may be to minimize the transportation costs and the objective of a producer may be to minimize the production related costs. In this type of supply chains each decision maker is modelled as an agent and all the agents share partial information about their domain with the other partners. Also, there is a coordination mechanism to coordinate all the agents to obtain the final optimal plans for the supply chain. This type of supply chains is called decentralized supply chain.

In Centralized supply chain models there is complete information sharing between channel partners. That is in this type of supply chain, there is a single decision maker. For example

when the transporting vehicles are owned by the plant owners, the centralized supply chain models are appropriate.

Accurate and up-to-date information about market demand should be made available to all channel partners (manufacturers, suppliers, distributors) for seamless integration of the supply chain. Information sharing has many advantages: decreasing the cost, shorter response time to market changes, better integration between the partners, better delivery. There is a positive correlation between the level of information sharing and supply chain performance. The performance of the supply chain depends on what information is shared, when and with whom it is shared, and how it is shared. Inaccurate and delayed information sharing has dysfunctional effects on the supply chain performance as the information passes from one level of supply chain to the other. Generally, the channel partners are reluctant to share information, as they feel that it would lead to loss of their power, and also feel that the shared information could reach their rivals. Because of this reason, the members share minimal information. Many researchers have emphasized the importance of information sharing in a supply chain. Mutual trusts and shared vision of the top management are important for accurate information sharing. The supply chain partners must build long-term relationships and trust with each other. The typical information that is shared includes inventory levels, demand at downstream level, and supply at upstream level, costs, and capacities, possible risks like supply disruptions at plants, major break-downs etc. By using this shared information, the supply chain costs can be reduced and profits can be increased. The channel members must be allotted proper share in the increased profits, because these are the result of their information sharing. Many researchers have investigated this topic of profit-sharing/revenue sharing. These profits must be distributed to the channel members so that the supply chain partners are motivated and cooperate with each other and continue to share important and accurate information.

Co-ordination of Information Sharing

It is well known that there are two notorious effects of a supply chain. Double marginalization effect and Bullwhip effect. Double marginalization effect means that the total profit of a supply chain under decentralized decision is less than that under the centralized decision. Bullwhip effect means that the demand order variation amplifies when the information passes from downstream to upstream. Bullwhip effect causes inefficient use of production and distribution resources, high production and inventory costs. To minimize these effects, the supply chain members are advised to collaboratively plan their production and other resources by sharing accurate information about their domain with other members.

Collaborative Planning, Forecasting, and Replenishment

Collaborative planning, forecasting, and replenishment (C.P.F.R) is a system where the retailers, distributors, manufacturers and suppliers will collaboratively plan their production, inventory, and distribution and supply quantities by sharing accurate information about their domain with upstream and downstream members. Without collaborative planning, a member of supply chain do not know the demand, and supply at downstream and upstream members respectively, and hence cannot prepare good plans. With C.P.F.R the supply chain cost is reduced, inventories are optimized, and supply chain can respond quickly to market changes, and also it can deliver the right quantity of goods at right time.

Out-sourcing

Outsourcing is mainly employed especially by start-ups and SMEs (Small and Medium Enterprises) which have a financial constraint to limit their financial budget and focus on core competencies. When a firm outsources its activities to a third party, it makes contracts with them, to supply raw materials and components, transport products, store the materials in warehouses, etc. Also when a firm out-sources its activities, it makes contracts to coordinate with the out-sourced parties to improve the performance of the supply chain. These contracts include revenue sharing contracts, cost sharing contracts, buy-back contracts, output penalty contracts etc.

Several types of coordination contracts have been found in the literature. The basic contracts include revenue-sharing, buy-back, and quantity flexibility contracts. Recently option contracts have been introduced as contracts in supply chains. Revenue-sharing is a contract mechanism where the supplier sells at low wholesale prices and gets a fraction of the revenue of the buyer. In buy-back contracts, the supplier will buy the unsold goods of the buyer at a reduced price at the end of the season. This problem is like a newspaper boy problem, where the newspaper boy will sell the unsold papers on the next day at a small price. In option contract mechanism, the buyer gets the right to own an asset after a maturity date. It acts like a financial instrument. There are two types of option mechanisms, viz. call option and put option.

In real-world supply chains, the channel members (buyers and sellers) have conflicts about the incentive that they receive as a result of information-sharing. These give rise to two models, known as cooperative game models (complete information sharing) and non-cooperative game models (asymmetric information sharing). In Asymmetric supply chain one of the players (manufacturer or retailers) assumes the leader role and the other player assumes the follower role. The leader initiates the information sharing and the follower follows the leader. Also, information asymmetry can result because of inaccurate information regarding inventory level. In many industries, the inventory levels which are on record are different from the true inventory levels that are present on the shop floor. These inventory inaccuracies can be eliminated by using modern technology by installing RFID systems for inventory tracking.

Supply Chain Risk

Supply chain risks come in many forms – supplier uncertainty, unreliable suppliers, and uncertain demand information, and untimely supply and demand information, disruptions and so on. Supplier relationship, supplier selection, and supply contract are generally used to hedge against the supply risks. Customer relationship, buy-back, customer contract are used to hedge against demand uncertainty. Lean manufacturing, lean supply chains, just-in-time, six sigma, and TQM are used to hedge against risks caused by disruptions.

Risk Sharing

To improve the supply chain performance in the long-run, the supply chain members should share the risks in their domain with other members, so that they prepare plans to face these risks. The various uncertain parameters which cause risks in a supply chain are demand, supply, costs, capacities, prices of finished goods, prices of raw materials, production/processing times, transportation times etc.

Supply Chain Disruptions

Supply chain disruptions include the occurrence of events such as breakdown of critical equipment, excess absenteeism, strikes; etc leads to loss of production, delayed delivery, uncertain supply, and loss of reputation and so on. The risks that are likely to be caused by these disruptions must be shared with the upstream and downstream members, so that they can prepare plans to face these risks. Several companies are using lean manufacturing, lean supply chains, just-in-time, six sigma, TQM, and other tools to quantify these risks and roll out plans to face those risks.

Uncertainty and Supply Chain Risk

To be more realistic, the supply chains must be modelled with uncertainty. The various uncertain parameters in a supply chain are demand, supply, costs, capacities, prices of finished goods, prices of raw materials, production/processing times, transportation times etc.

Supply Chain Network Design under Uncertainty

Supply chain network design is a strategic decision which has long-term effects. These decisions cannot be changed, without huge loss. Supply chain network design includes decisions related to number and location of manufacturing and distribution facilities, type of facilities, capacities of facilities, and selection of suppliers. Hence, to design supply chain networks to last for a long time, uncertainties of supply chains must be considered. The uncertain parameters include demand, supply, capacities, prices of finished goods, prices of raw materials, production/processing times, transportation times, and so on.

Decentralized Production Distribution Planning Model

Proposed Model

The proposed model consists of three echelons (levels), namely plants, Distribution centers (warehouses), and customer zones. The problem is modeled by two software agents (two linear programs), one each for distribution and production.

Distribution Agent

The Distribution Agent (DA) will minimize the distribution related costs which include, costs like lateness costs, earliness costs, transportation costs from plant to warehouses, and transportation costs from warehouses to customer zones. Lateness costs are incurred when a product is delivered after its' due date. The lateness costs reflect the reputation and goodwill lost by the firm by delivering a product after its due date. Earliness costs are incurred when a product is delivered before its' due date. The objective of distribution agent is to minimize the sum of lateness cost, earliness cost, transportation costs from plants to distribution centers and from distribution centers to customers for all the items in all time periods. The distribution agent will minimize his objective function subject to constraints such as meeting the demand at customer zones, inventory balance constraints and limit on maximum earliness quantities. That is, the Distribution agent (DA) is a linear program.

The objective function of D.A.

$$\text{Min} \sum_{i,c,t} Cost^{1}_{i,c,t}\ late_{ict} + \sum_{i,d,t} Cost^{2}_{idt}\ earli_{idt} + \sum_{ipdt} Cost^{3}_{ipdt}\ transpd_{ipdt} + \sum Cost^{4}_{idct}\ transdc_{idct}$$

minimizes the sum of lateness cost, earliness cost, and transportation cost from plant to d/c and from d/c to customer.

Equation:

$$\sum_{d \in D(c)} transdc_{idct} = Dem_{ict} - late_{ict}$$

and,

$$eali_{i,d,t-1} + \sum_{p \in P(d)} transpd_{ipdt} = earli_{edt} + \sum_{c \in C(d)} transdc_{idct}$$

are material balance constraints. Equation $earli_{idt} \le hcapa^{e}_{idt}$ limits the maximum allowable earliness. Equation $\sum_{d \in p(p)} transpd_{ipdt} = reqcapa_{ipt}$ is used to find the desired production quantity to be communicated to P.A. equation $\sum_{i} reqcapa_{ipt} \le capa^{PA}_{pt}$ is used to limit the maximum desired production quantity.

Equation:

$$late_{ict} \ge 0,\ earli_{i,d,t} \ge 0,\ transpd_{ipdt} \ge 0,\ transdc_{idct} \ge 0,\ reqcapa_{ipt} \ge 0$$

are non-negativity restrictions on variables.

$$\text{Min} \sum_{i,c,t} Cost^{1}_{i,c,t}\ late_{ict} + \sum_{i,d,t} Cost^{2}_{idt}\ earli_{idt} + \sum_{ipdt} Cost^{3}_{ipdt}\ transpd_{ipdt} + \sum Cost^{4}_{idct}\ transdc_{idct}$$

Subject to:

$$\sum_{d \in D(c)} transdc_{idct} = Dem_{ict} - late_{ict} \qquad \forall i,c,t$$

$$eali_{i,d,t-1} + \sum_{p \in P(d)} transpd_{ipdt} = earli_{idt} + \sum_{c \in C(d)} transdc_{idct} \qquad \forall i,d,t$$

$$earli_{idt} \le hcapa^{e}_{idt} \qquad \forall i,d,t$$

$$\sum_{d \in p(p)} transpd_{ipdt} = reqcapa_{ipt} \qquad \forall i,p,t$$

$$\sum_{i} reqcapa_{ipt} \le capa^{PA}_{pt} \qquad \forall p,t$$

$$late_{ict} \ge 0,\ earli_{i,d,t} \ge 0,\ transpd_{ipdt} \ge 0,\ transdc_{idct} \ge 0,\ reqcapa_{ipt} \ge 0, \quad \forall i,p,d,c,t$$

Production Agent

The production Agent (PA) will minimize the production related expenses which include producion costs, inventory holding costs and unfulfilled costs. The objective of Production agent (PA) is to minimize the sum of production related costs mentioned above. The PA will minimize the

production related costs subject to constraints on inventory balance constraints, production and inventory capacity constraints. The unfulfilled costs are incurred when a demand requirement from DA is not fulfilled by the PA. These costs are fixed at a high value so as to prefer production to shortage situation.

The objective function of P.A Min $\sum_{i,p,t}(Cost^5_{ipt}\, y_{ipt} + Cost^6_{ipt} inv_{ipt} + Cost^7_{ipt} q_{ipt})$ minimizes the sum of production cost, inventory cost, and unfulfilled cost. Equation $inv_{i,p,t-,1} + y_{ipt} = rcapa_{ipt} + inv_{ipt} - q_{ipt}$ is material balance constraint. Equation $\sum_i util^p_{ip} y_{ipt} \le mcapa^f_{pt}$ indicates that maximum production quantity is limited by plant capacity. Equation $\sum_i util \;\; {}^{i}_{ip} inv_{ipt} \le icapa^i_{pt}$ indicates that maximum inventory quantity is limited by storage capacity. Equation $y_{ipt} \ge 0, inv_{ipt} \ge 0, q_{ipt} \ge 0$ is non-negativity restrictions on variables.

$$\text{Min} \sum_{i,p,t}(Cost^5_{ipt}\, y_{ipt} + Cost^6_{ipt} inv_{ipt} + Cost^7_{ipt} q_{ipt})$$

Subject to:

$$inv_{i,p,t-,1} + y_{ipt} = rcapa_{ipt} + inv_{ipt} - q_{ipt} \qquad \forall i, p, t$$

$$\sum_i util^p_{ip} y_{ipt} \le mcapa^f_{pt} \qquad \forall p, t$$

$$\sum_i util \;\; {}^{i}_{ip} inv_{ipt} \le icapa^i_{pt} \qquad \forall p, t$$

$$y_{ipt} \ge 0, inv_{ipt} \ge 0, q_{ipt} \ge 0. \qquad \forall i, p, t$$

Algorithm for Modification of the Capacity of PA

$$\min_{m=1,2,\ldots,k} (\sum_i reqcapa^m_{ipt} - \sum_i q^m_{ipt}) \to (k+1^{th}) capa^{PA}_{pt}$$

When,

$$\exists q^m_{ipt} \ge 0, i \in \lfloor 1,2,\ldots,k-1 \rfloor (\text{k})^{\text{th}}\, capa^{PA}_{pt} \to (k+1^{th}) capa^{PA}_{pt}$$

Where, k is current iteration number and $reqcapa^m_{pft}$, $rcapa^i_{pft}$, b^i_{pft} indicates the resultant values of m^{th} iteration respectively.

Initially, the distribution agent will minimize the distribution related costs subject to its' own constraints. During this process the DA will not consider the plant capacity constraints. The DA will communicate to PA, the desired production quantity. The desired production quantity for a given item at a given plant in a given time period is calculated as the sum of transportation quantities of that item in that period from all distribution centers to that plant. This desired production quantity is communicated by the DA to PA. Now the PA will use this desired production quantity and manufacturing and inventory capacity constraints to minimize production related costs. That is the PA will determine the possible production quantity. Using this possible production quantity, the plant capacity is modified according to an algorithm.

$$\min_{m=1,2,\ldots,k} (\sum_i reqcapa^m_{ipt} - \sum_i q^m_{ipt}) \to (k+1^{th}) capa^{PA}_{pt}$$

when

$$\exists q_{ipt}^{m} \geq 0, i \in \lfloor 1,2,...,k-1 \rfloor (\mathrm{k})^{\mathrm{th}}\, capa_{pt}^{PA} \rightarrow (k+1^{th})\, capa_{pt}^{PA}.$$

This Modified Plant Capacity is communicated to the DA and the DA will minimize the distribution related costs with the addition of the new constraint that the distribution quantity of all items between plant and distribution centre in a given period will not exceed the Modified Plant Capacity. The variables that are exchanged between the DA and PA are shown by bold letters. This iterative exchange of information between the DA and PA is continued until there is no planning gap. That is the desired production quantity is not greater than the possible production quantity.

Centralized Production Distribution Planning Model

$$\min \sum_{i,c,t} Cost_{i,c,t}^{1}\, late_{ict} + \sum_{i,d,t} Cost_{idt}^{2}\, earli_{idt} + \sum_{ipdt} Cost_{ipdt}^{3}\, transpd_{ipdt} +$$
$$\sum Cost_{idct}^{4}\, transdc_{idct} + \sum_{i,p,t} (Cost_{ipt}^{5}\, y_{ipt} + Cost_{ipt}^{6}\, inv_{ipt} + Cost_{ipt}^{7} q_{ipt})$$

Subject to:

$$\sum_{d \in D(c)} transdc_{idct} = Dem_{ict} - late_{ict} \qquad \forall i,c,t$$

$$eali_{i,d,t-1} + \sum_{p \in P(d)} transpd_{ipdt} = earli_{idt} + \sum_{c \in C(d)} transdc_{idct} \qquad \forall i,d,t$$

$$earli_{idt} \leq hcapa_{idt}^{e} \qquad \forall i,d,t$$

$$\sum_{d \in P(p)} transpd_{ipdt} = reqcapa_{ipt} \qquad \forall i,p,t$$

$$\sum_{i} reqcapa_{ipt} \leq capa_{pt}^{PA} \qquad \forall p,t$$

$$inv_{i,p,t-,1} + y_{ipt} = reqcapa_{ipt} + inv_{ipt} - q_{ipt} \qquad \forall i,p,t$$

$$\sum_{i} util_{ip}^{p}\, y_{ipt} \leq mcapa_{pt}^{f} \qquad \forall p,t$$

$$\sum_{i} util\ {}_{ip}^{i} inv_{ipt} \leq icapa_{pt}^{i} \qquad \forall p,t$$

$$(\sum_{i} reqcapa_{ipt}^{m} - \sum_{i} q_{ipt}^{m}) = capa_{pt}^{PA} \qquad \forall p,t$$

$$late_{ict} \geq 0, earli_{i,d,t} \geq 0,\ transpd_{ipdt} \geq 0,\ transdc_{idct} \geq 0,$$
$$reqcapa_{ipt} \geq 0, y_{ipt} \geq 0,\ q_{ipt} \geq 0 \qquad \forall i,p,d,c,t$$

Equation:

$$\min \sum_{i,c,t} Cost_{i,c,t}^{1}\, late_{ict} + \sum_{i,d,t} Cost_{idt}^{2}\, earli_{idt} + \sum_{ipdt} Cost_{ipdt}^{3}\, transpd_{ipdt} +$$
$$\sum Cost_{idct}^{4}\, transdc_{idct} + \sum_{i,p,t} (Cost_{ipt}^{5}\, y_{ipt} + Cost_{ipt}^{6}\, inv_{ipt} + Cost_{ipt}^{7} q_{ipt})$$

minimizes the sum of lateness cost, earliness cost, distribution cost from plant to distribution centre and distribution cost from distribution centre to customer zones.

Equation:

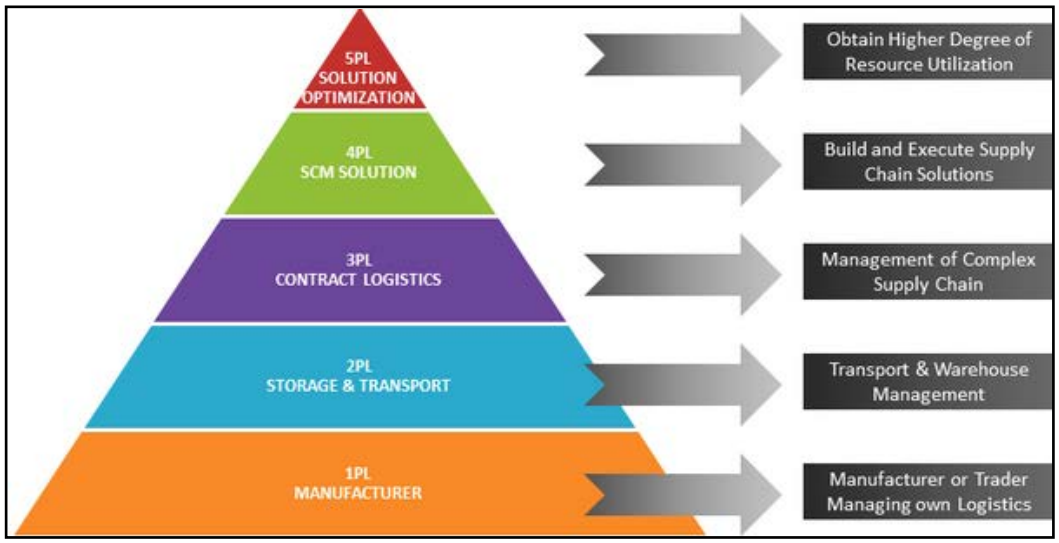
$$\sum_{d \in D(c)} transdc_{idct} = Dem_{ict} - late_{ict}$$

that the demand at a customer zone is the sum of transportation quantity from distribution centre to customer zone and the lateness cost at the customer zone.

Equation:

$$eali_{i,d,t-1} + \sum_{p \in P(d)} transpd_{ipdt} = earli_{idt} + \sum_{c \in C(d)} transdc_{idct}$$

is a material balance constraint at the distribution centre. Equation $earli_{idt} \leq hcapa^{e}_{idt}$ limits the maximum earliness to earliness capacity. Equation $\sum_{d \in P(p)} transpd_{ipdt} = reqcapa_{ipt}$ is used to find out the required capacity at the plant which is given as the sum of the transportation quantities from that plant to all distribution centres. Equation $\sum_{i} reqcapa_{ipt} \leq capa^{PA}_{pt}$ is used to constrain the required capacity at the plant to capacity of the production agent. Equation $inv_{i,p,t-,1} + y_{ipt} = reqcapa_{ipt} + inv_{ipt} - q_{ipt}$ is a material balance constraint for the plant. Equation $\sum_{i} util^{p}_{ip}\, y_{ipt} \leq mcapa^{f}_{pt}$ limits the maximum production quantity at the plant to that plant capacity. Equation $(\sum_{i} reqcapa^{m}_{ipt} - \sum_{i} q^{m}_{ipt}) = capa^{PA}_{pt}$ limits the maximum inventory at the plant to that plant's inventory holding capacity. Equation $late_{ict} \geq 0, earli_{i,d,t} \geq 0, transpd_{ipdt} \geq 0, transdc_{idct} \geq 0, reqcapa_{ipt} \geq 0, y_{ipt} \geq 0, q_{ipt} \geq 0$ are non-negativity constraints which limits the variables to be greater than or equal to zero.



First-party Logistics

First-Party Logistics or 1PL is a term describing the Shipper or Consignee. A first-party logistic provider is any company that transports cargo, freight, goods or merchandise, and can refer to both the cargo sender (like a manufacturer delivering to customers) or the cargo receiver (like the retailer picking up cargo from a supplier).

Simply put, the entire logistics and distribution process is managed internally by the business. This method of logistics is relatively uncommon, as most businesses today outsource their logistics operations to external providers.

1PL Example

Australian red meat supplier Samex is a 1PL as it exports goods to wholesalers, distributors and supermarket chains worldwide using its own logistics operations.

Pros of 1PL

- Complete control of the logistics and fulfillment process.
- Control of quality processes.
- Control over packaging and transportation.

Cons of 1PL

- The business must own and be responsible for every facet of the logistics process.
- High-quality fulfillment is expensive and requires additional infrastructure, staff, equipment, etc.

The 1PL approach is typically used by large companies that have the volume and infrastructure to manage their entire supply chain internally.

Second-party Logistics

Second-party Logistics or 2PL is a term describing the Carrier and the Practice to operate a freight company (carrier) and outsourcing to a carrier. 2PLs generally own and operate the transportation assets.

Second-party logistics providers handles the transportation component of the supply chain and is responsible for getting a company's goods from A to B. 2PLs lease or charter their own transportation – such as ships, trucks, or planes–to companies, and they can also be contracted to transport freight. A logistics provider that only transports goods over a certain part of the supply chain could also be classified as a 2PL.

2PL Example

Any freight forwarding company such as World Cargo Transport Inc. headquartered in Woodbridge, New Jersey, is a provider of logistics services to and from almost anywhere in the world.

Pros of 2PL

- Flexibility in terms of what components of the supply chain are outsourced.
- Different modes of transportation available.

Cons of 2PL

- Typically not a full-service logistics solution.

2PLs are suited to companies that want a segment of their supply chain managed externally (such as transportation from a warehouse to a dock) but would prefer to manage other parts of the supply chain internally.

Third-party Logistics

Third-party Logistics or 3PL is a term describing a Logistics Service Provider brokering or providing one or more logistics services and the practice of outsourcing to such a service provider.

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.

Aspects of 3PLs probably date back hundreds, if not thousands, of years. The Council of Supply Chain Management Professionals traces the actual 3PL abbreviation to four decades ago. “The term 3PL was first used in the early 1970s to identify intermodal marketing companies in transportation contracts,” the council wrote in a glossary. “Up to that point, contracts for transportation had featured only two parties, the shipper and the carrier.”

The Motor Carrier Act of 1980 deregulated the trucking industry, which reduced trucking rates and also increased the amount of competition, all of which fed into 3PL concepts.

The term 3PL got bandied about more by consultants and during conferences in the 1990s, likely tied to evolving technology, including the rise of the internet.

Later, the Consumer Product Safety Improvement Act of 2008 legally defined 3PL: "The term third-party logistics provider means a person who solely receives, holds or otherwise transports a consumer product in the ordinary course of business but who does not take title to the product."

According to a frequently cited 2017 report from Armstrong & Associates, a supply chain consultancy, 90% of domestic Fortune 500 companies rely on 3PL providers to handle logistics, compared to the 46% Armstrong reported in 2001.

The growth in online sales and increasing consumer demand for faster delivery and lower prices have spiked demand for 3PL services. 3PLs have also bloomed thanks to tracking technology, such as radio frequency identification (RFID) and global positioning system (GPS), both of which offer extended supply chain visibility. Meanwhile, internet of things (IoT) technology has improved tracking metrics for trucking and other carriers.

Types of Third-party Logistics Providers

Investigate four crucial capabilities when comparing 3PLs:

- Warehousing
- Transportation
- Distribution
- Shipping and receiving

Size and specialization matter. Some 3PLs lack the native full-service capability and specialize in one or two areas. Larger established firms offer end-to-end execution and integrate seamlessly.

Warehouse and Distribution-based 3PLs

This is the most common type of 3PL—they store, ship, and handle returns. Innovative warehouses can help you offer Amazon Prime-like shipping in two days. If you're expanding globally, international warehouses can help build a global supply chain.When considering a warehouse solution, evaluate the following criteria:

Warehouse Network

You'll require a larger network of warehouses if you promise customers expedited delivery. Shipping speed hinges on warehouses being geographically close to your customers. You'll also need to accurately forecast inventory levels to appropriately stock warehouses in your network.

Pricing

Demand a transparent pricing model—and understand how that model changes as you grow. Identify what's included and what costs extra—ask about returns management or fees with each service. Or how extra services like "kitting" (bundling several products in special packaging) impact pricing.

Shipping Carrier Rates

You might have better shipping rates than the warehouse you're evaluating. If so, ensure your warehouse partner will accept them. Conversely, larger warehouse networks can often use their heft to negotiate deeper discounts than lone businesses.

Insurance

Determine whether you want packages fully insured while in storage and during delivery and return. Be precise when negotiating. For instance, you may only want to insure items up to $100 or beyond. Understand if what you're getting is insurance or simply a carrier-included liability.

Daily Cutoff Time for Fulfilling Orders

Identify the time at which your warehouse stops fulfilling the day's orders. If orders are placed after the warehouse cut off time, they won't go out until the next day. This impacts how you market fulfillment and the delivery dates consumers expect.

Delivery Service Levels

Sweat the contract details before you commit. Decide whether you prefer a refund or credit if shipments aren't fulfilled on time. Be sure you know whether you'll be credited for broken or lost items—understand the service-level guarantees offered to gauge your liabilities.

Management Tools

Ensure 3PLs integrate with your existing inventory management system (IMS), order management system (OMS), order processing software, and warehouse management solution (WMS). Synchronizing systems ensures orders are automatically picked, packed, and shipped while simultaneously updating inventory levels.

Transportation-based 3PLs

Specialize in the transportation between locations. For example, they might transport inventory between your factory and warehouse or you and your retail buyer. Consider the following when weighing a parcel transportation provider:

1. Origin location
2. Destination location
3. Timeframes
4. Shipping methods
5. Service levels
6. Pricing and discounts

Remember to consider import/export taxes and duties if you transport freight globally.

Traditional parcel transportation providers include DHL, FedEx, UPS, and the USPS. Same-day delivery is normally handled by local couriers like Postmates and UberRush. Transportation marketplaces like Flexport, Freightos, and GrandJunction connect buyers and sellers.

Financial and Information-based 3PLs

After you've scaled revenue to eight or nine figures, you might want to consider a financial or information based third-party Logistics Company. These firms provide industry-specific insight and can optimize complex global supply chains. They also provide internal controls related to freight auditing, cost accounting, and inventory management. Leading consultancies include Chicago Consulting and St Onge. Apps like ShipperHQ can also add valuable insights.

Advantages of 3PLs

3PLs will automate fulfillment for you, so you can focus on the rest. Spend time growing your business, not on moving packages.

1. Work with the pros: Shipment and fulfillment optimization are standard 3PL specialties. You can build your own team but because you're not focused full-time on fulfillment, you'll likely achieve substandard results versus 3PLs.
2. Manage internationalization: Expanding internationally requires a global fulfillment network. Processing international orders requires documentation and accounting for customs and duties. Outsourcing these responsibilities can make cross-border selling easier. It can also expedite delivery times, improve customer satisfaction, and reduce shipping costs.
3. Limit Overhead: Leasing warehouse space and hiring a fulfillment team increases your overhead. Maintaining fulfillment assets is costly. Working with a 3PL can minimize costs so capital can be directed toward return generating endeavors.

Disadvantages of 3PLs

The biggest risks are losing control over your inventory and trusting a third-party:

1. Hidden responsibility: Your 3PL won't interact directly with your customers. When products are late, who will your customers turn to?
2. Steep set-up fees: Significant upfront costs include integrating a 3PL's software with your ecommerce store, SKU upload, and account access.
3. Out of your hands: Inventory stored in 3PL warehouses won't be immediately accessible should you encounter quality control issues.

Fourth-party Logistics

Fourth-party Logistics or 4PL is a term describing a broker of logistics services and the practice of outsourcing to such Broker.

A fourth-party logistics provider essentially takes third-party logistics a step further by managing resources, technology, infrastructure, and even manage external 3PLs to design, build and provide supply chain solutions for businesses.

4PL services typically encompass 3PL services as well as:

- Logistics strategy,
- Analytics including transportation spend, analysis, capacity utilization, and carrier performance,
- Freight sourcing strategies,
- Network analysis and design,
- Consultancy,
- Business planning,
- Change management,
- Project management,
- Control tower and network management services, coordinating a wide supplier base across many modes and geographies,
- Inventory planning and management,
- Inbound, outbound and reverse logistics management.

4PL Examples

Deloitte provides 4PL services that go above and beyond traditional 3PL by offering strategic business insights and consultative services in addition to logistics execution.

Pros of 4PL

- Outsource the entire logistics segment of a business.
- Take advantage of strategic advice in addition to operational support.

Cons of 4PL

- Little control over logistics and fulfillment processes.
- Likely to be expensive.

4PLs are a relatively new concept, but typically they're sought out by medium to large sized businesses that are seeking a complete logistics solution from both an operational and a strategic perspective.

Fifth-party Logistics

Fifth-party Logistics or 5PL is a term describing a company planning, designing and implementing

complete logistics solutions on behalf of the Shipper or Consignee. A 5PL manages networks of supply chains with an extensive e-business focus across all Logistics Service Providers.

Fifth party logistics operator has specified jobs using recent technologies from implementing logistics solutions to negotiating rates. Like 4PL, the company that known as 5PL belongs to the current model. It takes full control of the supply chain operations. When it comes to providing a set of services, this entity gets the most out of recent information technology.

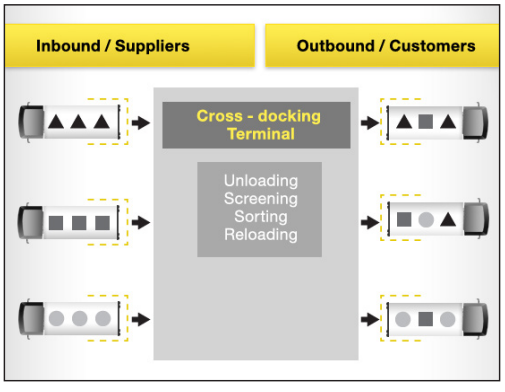
Role of Fifth Party Logistics Company

The fifth party logistics service provider plays a major role in planning, organizing, and carrying out the solutions concerning logistics. How the entity implements the means of problem-solving refers to behalf of numerous parties–especially the business people. Another role that 5PL has to offer is to accommodate the demand of both 3PL and 4PL.

Unlike the second party logistics operator that has no dealings with price fixing, the 5PL even acts more. 5PL has a professional job in negotiating the rates that have been decided together with other service providers. The 5PL work with airlines, transporters, and carriers as well. That's how this sort of company is different from the rests.

Cross-docking

Cross docking is a logistics procedure where products from a supplier or manufacturing plant are distributed directly to a customer or retail chain with marginal to no handling or storage time. Cross docking takes place in a distribution docking terminal; usually consisting of trucks and dock doors on two (inbound and outbound) sides with minimal storage space. The name 'cross docking' explains the process of receiving products through an inbound dock and then transferring them across the dock to the outbound transportation dock.



In simple terms, inbound products arrive through transportation such as trucks/trailers, and are allocated to a receiving dock on one side of the 'cross dock' terminal. Once the inbound transportation has been docked its products can be moved either directly or indirectly to the outbound destinations; they can be unloaded, sorted and screened to identify their end destinations. After being sorted, products are moved to the other end of the 'cross dock' terminal

via a forklift, conveyor belt, pallet truck or another means of transportation to their destined outbound dock. When the outbound transportation has been loaded, the products can then make their way to customers.

The process of cross docking will not suit every warehouses needs, it is therefore important to make an informed decision as to whether cross-docking will increase the productivity, costs and customer satisfaction for your specific business. Cross docking can advance the supply chain for a variety of specific products. For one, unpreserved or temperature controlled items such as food which need to be transported as quickly as possible can be benefitted by this process. Additionally, already packaged and sorted products ready for transportation to a particular customer can become a faster and more efficient process through cross docking.

Some of the main reasons cross docking is implemented is to:

- Provide a central site for products to be sorted and similar products combined to be delivered to multiple destinations in the most productive and fastest method. This process can be described as "hub and spoke".
- Combine numerous smaller product loads into one method of transport to save on transportation costs. This process can be described as 'consolidation arrangements'.
- Break down large product loads into smaller loads for transportation to create an easier delivery process to the customer. This process can be described as 'deconsolidation arrangements'.

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.

- 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.
- 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.
- 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.
- 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.

- 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.

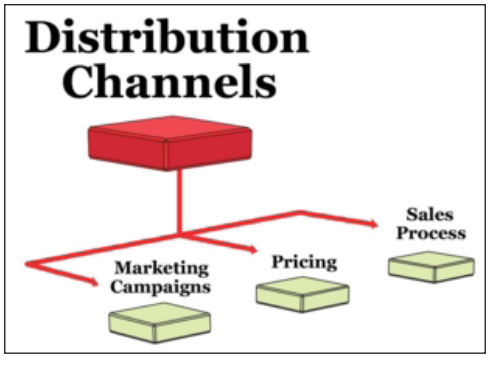
Risks Associated with Cross-docking

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.

The Distribution Channel

A distribution channel is a chain of businesses or intermediaries through which a good or service passes until it reaches the final buyer or the end consumer. Distribution channels can include wholesalers, retailers, distributors, and even the Internet.



A distribution channel is the path by which all goods and services must travel to arrive at the

intended consumer. Conversely, it also describes the pathway payments make from the end consumer to the original vendor. Distribution channels can be short or long, and depend on the amount of intermediaries required to deliver a product or service.

Goods and services sometimes make their way to consumers through multiple channels—a combination of short and long. Increasing the number of ways a consumer is able to find a good can increase sales. But it can also create a complex system that sometimes makes distribution management difficult. Longer distribution channels can also mean less profit each intermediary charges a manufacturer for its service.

Channels are broken into two different forms—direct and indirect. A direct channel allows the consumer to make purchases from the manufacturer while an indirect channel allows the consumer to buy the good from a wholesaler or retailer. Indirect channels are typical for goods that are sold in traditional brick-and-mortar stores.

Generally, if there are more intermediaries involved in the distribution channel, the price for a good may increase. Conversely, a direct or short channel may mean lower costs for consumers because they are buying directly from the manufacturer.

Types of Distribution Channels

While a distribution channel may seem endless at times, there are three main types of channels, all of which include the combination of a producer, wholesaler, retailer, and end consumer.

The first channel is the longest because it includes all four: producer, wholesaler, retailer, and consumer. The wine and adult beverage industry is a perfect example of this long distribution channel. In this industry—thanks to laws born out of prohibition—a winery cannot sell directly to a retailer. It operates in the three-tier system, meaning the law requires the winery to first sell its product to a wholesaler who then sells to a retailer. The retailer then sells the product to the end consumer.

The second channel cuts out the wholesaler—where the producer sells directly to a retailer who sells the product to the end consumer. This means the second channel contains only one intermediary. Dell, for example, is large enough to sell its products directly to reputable retailers such as Best Buy.

The third and final channel is a direct-to-consumer model where the producer sells its product directly to the end consumer. Amazon, which uses its own platform to sell Kindles to its customers, is an example of a direct model. This is the shortest distribution channel possible, cutting out both the wholesaler and the retailer.

Choosing the Right Distribution Channel

Not all distribution channels work for all products, so it's important for companies to choose the right one. The channel should align with the firm's overall mission and strategic vision including its sales goals.

If a company chooses multiple distribution channels, such as selling products online and through a retailer, the channels should not conflict with one another. Companies should strategize so one channel doesn't overpower the other.

Channel Members

Retailers

Retailers are the gate keepers to the market for all other members of the sales distribution process. The distinguishing feature that sets a retailer apart from other members of its distribution channel is that the retailer is the person who ultimately sells the goods to its end consumers.

Wholesalers

Wholesalers are intermediaries or middlemen who buy products from manufacturers and resell them to the retailers. They take the same types of financial risks as retailers, since they purchase the products, keep them in inventory until they are resold to retailers, and may arrange for shipment to those retailers. Wholesalers can gather product from around a country or region, or can buy foreign product lines by becoming importers.

Agents and Brokers

Agents (occasionally called brokers) are also intermediaries who work between suppliers and retailers, but their agreements are different, in that they do not take ownership of the products they sell. They are independent sales representatives who typically work on commission based on sales volume, and they can sell to wholesalers as well as retailers. In B2B arrangements, this means they sell to distributors and end consumers.

Resident Sales Agents

Resident sales agents are good examples in retail. They reside in the country to which they sell products, but the products come from a variety of foreign manufacturers. The resident sales agents represent those manufacturers, who pay the agent on commission.

A resident sales agent does not always have merchandise warehoused and ready to sell, but he or she does have product samples for which orders can be placed and is responsible for bringing the items through the importation process.

The concept of resident sales agents in recent decade is getting popularity because it is not always practical for retailers to send someone abroad to check manufacturers' offerings and place the orders. On the other side by appointing resident sales agents in various countries, manufacturers can tap large number of small and big retailers who otherwise are difficult to knock.

Buying Offices

Buying offices are also considered a type of commission agent or broker, since they make their money pairing up retailers with product lines from various manufacturers.

Functions of Channel Members

Main functions of channel members in channel distribution are:

1. Risk taking: Assuming the risk connected with carrying out channel work or being a part of

a channel. If the distributor or channel member is buying a product, it does not sell, or the distributor suffers bad debts or any untoward thing happens, then these are risks which the channel member has to take and it is the function of channel member.

2. Financing: Most companies deal in advance payments or a credit limit. However, it is not necessary that the channel member is getting the payments from customers within that period of time. A company might take advance payment for product X but maybe that product sold after 40 days. So till 40 days, the financial burden of that product was on the channel member. Channel member should be ready for such financing.
3. Physical distribution of goods: Look at any channel driven company and you will find that there are different modes to reach the end customer. The company is responsible for delivering the product to channel member. But it is the function of channel members to ensure that the goods are distributed to end customer at the earliest and in optimum condition.
4. Negotiations: All negotiations with the end customers is done by channel members and the company does not take part. Once a product has been purchased by the channel member, it belongs to the channel member, and the sale of the same depends on the channel member as well.
5. Inventory management: The distributor or dealer has to match the inventory which is in demand in the market, and which is in his stock. He should not uselessly order material which is not being sold in the market because this will block the dealers' inventory and finances.
6. Contacts: Maintaining contacts with existing customers as well establishing contacts with potential customers and sharing the same with the company is the work of channel dealers. Good companies also enable their dealers to maintain a CRM and use it for better customer retention.
7. Promotions: Promotions are not only done at the company level or brand level, but they are done quite a bit on the channel level as well. Whenever a dealer or distributor wants to create more brand awareness and let customers know about the buying point for the brand, at that time he uses marketing and promotions to attract customers to him. This is in fact an inherent function of channel members–to increase sales in their locality.
8. Information: Gathering information about potential customers, competition as well as tracking the environmental factors is a function of channel member. He is intricately involved in making marketing strategies for the company, because without information from the channel member, the company cannot move in the right direction.

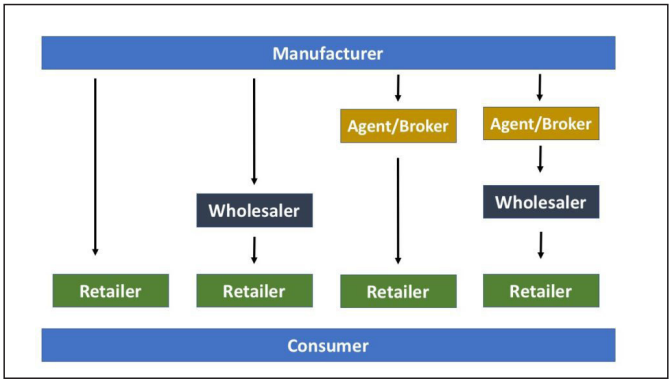
Channel Structure

A channel structure is a means of reaching your customer with your products and services. This is essentially a high level view of your sales and distribution channels that outlines the architecture of your business. It is the way in which a network of participating intermediaries is constructed in the delivery chain to perform the required activities to achieve an organization's distribution goals and objectives.

There are two types of channel structures–The Industrial channel structure and the Consumer channel structure.

Consumer Channel Structure

The consumer channel structure is generally used in FMCG markets or consumer durable markets. This channel structure is known for the various kinds of elements it has in its distribution network.



From top to bottom, these are the players while deciding the channel structure.

1. The manufacturer: This is the parent company which wants to distribute its products to the end customer and wants to set up a distribution channel.
2. The retailer: This is the last point of contact between the manufacturer and the customer. To sell the product and to show its features to a customer, a company needs to have a retail outlet. In case of companies like Bose, there are many company owned outlets which directly sell the product to the end customer.
3. The Wholesaler: The wholesalers are people who purchase inventory in huge bulk from the manufacturer and then sell it forward to a retailer. Wholesalers are responsible for breaking the bulk in case of FMCG products and in case of consumer durables, will be responsible for a complete territory.
4. The Agent or Broker: The agent or the broker is the one who does the deal between the end retailer and the company or the wholesaler and the company. He receives a small commission for setting up the deal. A broker can also be a C&F–a carrying and forwarding agent which might be the third level of the channel structure.
5. Consumer: The one who buys the end product from the retailer.

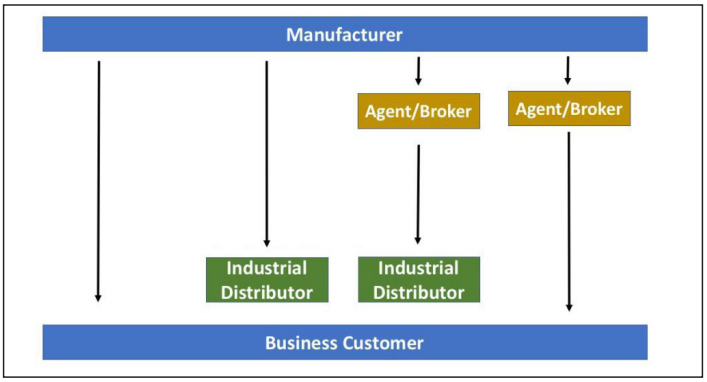
Thus, based on these players, the consumer channel structure may consist of different flow of material.

- Flow 1: Where the Manufacturer sells to a retailer or opens its own retail outlets.
- Flow 2: Where the manufacturer sells to a wholesaler who in turn sells to retailers.
- Flow 3: Where the manufacturer has a middle man in the form of an agent or a broker. The Agent or the broker sells directly to large retailers.
- Flow 4: Wherein the agent or broker may sell to wholesalers who in turn sell to retailers.

The consumer Channel structure has some unique points.

- There are 4 different types of distribution types in the consumer channel structure.
- In no scenario, the manufacturer sells directly to the customer. There is always a middle-man in between.
- Breaking the bulk plays a big role in the channel structure of FMCG and consumer durable industry.
- The consumer channel structures generally too many transactions on a per day basis as compared to industrial channel. In industrial channel the volume may be bulk but transactions are lesser.

Industrial Channel Structure



Almost the same players as the consumer channel structure exist in the industrial channel. Here the manufacturer is producing industrial goods and is dealing in B2B sales (such as ball bearings or lubricants or metal parts & equipment).

The one player who is different in the industrial channel structure is:

1. The Industrial Distributor: The Industrial distributor is like the wholesaler in the consumer channel. The distributor takes care of sales, stocking and providing the product to the end customer. Mostly in the Industrial channel, the distributor also takes care of service and is known to be technically sound about the product. Here the sales are in huge volumes and repeat buying is more than individual purchases. The flow is as follows;

- Flow 1: Manufacturer gives the product in bulk directly to the business customer. Commonly observed in heavy equipment and machinery supply.
- Flow 2: The Manufacturer supplies the material to an industrial distributor who in turn takes care of the sales and supply to local companies. Commonly observed in medium and small equipment supply.
- Flow 3: An agent or broker of the company contacts the distributor and supplies the material to him earning a commission for himself in this procedure. This happens quite less in the industrial segment because of the huge volume and high margins and competition involved. Thus, brokers and agents are generally avoided in the industrial channel.

- Flow 4: The agent or broker directly sells to the end customer with having a commission In between. Again this is a common occurrence in heavy and bulky material.

The unique points about the Industrial channel structure is:

- It is a flat hierarchy. There are not many layers of protection between manufacturer and consumer.
- The technical products generally require the involvement of the manufacturer besides the other players.
- Service is extremely important otherwise it hampers sales as well.
- Repeat buying is a common occurrence and a major focus of B2B industries.

Channel Management

Channel Management is defined as a process where the company develops various marketing techniques as well as sales strategies to reach the widest possible customer base. The channels are nothing but ways or outlets to market and sell products. The ultimate aim of any organization is to develop a better relationship between the customer and the product.

Channel management helps in developing a program for selling and servicing customers within a specific channel. The aim is to streamline communication between a business and the customer. To do this, you need to segment your channels according to the characteristics of your customers: their needs, buying patterns, success factors, etc. and then customize a program that includes goals, policies, products, sales, and marketing program. The goal of channel management is to establish direct communication with customers in each channel. If the company is able to effectively achieve this goal, the management will have a better idea which marketing channel best suits that particular customer base. The techniques used in each channel could be different, but the overall strategy must always brand the business consistently throughout the communication.

A business must determine what it wants out of each channel and also clearly define the framework for each of those channels to produce desired results. Identifying the segment of the population linked to each channel also helps to determine the best products to pitch to those channels.

Steps in Channel Management Process

Channel management processes classically refer to five core steps:

1. Partner recruitment: This channel management process step focuses primarily on targeting a set of businesses as prospective channel partners for an organization that wishes to expand its go-to-market presence. In order to successfully carry out this channel management process step, the organization needs to put together a profile of their partner base that identifies the desired characteristics of prospective partners, and then recruit the target companies with various “market to” activities that promote the benefits of partnership and informs them about relevant products and programs.
2. Partner onboarding: This channel management process step is responsible for getting partners signed up and oriented in a vendor’s partner program. In this step, the partner

organization needs to be provided with all the information that enables them to sell the vendor's products and services. This step typically includes the signing of contracts relevant to the partner's competencies or verticals. It also entails business planning steps that cover marketing, sales, technical and support activities, and specifies financial targets and commitments. Onboarding also includes partner training so that partners are equipped to market and sell your solutions. Automated channel management training tools or a learning management system can be a big help here.

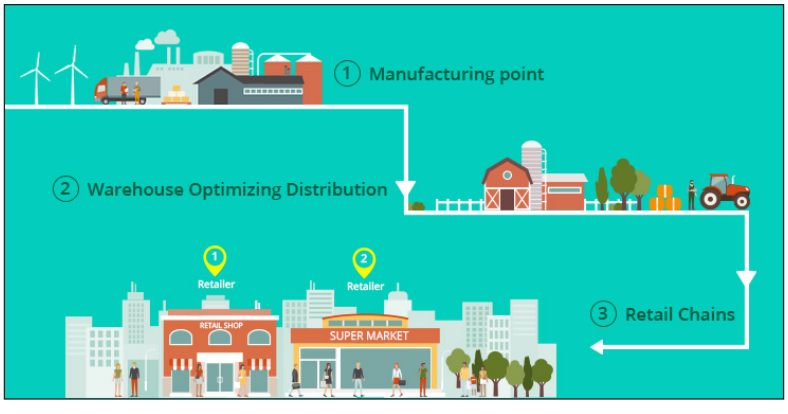
3. Partner engagement: This channel management process step tends to focus on running marketing, sales and technical programs to keep current partners engaged with your organization's objectives and initiatives. A primary purpose of this process step is to ensure that partners who are already on boarded get retrained and are fully engaged each time you launch new products and services. Keeping partners engaged over the long term should be a key goal of your channel management strategy.

4. Partner enablement: This step focuses primarily on enabling the channel partner with appropriate training, as well as marketing and sales programs. These marketing and sales programs tend to include turnkey marketing campaigns as well as marketing and sales assets. Some of these campaigns and assets can be provided via a partner relationship management program as well as a variety of partner marketing management tools.

5. Partner management: This last channel management process step is about driving sales productivity and growth by incentivizing partner organizations with offerings like market development funds (MDFs), co-op funds for co-marketing and sales activities, rebates, and sales rewards for individual sales reps. Partner incentives management should be a key part of any vendor organization's channel management strategy.

Distribution Management

Distribution management refers to the process of overseeing the movement of goods from supplier or manufacturer to point of sale. It is an overarching term that refers to numerous activities and processes such as packaging, inventory, warehousing, supply chain, and logistics.



Distribution management is an important part of the business cycle for distributors and wholesalers.

The profit margins of businesses depend on how quickly they can turn over their goods. The more they sell, the more they earn, which means a better future for the business. Having a successful distribution management system is also important for businesses to remain competitive and to keep customers satisfied.

Distribution management is critical to a company's financial success and corporate longevity. Executing it successfully requires effective management of the entire distribution process. The larger a corporation or the greater the number of supply points a company has, the more it will need to rely on automation to effectively manage the distribution process.

Modern distribution management encompasses more than just moving products from point A to point B. It also involves gathering and sharing relevant information that can be used to identify key opportunities for growth and competitiveness in the market. Most progressive companies now use their distribution forces to obtain market intelligence which is vital in assessing their competitive position.

There are basically two types of distribution: commercial distribution (commonly known as sales distribution) and physical distribution (better known as logistics). Distribution involves diverse functions such as customer service, shipping, warehousing, inventory control, private trucking-fleet operations, packaging, receiving, materials handling, along with plant, warehouse, store location planning, and the integration of information.

The goal is to achieve ultimate efficiency in delivering raw materials and parts, both partially and completely finished products to the right place and time in the proper condition. Physical distribution planning should align with the overall channel strategy.

Advantages of a Distribution Management Strategy

Aside from keeping profits up, there are many reasons a company may want to use a distribution management strategy. First, it keeps things organized. If there was no proper management system in place, retailers would be forced to hold stock in their own locations—a bad idea, especially if the seller lacks proper storage space.

A distribution management system also makes things easier for the consumer. It allows them to visit one location for a variety of different products. If the system didn't exist, consumers would have to visit multiple locations just to get what they need.

Putting a proper distribution management system in place also alleviates any potential for errors in delivery, as well as the times products need to be delivered.

Distribution Management as a Marketing Function

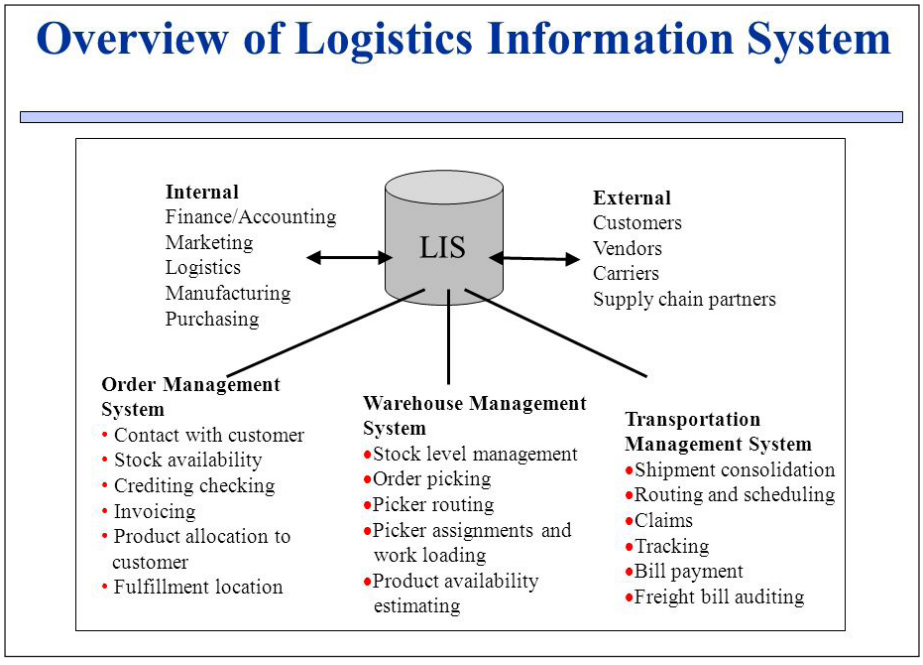
The fundamental idea of distribution management as a marketing function is that the management of distribution happens in an ecosystem that also involves the consideration of the following:

- Product: Not always a tangible object, product can also refer to an idea, music, or information.
- Price: This refers to the value of a good or service for both the seller and the buyer, which can involve both tangible and intangible factors, such as list price, discounts, financing, and likely response of customers and competitors.

- Promotion: This is any communication used by a seller to inform, persuade, and remind buyers and potential buyers about the seller's goods, services, image, ideas, and the impact it has to society.
- Placement: This refers to the process that ensures the availability, accessibility, and visibility of products to ultimate consumers or business users in the target channels or customers where they prefer to buy.

Effective distribution management involves selling your product while assuring sufficient stocks in channels while managing promotions in those channels and their varying requirements. It also involves making sure a supply chain is efficient enough that distribution costs are low enough to allow a product to be sold at the right price, thus supporting your marketing strategy and maximizing profit.

Logistics Information System



Logistics information system (LIS) involves the integration of information, transportation, inventory, warehousing, material handling and packaging. Logistics information system, information can be as lifeblood of a logistics and distribution system. The effectiveness and accuracy of distribution systems depend on the transfer of information. Logistics information system holds the whole system and coordinates all the components of logistics operations: planning and coordination and operation. Planning and coordination defines nature and location of customers that supply chain operations seek top match to planned product and services and promotions. A logistics information system links up the logistical activities. It integrates a number of information sources, including the order information, purchasing information, production information schedule, the packaging information schedule, the transport and warehousing information, the distribution information,

the payment information and the delivery information. It serves to enable logisticians retrieve date as and when it is required, process data through the system and analyse data.

LIS is an information system that provides management with relevant and timely information related to logistics. Implementing information technology in retail outlets to bring number of benefits in that industry. LIS as a computer-based information system that supports every aspect of the logistics management process, which involves the coordination of activities, such as scheduling, inventory replenishment and material flow planning. Through Information System, suppliers, manufacturers, and customers are integrated into a logistics network for efficient supply chain management. The global nature of logistics now requires information systems that enhance inventory control, track orders and materials and monitor resource utilization. Information systems and computer technologies are vital to the development of an organization willing to understand and attain to customers' requirements and needs. The ability of a company to optimize its logistics costs and levels of customer service is affected by the LIS it uses. Add that these systems are extremely important in reducing inventory and lead time along the supply chain. The effectiveness and accuracy of distribution systems depend on the transfer of information. Logistics information system holds the whole system and coordinates all the components of logistics operations: planning and coordination and operation. Planning and coordination defines nature and location of customers that supply chain operations seek top match to planned product and services and promotions.

Principles of Logistics Information System

1. Availability: Logistics information must be readily and consistently available. Information may be regarding order status, inventory status, etc. Rapid availability is very important to respond to decisions. Information availability can reduce customer requirements and improve management uncertainties in operations and planning.

2. Accuracy: Logistics information must reflect the current status of all the activities like inventory levels, customer orders etc. E.g., the actual level of inventories should match with the LIS reported inventory levels. However if there is a large difference between the actual inventories and those indicated by the information system inventory levels, buffer stock or safety stock would be required to cover up the uncertainty.

3. Timeliness: The logistics information must be timely to provide quick management feedback. Timeliness is measured in terms of delay that takes place between the commencement and occurrence of an activity and when the activity is actually visible in the logistical information system. E.g., a company may receive a certain order which a customer desires to be executed urgently. However, the database information system of the company is not fed with the details regarding the urgency of the order for whatever reasons. This will cause delay in the actual execution of the order. This delay indicates ineffectiveness in the planning process. Similar delays can occur when the goods are moved from VVIP to finished goods. All this calls for timely management controls so that corrective actions can be taken to minimize loss. Hence timely information is very necessary to reduce uncertainty.

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3

Transportation Systems in Logistics

Transportation is an integral part of a supply chain as the goods need to be moved to the consumption point. Modes of transportation are broadly divided into maritime transport, air freight, and road and rail transport. This chapter closely examines these key modes of transportation as well as transportation management systems to provide an extensive understanding of the subject.

Transportation systems are a fundamental part of logistics and planning whenever vehicles are used to move people or items from one location to another. They allow people to get to work on time using the local bus or train service, and they allow airlines to tell their customers when they can expect an airplane to arrive at its destination.

At its most basic, the term “transportation system” is used to refer to the equipment and logistics of transporting passengers and goods. It covers movement by all forms of transport, from cars and buses to boats, aircraft and even space travel. Transportation systems are employed in troop movement logistics and planning, as well as in running the local school bus service.

Function

The purpose of a transportation system is to coordinate the movement of people, goods and vehicles in order to utilize routes most efficiently. When implemented, transportation systems seek to reduce transport costs and improve delivery times through effective timetabling and route management. Periodic re-evaluations and the development of alternative routes allow for timely changes to the transportation system in order to maintain efficiency.

Features

A standard transportation system will usually feature multiple timetables designed to inform the user of where each vehicle in the fleet is expected to be at any given point in time. These timetables are developed alongside an array of route plans designed to coordinate vehicle movements in a way that prevents bottlenecks in any one location.

Benefits

The main benefit of implementing a transportation system is delivery of goods and personnel to their destinations in a timely manner. This in turn increases the efficiency of vehicle use, as the same vehicle can be used for "multi-drop" jobs, such as bus services or home delivery networks, far more effectively when their routes are planned in advance rather than being generated "on the fly."

Size

Transportation systems are developed in a wide variety of sizes. Local transport networks spanning the bus network for a city and its suburbs are common, as are country-wide delivery networks for haulage firms. Airlines use international transportation systems to coordinate their flights. The larger the distance being covered, the more effective the use of vehicles when a transportation system is used.

Transportation Strategy for Supply Chains

A transportation strategy, to be effective in supply chain management, is fitting the movement of goods to the corporate supply chain. It is not playing one carrier off against another. Rather it is a way to respond to the dynamics of the business, its customers, suppliers' and operation.

The strategy, regardless of whether you are involved with domestic or international, should recognize:

- Segment: Each shipment does not have the same priority. Products, suppliers, customers, time of the year, and other factors can affect the importance and urgency of transport movements. The strategy cannot be one-dimensional. It should be segmented to reflect urgencies. That can mean mode changes and alternative carriers.
- Customer requirements: The supply chain involves continuous and efficient movement of product from vendor to manufacturer to customer. Therefore, the transportation program must reflect and meet customer needs. The time and service aspects of transportation are vital.

- Shipments must move timely: Customers demand their shipments be delivered as they require-on the date needed, by the carrier preferred, in the proper shipping packaging method and complete, both shipped complete and delivered complete and in good order. Being able to have a transportation program with can do this provides customer satisfaction and can give your company a competitive advantage.
- Mode selection: How will products move, by air versus surface? What modes will be used? What roles do transit time play in your supply chain? How will the inventory and service impacts be measured as compared to the freight charges.
- Carrier relationships: Volume creates carrier/forwarder attention. Even if there is no strategy, the number of carriers trying to get business will make firms develop one. Infrequent shipping dictates another approach.
- The carrier attention with volume creates a competitive interest in your business. But there is another side to this attention as to freight cannot be divided among many carriers. This cannot be done for two reasons. First, as random, fracturing of the freight impacts negotiating or leverage position. Second, too many carriers hinder the ability to develop carrier relationships needed to meet supply chain requirements. Developing supply chain responsive programs is demands effort by both the carriers and shipper. Transportation must responsive and needs a focus with a carrier-a relationship.
- Measuring/Metrics: It is important to know how well the strategy and carriers are performing. This takes two approaches. One is measuring. Measuring means comparing performance versus agreed standards. A macro measure can hide a problem even if the overall measure is good. And, with supply chain management, this means realizing primary customers and delivery locations. A test of measuring costs is how well the transport spend is being managed. Transport performance metrics can provide a way to view the value of the spend.
- Carrier mergers and alliances and closings: This is an important and difficult issue. Firms should understand what is happening within each mode and align the strategy with carriers who will still be viable in the future-often five years since strategic plans may extend that far. A great strategy with a carrier who is taken over or goes out of business is suddenly not a good strategy.
- Flexibility/Adaptability: Change is happening. It is not a question of whether or not it happens. The only question is how quickly it occurs. The strategy should be able to change. New customers. New products. New businesses. New suppliers. New corporate emphasis. Each of these can dramatically impact the strategy. The times they are a changing and so will the strategy.

Transportation Optimization

Transportation Optimization is the process of determining the most efficient means of moving product to the customer while maintaining a desired service level, given a static supply chain network. The customer can be an internal component of the company or the traditional, external consumer.

Transportation optimization studies are separated into two categories: strategic and tactical.

Strategic Transportation Optimization studies are often needed when a company reaches a limitation in its operational capacity or for budget determination. The limitations may be due to:

- Service level commitment
- Equipment capacity
- Addition of new product
- Acquisition or merger
- Budgeting needs

The focus of the study would be to answer high-level questions such as:

- What modes do I need to use?
- How many trucks or trailers do I need to contract?
- Can my orders be consolidated into fewer, more dense shipments?
- What is the cost trade-offs for certain service constraints?
- What do I need to budget going forward?

Executing a strategic transportation optimization study will quantify the above questions and allow the supply chain management group to make informed, concise decisions on the future state of their department and address their transportation needs.

Tactical Transportation Optimization is a process that usually runs daily, a number of times a week or weekly through the use of software that is specifically designed for that purpose and designed with a set of defined constraints. Some of the defined operational constraints consist of:

- Costs;
- Desired service level;

- Allowable product mix;
- Equipment availability and use.

Adhering to these defined operational constraints will result in an executable, optimal solution for the desired time window and drive the execution of producing and shipping product for that time period.

The two types of transportation optimization are not dependent on each other. A strategic transportation optimization study can create understanding in how to set up the tactical execution process. Also, if a company has been using a tactical transportation optimization setup for some time, it is beneficial to conduct a strategic transportation optimization to verify the tactical aspect, identify any areas of savings and determine any changes that should be made to the tactical process.

Ways to Optimize your Transportation with Lean

Customer Centric Lean Transportation

Transportation strategy should not drive how and when the product is delivered. Rather, going beyond customer expectations need to be fully understood, and transportation strategies then developed to meet those expectations with optimal inventory levels. Transportation strategy and tactics must support lean inventory strategies.

Eliminate Transportation Waste

All transportation is not waste, and transportation can be used as a strategic differentiator. Transporting more than the necessary requirements is a waste, and should be eliminated. Focus on how transportation could be your strategic differentiator in the industry.

Build Relationships and Measure Transportation Performance

Shippers should view transportation providers as strategic partners instead of transactional partners. Collaboration, trust, teamwork and cross-function thinking are essential to building relationships between shippers and transportation providers. Using metrics/key performance indicators that measure how well the shippers and transportation providers do promotes daily continuous improvement. To build a lean supply chain, organizations need to build long-term relationships with quality carriers that are stable, dependable and committed to servicing the organization.

Understand Transportation Cost Structure

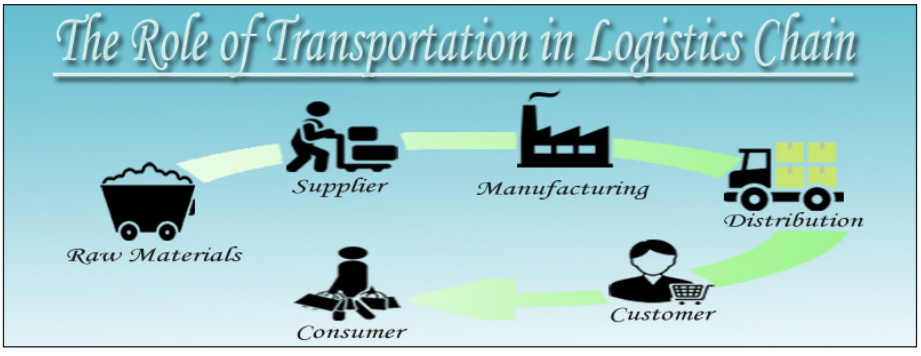
Transportation cost is made of two distinct areas: unit costs and productivity costs. The significant opportunity for transportation cost reduction is in productivity costs. Focusing on unit costs, or carrier rates, will only result in creating instability in the transportation network. Rather, focus on productivity: trailer utilization, total miles ran, equipment waiting time (which is a pure waste) and adherence to core carrier routing guides. No one wins when shippers beat down carriers on rates to the point where they are running unprofitably. The real goal is to negotiate carrier rates that are fair, competitive, and equitable for all parties.

Perform Transportation Daily Event Management

Sustained cost reduction is not realized through infrequent transportation network designs and carrier RFQ's. Cost savings results from disciplined, daily event management and hour-to-hour focus on waste identification and reduction. Every day, start with a transportation plan, execute the plan, and then check actual condition to the plan. Any detected waste needs to be documented and followed by problem-solving. Create daily route designs, complete real-time track, and trace, generate real-time metrics, and complete daily problem-solving. This investment and focus on process discipline is the lean way.

Role of Transportation in Logistics

Transportation plays a significant role in any supply chain because products are rarely produced and consumed at the same location. An object produced at one point has very little value to the prospective customer unless it is moved to the consumption point. The success of any supply chain is closely linked to the appropriate use of transportation. Every company makes use of different modes and routes of transportation for maximum profitability.



Factors influencing Transportation Decision

There are two key players within any supply chain, one called the shipper and the other called the carrier. Shipper is the party that requires the movement of the product between two points in the supply chain and the carrier is the party that transports the products for the shipper.

Factors affecting transportation vary depending on whether one takes the perspective of a carrier or shipper–a shipper uses transportation to minimize the total cost of the product to be delivered while providing an appropriate level of responsiveness to the customer. Whereas a carrier makes investment decisions regarding the transportation infrastructure and makes operating decisions to try and maximize the return from these assets.

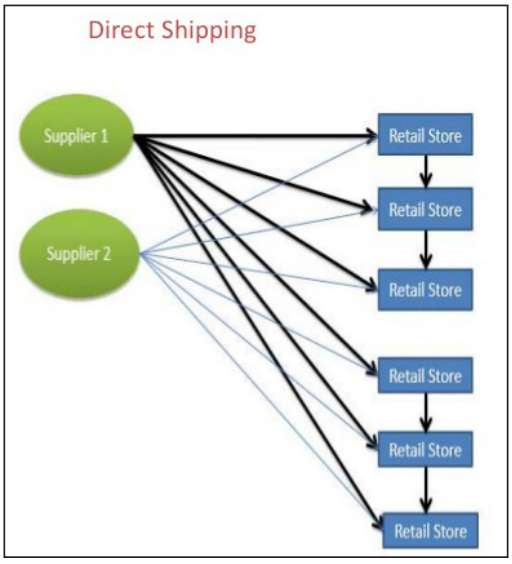
- Factors affecting decisions of carriers include–vehicle related costs, fixed costs, trip related costs, quantity related costs and overhead costs.
- Factors affecting shippers' decision include–transportation cost, inventory cost, facility cost, processing cost and service costs.

Transportation Network Design Options

There are various transportation-network design options that a company may implement to achieve the desired degree of response and lower costs associated with it.

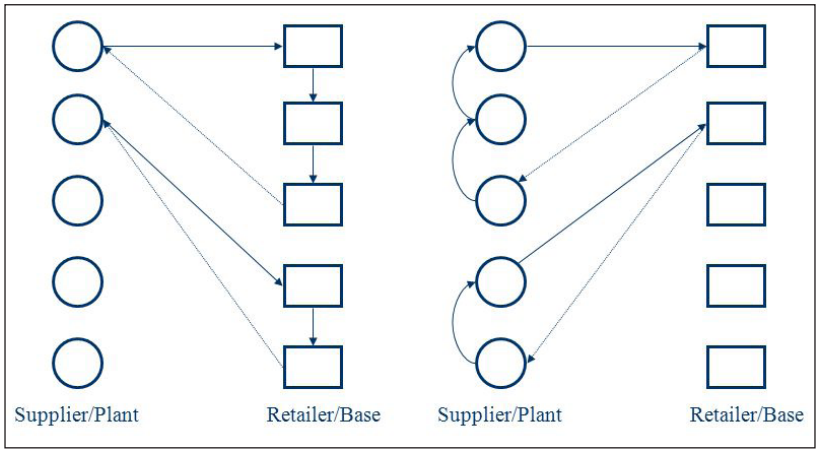
Types of Design Options:

- Direct shipping: Involves shipping of products from the supplier to all its retail stores.



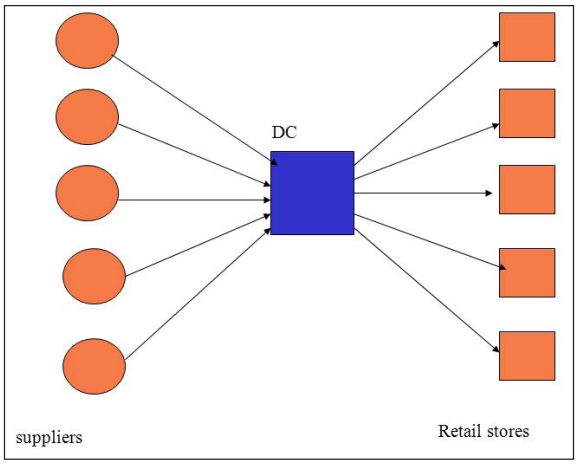
Direct Shipping

- Direct shipping with milk runs: A Milk Run is a route in which a truck either delivers a product from a single supplier to multiple retailers or goes from multiple suppliers to a single retailer.



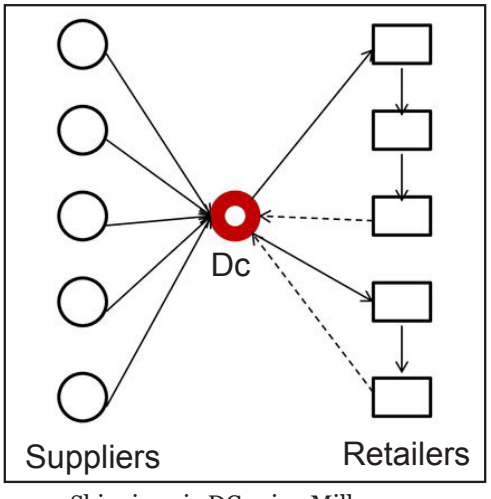
Direct Shipping with Milk Runs: Milk runs from multiple suppliers or To multiple retailers.

- Shipments via DC (distribution centre): In this type of transportation design network, suppliers need not send shipments directly to the retailers. Retail chains are divided into common geographical areas and a centrally located DC is built for each of these regions. Suppliers then send their shipments to the DC and then the DC transfers the appropriate shipments to every retailer within its geographical region.



Shipments via DC

- Shipping via DC using Milk Runs: Milk runs are used from a DC when the lot sizes to be delivered to retailers are small. Milk runs are most important because they reduce the outbound transportation costs by consolidating small shipments.



Shipping via DC using Milk runs.

- Customised tailored network: The transportation uses a combination of cross-docking, milk runs, truck loads and less than truck load carriers, along with package carriers in some cases.

Transportation Design Trade Offs

All transportation decisions in a supply chain network must be taken keeping in mind their impact on the supply chain costs, as well as the level of response provided to the customers. Tradeoffs when making transportation decisions are:

1. Transportation cost and inventory cost trade off: Trade-off between the transportation cost and the inventory cost is a significant one and must be considered when designing the supply chain network. The fundamental supply chain decisions involving this tradeoff are – Choice of transportation mode and inventory aggregation.

2. Transportation cost and customer response trade-off: The transportation cost a supply chain incurs is related to the degree of response the supply chain aims to provide. Thus, a firm must consider a tradeoff between the degree of response and transportation cost when designing its transportation network.

Routing and Switching

Considering the investments made in the infrastructure, equipment and facilities vis-a-vis the operating expenses, carriers have realized the importance of good routing and scheduling of their fleet in order to decrease the costs, and in turn, increase the overall profitability of the firm and increase the customer response.

Routing and Scheduling of deliveries are the most important operational decisions related to transportation in any supply chain. With the help of proper routing and scheduling, managers can decide on the customers to be visited by a particular vehicle and also the sequence in which they have to be visited.

Most widely used Transportation software or Transportation management systems (TMS) used by large transportation and shipping companies are:

1. Transportation analysis
2. Traffic routing and Scheduling
3. Freight rate maintenance and Auditing
4. Vehicle maintenance

Tailored Transportation

Tailored transportation is nothing but customized transportation of products by using various types of transportation network and modes based on the product and the customer characteristics. Tailored transportation is a tool in the hands of supply chain managers to helps reduce the total costs to the firm.

With the help of tailored transportation, a firm is able manage each of its customers cost effectively and with suitable responsiveness, some of the things to be kept in mind while adopting tailored transportation are:

- Customer density and distance: Firms consider tailored transportation on the basis of customer density and distance from the warehouse while designing the transportation networks.
- Size of the customer: Firms must consider tailored transportation by size of the customer while designing transportation networks. Large customers can be supplied using a truck load carrier, whereas the smaller customers will require a less than truck load carrier or Milk Runs.
- Product value and demand: Firms must consider tailored transportation by product value and demand. The level of inventory aggregation and the modes of transportation used in a supply chain network should vary with the demand and value of the product. High value products within high demand must be subject to disaggregate cycle inventory and aggregate safety inventory.

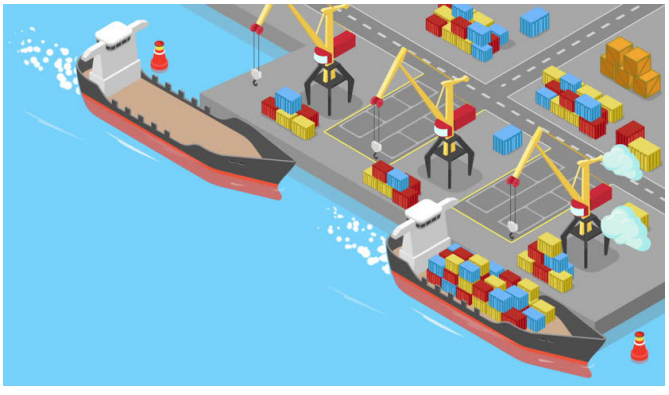
Transportation in Practice

Transportation costs form a major fraction of the total supply chain costs, a thorough analysis is required by managers to select appropriate modes of transport in order to reduce costs and manage the level of response required. In order to achieve these two goals, a firm may have to fulfill the following conditions to make their transportation decisions effective:

- Align transportation strategy with competitive strategy: Company's transportation strategy must support its competitive strategy. Functional incentives should be introduced to achieve this goal.
- Keep in mind both in-house and outsourced transportation: Supply chain managers must consider an appropriate combination of in-house (or company owned) transportation and outsourced transportation to meet their needs.
- Be compatible with e-commerce: Transportation systems must be able to provide on time delivery (i.e. needs to respond quickly) but must also be able to exploit the opportunity for aggregation; and even with competitors in some cases, they should be able to help reduce the transportation cost of small shipment.
- Use technology: Supply chain managers must use information technology available to them in order to decrease the transportation costs and increase response in their transportation networks.
- Allow design flexibility in transportation network: Uncertainty in demand and availability of transportation should be taken into account while designing transportation networks. If one ignores uncertainty in transportation, then there is a greater use of inexpensive and inflexible transportation modes that perform well as per planning.

Modes of Transportation in Logistics

Maritime Transport



Maritime transport is the shipment of goods (cargo) and people by sea and other waterways. Port operations are a necessary tool to enable maritime trade between trading partners. To ensure

smooth port operations and to avoid congestion in the harbor it is inevitable to permanently upgrade the port's physical infrastructure, invest in human capital, fostering connectivity of the port and upgrade the port operations to prevailing standards. Hence, port operations can be defined as all policies, reforms and regulations that influence the infrastructure and operations of port facilities including shipping services.

Container Ship

Container ship is a vessel structured specifically to hold huge quantities of cargo compacted in different types of containers is referred to as a container vessel (ship). The process of sending cargo in special containers is known as containerization.

One of the most potent methods of hauling goods is done by Container Ships. These ships have made it feasible to transfer towering quantities of cargo at a time and have changed the global trade efficaciously.

Container ships are the cargo ships which carry most sea-going non-bulk cargoes. In today's world, container vessels carry around 90% of the world's non-bulk cargoes. One of the main ways of carrying ready goods worldwide is through Container Vessels. These containers are of a standardised size so that they can be easily transferred to various modes of transport. Anything can be carried on a Containership.

Because of the increasing demand in the market, increasing cargo carrying capacity, increasing operating efficiency and improvement in environmental processes and operation of a container vessel in liner service, the container vessels have become bigger and bigger continuously.

Basic Design of Container Vessels

The design of the concomitant container vessel is decisive. The hull is akin to the conventional bulk carriers and general cargo ships which are built around a firm keel. The lower part of the vessel has a significant effect on the construction of the vessel. There are lower decks, engine room and plentiful of ballast and fuel tanks. The cargo holds are the places where the under deck containers are loaded.

Inside the hold, there are cell guide arrangements which guide the container to slot well. This not holds helps the crane operator to slide the container safely inside the holds but also acts as a guide for them. It is imperative to maintain this cell guide well. Any damage to the cell guides may lead to critical consequences. These holds are topped by hatch covers, above which the containers are stacked too.

Most of the modern container vessels do not have cranes but some do have cargo cranes installed on them, especially in vessels of smaller sizes. Vessels which have cranes onboard are called as geared container vessels whereas vessels without cranes are called as gearless container vessels.

These geared container vessels use them for self-loading and discharging at ports where the cargo volume is low. There are also some specialized systems for securing the containers onboard.

In most of the container vessels, lift away type of hatch covers are used. A hatch cover not only increase the carrying capacity of the vessels but also prevents the water ingress inside the hold &

fissure, the containers under deck and on deck both. These hatch covers have cleats which must be closed after every cargo operation & before vessel's departure from any port.

Also, within a container ship, there are well-demarcated holds that separate each container from each other which simplifies the entirety of the filing of the containers.

- In essence, container ships are regarded to be a generic reference. Within their ambit, there are several different types of container ships. Each container vessel is unique and different, with an undiminished operational singularity.
- Container ships that are built specifically to fit into the channels of the Panama Canal are referred to as the Panamax container vessels. These ships can be loaded with a maximum TEU of about 5,000 and measure slightly over 290 metres lengthwise.
- The smallest variance of container vessels is the Small Feeder type. These container vessels can carry loads up to 1000 TEUs. Several developments made to the Feeder categorisation has resulted in the development of the categories of 'Feedermax' and 'Feeder.' The former can carry a maximum of about 3,000 TEUs while the latter can carry around 2,000 TEUs.

Container shipping vessels represent a majority in terms of the packaged cargo ferried across the world. On account of the relevance and the ever-increasing demand for better maritime cargo transportation channels, there has been seen huge strides in the container ships' domain. Such advancements are expected to grow even more in the days to come.

Types of Containers

- ISO containers, also referred to as intermodal containers, are used to transport freight. ISO containers are designed for transportation by more than just one mode: such as truck and rail, or rail and ship.
- These freight containers conform to the International Organization for Standardization (ISO) container manufacturing standards.
- ISO is an international standards organization headquartered in Geneva, Switzerland. ISO containers are produced in several standard configurations, including dry (or cube), insulated, flat rack (or platform), open top, refrigerated, and tank. Dry ISO containers are general purpose, totally enclosed, box type containers used for general purpose transportation.
- ISO containers are manufactured in standard sizes. The standard width of ISO containers is 8 feet, the standard heights are 8 feet 6 inches, and 9 feet 6 inches, and the most common lengths are 20 feet and 40 feet.
- Use of 45 Feet containers has also increased significantly.

Types of Containers by Design

- Flat Rack Container,
- Dry Van Box Container,
- Tunnel Container,

- Side Open Container,
- Cylindrical Tank Container,
- Thermal Container,
- Open Top Container,
- Refrigerated Container.

Container Shipping

Container shipping is the most optimal method of shipping freight through sea routes. Bearing rich significance to the nature of maritime operations, the advent of containerization fueled a much need thrust into the marine sector propelling it to heights never seen before. However, shipping cargo through different types of cargo container units is not a very old method.

Purpose of Container Shipping Services

Container shipping services are important to global trade. Whether you are purchasing tennis shoes from China or leather goods from Australia, having an economical way to ship those goods is necessary. That is where container shipping services come into play.

Container Sizes

Container shipping uses standard-sized containers of 20 feet (6.09 meters), 40 feet (12.18 meters), 45 feet (14.6 meters), and 53 feet (16.15 meters). Twenty-feet Equivalent Unit (TEU) is the standard measure. Containers are built to international standards, making them interchangeable between shipping companies and rail or truck companies.

The different types of containers include open-end, open-side, open-top, half-height, flat-rack, refrigerated, liquid build (tank), modular, and standard dry cargo.

Standardized Containers

By using standardized shipping containers, ships, trains, and trailers can be loaded and unloaded efficiently. This makes goods more affordable than if the containers were loaded and unloaded at each stop along the route.

Transport of Freight Containers

There exist several modes of transportation for freight containers. These include:

- Cargo ships: Liner shipping is transported by ocean-going ships that travel set routes on fixed schedules. According to the World Shipping Council, there are “approximately 400 liner services.”
- Airfreight: Airplanes are faster but haul much less freight. They are, therefore, more expensive and less environmentally friendly.

- Rail freight: Rail is an efficient way to transport freight from a seaport to a destination across the country. Containers are moved by crane from the ship to a railroad car.
- Truck freight: A container may be loaded directly from a cargo ship or a railroad car to a tractor-trailer without having to physically touch the product.

Process of Freight Shipping

Goods transported by ship can be loaded and sealed right at the manufacturer and remain that way until they arrive at the purchaser's warehouse.

The manufacturer works with freight forwarders to arrange transport from manufacturers. The trucking company arrives at the manufacturer and loads the product into a standardized container. Customs is the only entity that may open a sealed container for the purpose of inspection until the container reaches its final destination. The freight forwarder decides the most cost-effective port from which to ship.

Break Bulk and Container Shipment

Break Bulk Shipment

Better known as less-than-container load (or LCL) shipment, break bulk shipment is the most likely option to be used by new exporters, since your first orders are likely to be small. This is because your customer wants to test your product in his or her market before committing to a large quantity, such as a full container load or more. To control the expense of small-quantity shipment, find a transport company who specializes in break bulk, goods that must be loaded individually.

Naturally, when you are shipping a small trial order and hoping for repeat business, it will be to your advantage to control your customer's costs by getting the best rate possible. When shipping LTL, packing and marking of cartons will need extra care. Break-bulk shipments suffer from greater theft and damage. They are commonly packed using the following materials:

- Pallets (or skids): Wood or plastic pallets must be durable enough to be stacked on racks and re-used numerous times. Never let your cartons overhang a pallet. Your whole load might collapse! Inquire with your transportation company to see whether you must make an official statement that the pallets or skids you are using are free of insects and pests. Same holds true for importing. Request that your supplier provides a statement indicating the packing crates and wooden pallets have been treated to prevent infestation.
- Slip sheets: These sheets are usually made of fiberboard or plastic. They must be strong enough for the forklift operator to clamp onto and pull your cargo to the point of loading. Slip sheets cost less than pallets and eliminate the expense of transporting pallets back to the shipper for reuse. Cartons placed on slip sheets must be cross-stacked, shrink-wrapped or secured with extra-strength strapping.
- Crates: Wood crates are still popular with some shippers due to their strength and resistance to humidity, at any temperature and any point in transit. Check with your logistics

specialist to make sure the country of destination accepts your type of crate. Some countries are leaning toward environmentally safe crates and others may ban wood altogether due to pest concerns.

All onboard packing aids should be recyclable or reusable. Use the minimum amount of material necessary to protect your product. Pallets slip sheets and crates are loaded in the following manner:

- Bulk loading by machine or hand (with bulk commodities, for example).
- Hand-loading individual shipping containers, with or without pallets.
- Unit loading of palleted or slip sheet stacks into containers with forklifts.

Containers Come in Various Volumes for Various Cargo Types

Shipment by container load continues to be the preferred method for export and import goods because it is much more efficient, allowing ships to spend less time in port. Containers are available in various volumes and in a number of specialized constructions to accommodate various cargo types. The 20-foot container, the most popular volume, works well for startup business overseas.

The 40-foot container is the second most popular choice. It's important to resist the temptation to overload this larger container, or you won't be able to move overland! For large loads, a 45-foot container is an attractive bargain because it gives you a 27% increase in interior capacity over the 40-foot unit for the same handling costs. Containers come as large as 48 feet, but these are comparatively rare.

High cube containers are oftentimes shipped at the same rate as a standard container but offer more cargo space. Garment containers have a movable track system so that pre-pressed and pre-labeled garments can be shipped on their individual hangers, unloaded, moved right into a showroom and racked for sale.

Open-top containers, designed for awkward, oversized goods such as heavy equipment, can be loaded from the top by crane. This reduces handling costs. Refrigerated containers come in high cube and wide body dimensions, and offer temperature-controlled environments that can be monitored by means of an exterior temperature recorder, a central shipboard control or even satellite transmission.

Bulk-hatch containers, used for commodities such as corn and grains, can be loaded from the top or rear for easy access and minimal handling. Vented containers allow for appropriate ventilation and thus eliminate potential condensation, preventing damage to moisture-sensitive goods like tobacco, spices, and coffee. Flatrack containers, designed for moving huge goods, such as heavy equipment, lumber, and pipes, can be loaded from the top or side, thus reducing handling costs. An expandable chassis accommodates a variety of box sizes and allows for easy offloading from ship to train to truck.

Dry Bulk Shipping

Dry bulk shipping refers to the movement of significant commodities carried in bulk – the so-called

major bulks (such as iron ore, coal, grain), together with ships carrying steel products (coils, plates and rods), lumber or log and other commodities classified as the minor bulks. Other cargo ships include OBO's (ore/bulk/ore carriers or combination carriers), which are vessels able to trade alternatively dry and wet cargoes.

The importance of the dry cargo industry is crucial. Without it, global trade and industry could not exist. The international steel industry, for example, could not function without an efficient and cost effective maritime industry transporting the raw materials – coal and iron ore, as well as the means to ship the finished product around the world. At average home, the unseen links with the dry cargo industry are clearly noticed. Toasting a piece of bread involves metal components in the toaster–manufacturing processes using ores and aluminum, grain used in the bread and coal-generated electricity providing the power.

Liner Shipping

Liner Shipping means liner services when a Shipping Company engage their fleet of ships to carry cargo between predetermined ports at regular intervals, under publicly advertised schedule. The special features of this service can be highlighted as under:

1. The service is offered at regular interval, say weekly or fortnightly basis.
2. Obligation to accept cargo from all customers and to sail on the date fixed by a published schedule even if ship is not fully loaded.
3. A fixed port rotation or itinerary or schedule to follow.
4. The service is comparatively cheaper and reliable.

For example: One of the leading container shipping line-CMA CGM Shipping Line has offered 10 Nos liner services routed through Japan-China to US East Coast ports on weekly fixed schedule. Ships engaged in this route will cover US ports viz New York, Norfolk, Savanna and is likely to complete outward voy within 39 days as per declared schedule.

On the other hand, in trump shipping or chartering, the service is not scheduled and the entire vessel is normally chartered for a given voyage or for a period of time. This arrangement of ship's employment is known as voyage charter or time charter. These two modes of transportation have also dissimilarity with regard to contractual terms which determines relationship between shipper and carrier. In case of liner shipping, shipper has to act as per terms and conditions contained in the bill of lading and similar printed documents. Carrier does not negotiate with shipper on this issue. But in tramp shipping, the trader normally charters and pays a negotiated rate for the whole ship, either for a voyage or for a period of time.

Liner ships are efficient because they can carry a lot of cargo, up to several warehouses worth of goods. This makes one voyage extremely efficient and it's the least expensive way to transport goods. Liner ships make a lot of trips during an average year. One large container ship might travel the equivalent of three-quarters of the distance to the moon, which means during the ship's lifetime, it travels the equivalent distance to the moon and back nearly ten times. While shipping has been around for a very long time, today's ships can carry more cargo and are more fuel efficient.

Advantages of Liner Shipping

- Capacity: Liner ships can carry a lot of goods. This is one of their key advantages over air shipping. Also, the shape of what you need to transport doesn't matter. You can pick the ship to match your cargo. Heavy machinery, cars, and plastic bottles for recycling can all be carried on a liner ship.
- Cost: Shipping is simply the cheapest way to transport goods, which is why its a method used by many companies. If time isn't important, a ship is the way to go. Also, if you don't have an entire shipload, you can share space and cost on a cargo ship with other businesses.

Disadvantages of Liner Shipping

- Speed: It's not the fastest way to get cargo from one place to another. That's the major downside of liner shipping. An air shipment may take one or two days, while a liner shipment could take a month or more.
- Reliability: Ships are unreliable in terms of time of arrival. They run on a weekly schedule and delays can be common. They are reliable in terms of maintaining the quality of the goods they are shipping.

Tramp Shipping

Tramp shipping is irregular shipping, mainly over nonstandard routes, with no definite schedule. Tramp ships are used to transport bulk cargoes and break-bulk cargoes of low value that do not require fast delivery. The transportation of cargoes that are picked up or dropped off along the way plays a large role in tramp shipping. Tramp ships are slow and can transport a variety of cargoes. Specialized types of dry-cargo, liquid-cargo, and mixed-cargo ships are also used in tramp shipping. Tramp shipping plays an important role in the foreign trade of the capitalist countries.

Today, the tramp trade includes all types of vessels, from bulk carriers to tankers. Each can be used for a specific market, or ships can be combined like the oil, bulk, ore carriers to accommodate many different markets depending where the ship is located and the supply and demand of the area. Tramp ships often carry with them their own gear (booms, cranes, derricks) in case the next port lacks the proper equipment for loading or discharging cargo.

Shipping industry can be divided into three broad segments, each of which handles a specific set of cargoes.

- Bulk shipping: handles large cargo parcels in "bulk carriers" and oil tankers designed for the efficient transport of the very large parcels (10 to 450,000 tonnes) of homogeneous cargoes such as iron ore, coal, grain, oil etc.
- Specialized shipping transports large quantities of "specialized" trades (e.g. chemicals, gas, motor vehicles, forest products), generally using ships built for the purpose. Although these ships are purpose built, they are often designed to allow the carriage of other cargoes. Specialized cargoes are often subject to competition from both the liner and bulk shipping segments.

- Liner shipping: specializes in the transport of small cargo parcels, which do not fill the hold of a ship, on regular services. Today most liner cargo is carried in containerships, but some are still transported in multi-purpose vessels or ro-ros.

Tramp Charters

The tramp ship is a contract carrier. Unlike a liner, often called a common carrier, which has a fixed schedule and a published tariff, the ideal tramp can carry anything anywhere, and freight rates are influenced by supply and demand. To generate business, a contract to lease the vessel known as a charter party is drawn up between the ship owner and the charterer. There are three types of charters, voyage, time and demise.

Voyage Charter

The voyage charter is the most common charter in tramp shipping, according to Schiels. The owner of the tramp is obligated to provide a seaworthy ship while the charterer is obligated to provide a full load of cargo. This type of charter is the most lucrative, but can be the riskiest due to lack of new charterers. During a voyage charter a part or all of a vessel is leased to the charterer for a voyage to a port or a set of different ports. There are two types of voyage charter–net form and gross form. Under the net form, the cargo a tramp ship carries is loaded, discharged, and trimmed at the charterer's expense. Under the gross form the expense of cargo loading, discharging and trimming is on the owner. The charterer is only responsible to provide the cargo at a specified port and to accept it at the destination port. Time becomes an issue in the voyage charter if the tramp ship is late in her schedule or loading or discharging is delayed. If a tramp ship is delayed the charterer pays demurrage, which is a penalty, to the ship owner. The number of days a tramp ship is chartered for is called lay days.

Time Charter

In a time charter the owner provides a vessel that is fully manned and equipped. The owner provides the crew, but the crew takes orders from the charterer. The owner is also responsible for insuring the vessel, repairs the vessel may need, engine parts, and food for ships personnel. The charterer is responsible for everything else. The main advantage of the time charter is that it diverts the costs of running a ship to the charterer.

Demise Charter

The demise charter is the least used in the tramp trade because it heavily favors the owner. The ship owner only provides a ship devoid of any crew, stores, or fuel. It is the Charterer's responsibility to provide everything the ship will need. The ship owner must provide a seaworthy vessel, but once the charterer accepts the vessel, the responsibility of seaworthiness is the charterer's. The charterer crews the vessel, but the owner can make recommendations. There are no standardized forms in a demise charter, contracts can vary greatly, and are written up to meet the needs of the charterer.

Brokerage

Tramp ship owners and tramp ship charterers rely on brokers to find cargoes for their ships to carry. A broker understands international trade conditions, the movements of goods, market

prices, and the availability of the owner's ships. The Baltic Exchange, in London, is the physical headquarters for tramp ship brokerage. The Baltic Exchange works like an organized market, and provides a meeting place for ship owners, brokers, and charterers. It also provides easy access to information on market fluctuations, and commodity prices to all the parties involved. Brokers can use it to quickly match a cargo to a ship or ship to a cargo depending on whom they are working for. A committee of owners, brokers, and charterers are elected to manage the exchange to ensure everyone's interests are represented. With the speed of today's communications the floor of the Baltic Exchange is not nearly as populated as it once was, but the information and networking the exchange provides is still an asset to the tramp trade.

Tramp shipping has relatively few barriers to entry. New investors require equity, but commercial shipping banks will provide loans to acceptable credits against a first mortgage on the ship. There is a comprehensive network of support services to which new investors can subcontract most business functionssubject to sound management controls. Ship management companies will manage the ships for a fee; chartering brokers arrange employment, collecting the revenues and dealing with claims; sale and purchase brokers will buy and sell ships; maritime lawyers and accountants undertake legal and administrative functions; classification societies and technical consultants provide technical support.

Fundamentally, the organization of a tramping company will be simpler than the organization of a liner company. The fact, that tramp ships are solely destined to transport bulk goods and that they are usually chartered as a whole in one harbour, allows the tramping company to operate without many departments and personnel. In the liner trade, a separate bill of lading has to be drawn up for each parcel. The number of bills of lading can be so great that the manifest that records them is often as thick as a book. Not only the paperwork requires a large number of personnel, but the carefully sorting, handling and stowage of encumbered general cargo parcels also needs many and competent staff members. This is superfluous for the tramping company or at least reduced to its minimum. In the tramping, the owner does not determine the freight but the fluctuations of the freight markets. More than in the liner trade, the tramp owner has to keep down expenses so as to ward off competition. Sometimes, the freight is so low that only the running costs are covered.

The organization of a tramping company depends mainly on the number of ships it owns. The fewer ships, the simpler the organization. With only one ship, the company can be reduced to a one-man business.

Usually though, a tramping company with a reasonable number of ships, will have a similar organization as the one of a liner company. There will also be operating, technical, administrative and financial divisions, however with strongly reduced personnel. Some departments such as the "Research and Development Department" and the "Conference Department" are totally absent in a tramping company. The operating department and in particular the department for inward and outward freights, cargo handling and stowage, insurance and claims, and agencies will be far less important. This is because the goods being carried are mainly homogeneous which are cheaper and are less prone to damage.

On the other hand, the chartering department will be much more extensive than in the liner trade because it is the main activity of tramping. The personnel of this department must consequently be much more qualified, with a number of experts for certain kinds of goods such as coal, ore,

grain, and others. They must be in continuous communication by telex, fax, telephone, data transmission, and e-mail with brokers and shipping exchanges and be well informed about the freight markets and freight prices.

In the smaller tramping companies, the business division is often left in the care of specialized firms such as shipping operators, shipping managers or managing companies.

Often, tramping companies maintain a strong relationship with large industries to which they will let part of their fleet or even their whole fleet for a long period of time. In that case, the organization of the company will be still more simplified.

In tramp shipping, tramp ships are being used. As the name indicates, this branch of the shipping industry is very irregular in its activities. Tramp ships are sent in where the most paying freights are available. Therefore, tamping is very unstable and very little organized.

Tramp ships are, in accordance with the demand, contractually put at the disposal of charterers, to carry, for one or more voyages, a quantity of goods between named harbours (in voyage charter) or to carry out a number of transport assignments in a certain period of time (in time charter). In the broadest sense of the word, tramp shipping is the activity that is done with ships in voyage charter. Usually, under a charter agreement, they have to perform only one voyage so that each voyage stands completely apart from the other. The vessel is an independent operating and competing unit and its operation is highly individual. The sailing schedule of a tramp ship is consequently very irregular. The ship operator must see to it that his ship is rarely idle and in the port of discharge or in a harbour as close as possible to the port of discharge, he must always try to get a new charter for the ship.

Tramp ships vary considerably in size and are sometimes of lesser quality than the liner ships. Because the cargoes usually don't have to be transported at a high speed and the ship doesn't need highly sophisticated equipment, tramp ships are relatively slow and cheap. However, the present-day tramp fleet counts numerous modern bulk carriers suitable for different sorts of cargoes, including tankers and specialized ships. Owners of modern and cost-effective tramp ships have a better chance than their competitors who offer inferior and less flexibility in the freight market.

The cargo consist of unpackaged bulk goods (ore, coal, grain, phosphates, and others) or a massive amount of general cargo (e.g. saw wood) or seasonal products; with preferably a full cargo which belong to one shipper. No special care is given to manipulation and stowage; speed of delivery is not of primary importance.

Compared with the liner trade, the freight is low and is consequently in accordance with the relative low value of the goods. The freight is established on the international freight market, in the accordance with the rules of offer and demand. The Baltic Exchange in London is the main market. The freights are not fixed because they follow the feverish fluctuations of the freight markets.

A tramp carrier has the following characteristics:

1. Homogenous transportations: These ships are used for transportation of huge quantity of homogeneous cargo, which is carried in bulk quantity. Examples of such cargo are gain, coal, sugar, timber, wheat, ore phosphate etc.
2. No fixed Route and Tariff: It does not have fixed route and predetermined schedule of

departure. Tramps ply on the rule of demand and supply in the market. They are not committed to any discipline in respect of service schedule and freight rates. Their freight nays and thrill are purely market, driven. They run where there is driven. They run where there is demand. They can be compared to private buses in a marriage season whore there are no fixed rates and totally depend on flu season's demand.

Generally, each tramp carries cargo of few ship users. They carry on specific voyage or consecutive voyage. In other words, for the same route they move continuously, one voyage after another. So loading and discharging are confined to a few ports.

3. Less Expensive and Less Operating Costs: As they carry homogeneous cargo, their equipment is simple. Bulk cargoes are normally loaded and discharged by mechanical equipment, elevators and pumps that are less expensive. As they carry comparatively low unit value commodities, a tramp is operated at the lowest possible operating cost.
4. Terms and Conditions Negotiable: As their services, terms and conditions, freight charges are not fixed, they are not given and totally negotiable.

Features of Liner Shipping and Tramp Shipping

Liner Shipping Service

The liner ship has the following features:

1. Liner ship is designed to carry a variety of cargo, with spaces for bales, bundles, boxes, barrels, drums, etc. as well as for reefer (refrigerated) cargo. The designs of the holds and number of decks in cargo will be different from those of a tramp. With the increased share of containerized cargo, specially designed container ships for carrying different categories of containers operate.
2. The cargo handling equipment on a liner will be varied and sophisticated for quick loading and unloading of cargo to ensure a quick turnaround. A quick turnaround means that the ship spends the least possible time in the port and most of its time in transit.
3. Liner ships frequently operate between fixed ports and normally loads in several ports. It serves a number of discharging ports along a pre-determined route.
4. In order to ensure speedier carriage, liner ship is fitted with sophisticated and expensive propelling machinery.
5. Liner shipping service provides pre-announced scheduled services on given terms and conditions of carriage. These conditions in the receipt mostly relate to the responsibilities and liabilities of the ship-owners, carriage, and delivery of cargo.
6. Liner shipping generally offers carriage on fixed and stable freight rates.

Tramp Shipping Service

The tramp carrier has the following characteristics features:

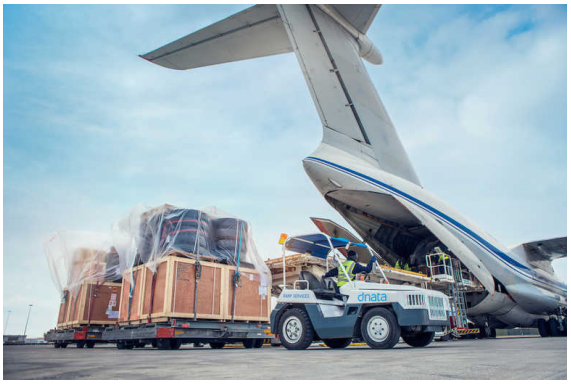
1. Tramp carrier is primarily designed to carry the more simple and homogeneous cargo in huge quantity. It is, therefore, designed to completely utilize its carrying capacity for carriage of one type of cargo.

2. Since one kind of homogeneous cargo is to be handled, a tramp will have the comparatively simple equipment. Bulk cargos are normally loaded and discharged by mechanical equipment, elevators, pumps, etc.
3. Because of the comparatively low unit value of commodities carried, a tramp will be operated at the lowest possible cost. This objective can be achieved by operating ships having relatively less speed by fitting less expensive propelling machinery.
4. A tramp generally carries cargos of one or two ship users. Hence, loading and discharging are confined to a few ports.
5. Tramp carriers do not have a fixed route and predetermined schedule of departure as it is to be engaged by one/two users as and when their need arises.
6. Tramp carrier offers services at terms and conditions, including freight/hire charges, which are not fixed and given but are negotiable.

Advantages of Sea Transport

- It's cheaper: Shipping industry has the most competitive freight costs, as is one of the most cost-effective ways of goods transportation through long distances.
- It's the ideal way to move big volumes of cargo: Vessels are built to carry huge amounts of goods and raw materials in comparison with the capacity of airplanes or trucks. In addition, shipping allows the movement of liquids, gas and dangerous cargo. For this matter, there are certain regulations to keep the safety of the vessel, the crew, and the cargo.
- It's safe: The percentages of losses caused by incidents during transport by sea have dropped until it lowest since a decade according to reports from Allianz.
- It's eco-friendly: In comparison with the road transport, the maritime industry is less dangerous for the environment. The shipping industry is responsible for only 12% of the total of pollution generated by human economic activities.

Air Freight



Air freight or air cargo allows the transport of goods quickly by air. Shipping cargo by air has always been a high cost-to-weight form of shipment, countered by the fact that it's the fastest way to transport goods internationally.

Types of Air Cargo

There are two types of air cargo – general and special cargo.

General cargo includes high value goods, such as electronics, jewellery and pharmaceuticals. Air shipping is more expensive than shipping by sea, but due to the high margins and the fact that many electronic goods are fragile, air freight is the most appropriate form of transport.

Special cargo requires special conditions for transporting goods, such as temperature control, certain air conditions or protected casing (e.g. if the goods are hazardous or livestock).

Disadvantages of Ship by Air Freight

The following goods cannot be transported by air:

- UN classified dangerous goods;
- Lithium Batteries;
- Power Supplies or Power Banks;
- Illegal Goods;
- Firearms;
- Flammable Substances;
- Explosives;
- Biochemical Products.

Process of Transportation of Goods by Air Transport

Air freight can be consolidated into consoles. Consolidating freight with other shippers is often more cost effective due to economies of scale, although it can often take time to pair up or group shipments.

When shipping goods, you'll require a Master Airway Bill (MAWB), which is essentially a note issued by an airline or authorized agent which shows evidence of the contract of carriage. An airway bill works in a similar way to a bill of lading.

Air Freight Costs and Pricing

Air freight pricing is calculated from three factors:

1. Shipment Type (size and weight of goods, as well any specific requirements in the case of special cargo).
2. Destination (international airport or a local/goods only airport).
3. Speed at which delivery is required.

In addition to this, air freight would incur other additional costs such as insurance, surcharges and customs duty/taxes.

Trade Finance Global has a network of freight forwarders, freight experts and shipping/logistics partners that can help you get your goods from A to B.

Air transport can be provided through:

- Schedules air carriers using world airlines and other global logistics service providers;
- Air charters: where it is possible to charter planes/helicopters or perhaps to have the use of military aircraft to allow a totally dedicated movement to take place. It is possible to move goods without being constrained by commercial timetables and specific airport locations. The charter may be totally ad hoc, that is, a 'one-off' charter to achieve a particular humanitarian objective. Alternatively it may be a regular event, monthly for example, in order to transport routine supplies or perhaps members of staff. Logisticians should all be familiar with their internal guidelines on the use of military assets.

Factors that influence the decision to charter and the nature of the aircraft chartered:

- Availability and cost of different types of aircraft;
- The nature, quantity, weight, size and volume of the cargo;
- Equipment for the aircraft and cargo handling available at origin and destination;
- The distance to be travelled and possible constraints on certain airspace;
- Ability of certain airports to handle particular types of aircraft;
- Possible noise and operating hours restrictions at certain airports;
- Securing landing and over-flight permission;
- Availability of customs and immigration at the airport.

Sending Goods by Air

The air waybill (AWB) is the most important document related to airfreight. Its completion is regulated by IATA definitions. Each AWB has a unique identifying number, the first part of which is the IATA airline code number. The AWB is the carrier's receipt by air, evidence of the contract of carriage and is usually non-negotiable. It is made out to a named consignee who is the only party to whom the carrier can deliver.

Packaging and labeling for air transport is an important consideration. Limited space on aircraft will require packaging, plus cargo, to be within the allowable weights and dimensions for that specific aircraft. Unit load devices vary and the specific requirements need to be coordinated before final packaging to avoid delays. However, the method of loading and unloading and onward transit may still require a strong and durable packaging medium.

Ultimately, it is the nature of the goods being transported that will determine the precise nature of the packaging.

Types of Air Freight Carriers

All-cargo Carriers

As the name connotes, these carriers move air cargo and offer freight services, but do not offer passenger services. All-cargo carriers have less weight and dimension limitations due to the wide-body and containerized cargo aircrafts in their fleet which leave plenty of room for larger, heavier items, such as aerospace and automotive parts and materials. This category also includes heavy-lift cargo freighters designed for project cargo. Since heavy-lift freighters are uncommon, their charter services are highly specialized and rarely operate on a scheduled basis.

Integrated Express Carriers

These carriers will move your cargo from the door at point A to the door at point B. They will pick-up your shipment from origin via truck, fly it to its destination terminal, then delivers it to the destination via truck. Some of the most popular integrated express carriers in North America are UPS, FedEx Express, and DHL (though DHL discontinued their domestic pick-up and delivery service in the U.S. as of 2009). These types of carriers rely heavily on their air cargo hubs, where they will unload the cargo, sort it by destination, and load it onto the appropriate outbound aircraft–all through the use of automated sorting. This process allows for quick turnaround times and extensive delivery capabilities.

Combination Aircraft Carriers

Carriers that have both passenger and freighter aircrafts in their fleet are known as Combination Aircraft Carriers. Examples of such companies are Lufthansa and Emirates.

Advantages of Air Freight

1. The fastest shipping method: When your goods need to be moved quickly, air freight is the best solution compared to sea freight or road transport.
2. Highly reliable arrival and departure times: The arrival and departure times of flights are highly reliable, as airlines tend to be very on top of their schedules. Even missing a flight wouldn't cause much delay as there are usually flights departing every hour.
3. Send your cargo almost anywhere: Many airlines have a large network of destinations that covers almost the entire world. This means that you can send the shipment to nearly every destination.
4. Low insurance premium means large savings: As the transportation time for air cargo is comparatively short, the insurance premium is lower. Even if air freight can be expensive, this brings about savings in terms of lower insurance costs.
5. High level of security and reduced risk of theft and damage: Shipping by air offers the advantage of a high level of security, as the airport safety controls over cargo are tightly managed. Tightly managed airport controls also reduce the cargo exposure to theft and damage.
6. Less need for warehousing and fewer items in stock: With the quicker transit times of air

freight, you have less need for local warehousing and do not need to keep items in stock. Customs clearance, cargo inspection and cargo handlers are more efficient, as most cargo is cleared within a matter of hours.

7. Less packaging required: Normally, air shipments require less heavy packing than for example ocean shipments. This means that you save both time and money to provide service for additional packing.

8. Follow the status of your cargo: Many companies give you the opportunity to track your goods using a web application, which means you can monitor the status of your cargo from departure to arrival to keep constantly updated.

Developing a Plan of Action

Normally, an air operation Plan of Action (POA) is part of an organization's logistics plan, but can also be published as a stand-alone document.

Generally, the logistics plan defines the logistics requirements and actions needed to achieve the objectives established by the project managers. However, the scope of the air operations POA can extend beyond the scope of the organization's requirement because it may include partnering/ collaboration with other organizations or support to other organizations. If this is the case, the air operations PAO should be considered as a standalone document.

The air operations POA should justify the need to charter air assets and provide a rationale for the decision to select one or other of the air operation concept (models). The air operations POA should include the following:

- Specify the concept: identify the airport of entry, staging base and the follow-on modes of transport (i.e. truck, rail, train, boat and regional aircraft);
- Where an airlift service will be the follow-on transport, justify the reason for this approach; provide specifications of aircraft categories and types; identify the operations base and delivery airfields; identify action officer for chartering of aircraft;
- Include specifications for and actions to be taken to acquire ground support equipment; identify action officer;
- Where a passenger service is required, elaborate guidelines for passenger acceptability; i.e. who will be allowed to use the commuter service;
- Identify the resources and deficiencies at the operations and staging bases and destination airfields; i.e. security, ground handling, fuel, communications, infrastructure, storage, etc. Identify action officer to correct deficiencies;
- Where a helicopter operation is proposed, identify operations base, pick-up points and helipads and their resources and deficiencies (e.g. fuel, atc, communications, security). Where, for security reasons, helicopters cannot overnight at the pick-up points, identify secure bases and their resources and deficiencies;
- Indicate the minimum period for which the chartered aircraft will be required;

- Estimate required fuel quantities and availability and any required actions to secure fuel provisioning; identify action officer;
- Determine the required staff and their locations; identify action officer for recruitment;
- Define responsibilities and deployment staff required;
- Determine relationship and interface between different entities involved;
- Describe reporting lines and procedures;
- Indicate the required operational support equipment, including specifications and procurement needs, inclusive of the office and aviation operational required equipment; identify action officer;
- Propose the estimated cost of the required air operation.

Road and Rail Transport

Road Transport

If an organization decides to acquire its own vehicles, there are a number of areas to be considered. The type of vehicle, in terms of the chassis-cab and the body type, needs to be determined. The nature of the operation may also require that mechanical handling aids need to be incorporated into the overall vehicle specification.

Advantages

The advantages of owning vehicles include:

- Vehicles can be built specifically to carry a particular product. Special equipment for materials handling can be attached;
- The driver can be specially trained and will fulfil the 'ambassador' role for the organisation;
- Vehicles can carry the company livery, perhaps the aid organisations logo and, where appropriate, the red cross; and
- Management retains total control over the vehicle and its operation.

Disadvantage

Management of the transport function can occupy a great deal of management time, requires specific expertise and significant capital investment. In contrast, third party carriers can often provide more cost-effective transport facilities but careful consideration must be given to the level of service required.

Third Party Advantages and Disadvantages

Even if an organization owns its vehicles, there may well be occasions when a need arises for additional capacity, to meet peak activity or other short term needs. This can be met by the use of vehicles supplied by a commercial transport provider (third party).

The advantages of using third party transport include:

- Organizations can use commercial providers to meet fluctuating demand requirements;
- Variable loads and journeys can be catered for;
- The haulier may be able to offer a more cost-effective and a more efficient service; and
- Responsibility for administration of vehicles and drivers is no longer the responsibility of the organization, allowing staff to concentrate on more productive areas. There is no requirement for capital to be invested in transport.

Disadvantages

A measure of control is lost with third party operations. Performance feedback and communication with customers' needs to remain a strong feature and be controlled by the contracting organization.

Selecting Vehicle Types

It is important to be able to select the appropriate vehicle for the purpose required even if, at a later stage, it is necessary to revise this choice to reflect availability in the field.

Selecting the Body Type

The specification of the vehicle body will vary according to the goods or materials being carried and security. There are many variants of body type available; a description of the main body types.

Platforms

The simplest and cheapest body type is the platform or flat bed. It provides all round access to the load, but offers little security or protection from the weather. Loads also need to be restrained. This will generally involve roping and sheeting, which is a time consuming operation.

Van Body

The van or box body reduces the payload of the vehicle, but provides protection for a perishable

product and added security. Construction will depend upon the needs for insulation, waterproofing or strength. Access is usually provided by a rear door. Sometimes a door will be built into one, or both, of the body sides.

Curtain Sided Bodies

Curtain sided bodies overcome the disadvantages of access, since the curtains can be pulled back to reveal the full length of the platform. This improves the speed of loading as well as unloading. Advantages of load restraint and weather protection are maintained, while body weight is less than the box body. Other variants will replace the curtains with sliding panels.

Tankers

Tankers are designed to carry powders or liquids. They require a pumping mechanism and piping to discharge the load.

Bulk Carriers

Bulk carriers are generally built as box bodies without the roof. They will require a tipping mechanism to allow the load to be discharged.

Drawbars

A rigid master truck with a drawbar trailer is the usual configuration. The bodies may be of the demountable type. Drawbars offer increased cubic capacity for bulky lighter loads.

Road Transport Documentation

Whether the vehicles being used are owned, hired or are managed by a third party, it is important to ensure that all local laws relating to the licensing, insurance and regulation of vehicles are being adhered to :

- Normally a license to operate the vehicle on a public highway is required;
- For larger trucks there may be an additional license fee to be paid;
- Vehicles should be insured to at least the minimum required by law; different organizations will have internal policies regarding the extent to which their own vehicles should be insured; and
- Vehicles may also require documentation relating to the maximum permissible weights in terms of gross vehicle weight, axle weight and payload.

Rail Transport

Rail transport is a safe land transportation system when compared to other forms of transportation. Rail transportation is capable of high levels of passenger and cargo utilization and energy efficiency, but is often less flexible and more capital-intensive than highway transportation is,

when lower traffic levels are considered. Rail transport costs less than air or road transport. It is very suitable for the movement of large load sizes over longer distances, but it has the following disadvantages:

- It lacks the versatility and flexibility of motor carriers since it operates on fixed track facilities. It provides terminal to terminal, rather than point to point delivery services.
- Though it offers an effective method of bulk haulage, it is slow.

Documentation for movement by rail is controlled through the rail waybill. The rail waybill is a non-negotiable document. It contains the instructions to the railway company for handling, dispatching and delivering the consignment. No other document is required expect for international transport across borders, where enquiries should be made locally as to the proper documentation needed.

Transportation Management Systems

A transportation management system, (TMS) is a platform that's designed to streamline the shipping process. It is a subset of supply chain management concerning transportation solutions. A TMS allows shippers to automate the processes they have in place and receive valuable insights to save time and reduce spend on future shipments.

Distribution companies, e-commerce organizations and anyone else that moves freight on a regular basis realizes there are many moving parts to the shipping process, both literally and figuratively. From quoting to delivery, those shipping freight are almost always looking for ways to optimize spend and improve processes. Thanks to transportation management systems (TMS), shippers have a solution on their side to do just that.

Benefits of TMS

- Technological capabilities: With a transportation management system, you as the shipper will have the technology you need to make routing decisions based on quotes, transit time and carrier mix. This centralized location for quoting will eliminate unnecessary stress and time spent during the booking process.

- Simplify processes: A TMS can help to simplify the carrier selection process by allowing you to evaluate the merchandise being sent and matching it with a carrier in the network. By managing this entire process in one place, you will be able to revisit past shipments and quickly match similar loads to the appropriate carriers.
- Track freight: With a TMS, you can track freight that's on the road and even receive alerts to any transit exceptions or unforeseen delays from one location. It's impossible to control human error or Mother Nature; however, a TMS will let you see when delays are occurring and why.
- Business insights: Robust transportation management systems will offer you in-depth insights and reporting capabilities. For example, let's say you oversee the shipping process for 20 locations that each sends five shipments out a week. That's 100 shipping invoices to create and shipments to evaluate each week. With a TMS, information will all be stored in one location and custom reports can be created to analyze things like the discrepancies between rates and final invoices.

TMS Challenges

1. Keeping quotes organized: If you're working with a number of different shipments, you don't want to be on the phone or jumping from website to website asking for rates from the carriers in your network. Dialing different carriers and requesting quotes can be a time-consuming process, taking you away from other aspects of the business that need attention.
2. Selecting the best carrier: Not all shipments are the same. Sometimes, shipments are time or temperature sensitive, require special delivery services or need to be handled with extreme care. As a result, not all shipments should be handled by a single carrier. While some carriers might be best-suited to handle long hauls, others might offer the specialized services you need for a small added price.
3. Tracking shipments: Businesses don't always use the same carriers for all their freight. It's common for a number of different shipments to be in transit aboard different company trucks all over the map. Consequently, the freight tracking process can become very challenging. Without a TMS, you or someone within your organization may have to enter shipment numbers into forms on a number of different carrier sites.
4. Gathering insights: Without a TMS in place, you may have a general gut feeling of who the cheapest carrier has been over the past year, or which carrier had the highest percentage of on-time shipments.

Fleet Management

Fleet management is the function that oversees, coordinates and facilitates various transport and transport related activities. Fleet management underpins and supports transport related activities through the management of the assets that are used.

Effective fleet management aims at reducing and minimizing overall costs through maximum, cost effective utilization of resources such as vehicles, fuel, spare parts, etc.

The administration and financial management of fleet is very organizational specific. It largely depends on donor requirements and organizational policies. For example, in some organizations vehicles are restricted to specific projects and others utilize vehicle pools to serve multiple projects. Driving policies can vary from a strict reliance on a dedicated driver from the organization, to using staff to drive the vehicles. The administrative policies of the individual organization will dictate which approach will be utilized. This results in the custodian of the fleet management function to be very much dependent on organizational policies and structures.

Aspects of Fleet Management

- Identifying needs
- Acquisition Process
- Insurance
- Vehicle leasing (internal and external)
- Vehicle Management:
  - Fleet management systems
  - Vehicle maintenance and up-keep
- Vehicle usage:
  - Vehicle disposal
- Health, Safety and Security:
  - Complying with Legislature and security requirements
  - Drivers

Identifying Needs

Identification of fleet needs is dependent on the nature of emergency and operations, and the size and area of operation, urban operations could utilize smaller saloon cars whereas remote field operation may require larger four-wheel drive vehicles for extreme terrain. Vehicle selection criteria are guided by:

- Donor criteria applicable to the purchase;
- Uniformity of fleet;
- The appropriate vehicle type for local fuel availability;
- The purpose of the vehicle (cargo or passenger);
- The terrain in which the vehicle will operate;
- Global acquisition cost;
- Availability of local dealers;
- Local availability of spare parts for the intended vehicle;
- Warranties; and
- Local availability of competent mechanics.

Depending on the level of emergency the criteria may vary.

Acquisition Process

- The general criteria for selection of a vehicle should be in conformity with the standard recommended vehicles.
- The standard tender process is adopted for vehicles, as for all other goods and services, bulk items and items bought on a regular basis. In some cases, the process may result in outsourcing of some aspects of the vehicle management or leasing of vehicles
- For small daily purchases such as spark plugs, filters etc. petty cash/float may be used by the fleet manager.

Insurance

Careful consideration should be given to the form of insurance selected for the vehicles belonging to the organization. The minimum legal requirements must always be complied with; this is usually at least third party cover.

To ensure compliance with the vehicle insurance requirements, all personnel using operation vehicles under the responsibility of the organization must be fully conversant with accident and incident reporting procedures for vehicles and personal injury.

Personnel requirements: the insurance cover for personnel will depend on the type of policy the organization takes to cover its vehicles: third party, third party fire and theft, comprehensive or liability insurance.

Rent or outsource: insurance coverage for leased or outsourced vehicles will be dependent upon what the organization negotiates with the service provider. The organization will either adopt the service providers insurance as - is or adopt it with amendments. An alternative is to completely outsource the fleet management, but again the type of insurance will be dependent upon what is negotiated with the service provider.

Vehicle Leasing

"A vehicle or asset lease is a contract by which one party lets vehicles or assets to another party for a specified period of time".

A lease is a written agreement by which one party agrees to let another party have the use of specified assets for a period of time for a fixed amount of money.

In an external leasing option, the ownership could:

- Remain with the leasing company or entity, but the rights for use are passed on to the lessee for the period of the lease;
- In other cases, at the expiry of the lease, the ownership is transferred to the lessee; and
- The ownership remains with the lessee, but management of some aspects such as maintenance, could remain with the leasing company depending on negotiations.

However internal leasing is different. The organization itself owns the vehicles which are centrally managed and issued to programs on a cost recovery basis. Organizations therefore budget for leasing costs only.

Features of an External Leasing Agreement

- Lease agreement is drawn up between the organization and the leasing company clearly specifying the terms of agreement.
- In some cases the lessee may pay a monthly bill irrespective of mileage covered or a fixed amount with additional costs per kilometre outside of a specified range.
- Depending on nature of agreement the lessor may be responsible for:
    - Repair and maintenance at agreed intervals;
    - Insurance;
    - In some cases the vehicle may come with a driver.
- The lessee is responsible for:
    - Provision of competent drivers;
    - Monthly payment; and
    - Managing routing of vehicle.

- The lessee's drivers will be responsible for good driving.

The contents of the agreement will depend largely on the negotiating power of the lessee.

Advantages of Leasing

- Routine repair or maintenance costs are built into leasing costs.
- No overheads in garage set-up and maintenance.
- No high initial purchase items in lessee's books.
- The lessor bears most of the risk.
- The organization is able to focus on core business.

Disadvantages of Leasing

- The organization losses control of some aspects of its fleet management.
- Discontinuation of services by the service provider can cause huge disruptions in the day-to-day operations.
- If the leasing contract is cancelled for any reason, the organization may have to make heavy investments in vehicle purchases or temporary hire to ensure business continuity.
- The organization would not be able to build up any institutional capacity in fleet management.

Outsourcing

The nature of the contract is dependent on the ownership status which could be:

- An external company is contracted to supply and manage the vehicles;
- An external company supplies the vehicles but the management remains with the organization; and
- The vehicles are owned by the organization and an external company undertakes the management of the fleet.

The preferred options are dependent on the organizations approved procurement or sourcing policies and operational needs. Contracting, sourcing and leasing are done in strict adherence with the organizations approved procurement policy.

In emergency situations outsourcing and external leasing are common practices. In a rapid on-set emergency, it takes time to ship-in or purchase vehicles for use in the response. Organizations are sometimes left with the option of outsourcing or leasing vehicles or trucks from the local market. In the initial days of the emergency, this can prove to be an expensive option. In emergency situations, there are usually very many organizations and very few assets. The high demand may cause price increases.

Vehicle Management

The location of the vehicle management function within organizations' structures varies from organization to organization. The management may be located within administration, transport function or have an independent fleet manager. For the purpose of the Logistics Operations Guide the manager will be referred to as the fleet manager (FM).

Vehicles are expensive but critical to an organizations' operation. They facilitate the movement of personnel and the delivery of relief supplies to beneficiaries. Vehicle management is also one of the aspects of supply management that can be easily abused if not properly managed. If properly managed this aspect would ensure:

- Availability of vehicles as and when required;
- Cost efficiency;
- Programme or response continuity;
- Staff safety;
- Safety on the roads;
- Vehicle safety;
- Vehicle security; and
- Performance management.

To achieve the above, some of the measures taken by the FM are:

- Every vehicle carries a logbook;
- Logbooks are checked on a weekly basis;
- Vehicles are logged out and signed for before every trip. A vehicle allocation chart is recommended;
- The driver records all fuel and maintenance costs in the log book or fuel request and purchase voucher, indicating the reading on the odometer at the time of the expense;
- Fuel can be purchased from a central petrol station and a receipt issued. Where there is no appointed petrol station, the vehicle fuel request form is completed and approved before funds are released for fuelling. Should the driver have to purchase fuel from their own funds or petty cash, the amount spent on the purchase will be reimbursed;
- All vehicle keys are surrendered at the end of the day;
- Drivers adhere to the carrying capacity as provided by the traffic law;
- No unauthorized staff members are allowed to drive the organizations vehicles. Vehicles will be assigned at the discretion of the approving officer; and

- All new staff (those who have a driving license but have not driven for a specified period), will not be allowed to drive the organization's vehicles unless accompanied by a qualified driver or have been re-tested by the registered automobile association and authorized to drive.

Fleet Management Systems

In recent times, to address problems in fleet management and the ever expanding need to monitor usage of vehicles, commercial organizations have designed automated control systems and other approaches to vehicle management. Simple management systems can be designed in-house for internal use to provide a good analysis of the vehicles and driver performance.

Vehicle management systems are structured in a way that enables the capturing of information on various aspects of fleet usage, maintenance and operations. For example:

- Distances travelled;
- Destinations reached;
- Distance travelled by vehicle showing official and private mileage;
- Fuel consumption;
- Repair and maintenance per vehicle;
- Rate of consumption of spare parts; and
- Servicing planned and completed.

The reports can be produced on a weekly, monthly or bi-monthly basis, depending on the needs of the organization. Weekly reports may comprise a summary weekly refuelling by vehicle which may highlight any exceptions to targets set per vehicle, whereas monthly reports may comprise:

- Summary refuelling by vehicle and average fuel consumption;
- Summary mileage per vehicle;
- Repairs or maintenance; and
- Any accidents.

Vehicle Maintenance and Up-keep

Maintenance

Vehicles are regularly maintained for optimum performance, and kept in good repair. In emergency situations the Logistician is sometimes tasked with the responsibility of managing the vehicle fleet. To streamline vehicle management the FM should put in place a simple process. Such a process could entail the following:

Maintenance Options

There are three main options:

1. "In house maintenance" – Performed using the facilities and staff of the organization.
2. "Outsourced maintenance" – Under taken by an outside contractor.
3. "Contract hire" – Undertaken by an outside contractor as part of a vehicle operating system.

It will be necessary to review the operational requirements and match the most suitable form of maintenance to the individual operation.

Whichever mix is selected, it must be preventative and must be under the control of a competent manager; if it is not, the condition of the vehicles may quickly decline and running costs may increase.

Maintenance Planning

Whichever maintenance options is followed, vehicle maintenance schedules must be drawn up together with, and published by the FM as part of the vehicle planning.

All members of the management team must make a commitment to respecting the scheduled dates for maintenance.

A master vehicle inspection and servicing schedule should be drawn up for one year, a wall chart is recommended. This chart can also be used to show road tax renewal, annual inspection dates, etc.

Vehicle servicing is a compromise between inadequate attention, resulting in progressive deterioration in condition and the ensuing serious consequences, and too much attention, which is costly and unnecessary.

The person responsible for the condition of the vehicles must decide the scope of the servicing work required and how often this should be carried out; taking into account the manufacturer's guidelines and kilometres travelled and in which type of environment the vehicle has been used.

Preventative Maintenance

This is done on an ongoing basis. This type of maintenance addresses the basic things that could cause a problem in vehicles if they are not properly maintained. The Logistician or FM develops an inspection check-list to be used by all drivers as a guide.

Each day, the first driver to use a vehicle will inspect the vehicle using the check-list.

Routine Maintenance

This type of maintenance is done on a monthly basis. It may cover the following:

- The vehicle supervisor should periodically organize a test drive each vehicle and report on its condition and also ensure that normal/regular service has been done for all vehicles;

- Tyres: any abnormal wearing should be reported to the FM; and
- Cleaning of the engine at least once a month.

In emergency situations, in the absence of local facilities, the organization would have to undertake its own maintenance and ensure that:

- An experienced mechanic is hired;
- A secure workshop area is identified or set up;
- The necessary tool and equipment are available;
- There is continuous performance monitoring and a system for measuring & monitoring:
  - Fleet performance;
  - Costs and performance.

Selection of Garage

Based on the organization's needs, the criteria for selection of the right garage are set with the input of the Logistics officer and the FM, keeping in mind the organizations approved procurement procedures. For example the minimum requirements may include:

- Number of qualified technical staff and details of qualifications;
- List of minimum equipment;
- Services offered;
- Accessibility/location;
- Credit facilities;
- Satisfactory references;
- Financial stability;
- Repair/service costs;
- Spare parts available.

Basic Spare Parts in a Workshop

Should the organization decide to manage its vehicle maintenance in-house, certain fast moving spares are recommended for stocking. This reduces vehicle down-time.

The number of vehicles owned by the organization will determine the purchase of these parts and equipment.

Maintenance Documentation

- Vehicle maintenance summary: Whoever maintains the vehicles must make a detailed

written servicing record report, listing the work done, parts and fluids used and costs incurred on each job. The FM must keep this on the individual vehicle file.

- Workshop job cards: When the written order is received, the workshop raises a workshop 'job card' for each vehicle entering for inspection, service or defect rectification. Work should not be carried out without a job card; each card should include the following information:
  - Details of all work required to be carried out;
  - Actual work carried out;
  - Name of staff and hours worked;
  - Details of spare parts and materials used; and
  - Space for the cost of the work. Once all relevant information has been taken from the job cards they should then be filed with the vehicle files.
- Vehicle files and documentation: General vehicle correspondence files should be maintained for each vehicle. This file should contain the following documents to facilitate tracking of expenditure and maintenance:
  - Copies of purchase request;
  - Copy of internal service request;
  - Copy of local purchase order;
  - Invoice;
  - All important documentations (bill of lading, etc);
  - Insurance papers;
  - Copies of all repair bills;
  - Job order;
  - Accident report;
  - Fuel log-in sheets.

Vehicle Usage

This aspect of vehicle management is very sensitive and is often abused. It is therefore necessary to have a clearly defined policy regarding vehicle usage and staff benefits. Understandably, most organizations do not have the capacity to assign a driver for each vehicle that they own. Under these circumstances, after testing, staff may be authorized to self-drive. The vehicles would in most cases be pooled and rotated based on needs, except where a specific donor requirement conditions ties a vehicle to a specific project. For practical reasons, light vehicles are utilized for office operations and within urban settings and heavy vehicles for field based operations.

Vehicle Disposal

Running old vehicles may lead to high costs of maintenance and uneconomical fuel consumption. To avoid this, organizations should have approved and clearly stipulated policies and procedures on how and when to replace and dispose of vehicles/assets. The need to dispose may arise due to any of the following reasons:

- As a result of extensive unrepairable damage, or cost-prohibitive repairs;
- When the vehicle attains the stipulated mileage or years for disposal;
- When the vehicle is no longer economically sustainable;
- When the vehicle is no-longer required;
- When programs downscale or shut down.

The disposal procedure applied for vehicles will apply for all other assets such as:

- Generators,
- Boats/canoes/barges,
- Motorcycles,
- Fork lift trucks.

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Inventory Planning and Control

The process which is involved in determining the ideal quantity as well as timing of inventory in order to align it with production and sales capacity is referred to as inventory planning. Some of the types of inventory which are dealt within it are work in progress inventory and finished goods inventory. The diverse aspects and methods of inventory planning and control have been thoroughly discussed in this chapter.

Inventory is the life blood of the industries. But an excess or shortage of inventory is harmful.

The term inventory is used to denote the stock on hand at a particular time comprising raw materials, goods in the process of manufacture and finished goods. An inventory has a primary significance for accounting purposes to ascertain the correct income for a particular period. Inventory plays a very important part in the determination of profit of a business.

Need for Inventory

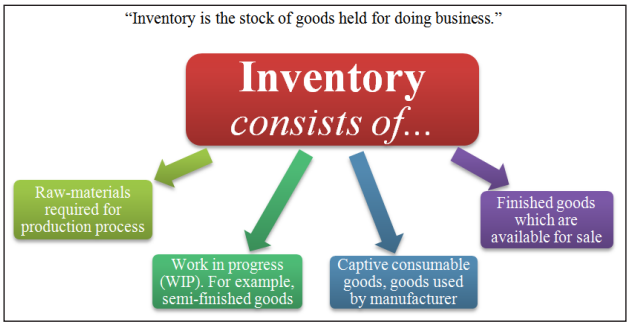
A businessman needs inventory to carry on the day-to-day operations of his business. Now business activity has increased and the problem of inventory has also become more complex. The businessman needs more cash to conduct his daily business activities. Therefore, the higher the level of inventory, the lower the level of cash.

One of the causes for the failure of a business is a huge inventory. The existence of large quantities of inventories is naturally a cause for alarm. The need for inventory must be balanced against the preference for liquidity. If we can stock the required inventory well in advance, we are able to save the cost of idle time of machinery and the cost of idle time of men.

Nature of Inventories

1. Safety Inventory: Safety inventory provides for failures in supplies, unexpected spurt in demand, i.e. an insurance cover.

2. Excessive Inventory: Management is compelled to build up excessive inventory for reasons beyond its control as a measure of government price support of commodity as in the case of strategic import.
3. Normal Inventory: It is based on production plan and the time of supplies and economic ordering quantity levels. It also includes a reasonable factor of safety.
4. Flabby Inventory: It includes finished goods, raw materials and stores held because of poor working capital management and inefficient distribution.
5. Profit Making Inventory: It represents stock of raw materials and finished goods held for realising stock profit. It is a must for every concern to make inventory profitable for adequacy of business operations.



Motives of Holding Inventory

The decision to hold the inventories is based on certain basic motives.

The motives behind the holding of inventories can be broadly classified as under:

1. For speculative purposes: In a situation of inflation, it may happen that the value of stock increases overtime at a rate which is higher than the cost of holding stocks. The motive to hold inventories for speculative purposes would depend upon the expectations of the price increase as against the holding cost of inventory which includes the prevalent market rate of interest or capital cost, the cost of storage and handling, and the cost of deterioration and obsolescence.
2. To facilitate a constant rate of output flow: The ordinary motive for holding inventories is to enable a constant rate of output flow of the business firm for the uninterrupted supply for which every firm should hold stock of raw materials and semi-finished goods. In business, it is always advisable to hold some precautionary stock to overcome the special problems, like power shortages, transport bottlenecks, labour unrest, etc.
3. To meet demand: The motive to hold inventories to meet demand is quite important for a firm. It is essential to note that demand varies in an unpredictable manner. The changes in the demand for the commodity are not under the control of the firm.

Market Structure and Inventories

The firm operates in a market; the decision to hold inventories is an important managerial function. The decision to hold inventories depends on the market structure within which the firm is operating.

On the basis of competition, markets are classified into:

1. Perfectly Competitive Market:

   In a perfectly competitive market, the individual firm is only a 'price taker' and not 'price maker' and the individual firm cannot have a price policy of its own. The individual firm will pay attention to the production side to reduce the cost of production. It will adjust output to the market price. There is no need of incurring any expenditure on advertisement and publicity.

   The firm need not keep the inventories of finished goods because all output can be sold at a given price. The sellers know the potential sales at various price levels in the market. The firm need not bother about future expectations of prices.

2. Imperfect Market:

   Imperfect competition is a term denoting a market situation which is not perfect. Each firm produces basically the same product but endeavours to distinguish it from its rivals by product differentiation. There will be no unique price; instead there will be a cluster of prices. The firm gains and retains his customers by competitive advertising and sales promotion.

   In case of imperfect competition, the demand is uncertain and the firm needs to keep inventories to take advantage of profitable sales opportunities. The optimum level of inventory will depend upon the variability of sales and the relationship between revenue and cost.

   Pricing is not the problem, but product differentiation is the problem, and competition is not on prices but on products. Greater the difference between price and marginal cost, the greater will be the level of inventory stock.

   Oligopoly refers to that form of imperfect competition where there will be only a few sellers. Another feature of oligopolist market with product differentiation is price rigidity. The price will be kept unchanged due to fear of retaliation and prices tend to be sticky and inflexible. No firm would indulge in price-cutting and there is a tendency for price stability.

   The stocks of finished goods provide the adjustment mechanism necessary when demand does not equal supply. An oligopolist relies more on the short run adjustments in its level of stocks than on price changes. When stocks fall quickly, they exert a pressure for price increase, similarly when stocks grow quickly, the cost of holding inventories would grow to force the firm for a price decrease.

Cost of Holding Inventory

Holding of inventories has considerable costs. The burden of the cost of inventory is expressed in terms of money.

These costs are divided into the following:

1. Set up Cost:

   These costs include clerical cost on orders and discount rates on quantity of goods purchased. The costs are included in the cost of material at two stages. Firstly, when material

is purchased and stored, and secondly, when goods manufactured are stored from the said material. Every company has to store its goods that it wants to be sold. Storage function is necessary because production and consumption cycles rarely match.

2. Cost of Spoilage and Obsolescence:

   The next is the cost of spoilage and obsolescence. It refers to loss of goods while in stock. Any product or material is bound to spoil if stored for a long time. The risk of spoilage is an open risk. The cost of spoilage is bound to be taken into account.

   Similarly, the cost of obsolescence, some spare parts and machine components may become obsolete if they are stored for a long time. This is true when there are rapid technological changes. As a result, the cost of spoilage and obsolescence gives rise to the accountability of inventory cost.

3. Cost of Placing an Order:

   This cost may be for placing order on outside suppliers for procuring raw goods to be manufactured inside the firm. Depending upon the type of stock, this cost may vary.

Cost of placing an order includes the following:

- Set up cost of machines,
- Cost involved in follow-up,
- Cost involved in receiving the order,
- Paper work costs.

4. Cost of Carrying Stock:

   This is the cost which a firm actually incurs for carrying the stock.

Cost of carrying stock is calculated by taking into consideration the following items:

- Interest on capital,
- Tax and insurance charges,
- Storage cost,
- Allowance for spoilage,
- Obsolescence.

5. Cost of Running out of Stock:

   Whenever stock exhausts for any item, this cost is incurred. These costs are different in nature. The cost of running out of stock for a raw material or spare part is made up of plant down time and possible special delivery costs. For a finished good, such costs are known as dissatisfaction to customers or lost customers.

Methods of Evaluating Inventories

The commonly practiced methods of evaluating inventories are listed below:

1. First in First Out:

   It is commonly known as the recent purchase method. The method assumes that the goods first purchased are the goods first sold or the units that are the first to enter the plant are also the first to leave it. This method ensures that materials should be issued at actual cost and no profit or loss should occur on this account.

   This system goes smooth if the prices are stable. During inflation, operating statements reflect inventory profits, which do not represent disposable income. However during deflation, it results in narrowing of profits.

2. Last in First Out:

   It is generally called as the 'replacement cost' method. The method is based on the theory that the goods sold are those most recently purchased. It works in the reversal order to first in first out. The main advantage of this method is that materials are issued at cost and relate as closely as possible to current price levels. This method tends to level profits and losses during inflation and deflation.

   Thus it maintains the real capital intact. During inflation, the recent requisitions tend to lower the margin of profit because of their higher costs. However, during deflation the fall in profit is reduced because of the lower cost of the last units acquired.

3. Base Stock Method:

   This method works more or less similar to the first in first out method, with the addition of a fixed minimum quantity of stock which is always maintained and carried forward at the end of each year at actual cost. In practice, many concerns maintain a minimum stock inventory in store.

   When emergency arises, it is released. This method minimizes violent fluctuations in the gross profit. This method is prevalent in extractive industries and also applied to those industries where a variety of raw materials are used.

4. Average Method:

   There are different types of averages. They are the simple average, weighted average, periodic simple average and periodic weighted average. Under simple average method, materials are not charged at actual cost but an approximate figure is calculated by dividing the total of the prices by the number of prices which may result in profit or loss.

   The weighted average method is similar to simple average. However, weighted average is calculated each time a purchase is made. To eliminate the effect of earlier prices, the total quantities and total costs are considered.

   The periodic simple average is also similar to simple average price except that the issue price is calculated at the end of the period. It can be calculated by dividing the total prices of the materials by the number of prices periodically.

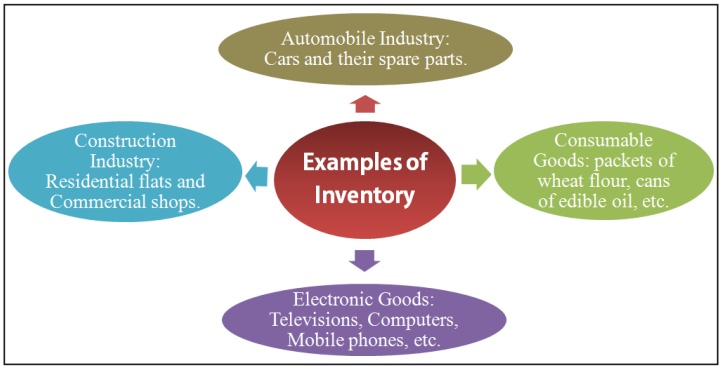
The periodic weighted price is calculated at the end of the period by dividing the total cost of purchases by the total quantities purchased. This method is more accurate than the previous one because of the inclusion of total quantities and total cost.

5. Standard Price Method:

   In the light of the various variations, with a view to showing what it should be at the expected level of efficiency, the pre-determined price is ascertained for each material in advance of the accounting period. Thus the standard price is compared with the actual price. When this method is followed the figures of profit are more realistic.

Examples of Inventory

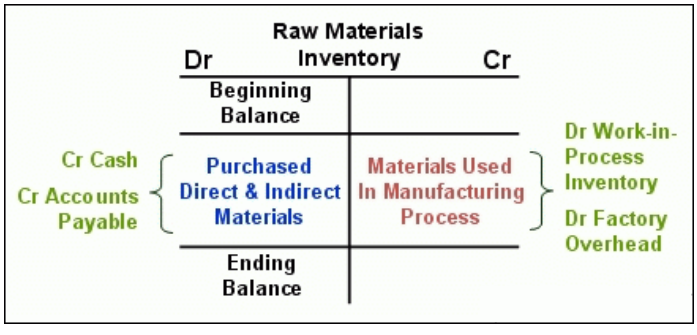
The examples of inventory of some major industries are depicted below.



Following are examples of inventory seen in four major industries:

1. Automobile industry's inventory comprises of the total number of cars and their spare parts.
2. Consumable goods' inventory contains packets of wheat flour, cans of edible oil, etc.
3. Electronic goods' inventory includes televisions, computers, mobile phones, air-conditioners, refrigerators, etc.
4. Construction industry's inventory mainly covers residential flats and commercial shops.

Raw Materials Inventory



Raw materials inventory is the total cost of all component parts currently in stock that have not yet been used in work-in-process or finished goods production.

The cost of raw materials on hand as of the balance sheet date appears in the balance sheet as a current asset. Raw materials may be aggregated into a single inventory line item in the balance sheet that also includes the cost of work-in-process and finished goods inventory.

Raw materials of all types are initially recorded into an inventory asset account with a debit to the raw materials inventory account and a credit to the accounts payable account.

When raw materials are consumed, the accounting treatment varies, depending on their status as direct or indirect materials. The accounting is:

- Direct materials: Debit the work-in-process inventory account and credit the raw materials inventory asset account. Or, if the production process is brief, bypass the work-in-process account and debit the finished goods inventory account instead.
- Indirect materials: Debit the factory overhead account and credit the raw materials inventory asset account. At the end of the month, the ending balance in the overhead account is allocated to the cost of goods sold and ending inventory.

Raw materials may sometimes be declared obsolete, possibly because they are no longer used in company products, or because they have degraded while in storage and so can no longer be used. If so, they are typically charged directly to the cost of goods sold, with an offsetting credit to the raw materials inventory account.

Types of Raw Materials

Direct Raw Material

The Direct raw material is one that is part of the final product, ie it is easily identifiable and is physically present in the composition of the finished product once the manufacturing process is completed.

These materials usually represent a high percentage of the cost of processing the good. The term raw material can be defined as any substance, element or component that is used in the manufacture of goods and products.

Importance of Direct Raw Material

They are the most costly components for the manufacture of goods and products, direct raw materials play a relevant role in any production process and are therefore decisive in defining the economic situation of nations.

One of the key factors of the success of the economy of any country is determined by:

- The amount of natural resources it possesses within its borders.
- The existence of fossil fuels that allow the extraction of these resources.

- The creation of policies that encourage local entrepreneurs to convert them into finished products, or exploit them to be used as direct raw materials in a number of applications.

North America is a good example of the above. Among the major industries of the continent are Ford, Chrysler and General Motors, aircraft builder Boeing and Microsoft, the world leader in information technology.

On the other hand, Canada enjoys great wealth derived mainly from the extraction and export of raw materials.

A country with a large amount of natural resources will not require large investments to import large volumes of direct raw materials.

In addition, these materials can also be exported if they are components of production that are attractive for the economic activities that are developed in other locations.

Examples of Direct Raw Material

To illustrate the concept of direct raw material it may be convenient to identify the different elements that are added in the assembly lines or in the production cycles of the companies.

Once raw materials are received within the companies' warehouses, they may or may not require additional work to be inserted into the production chain.

Subsequently, these elements or materials are included in the different stages of the process.

The inclusion of the component can be done through a simple assembly or require the use of physico-chemical methods that allow the component to be coupled to the product being manufactured.

Direct raw materials are typically treated at the accounting level as a cost rather than a good or piece of inventory.

In this way it is possible for financial analysts to trace the amount of resources that the company spends in the production of a good and subsequently take measures that allow optimizing the production process.

Listed below are some of the direct raw materials used by three major companies in different industries:

Harley Davidson

The company Harley Davidson orders different raw materials such as sheet and cast iron pipes to its suppliers of metals. Subsequently, these components are treated, molded, welded and chrome to be converted into exclusive exhaust pipes.

Although the exhaust pipe is completely finished, the motorcycle is still incomplete, it is a product in process manufacturing, so the exhaust part should be considered as a direct raw material. It should not be lost sight that the ultimate goal is the presentation of a Harley Davidson motorcycle.

Accordingly, the handlebars, fenders, pipes, gas tank and windshield represent direct raw materials used in the production of a motorcycle. All these components are indispensable to manufacture the finished product.

Nike

Some of the direct raw materials commonly used in the manufacture of Nike Shoes are listed below:

- Polyester
- Organic Cotton
- Vinyl Acetate (EVA)
- Polyurethane
- Natural rubber
- Naphtha phthalates (Phthalic acid esters)

The sole of the sports shoes marketed by Nike usually have at least three layers: insole, midsole and outer sole.

The template regularly is a thin layer of artificial ethyl vinyl acetate (EVA).

The components of the midsole, which provide most of the cushioning, vary from model to model, but often contain polyurethane surrounded by different materials such as liquid silicone, polyurethane foam, among others.

The outer sole is often made from a blend of natural rubber, synthetic rubber and different chemical compounds that provide varying degrees of flexibility and strength according to the design to be made.

Manzana

Some of the components or raw materials that are easily identifiable on the Iphone 6S are as follows:

- Aluminum is present in the housing.
- The cobalt plate constituting 60% of the battery.
- The synthetic coating used by the camera lens.
- Elements such as gold, silver, copper and tungsten are used in the internal electrical connections of the phone.
- Silicone is one of several compounds present on the screen of the mobile device.

Indirect Raw Materials

Indirect materials are materials used in the production process, but which cannot be linked to a specific product or job. Alternatively, they may be used in such insubstantial quantities on a

per-product basis that it is not worthwhile to track them as direct materials (which involves including them in the bill of materials). Thus, they are consumed as part of the production process, but are not integrated in substantial amounts into a product or job. Examples of indirect materials are:

- Cleaning supplies
- Disposable safety equipment
- Disposable tools
- Fittings and fasteners
- Glue
- Oil
- Tape

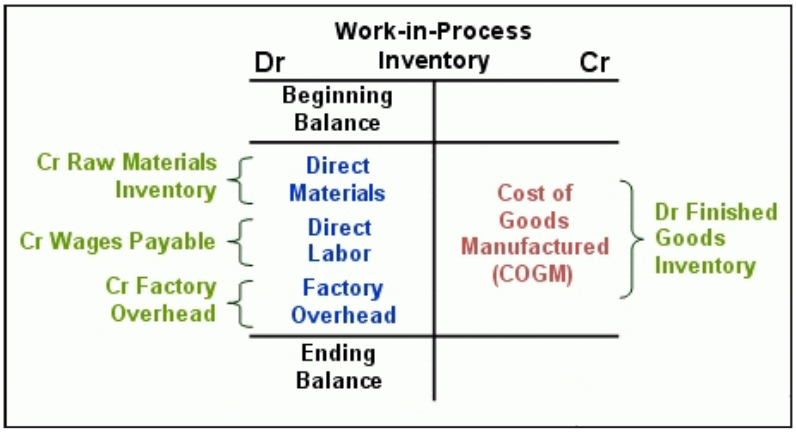
Indirect materials can be accounted for in one of two ways:

1. They are included in manufacturing overhead, and are allocated to the cost of goods sold and ending inventory at the end of each reporting period based on some reasonable method of allocation.
2. They are charged to expense as incurred.

Of the two accounting methods, inclusion in manufacturing overhead is considered more theoretically accurate, but if the amount of indirect materials is small, it is quite acceptable to instead charge them to expense as incurred.

Indirect materials are not usually tracked through a formal inventory record keeping system. Instead, an informal system is used to determine when to order additional indirect materials.

Work in Progress Inventory



Work-in-process inventory is materials that have been partially completed through the production

process. These items are typically located in the production area, though they could also be held to one side in a buffer storage area. The cost of work-in-process typically includes all of the raw material cost related to the final product, since raw materials are usually added at the beginning of the conversion process. Also, a portion of the direct labor cost and factory overhead will also be assigned to work-in-process; more of these costs will be added as part of the remaining manufacturing process.

It is time-consuming to calculate the amount of work-in-process inventory, determine the percentage of completion, and assign a cost to it, so it is standard practice in many companies to minimize the amount of work-in-process inventory just prior to the end of a reporting period.

Work-in-process is an asset, and so is aggregated into the inventory line item on the balance sheet (usually being the smallest of the three main inventory accounts, of which the others are raw materials and finished goods).

It is generally considered a manufacturing best practice to minimize the amount of work-in-process in the production area, since too much of it interferes with the process flow. Also, if work-in-process is allowed to pile up at one work center before being shifted to the next one, this means that a series of flawed units could build up before being discovered at the next work center. Further, production expediters may be used to force certain key jobs through the pile of work-in-process jobs, which throws the production system into an even greater muddle. Instead, work-in-process should move between work centers one unit at a time, with very little inventory piling up between workstations. Ideally, a lean production environment should contain so little work-in-process inventory that the amount on hand is immaterial.

Work-in-process is a much more significant issue when it involves the construction of a building. In this case, work-in-process includes the accumulated cost of the asset, which will continue to increase until the structure is declared complete.

Calculation of Ending WIP Inventory

The calculation of ending work in progress can be done as per below:

- The purpose of the WIP to figure out the production cost at each stage of the process. And this excludes the value of raw materials which are being held up in the inventory for sale.
- Apart from it, the WIP figure also excludes the value of the finished goods that are held up into inventory for the anticipation of future sales.

Examples of WIP Inventory

Below are some of the examples of Work in Progress (WIP) Inventory.

Example 1: Consider a car manufacturer that assembles cars. It passes through multiple work stations for a different operation to perform in a systematic manner after finishing and painting. It rolls out to the inventory. As the cars move from one department to another, more costs are added to production.

Example 2: Let's assume a company ABC manufactures certain widgets. And it manufactures one widget in two weeks. On the closing day of the month, when the company was accounting the availability

of widget in its inventory and sees that it had only 10,000 widgets and out of these 4,000 were partially completed widgets These partially completed widgets recorded as a work in process widgets on the left-hand side of the balance sheet (which was considered it to be an asset for the company).

Example 3: Suppose the XYZ widget company has an initial WIP inventory of $10,000 for the year. During the span of the time, the company incurs manufacturing costs of $250,000 and produces finished goods from the raw material costing $ 240,000. If we calculate the overall WIP inventory of the company is 10,000, plus $250,000 minus $240,000. This leaves the outstanding inventory of process is $20,000.

Difference between Work in Progress Inventory and Work in Process

- Work in the process represents partially completed goods or in other terms, these goods refer to be goods–in process. For a short period of time, work in the process also considers being a product which is moving to the finished product from raw materials. The best example of work in process is manufactured goods.
- Work in progress is a term referring to assets that require a sufficient amount of time for completion of the manufacturing process such as shipbuilding or construction projects. But, this difference is not sufficient to justify the predefined norms, so in such a situation, we consider the unfinished product is a part of the work in process. This inventory is found on a manufacturing company's balance sheet which comprises of labor employed, a material in inventory and manufacturing overhead.

Difference between Progress Inventory and Finished Good

- The difference between the work-in-process and finished goods is based on the inventory's stage of completion, which define how readily the goodwill sale it out. WIP speaks much more about the intermediary stages of the completion of the good in inventory. In which inventory has started to progress from the raw material to the final finished product through different phases of development or assembly. While finished good refers to the final stage of completion where all the required operations are done and waiting for the next subsequent stage i.e. sale to a customer.
- As such, the difference between work in progress and finished goods is a measure of completion of the inventory stage from the raw material. While WIP and finished goods refer to the intermediary and final stages of an inventory life cycle, respectively.

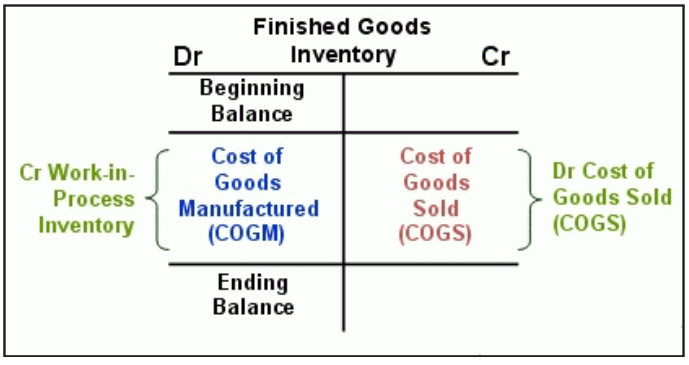
Importance of Work in Progress Inventory

Work in process is not worth as much as completed goods, but they are worth more than raw materials because they have incurred some labor and overhead.

Changes in the amounts of work in process can be telling. For instance, an increase suggests an uptick in demand for a company's goods (which is almost always a good thing for the company's shareholders, though it may also signal that the company will need capital soon to cope with the growth). In turn, widespread increases in work in process for an industry or entire economic sector may indicate economic growth; likewise, decreases may indicate a pending slowdown.

Finished Goods Inventory

Finished goods inventory is the third group of inventory owned by a manufacturer and consists of products that are ready for sale. You can think of this like merchandise owned by a retailer. These goods are completely finished, made it through the production process, and ready for consumers to buy.



Finished goods inventory is a unique asset to manufacturers. Retailers don't have to classify their inventory into segments because their entire inventory is completed and ready for sale.

Manufacturers, on the other hand, physically produce their inventory and have to account for it throughout the production process. It might be helpful to take a look at the production process. Let's look at an example.

Example: When a manufacturer decides to make a product, it must order the basis stock needed to build the product. This stock could be bars of steel, sheets of metal, or blanks of plastic—anything in its raw form. The stock is classified as raw materials inventory.

These raw materials are machined and put through the assembly process. This process could take days or weeks. In the meantime, these goods are transferred from the raw materials account into the work in process inventory account.

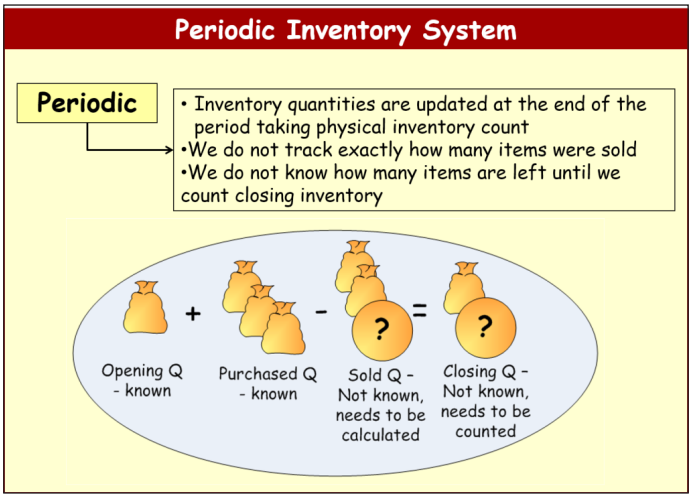
After the goods have made it through the entire assembly line and are completely ready for sale, they are transferred out of the work in process account to the finished goods inventory account.

This process allows a manufacturer to track how much inventory it has at any stage in the production process. At the end of a period, these three categories of inventory are usually stated separately on the balance sheet, so investors and creditors can understand the value of the inventory. In other words, finished goods are usually worth much more than raw materials. Investors and creditors want to know the mix of inventory rather than just having a total.

Periodic Inventory System

The periodic inventory system is a method of inventory valuation for financial reporting purposes in which a physical count of the inventory is performed at specific intervals. This accounting

method takes inventory at the beginning of a period, adds new inventory purchases during the period and deducts ending inventory to derive the cost of goods sold (COGS).



Under the periodic inventory system, a company will not know its unit inventory levels or COGS until the physical count process is complete. This system may be acceptable for a business with a low number of SKUs in a slow-moving market, but for all others, the perpetual inventory system is considered superior for the following main reasons:

1. The perpetual system continuously updates the inventory asset ledger in a company's database system, giving management an instant view of inventory; the periodic system is time-consuming and can produce stale numbers that are less useful to management.

2. The perpetual system keeps updated COGS as movements of inventory occur; the periodic system cannot give accurate COGS figures between counting periods.

3. The perpetual system tracks individual inventory items so that in case there are defective items—for example, the source of the problem can quickly be identified; the periodic system would most likely not allow for prompt resolution.

4. The perpetual system is tech-based and data can be backed-up, organized and manipulated to generate informative reports; the periodic system is manual and more prone to human error, and data can be misplaced or lost.

Special Considerations: COGS

The cost of goods sold, commonly referred to as COGS, is a fundamental income statement account, but a company using a periodic inventory system will not know the amount for its accounting records until the physical count is completed.

Suppose a company has a beginning inventory of $500,000 on January 1. The company purchases $250,000 of inventory during a three-month period, and after a physical inventory account, it determines it has ending inventory of $400,000 at March 31, which becomes the beginning inventory amount for the next quarter. COGS for the first quarter of the year is $350,000 ($500,000 beginning + $250,000 purchases - $400,000 ending).

Due to the time discrepancies, it becomes the onus of the manager or business owner responsible for monitoring period inventory if it makes sense to their bottom line to allocate hours to count inventory daily, weekly, monthly, or yearly.

Periodic Inventory Accounting

Under a periodic inventory system, inventory purchases made by a company are initially stored in a purchases (asset) account with the following journal entry:

	Debit	Credit
Purchases	xxx	
Accounts payable		xxx

There may be a number of these entries during an accounting period, which gradually increases the amount in the purchases account. At the end of the accounting period, the entire balance in the purchases account is shifted into the inventory (asset) account. This means that the purchases account is really an accumulation account for a single accounting period, rather than an account that holds a balance over multiple periods. The entry at the end of the period is:

	Debit	Credit
Inventory	xxx	
Purchases		xxx

Notice that there is no particular need to divide the inventory account into a variety of subsets, such as raw materials, work-in-process, or finished goods. The reason is that the level of inventory tracking is so infrequent that there is no point in using additional inventory accounts, since the balance in any one account will likely be inaccurate in comparison to the actual inventory count at any given time.

The final periodic inventory entry in an accounting period arises immediately after the physical count of the inventory, when the accounting staff establishes the actual cost of the inventory on hand at the end of the month. It then subtracts this actual ending inventory cost from the cost that has accumulated in the inventory account, and charges the difference to the cost of goods sold account with this entry:

	Debit	Credit
Cost of goods sold	xxx	
Inventory		xxx

A variation on the last two entries is to not shift the balance in the purchases account into the inventory account until after the physical count has been completed. By waiting, you can then merge the final two entries together and apportion the balance in the purchases account between the inventory account and the cost of goods sold, using the following entry. The end result is the same, but with fewer entries.

	Debit	Credit
Cost of goods sold	xxx	
Inventory	xxx	
Purchases		xxx

An additional entry that is related to the periodic inventory system, but which does not directly impact inventory, is the sale transaction. The following entry shows the transaction that you record under a periodic inventory system when you sell goods. There is not a corresponding and immediate decline in the inventory balance at the same time, because the periodic inventory system only adjusts the inventory balance at the end of the accounting period. Thus, there is not a direct linkage between sales and inventory in a periodic inventory system.

	Debit	Credit
Accounts receivable	xxx	
Sales		xxx

Advantages and Disadvantages

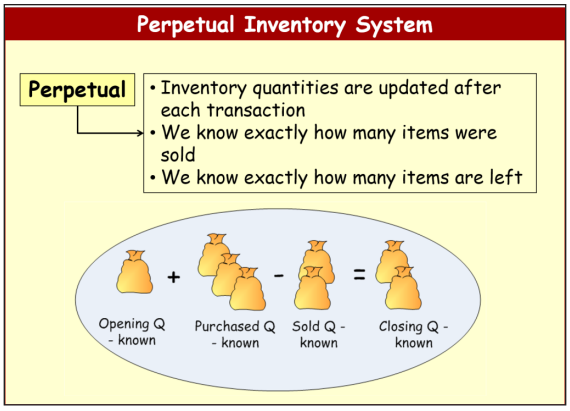
The periodic inventory system is most useful for smaller businesses that maintain minimal amounts of inventory. For them, a physical inventory count is easy to complete, and they can estimate cost of goods sold figures for interim periods. However, there are several problems with the system:

- Minimal information: It does not yield any information about the cost of goods sold or ending inventory balances during interim periods when there has been no physical inventory count.
- Estimation errors: You must estimate the cost of goods sold during interim periods, which will likely result in a significant adjustment to the actual cost of goods whenever you eventually complete a physical inventory count.
- Large adjustments: There is no way to adjust for obsolete inventory or scrap losses during interim periods, so there tends to be a significant (and expensive) adjustment for these issues when a physical inventory count is eventually completed.
- Not scalable: It is not an adequate system for larger companies with large inventory investments, given its high level of inaccuracy at any given point in time (other than the day when the system is updated with the latest physical inventory count).

Perpetual Inventory System

Perpetual inventory is a method of accounting for inventory that records the sale or purchase of inventory immediately through the use of computerized point-of-sale systems and enterprise asset management software. Perpetual inventory provides a highly detailed view of changes in inventory with immediate reporting of the amount of inventory in stock, and accurately reflects the level of goods on hand.

A perpetual inventory system is superior to the older periodic inventory system because it allows for immediate tracking of sales and inventory levels for individual items, which helps to prevent stockouts. A perpetual inventory does not need to be adjusted manually by the company's accountants, except to the extent it disagrees with the physical inventory count due to loss, breakage or theft.



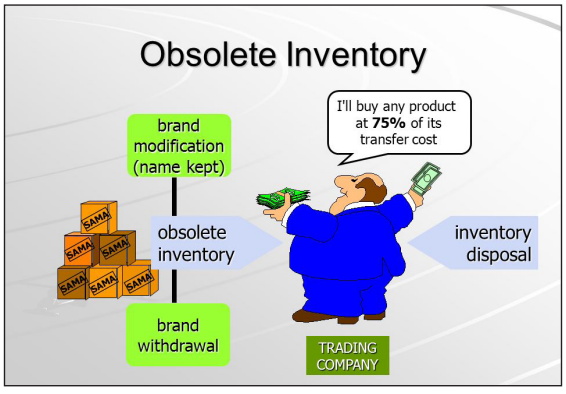
Difference between the Periodic and Perpetual Inventory Systems

The periodic and perpetual inventory systems are different methods used to track the quantity of goods on hand. The more sophisticated of the two is the perpetual system, but it requires much more record keeping maintaining. The periodic system relies upon an occasional physical count of the inventory to determine the ending inventory balance and the cost of goods sold, while the perpetual system keeps continual track of inventory balances. There are a number of other differences between the two systems, which are as follows:

- Accounts: Under the perpetual system, there are continual updates to either the general ledger or inventory ledger as inventory-related transactions occur. Conversely, under a periodic inventory system, there is no cost of goods sold account entry at all in an accounting period until such time as there is a physical count, which is then used to derive the cost of goods sold.
- Computer systems: It is impossible to manually maintain the records for a perpetual inventory system, since there may be thousands of transactions at the unit level in every accounting period. Conversely, the simplicity of a periodic inventory system allows for the use of manual record keeping for very small inventories.
- Cost of goods sold: Under the perpetual system, there are continual updates to the cost of goods sold account as each sale is made. Conversely, under the periodic inventory system, the cost of goods sold is calculated in a lump sum at the end of the accounting period, by adding total purchases to the beginning inventory and subtracting ending inventory. In the latter case, this means it can be difficult to obtain a precise cost of goods sold figure prior to the end of the accounting period.
- Cycle counting: It is impossible to use cycle counting under a periodic inventory system, since there is no way to obtain accurate inventory counts in real time (which are used as a baseline for cycle counts).
- Purchases: Under the perpetual system, inventory purchases are recorded in either the raw materials inventory account or merchandise account (depending on the nature of the purchase), while there is also a unit-count entry into the individual record that is kept for each inventory item. Conversely, under a periodic inventory system, all purchases are recorded into a purchases asset account, and there are no individual inventory records to which any unit-count information could be added.

- Transaction investigations: It is nearly impossible to track through the accounting records under a periodic inventory system to determine why an inventory-related error of any kind occurred, since the information is aggregated at a very high level. Conversely, such investigations are much easier in a perpetual inventory system, where all transactions are available in detail at the individual unit level.

Obsolete Inventory



Obsolete inventory is any item remaining in stock that cannot be sold or used in the production of salable goods. These items have typically been replaced in the marketplace by more advanced or inexpensive goods, so there is no longer any demand for them. Since these goods cannot be used, their cost is either written off or written down. A write off completely eliminates the inventory asset from the accounting records, while a write down reduces the amount of the recorded asset to the price at which it can still be sold.

Ideally, a business should maintain an obsolete inventory reserve that is paired with and offsets the inventory asset accounts. The amount in this reserve should be the estimated amount by which the inventory asset will be written down, once specific inventory items have been identified as obsolete.

It is possible that some obsolete inventory can be sold off at very low prices; the prices obtained will be higher if the materials management department maintains close watch over the inventory and dispositions items as soon as their usage levels begin to decline.

The presence of a large amount of obsolete inventory is a significant red flag that a business may be entering financial difficulties, since it either implies that the market for the company's goods is weak, or that management is not able to properly manage its inventory asset.

Example:

Consider Company XYZ, a cheese manufacturer. Company XYZ makes a batch of 1,000 wheels of cheese that are no longer edible after December 31. Company XYZ is able to sell 750 wheels of the batch, but the other 250 are sitting in the warehouse. December 31 comes, and the cheese is no longer sellable. It is obsolete inventory.

Generally accepted accounting principles (GAAP) require companies to write off obsolete inventory as soon as it is identified. Physically, the company can still attempt to sell the products at a substantial discount (though in this example, that would probably be illegal), sell them as replacement parts or donate them to charity. In most cases, the company might choose to discard the products or sell them at scrap prices.

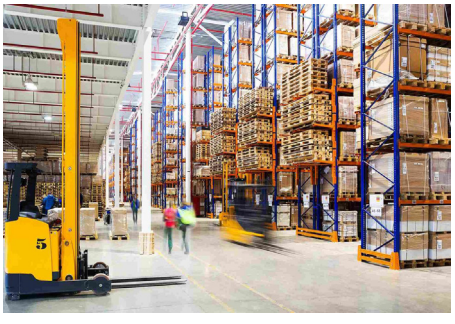
Importance of Obsolete Inventory

Accounting rules require companies to establish a reserve account for obsolete inventory on their balance sheets and expense their obsolete inventory as they dispose of it, which reduces profits. Thus, obsolete inventory can create huge losses.

Obsolete inventory is a sign that a company may have "fallen behind the times," because the demand for its one or more of its products has clearly fallen. Alternatively, obsolete inventory might also indicate poor management practices, in that companies may have ordered or manufactured too much of a product due to poor sales forecasting methods, poor inventory management, inflexible operations or too much wishful thinking.

Inventory Management

Inventory management is a component of supply chain management that involves supervising non-capitalized assets, or inventory, and stock items. Specifically, "inventory management supervises the flow of goods from manufacturers to warehouses and from these facilities to point of sale." Thus, inventory management hinges on detailed records of products or parts as they enter and leave warehouses and points of sale.



Inventory management is critical to the bottom line because inventory is a major asset that remains an investment until the products sell. Several costs are tied to inventory management because businesses must store, track, and insure inventory. Overall, best practices in inventory management involve sound purchasing plans to guarantee items are available when they are needed without having too few or too many on hand and the necessary tools for tracking existing inventory.

Methods of Inventory Management

There are two common inventory management strategies: the just in time method and the materials requirement planning method.

Just in Time Method

The just in time method (JIT) of inventory management involves companies planning to receive items as they are needed instead of maintaining high levels of inventory. One benefit of this inventory management method is that companies do not have a great deal of money tied up in inventory levels; they reduce storage and insurance costs and the cost of liquidating unused inventory. Another benefit of the just in time method is that companies reduce waste.

Challenges of the just in time method of inventory management come into play when manufacturers and retailers have to work together to monitor the availability of manufacturing resources and consumer demand. Just in time inventory management also is considered risky because companies take a gamble with being unable to fill orders; being out of stock reduces revenue and may harm customer relations.

Materials Requirement Planning Method

The materials requirement planning method (MRP) of inventory management involves companies scheduling material deliveries based on sales forecasts. Typically a computer-based inventory management system, MRP breaks down inventory requirements into planning periods so that production can be completed efficiently while keeping inventory levels and storage costs at a minimum. Another benefit of MRP inventory management is that it aids production managers in planning for capacity needs and allocating production time.

One of the most significant disadvantages of the MRP inventory management method is that the systems often are expensive and involve a time-consuming implementation period. It also may be challenging for companies to put quality information into the MRP system to gain accurate forecasts; to reap the full benefits of MRP inventory management, organizations must be prepared to maintain current and accurate bills of materials, part numbers, and inventory records.

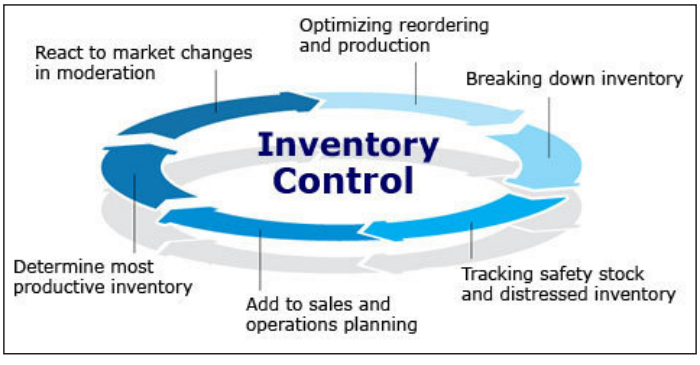
Inventory Management Best Practices

Companies that continue to rely on manual inventory tracking with spreadsheets run the risk of data entry errors, shipping mistakes, and lack of inventory knowledge. Thus, implementing inventory management best practices is important for business success and the bottom line:

- Determine whether a continuous review system or periodic review system is the best type of inventory management system for your business.

- Implement a cycle counting program after considering counting frequency, counting strategy, and cycle count management.
- Manage your inventory by knowing the inventory levels that are most beneficial to the flow of your business; track data to make better inventory management decisions.
- Implement quality control procedures so that all employees can work toward the same goals.
- Optimize inventory levels to boost efficiency and meet customer demands.
- Prepare for growth and implement inventory management best practices that will support your business goals.

Inventory Control



Inventory control, also referred to as stock control, is so broad and incorporates so many functions that it is difficult to describe in a limited definition. Inventory control refers to "all aspects of managing a company's inventories: purchasing, shipping, receiving, tracking, warehousing and storage, turnover, and reordering." Inventory control is such a critical piece of an organization's operations and bottom line that it is too important to leave to human error or antiquated systems. That's why so many companies opt to invest in inventory control systems, so that all of the components of inventory control are managed by one integrated system.

Advantages of Inventory Control

The ultimate goal of your inventory control should be to maximize your organization's use of inventory. When you maintain proper inventory levels, you can rest easily knowing that your capital is not unnecessarily tied up in your inventory. If you are in manufacturing, inventory control also protects production if there are problems with bottlenecking or the supply chain.

Typical benefits of a computerized inventory control system include:

- Increased profitability.
- Having enough stock on hand so that you don't run out.
- Barcodes and inventory control labels to track inventory efficiently.

- Reduction or elimination of inventory write-offs.
- The ability to conduct audits more quickly and efficiently.

Pros of Computerized Inventory Control

If you handle several warehouse locations or need to access your inventory levels on the go, a computerized inventory control system may be right for your organization's needs. Inventory control software solutions are more efficient than manual ones, allowing for more flexibility and an easier time retrieving information. Computerized inventory control systems allow you to quickly get a real-time glimpse into your inventory value. Other beneficial features of computerized inventory control include:

- Inventory data integrated with accounting and invoicing systems, along with sales order processing and purchase order processing so that inventory levels and data update automatically.
- Automatic inventory monitoring, so that orders are placed as soon as the re-order level is reached.
- Automatic batch control.
- Ability to identify the least expensive and fastest suppliers.
- Barcoding systems enhance the processing and ordering process and speed up the inventory management process.

Inventory Cost

Inventory cost includes the costs to order and hold inventory, as well as to administer the related paperwork. This cost is examined by management as part of its evaluation of how much inventory to keep on hand. This can result in changes in the order fulfillment rate for customers, as well as variations in the production process flow.

Inventory cost, explained by each business owner with varying importance, plays a major role in the working capital requirements of a business. Based on the overall inventory needs, a company can plan the cash flow cycles properly to avoid problems which may even cause the business to cease operations. This makes sense when one keeps in mind that perhaps the most common reason a business closes is lack of cash.

There are a variety of inventory cost methods to minimize expenditure. On the material side, a business can set up equipment, ranging from simple placement of items for optimal usage to accounting systems which serve as inventory management, which simplify and change based on the needs the business has for its inventory. In reference to processes, employees can be trained to use available resources to achieve maximum effect. When you understand the science of supply chain management, you can make sense of the most complicated of inventory projects. For smaller assignments, the average person can turn a catastrophe to a working system with a foundation of proper planning. Inventory can be as affordable or costly as the business and manager allow it to be.

Inventory Cost Formula

The inventory cost formula, summing total cost of inventory, is often referred to as inventory carrying rate.

Inventory Carrying Rate = (Inventory Costs/Inventory Value) + Opportunity Cost (as a percentage) + Insurance (as a percentage) + Taxes (as a percentage)

Inventory Cost Calculation

When one has the proper information, inventory cost calculations can be very simple.

Example:

- Inventory Costs = $5,000
- Inventory Value = $50,000
- Opportunity Cost = 10%
- Insurance = 4%
- Taxes = 7%

Inventory Carrying Rate = ($5,000 / $50,000) + 10% + 4% + 7% = 10% + 10% + 4% + 7% = 31%

Inventory Cost Example

For example, Stan is the warehouse manager for a distribution plant. His work has made him an expert in the science of managing inventory operations. Stan understands his work and enjoys doing it.

However, Stan wants to assemble inventory cost accounting figures. As the essence of the business, Stan makes sure to keep track of this value on a regular basis.

First, Stan calculates inventory costs:

If,

- Equipment = $2,500
- Labor = $1,500
- Protective measures = $300
- Handling = $500
- Obsolescence = $100
- Pilferage = $100

Then,

Inventory Cost = $2,500 + $1,500 + $300 + $500 + $100 + $100 = $5,000

Next, Stan finds the ratio of inventory costs to inventory value:

If,

- Cost of Inventory = $5,000
- Value of Inventory = $50,000

Then,

Inventory Cost / Inventory Value = $5,000 / $50,000 = 10%

Stan then does research to find the cost of opportunity, insurance, and taxes. These are found as a percentage:

- Opportunity Cost = 10%
- Insurance = 4%
- Taxes = 7%

Finally, Stan adds these percentages together to finally find inventory carry rate:

Inventory Carrying Rate = 10% + 10% + 4% + 7% = 31%

Stan's inventory carry rate has remained unchanged. Stan is happy about this. Therefore, he keeps constant research in the industry magazines, with professional contacts, and the newest products and services. As long as Stan maintains this research he can keep his warehouse running in peak condition.

Types of Inventory Cost

Ordering Costs

Ordering costs, also known as setup costs, are essentially costs incurred every time you place an order from your supplier. Examples include:

- Clerical costs of preparing purchase orders: There are many kinds of clerical costs, such as invoice processing, accounting, and communication costs.
- Cost of finding suppliers and expediting orders: Costs spent on these will likely be inconsistent, but they are important expenses for the business.
- Transportation costs: The costs of moving the goods to the warehouse or store. These costs are highly variable across different industries and items.
- Receiving costs: These include costs of unloading goods at the warehouse and inspecting them to make sure they are the correct items and free of defects.
- Cost of electronic data interchange (EDI): These are systems used by large businesses and especially retailers, which allow ordering process costs to be significantly reduced.

There will be an ordering cost of some amount, no matter how small your order might be. The more orders placed, the greater the ordering costs. This ordering cost can be spread out if you placed a bulk order to use goods over a long period of time. However, if your business orders raw materials only as needed so that it keeps little stock on hand, you might be able to tolerate high ordering costs as this is balanced by an overall lower holding cost.

Holding Costs

Also known as carrying costs, these are costs involved with storing inventory before it is sold.

- Inventory financing costs: This includes everything related to the investment made in inventory, including costs like interest on working capital. Financing costs can be complex depending on the business.
- Opportunity cost of the money invested in inventory: This is found by factoring in the lost alternatives of tying money up in inventory, such as investing in term deposits or mutual funds.
- Storage space costs: These are costs related to the place where the inventory is stored and will vary by location. There will be the cost of the storage facility itself, or lease payments if it is not owned. Then there are facility maintenance costs like lighting, heating, and ventilation. Depreciation and property taxes are also included in this.
- Inventory services costs: This includes the cost of the physical handling of the goods, as well as insurance, security, and IT hardware and applications if these are used. Expenses related to inventory control and cycle counting are further examples.
- Inventory risk costs: A major cost is shrinkage, which is the loss of products between purchasing from the supplier and final sale due to any number of reasons: theft, vendor fraud, shipping errors, damage in transit or storage. The other main example is dead stock.

Shortage Costs

These costs, also called stock-out costs, occur when businesses become out of stock for whatever reason.

- Disrupted production: When the business involves producing goods as well as selling them, a shortage will mean the business will have to pay for things like idle workers and factory overhead, even when nothing is being produced.
- Emergency shipments: For retailers, stock-outs could mean paying extra to get a shipment on time, or changing suppliers.
- Customer loyalty and reputation: Aside from the loss of business from customers who go elsewhere to make purchases, the company takes a hit to customer loyalty and reputation when their customers are unhappy.

Inventory Valuation

Inventory valuation is the cost associated with an entity's inventory at the end of a reporting period. It forms a key part of the cost of goods sold calculation, and can also be used as collateral for loans. This valuation appears as a current asset on the entity's balance sheet. The inventory valuation is based on the costs incurred by the entity to acquire the inventory, convert it into a condition that makes it ready for sale, and have it transported into the proper place for sale. You are not allowed to add any administrative or selling costs to the cost of inventory. The costs that can be included in an inventory valuation are:

- Direct labor
- Direct materials
- Factory overhead
- Freight
- Handling
- Import duties

It is also possible under the lower of cost or market rule that you may be required to reduce the inventory valuation to the market value of the inventory, if it is lower than the recorded cost of the inventory. There are also some very limited circumstances where you are allowed under international financial reporting standards to record the cost of inventory at its market value, irrespective of the cost to produce it (which is generally limited to agricultural produce).

Inventory Valuation Methods

When assigning costs to inventory, one should adopt and consistently use a cost-flow assumption regarding how inventory flows through the entity. Examples of cost-flow are:

- The specific identification method, where you track the specific cost of individual items of inventory.
- The first in, first out method, where you assume that the first items to enter the inventory are the first ones to be used.
- The last in, first out method, where you assume that the last items to enter the inventory are the first ones to be used.
- The weighted average method, where an average of the costs in the inventory is used in the cost of goods sold.

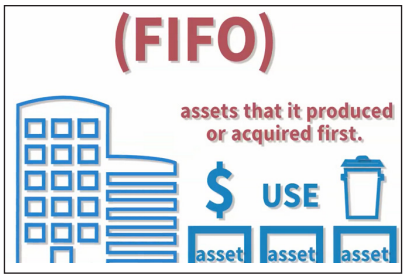
Whichever method you choose will affect the inventory valuation recorded at the end of the reporting period.

Inventory valuation is important for the following reasons:

- Impact on cost of goods sold: If you record a higher valuation in ending inventory, this leaves less expense to be charged to the cost of goods sold, and vice versa. Thus, inventory valuation has a major impact on reported profit levels.
- Loan ratios: If an entity has been issued a loan by a lender, the agreement may include a restriction on the allowable proportions of current assets to current liabilities. If the entity cannot meet the target ratio, the lender can call the loan. Since inventory is frequently the largest component of this current ratio, the inventory valuation can be critical.
- Income taxes: The choice of cost-flow method used can increase or reduce the amount of income taxes paid. The LIFO method is commonly used in periods of rising prices to reduce income taxes paid.

First In First Out Inventory Method

The first in, first out (FIFO) method of inventory valuation is a cost flow assumption that the first goods purchased are also the first goods sold. In most companies, this assumption closely matches the actual flow of goods, and so is considered the most theoretically correct inventory valuation method. The FIFO flow concept is a logical one for a business to follow, since selling off the oldest goods first reduces the risk of inventory obsolescence.



Under the FIFO method, the earliest goods purchased are the first ones removed from the inventory account. This results in the remaining items in inventory being accounted for at the most recently incurred costs, so that the inventory asset recorded on the balance sheet contains costs quite close to the most recent costs that could be obtained in the marketplace. Conversely, this method also results in older historical costs being matched against current revenues and recorded in the cost of goods sold; this means that the gross margin does not necessarily reflect a proper matching of revenues and costs. For example, in an inflationary environment, current-cost revenue dollars will be matched against older and lower-cost inventory an item, which yields the highest possible gross margin.

Example:

Use the following information to calculate the value of inventory on hand on Mar 31 and cost of goods sold during March in FIFO periodic inventory system and under FIFO perpetual inventory system.

Mar 1	Beginning Inventory	68 units @ $15.00 per unit
Mar 5	Purchase	140 units @ $15.50 per unit
Mar 9	Sale	94 units @ $19.00 per unit
Mar 11	Purchase	40 units @ $16.00 per unit
Mar 16	Purchase	78 units @ $16.50 per unit
Mar 20	Sale	116 units @ $19.50 per unit
Mar 29	Sale	62 units @ $21.00 per unit

Solution:

FIFO Periodic:

Units Available for Sale	= 68 + 140 + 40 + 78 = 326		
Units Sold	= 94 + 116 + 62 = 272		
Units in Ending Inventory	= 326 – 272 = 54		
Cost of Goods Sold	Units	Unit Cost	Total
Sales From Mar 1 Inventory	68	$15.00	$1,020
Sales From Mar 5 Purchase	140	$15.50	$2,170
Sales From Mar 11 Purchase	40	$16.00	$640
Sales From Mar 16 Purchase	24	$16.50	$396
	272		$4,226
Ending Inventory	Units	Unit Cost	Total
Inventory From Mar 16 Purchase	54	$16.50	$891

FIFO Perpetual:

Date	Purchases			Sales			Balance		
	Units	Unit Cost	Total	Units	Unit Cost	Total	Units	Unit Cost	Total
Mar 1							68	$15.00	$1,020
Mar 5	140	$15.50	$2,170				68	$15.00	$1,020
							140	$15.50	$2,170
Mar 9				68	$15.00	$1,020	114	$15.50	$1,767
				26	$15.50	$403			
Mar 11	40	$16.00	$640				114	$15.50	$1,767
							40	$16.00	$640
Mar 16	78	$16.50	$1,287				114	$15.50	$1,767
							40	$16.00	$640
							78	$16.50	$1,287
Mar 20				114	$15.50	$1,767	38	$16.00	$608
				2	$16.00	$32	78	$16.50	$1,287
Mar 29				38	$16.00	$608	54	$16.50	$891
				24	$16.50	$396			

Advantages of FIFO Method Inventory Valuation

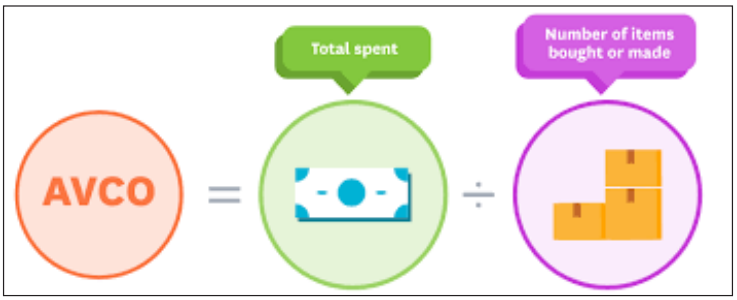
- FIFO method of accounting saves time and money spend in calculating the exact inventory cost that is being sold because the recording of inventory is done in the same order as they are purchased or produced.
- Easy to understand.
- Ending inventory is valued based on the most recent purchase price; therefore, inventory value is a much better reflection of current market prices of similar products.
- As oldest available units are used for the cost of goods sold calculation, possible risk of reduced net realizable value (NRV) and resulting loss recognition is negated as an entity is not dragging any old inventory units in records.
- As the closing stock value is critical in current asset calculation and related accounting ratios (for example liquidity ratios) therefore, the FIFO method of inventory valuation is much relevant to value ending inventory.
- Normally in an inflationary environment, prices are always rising which will cause an increase in operating expenses, but with FIFO accounting, same inflation will cause an increase in ending inventory value that will help increase gross profit and ultimately covering other inflated operating expenses.

Disadvantages of FIFO Method of Inventory Valuation

- One of the biggest disadvantages of FIFO accounting method is inventory valuation during inflation, First In First Out method will result in higher profits, and thus will results in higher "Tax Liabilities" in that particular period. This may result in increased tax charges and higher tax-related cash outflows.

- Use of First in First Out method is not a suitable measure of inventory in times of "hyper-inflation". During such times, there is no particular pattern of inflation which may result in prices of goods to inflate drastically. Thus in such periods the matching of most prior purchases with most recent sales would not be appropriate and present a distorted picture as the profit may be pumped up.
- FIFO method of inventory valuation is not an appropriate measure if the goods/materials purchased have fluctuation in their price patterns as this may results in misstated profits for the same period.
- Although FIFO inventory valuation method is easy to understand it may get cumbersome and clumsy to extract and operate the costs of goods, as a substantial amount of data is required which may result in clerical errors.

Average Cost Inventory Method



Average cost method (AVCO) calculates the cost of ending inventory and cost of goods sold for a period on the basis of weighted average cost per unit of inventory. Weighted average cost per unit is calculated using the following formula:

$$\underset{\text{Unit Cost}}{\text{Weighted Average}} = \frac{\text{Total Cost of Inventory}}{\text{Total Units in Inventory}}$$

Like FIFO and LIFO methods, AVCO is also applied differently in periodic inventory system and perpetual inventory system. In periodic inventory system, weighted average cost per unit is calculated for the entire class of inventory. It is then multiplied with number of units sold and number of units in ending inventory to arrive at cost of goods sold and value of ending inventory respectively. In perpetual inventory system, we have to calculate the weighted average cost per unit before each sale transaction.

The calculation of inventory value under average cost method is explained with the help of the following example:

Apply AVCO method of inventory valuation on the following information, first in periodic inventory system and then in perpetual inventory system to determine the value of inventory on hand on Mar 31 and cost of goods sold during March.

Mar 1	Beginning Inventory	60 units @ $15.00 per unit
Mar 5	Purchase	140 units @ $15.50 per unit
Mar 14	Sale	190 units @ $19.00 per unit
Mar 27	Purchase	70 units @ $16.00 per unit
Mar 29	Sale	30 units @ $19.50 per unit

Solution:

AVCO Periodic

Units Available for Sale	= 60 + 140 + 70 = 270		
Units Sold	= 190 + 30 = 220		
Units in Ending Inventory	= 270 – 220 = 50		
Weighted Average Unit Cost	Units	Unit Cost	Total
Mar 1 Inventory	60	$15.00	$900
Mar 5 Purchase	140	$15.50	$2,170
27 Purchase	70	$16.00	$1,120
	270	$15.52	$4,190
$4,190 ÷ 270			
Cost of Goods Sold	220	$15.52	$3,414
Ending Inventory	50	$15.52	$776

AVCO Perpetual

Date	Purchases			Sales			Balance		
	Units	Unit Cost	Total	Units	Unit Cost	Total	Units	Unit Cost	Total
Mar 1							60	$15.00	$900
Mar 5	140	$15.50	$2,170				60	$15.00	$900
							140	$15.50	$2,170
							200	$15.35	$3,070
Mar 14				190	$15.35	$2,916	10	$15.35	$154
Mar 27	70	$16.00	$1,120				10	$15.35	$154
							70	$16.00	$1,120
							80	$15.92	$1,274
Mar 29				30	$15.92	$478	50	$15.92	$796
Mar 31							50	$15.92	$796

Advantages of AVCO Method

1. Biggest advantage of using AVCO method over other cost formulas like FIFO or LIFO is that it significantly simplifies calculation and record keeping and can easily process even if entity has high frequency of inventory ordering. As bookkeepers don't have to keep track of each and every batch bought and its respective price, volume of record and probability of human error greatly reduces.

2. AVCO is much better method than FIFO or LIFO when it comes to goods that cannot be separated or it is impossible to distinguish one batch of goods from the other for example, earth produce like oil, wheat, iron ore etc. When they are extracted the batches lose their individual identity and thus used in random. AVCO treats the inflow of inventory in the same way as identity of each batch is lost when average cost is calculated. Therefore, it is much suited and relevant in such industries.

3. AVCO is widely accepted method for inventory valuation and it is also permitted under numerous accounting standards and guidelines e.g. IFRSs permit use of AVCO method.

4. AVCO method automatically adjusts the effects of random price hikes and dips especially near the end and start of the period. Suppose entity has units left from only that batch that was bought in the last month when prices suddenly increased many folds but are expected to go normal again then in such case if FIFO method is used it will cause disproportion because of increased ending stock value. But AVCO method will manage it much better as it will spread the effect of hike and thus normalize sudden fluctuations.

5. Cost of sales calculation will be much more consistent and less affected by prices changes under AVCO method as compared to FIFO and LIFO. In case of rising prices, unlike FIFO method which gives understated cost of goods sold, or LIFO method which will give cost of goods sold of the whole period as per prices prevailing at the end of period, AVCO will be in the middle of both. Therefore, the making period-to-period comparisons much more meaningful and requiring lesser adjustments unlike FIFO or LIFO that may require price adjustments for analysis purposes.

Disadvantages of AVCO Method

1. Cost of ending inventory determined under AVCO method may be significantly different from the prices prevailing for similar products at such date. Thus making it difficult to make appropriate judgment regarding lower of cost and NRV rule. As closing stock figure is significant in profit and current asset totals, these figures may be unreliable for decision making purposes and may require reinstatement for assessment purposes.

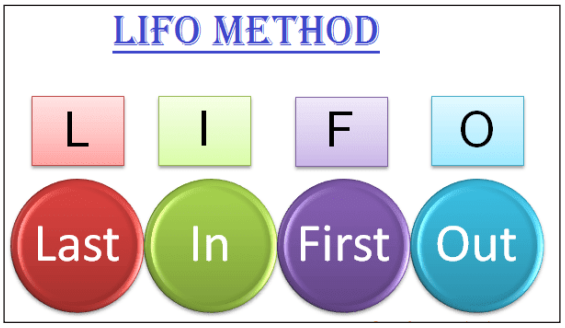
2. If entity is using cost plus pricing strategy to price its products, then every time new purchase is made at a different rate than previous it will cause price to change as well. Such frequency of price change may annoy customers and also difficult for management to quote to its potential clients and related pricing and costing decisions.

3. Under AVCO method each batch loses its identity, thus it may become hard to correctly value the items where age of unit plays an important role. In such situations, AVCO will be of much lesser help than FIFO or LIFO that keep track of individual batch of units produced or bought.

4. The average cost calculations often give cost per unit in long decimals that are rounded for record purposes. Such approximation differences may become material collectively by the end of the period especially if it involves large volumes of transactions. And may end up distorting gross profit and current asset figures.

5. Although AVCO method help normalize the fluctuations but it may still be affected if large quantities of inventory are purchased at the start or end of the period especially when prices differ from the rest of the period.

Last In First Out Inventory Method



The LIFO (Last-in, first-out) process is mainly used to place an accounting value on inventories. It is based on the theory that the last inventory item purchased is the first one to be sold. LIFO method is like any store where the clerks stock the last item from front and customers purchase items from front itself. This means that inventory located at the back is never bought and therefore remains in the store. Presently, LIFO is hardly practiced by businesses since inventories are rarely sold, therefore they become old and gradually lose their value. This brings significant loss to company's business.

The only reason for using LIFO is when companies assume that inventory cost will increase over time, which means prices will inflate. While implementing LIFO system, cost of recently obtained inventories goes higher, as compared to inventories, purchased earlier. As a result, the ending inventory balance is valued at previous costs whereas the most recent costs appear in the cost of goods sold. By moving high-cost inventories to cost of goods sold, businesses can lower their reported profit levels and defer income tax recognition.

Advantages of using LIFO Method

- During inflation environment, cost of goods is higher whereas remaining inventory balance in lower. Through LIFO, the main advantage lies in reporting lower profits, which in turn, allows businesses to pay less tax.
- It is more apt for matching cost and revenue figures and allows complete recovery of material cost.
- LIFO is simple to understand, easy to operate.

Disadvantages of using LIFO Method

- Firstly, inventory valuation does not talk about current prices, hence LIFO of no relevance, in assessing current situations.

- It is more difficult and complex to maintain. If most recent purchased inventories are always used as cost of goods sold, it creates older and outdated inventories, which can never be sold. Therefore, it is quite unrealistic.
- LIFO calculations are more complicated, especially when prices keep fluctuating.
- Clerical work is more in LIFO procedure
- If businesses plan to expand globally, LIFO is definitely not the right choice for valuing company's current assets.

Example of LIFO Method

Using LIFO on the following information to calculate the value of ending inventory and the cost of goods sold as of March.

March 1	Beginning Inventory	60 units @ USD. 900.00
March 5	Purchase	140 units @USD. 930.00
March 14	Sale	190 units @ USD.1140.00
March 27	Purchase	70 units @ USD.960.00
March 29	Sale	30 units @ USD.1170.00

Solution:

LIFO Periodic

Units Available for Sale	= 60 + 140 + 70 = 270		
Units Sold	= 190 + 30 = 220		
Units in Ending Inventory	= 270 – 220 = 50		
Cost of Goods Sold	Units	Unit Cost	Total
Sales From Mar 27 Inventory	70	USD.960.00	USD.67,200
Sales From Mar 5 Purchase	140	USD.930.00	USD.1,30,200
Sales From Mar 1 Purchase	10	USD.900.00	USD.9000.00
	220		Rs.3440
Ending Inventory	Units	Unit Cost	Total
Inventory From Mar 27 Purchase	50	USD.15.00	USD.750

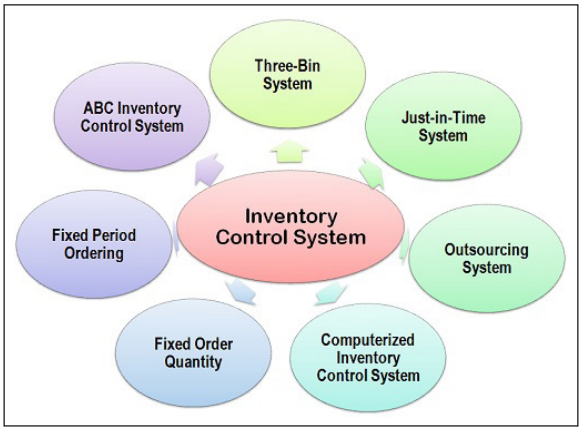
LIFO Accounting

Date	Purchases			Sales			Balance		
	Units	Unit Cost	Total	Units	Unit Cost	Total	Units	Unit Cost	Total
Mar 1							60	USD.15.00	USD.900
Mar 5	140	USD.15.50	USD.2,170				60	USD.15.00	USD.900
							140	USD.15.50	USD.2,170
Mar 14				140	USD.15.50	Rs.2,170	10	USD.15.00	USD.150

				50	USD.15.00	Rs.750			
Mar 27	70	USD.16.00	USD.1,190				10	USD.15.00	USD.150
							70	USD.16.00	USD.1,120
Mar 29				30	USD.16.00	Rs.480	10	USD.15.00	USD.150
							40	USD.16.00	USD.640
Mar 31							10	USD.15.00	USD.150
							40	USD.16.00	USD.640

Inventory Control System

The Inventory control system is maintained by every firm to manage its inventories efficiently. Inventory is the stock of products that a company manufactures for sale and the components or raw materials that make up the product. Hence, an inventory comprises of the buffer of raw material, work-in-process inventories and finished goods.



Following are the popular Inventory Control Systems that are being used by big manufacturers and the retail units:

1. ABC Inventory Control System,
2. Three-Bin System,
3. Just-in-Time (JIT) System,
4. Outsourcing Inventory System,
5. Computerized Inventory Control System,
6. Fixed Order Quantity,
7. Fixed Period Ordering.

There are several inventory control systems that are in practice, and these range from simple system to a complex one depending upon nature and the size of the business operations. Talking

about the simple system, several small manufacturing firms operate a two-bin system; wherein inventory is stored in two bins. Once the inventory in one bin is used, and the order is placed, meanwhile, the inventory from the other bin is used by the firm.

This system is quite inadequate for the larger firms that deal in several product lines and maintain a heavy sales counter. Thus, self –operating or an automatic computer system is to be employed to keep track on the inventory stock and place the order in case of a shortage.

Always Better Control Method of Inventory Control

The main objective of inventory control is to minimize the carrying costs of inventory. Very often all kinds of inventory are not equally important. A small number of important items account for the dominant part of total inventory investment while a large number of items constitute so small a value that they have little effect on the results.

Therefore, much greater control is required on the first type of items than on the others. The stock of items which are expensive has to be kept at the minimum. Items which are voluminous but relatively inexpensive are kept in large stocks as frequent ordering of such items is costlier.

The two types of items are categorised as “A” and “C”, the items falling midway between these are put into “B” category. Maximum attention is focused on items in category A as they constitute the most important class of inventory; items in class B receive moderate attention as they constitute an intermediate position.

Items in category C have negligible importance and; therefore, minimum attention is paid to them. This selective inventory control is called ABC analysis.

Thus, the ABC analysis yields a saving of 22.5 per cent. The ABC analysis helps to focus control efforts in areas where it is most needed. It must be remembered that ABC analysis does not prohibit more than three categories of inventory.

The basis of classification is usage value of the items and not their physical quantities. An item in category C may be critical in the sense that its non-availability may hamper production. Therefore, management should be vigilant.

Steps in ABC Analysis

The steps involved in ABC analysis are as follows:

a. Calculate the annual usage value of each item by multiplying the number used with the price of the item.

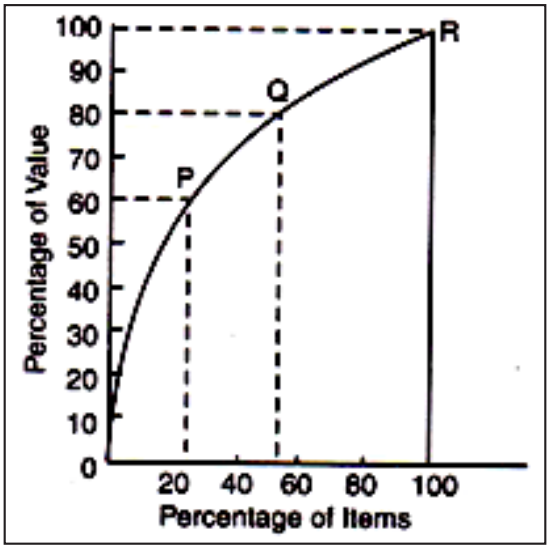
b. Arrange the items in descending order according to the usage value.

c. Compute percentage of total usage value for each item.

d. Find out the average inventory of each item by dividing the usage value with 2 and number of orders.

The ABC analysis can be shown on a graph too. For this purpose the cumulative percentages of the number of items are shown on X-axis and percentage of values on F-axis. Where the plotted curve takes a sharp turn a point is marked.

Each such point indicates one category of items. For example, in figure point P on the curve indicates 20% of item; with 60% usage value. This category can be called A. Point Q shows 30% items with 20% usage value. This category is B. Point R reflects 50% items with 20% usage value which is category C.



ABC classification of inventory

Advantages of ABC Analysis

1. It ensures better control over the costly items in which a large amount of capital is invested.
2. It helps in developing scientific method of controlling inventories. Clerical costs are considerably reduced and stock is maintained at optimum level.
3. It helps in maintaining stock turnover rate at comparatively higher level through scientific control of inventories.
4. It ensures considerable reduction in the storage expenses. It results in stock carrying stock.
5. It helps in maintaining enough safety stock for C category of items.

Limitations of ABC analysis

ABC analysis is not the ultimate exercise in inventory control. It needs to be supplemented with detailed monitoring and executive judgment. Items falling in category C maybe essential for smooth production. Therefore, their inventory level should be carefully monitored.

As the number and value of items may change over time constant review of categorization of items is required, in practice, the items falling in category C may be many and lot of time may be spent on their management. As a result adequate time may not be available for effective management of A and B categories.

Three-bin System

The Three-Bin System is like a two-bin system, wherein the third bin of inventory is reserved with the supplier. In other words, a manufacturing firm keeps a stock of inventory in two bins, and at the same time, the supplier of the inventory will keep one bin reserved at his location.

The Three-bin is built on the concept of Kanban system, a system used by the Japanese manufacturers, who regulate the supply of the components through the use of a card, displaying the set of specifications and instructions. This card is shown by the work centres when they wish to draw inventory from the supply bins.

All the three bins, one at the shop floor, another at the back store and the third bin at the supplier's location are well equipped with a Kanban card, to track the movement of inventory.

Once the inventory is used from the bin placed on the shop floor, it gets replenished from the bin stored back store. Later the bin in the back store is sent to the supplier to get it replenished from the inventory reserved with the supplier. Then, the supplier will manufacture more inventories to fill the empty bin placed with him.

Thus, the three-bin system is followed to have a secured flow of inventories throughout the production of the finished goods.

Just-in-time Inventory

Just in time inventory, also known as JIT inventory is the reduced amount of inventory owned by a business after it installs a just-in-time manufacturing system. This type of system is called a "pull" system. The intent of a JIT system is to ensure that the components and sub-assemblies used to create finished goods are delivered to the production area exactly on time. Doing so eliminates a considerable amount of investment in inventory, thereby reducing the working capital needs of a business.

Under the JIT concept, inventory may be reduced by the following means:

- Reduced production runs: Fast equipment setup times make it economical to create a very short production run, which reduces the investment in finished goods inventory.
- Production cells: Employees walk individual parts through the processing steps in a work cell, thereby reducing scrap levels. Doing so also eliminates the work-in-process queues that typically build up in front of a more specialized work station.
- Compressed operations: Production cells are arranged close together, so there is less work-in-process inventory being moved between cells.
- Delivery quantities: Deliveries are made with the smallest possible quantities, possibly more than once a day, which nearly eliminates raw material inventories.
- Certification: Supplier quality is certified in advance, so their deliveries can be sent straight to the production area, rather than piling up in the receiving area to await inspection.
- Local sourcing: When suppliers are located quite close to a company's production facility, the shortened distances make it much more likely that deliveries will be made on time, which reduces the need for safety stock.

Evaluation of JIT Inventory

The benefits of reducing the investment in inventory are substantial, which can lead a company to pare away too much inventory. When this happens, any unanticipated disruption to the flow of materials can bring operations to a halt almost immediately. Consequently, JIT concepts should certainly be followed, but be aware that there is a lower limit on how far you can reduce inventory levels.

Need of JIT Concept

The main focus of JIT is to identify and correct the obstacles in the production process. It shows the hidden problems of inventory. Just in time method prevents a company from using excessive inventory and smoothens production operations if a specific task takes longer than expected or a defective part is discovered in the system. This is also one of the main reasons why the companies (which are opted for JIT) invest in preventive maintenance; when a part/equipment breaks down, the entire production process stops.

The prime objective of JIT is to increase the inventory turnover and reduce the holding and all connected cost. This concept was made applicable again by the Japanese firms, placing an order for the material, the same day for the production of the product.

Thus, the Just in time approach eliminates the requirement to carry voluminous inventories and incur heavy carrying other related costs to the manufacturer. In order to avail the benefits of JIT system, there should be an optimum synchronization between the manufacturing cycle and delivery of material. Just in times requires a good understanding of the supplier and the manufacturer in terms of the quantity and delivery of the material. In the event of any misunderstanding between the manufacturer and supplier of the material, the entire production process may come to a halt.

One example of JIT system is a car manufacturer, a manufacturer of the cars operates with bare minimum inventory levels, as there is a strong reliance on the supply chain to deliver the parts required to manufacture cars. The parts required in the manufacturing of cars do not arrive before or after they are needed; rather, they arrive only when they are needed.

Successful JIT implementation wholly depends on how the manufacturer manages its suppliers. A lot of pressure is exerted on them, as the suppliers of the materials have to be ready with an ample quality material, as the need arises.

Elements Involved in JIT

Continuous Improvement

- Attacking fundamental problems and anything that does not add value to the product.
- Devising systems to identify production and allied problems.
- Simplicity: Simple systems are simple & easy to understand, easily manageable and the chances of going wrong are very low.

- A product: oriented layout for less time spent on materials and parts movement.
- Quality control at source to ensure every worker is solely responsible for the quality of their own produced output.

Eliminating Waste

There are seven types of waste:

1. Waste from product defects
2. Waste of time
3. Transportation waste
4. Inventory waste
5. Waste from overproduction
6. Processing waste

Waste minimization is one of the primary objectives of Just In Time system. This needs effective inventory management throughout the whole supply chain. Initially, a manufacturing entity will seek to reduce inventory and enhance operations within its own organization. In an attempt to reduce waste attributed to ineffective inventory management, SIX principles in relation to JIT have been stated by Schniededans and they are:

1. Reduce buffer inventory,
2. Try for zero inventories,
3. Search for reliable suppliers,
4. Reduce lot size and increase the frequency of orders,
5. Reduce purchasing cost,
6. Improve material handling.

Advantages and Disadvantages of Just-in-time Systems

Advantages of Adopting Just-In-Time Systems include:

- Just-in-time approach keeps stock holding costs to a minimum level. The released capacity results in better utilization of space and bears a favourable impact on the insurance premiums and rent that would otherwise be needed to be made.
- The just-in-time approach helps to eliminate waste. Chances of expired or out of date products; do not arise at all.
- As under this management method, only essential stocks which are required for to

manufacturing are obtained, thus less working capital is required. Under this approach, a minimum re-ordering level is set, and only when that level is reached, order for fresh stocks are made and thus this becomes a boon to inventory management too.

- Due to the abovementioned low level of stocks held, the ROI (Return On Investment) of the organizations be high in general.
- As this approach works on a demand-pull basis, all goods produced would be sold, and thus it includes changes in demand with unanticipated ease. This makes JIT appealing today, where the market demand is fickle and somewhat volatile.
- JIT emphasizes the 'right-first-time' concept, so that rework costs and the cost of inspection are minimized.
- By following JIT greater efficiency and High-quality products can be derived.
- Better relationships are fostered along the production chain under a JIT system.
- Higher customer satisfaction due to continuous communication with the customer.
- Just In Time adoption result in the elimination of overproduction.

Disadvantages of Adopting Just-In-Time Systems include:

- JIT approach states ZERO tolerance for mistakes, making re-work difficult in practice, as inventory is kept to a minimum level.
- A successful application of JIT requires a high reliance on suppliers, whose performance is outside the purview of the manufacturer.
- Due to no buffers in JIT, production line idling and downtime can occur which would have an unfavourable effect on the production process and also on the finances.
- Chances are quite high of not meeting an unexpected increase in orders as there will be no excess inventory of finished goods.
- Transaction costs would be comparatively high depending upon the frequency of transactions.
- JIT may have certain negative effects on the environment due to the frequent deliveries as the same would result in higher use and cost of transportation, which in turn would consume more fossil fuels.

Outsourcing Inventory System

The Outsourcing Inventory System is adopted by the firms to reduce the burden of manufacturing the components of the finished goods in-house i.e. within the organization. Thus, a system of buying the products or components from outside vendors rather than manufacturing internally is called as Outsourcing Inventory system.

Many companies develop a single source of supply from where the needs of the material can

be fulfilled. While many others help in developing the small and medium sized ancillary units to supply the adequate quality components, as required for the manufacturing of the finished goods.

Tata Motors is the prominent example that uses the outsourcing inventory system. It has developed several ancillary units around its manufacturing plants to get the parts and components in time. This has benefited the ancillary units as well; with the help of Tata Motors they are able to manufacture the best quality components.

Likewise, Tata Motors, Maruti, an automobile company, uses this inventory system to fulfil its need for the components.

Thus, with the help of an outsourcing inventory system, a manufacturing firm can reduce both the time and money involved in manufacturing the components in-house. Also, it enables an organization to capitalize the manufacturing efficiency of others, which could not have been possible, if manufactured internally.

Computerized Inventory Control System

A Computerized Inventory Control System is the integration of sub-functions involved in the management of inventory into a single cohesive system. It is software installed on the computer systems that enables a firm to keep a check on the inventory levels by performing the automatic counting of inventories, recording withdrawals and revising the stock balance.

It is very difficult for any firm to maintain a large stock of inventories, and therefore, many firms have adopted the JIT system in terms of Minimum and Maximum limit for the stock. There is an inbuilt system for placing orders in computer systems that automatically generates a PO to the supplier when the minimum level of the stock or the reorder point is reached. The benefits of a computerized inventory control system can be derived, when the business integrates its inventory control system with the other systems such as accounting and sales that helps in better control of inventory levels.

In practice, when the inventory level reaches to its minimum point, the system automatically generates a purchase order, which is sent to the supplier electronically. Also, the other copy of the PO is sent to the accounting department. Once the material is received from the supplier, an inventory gets updated on the system and at the same time, the notification is sent to the accounting department, which is used against the supplier's Invoice and the PO copy.

Thus, a computerized inventory control system has made a life of both the manufacturer and the big retailer easy, who can manage their inventories electronically without wasting much time on the manual tracking system. Also, all the documents, such as purchase order, Invoice, account statement gets automatically generated with a use of computerized inventory control system.

But however, too much reliance on the technology may be problematic in the situations of power failure and lost internet connectivity, as it may bring a system to a standstill. Also, the accuracy of inventory items inserted in the system depends on the data entry made by the person. Thus, a proper entry should be made to obtain the correct inventory levels.

Benefits of using a Computerized Inventory System

Quick and Accurate Counting

Even if you use a perpetual inventory system, you'll need to do a physical count occasionally to make sure your inventory records are accurate. One of the greatest advantages of a computerized inventory system is that it makes for faster, more accurate counting.

Scanning barcodes or QR codes is faster and easier than writing down stock numbers manually or flipping through pages of inventory sheets, looking for the correct item. It also means you won't have to transfer those numbers manually to your accounting software or inventory database, which eliminates another possible source of errors and several hours of data entry time. Instead, it's a quick electronic upload.

Better Receiving and Shipping

Computerized inventory systems make shipping and receiving orders simpler as well, and leave less room for error. You can simply scan the product into inventory as it's received, and it will show in your on-hand inventory. In much the same way, when you send out an order to your customers, you can scan each item out of inventory.

In retail, your cashiers do the same thing as they swipe or scan each item sold. You'll still need to train your staff to double-check the contents of each box against the order or invoice, but you're still eliminating one or more data entry steps in which errors can occur.

Reduced Shrinkage and Missing Inventory

Every time you count your inventory, you'll find that some of what you're supposed to have just isn't there. There are a number of potential reasons for that, with shoplifting and employee theft leading the list. Your own in-house administrative errors and vendor fraud are significant factors too.

According to figures from a 2017 National Retail Federation survey, they account for a combined total of more than 26 percent of shrinkage, which can add up to real money. By reducing opportunities for errors in your counting, shipping and receiving processes, computerized inventory systems can help bring that number down.

Better Inventory Management

If you use a periodic inventory system, your book inventory count will usually be outdated by the time your accountant finishes updating the data. This means you'll need to always carry at least a small amount of extra inventory to cover your projected sales, or your projected production if you're a restaurant or manufacturer. That tie up money and storage space you'd otherwise have at your disposal.

With a computerized perpetual inventory system, you'll always know your inventory levels with just a glance. You may be able to carry less inventory or even go to a full-blown, just-in-time inventory system, with product arriving from your vendors as it's needed. That can represent a real cost saving.

Real-time Management Information

One of the crucial advantages of a computerized perpetual inventory system is that it gives you the management information you need in real time. That goes beyond current sales figures and inventory levels, to the heart of your operations. Consider your cost of goods sold (COGS), for example. It's a figure that measures how efficiently you turn your supplies into sales revenues, or in the case of a retailer, what margins you've made on the products you've sold.

In a periodic inventory system, you only truly know your COGS at the end of an inventory cycle, when you've physically counted your inventory and your accountant can do the math. In between, you work from a cost flow assumption, which amounts to little more than a "best guess." With a perpetual inventory system, you can see up-to-date COGS at any time, which means you'll identify –and be able to correct–problems as they occur.

Disadvantages of Computerized Inventory System

System Crash

One of the biggest problems with any computerized system is the potential for a system crash. A corrupt hard drive, power outages and other technical issues can result in the loss of needed data. At the least, businesses are interrupted when they are unable to access data they need. Business owners should back up data regularly to protect against data loss.

Malicious Hacks

Hackers look for any way to get company or consumer information. An inventory system connected to point-of-sale devices and accounting is a valuable resource to hack into in search of potential financial information or personal details of owners, vendors or clients. Updating firewalls and anti-virus software can mitigate this potential issue.

Reduced Physical Audits

When everything is automated, it is easy to forego time-consuming physical inventory audits. They may no longer seem necessary when the computers are doing their work. However, it is important to continue to do regular audits to identify loss such as spoilage or breakage. Audits also help business owners identify potential internal theft and manipulation of the computerized inventory system.

Fixed Order Quantity

The Fixed Order Quantity is the inventory control system, wherein the maximum and minimum inventory levels are fixed and maximum and fixed amount of inventory can be replenished at a time when the inventory level reaches the auto set reorder point or the minimum stock level.

In other words, an auto-reorders point is linked with the pre-fixed amount of inventory in the system, which automatically places an order with the supplier for the maximum stock capacity, as soon as the inventory level reaches its minimum set-point. The firm is required to set the maximum and minimum stock capacity based on its storage space and the sales trend.

The Fixed Order Quantity system is followed by many firms since it helps to reduce the reorder mistakes, manage the storage capacity efficiently and prevent the unnecessary blockage of funds, which can be used elsewhere. Also, this method ensures the regular replenishment of inventory items, which are currently being used in the production process.

The Fixed Order Quantity method assumes that all the variables are known with certainty and remains constant. Such variables could be the sales, unit cost, holding cost, Lead time, stock out cost, etc. But, however, this assumption could not be true in the real life situations and despite this, the method is frequently applied by the firms and yields excellent results.

Fixed Period Ordering

The Fixed Period Ordering is an inventory control system, wherein the order for the replenishment of inventory items is sent periodically or after a fixed time interval. It is also called as Fixed Period Deficit Ordering system, because every time the order is placed, the order quantity is different.

Thus, fixed period ordering is a method wherein the firm places an order with the supplier for the supply of different quantities of material at a fixed time interval. This enables a firm to take into consideration the sales trend and the customer's preferences in a particular period before placing the replenishment order with the supplier.

The fixed period ordering system is helpful for a firm in the following ways:

- The large fluctuations in the demand patterns can be handled efficiently.
- The seasonal variations are considered before placing an order.
- The inventory can be managed more efficiently, by continually checking it against the preset reorder level.
- Best suited for the "A" category inventory items, which are of high value.
- A longer lead time is manageable.

Thus, fixed ordering system enables a firm to procure that much inventory which is required in a particular period and helps in reducing the unnecessary expenditure in the form of funds blocked in inventory items of no use.

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5

Warehouse Management

A building which is used for storing goods is called a warehouse. Warehouse management refers to the control of the regular operations of a warehouse. Some of the different types of warehouses are private warehouse, public warehouse and bonded warehouse. The topics elaborated in this chapter will help in gaining a better perspective about these types of warehouses and their management.

Warehouse

Warehouse is defined as the storage structure build for the defense of the quality and quantity of the stocked up produce. The requirement for a warehouse is felt when there is a time gap between the production of the product and the consumption of products.

Warehouses enable the businessmen to carry on production all through the year and sell their products, at any time there is sufficient demand. Need for warehouses occur also because some goods are fashioned only in a specific season but are asked for throughout the year. Likewise, certain products are shaped all through the year but asked for only during a specific season.

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 stabilize prices.

Minimisation 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.

Warehousing

Warehousing can 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.

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 warehouses.

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.

Importance of Warehousing in the Development of Trade and Commerce

Warehousing or storage refers to the holding and preservation of goods until they are dispatched to the consumers. Generally, there is a time gap between the production and consumption of products. By bridging this gap, storage creates time utility.

There is need for storing the goods so as to make them available to buyers as and when required. Some amount of goods is stored at every stage in the marketing process. Proper and adequate arrangements to retail the goods in perfect condition are essential for success in marketing. Storage enables a firm to carry on production in anticipation of demand in future.

A warehouse is a place used for the storage or accumulation of goods. It may also be defined as an establishment that assumes responsibility for the safe custody of goods. Warehouses enable the businessmen to carry on production throughout the year and to sell their products, whenever there is adequate demand.

Need for warehouse arises also because some goods are produced only in a particular season but are demanded throughout the year. Similarly certain products are produced throughout the year but demanded only during a particular season. Warehousing facilitates production and distribution on a large scale.

Need of Warehousing

- Some commodities are produced in a particular season only. To ensure their off season availability, warehousing is required.
- Some products are produced throughout the year but their demand is seasonal. Warehousing is important in such cases.
- For the companies which opt for large scale production and bulk supply, warehouse is an unavoidable factor.
- Warehousing help companies ensure quick supply of goods in demand.
- Production of goods and their movement of goods are important for the companies for continuous production of goods.
- Warehousing is also important for price stabilization. For necessary goods, the Government stores them in the warehouses and controls its supply in the market as per the price fluctuations.
- Vital need of warehousing is for bulk breaking. Consider a trade agent who imports goods from a country for a large number of buyers in his own country. He first takes the goods to his warehouse and breaks it into small parts for supply to the buyers.
- As far as cost saving is considered, warehousing helps the traders with cross docking. All the goods are consolidated in the warehouse and then stuffed into containers according their destination. This is mainly beneficial for small traders who export low quantity of goods.

Benefits of Warehousing

Warehousing has many benefits to offer to traders/businessmen, whether it is wholesale or retail, it provides a number of benefits listed as under:

Safety and Preservation

Manufacturers, importers, wholesalers, exporters, traders and stockiest use warehouses to store their goods (raw materials and finished items) before distribution and sale. Besides, serving the

storage purpose, warehousing facilitates preservation facility against water, fire, theft and climatic changes. Due to technological advancements, safety measures and computerization, warehouses minimize spoilage, errors, accidents, omissions, breakage, deterioration in quality etc.

Trouble Free Handling

Today warehouses are usually large plain buildings in industrial or institutional areas of cities and towns equipped with loading docks to load and unload trucks, from railways, seaports or airports. They also have automatic forklifts and cranes for moving goods from one place to another within the warehouse area. Some warehouses are completely automated with no workers working inside resulting in minimum wastage and easy handling during loading and unloading goods.

Ensuring Continuous Supply

Certain commodities like agricultural products are produced during a certain period of year but consumed or required throughout the year. Warehouses ensure adequate supply of such seasonal products throughout the year without any break.

Lifeline for Small Traders

Due to rising costs of land and financial limitations, small traders cannot afford to have their private warehouses. Public or government warehouses facilitate them to store goods at affordable rates. In absence of warehouses, it will be difficult for small traders to survive in cut-throat competition because 'stock out' situation if persists for long, can disrupt the image and goodwill of the traders especially the small traders who have no limited marketing budget to spend.

Assisting in Continuous Production

Warehouses facilitate the manufacturers to produce goods throughout the year without much attention of raw material shortage. The manufacturers who usually produce in bulk require raw materials in large quantity. Warehouses assist them to provide agricultural (seasonal) and industrial goods all over the year.

Location Advantage

Most of the warehouses are located at a convenient place near railways, highways, seaports and airports that facilitate smooth movements of goods. Further, convenient location reduces the distribution cost to great extent.

Employment Generation

Warehouses are usually large plain buildings in industrial areas of cities and towns covering huge storage area. Warehouses located in or near industrial areas are so big that can store goods of large number of businessmen at a time. Further, besides storage, warehouses perform several functions like procurement, sorting, dividing, marketing, preparing for shipment, handling, inventory control, display, order processing, financing, transportation, grading and branding and so on resulting in employment generation in various sections and at various levels. It is the source of bread and butter for several laborers, workers, employees and officers.

Financing

When businessmen store goods in the warehouses upon certain formalities, they get 'deposit receipt', which acts as a proof about the deposit of the goods. Warehouses also issue a document in the name of owner against storage of goods, which is known as warehouse-keeper's warrant. This document can be transferred by simple endorsement and delivery. Businessmen on account of these documents (warrants) may get financial aids/loans from banks, private tenders on financial companies. In some cases, warehouses also provide finance to the businessmen on keeping goods as collateral security.

Risk Reduction

Warehouse owners/authorities make certain that the goods stored in their warehouses are well protected, preserved and monitored. In order to keep proper information about good details, to save goods from theft and pilferage, warehouses employ employees and security staff.

For perishable items, they provide cold storage facility, to protect warehouse from fire, fire-fighting equipments are used. On requirement, goods stored may be insured against unforeseen mishaps like loss due to fire, theft and natural disasters.

Assisting in Selling

Most of the warehouses, as per requirements from depositors' side, provide assistance towards inspection of goods, sorting, branding, packaging, financing and labeling that is essential towards sale of goods. In certain cases, transport arrangements may be availed to depositors for their bulk deposits.

Types of Warehouses

Private Warehouse

The private warehouse is a storage facility that is mostly owned by big companies or single manufacturing units. It is also known as proprietary warehousing and can be operated as a separate division within a company.

The private warehousing can be done on on-site and off-site basis and serves as fixed corporate investment in land, building and equipment.

1. On-site warehouse: The on-site warehouse can either be at some centralized location or can be separately situated at different manufacturing facilities.
2. Off-site warehouse: The off-site warehouses are the storage facilities that are located closely to the marketing areas and are used for storing on-site inventory. These warehouses also serve as distribution center for finished goods.

Advantages

- Degree of control;

- Less costly in the long term;
- Better use of human resources;
- Tax benefits;
- Intangible benefits.

Disadvantages

- It's been costly for its fixed size and cost;
- High opportunity cost (high risk);
- Low Rate of return;
- High start-up cost.

Public Warehouse

A public warehouse is a business that provides short or long-term storage to companies on a month-to-month basis. Public warehouse fees can be a combination of storage fees and inbound and outbound transaction fees. A public warehouse can charge per pallet or charge for each square foot that is used by a company.

The public warehouse is not only a facility where a company can store their products, but the public warehouse offers inventory management, physical inventory counts, and shipping functionality. The public warehouse charges their clients for a certain rate for the goods stored, the volume of the warehouse used and the services the client wishes to use.

The company using the public warehouse does not have to employ warehouse staff, does not require any inventory software or warehouse equipment. The owner of the public warehouse is responsible for the costs and passes this on to their clients based on the rate they are charged.

Although most companies see public warehousing as a short-term solution it can often turn into a long-term relationship as companies been accustomed to the convenience of the public warehouse services. Companies that own and operate public warehouses invest significantly in modern facilities to remain competitive. They offer clients increasing levels of flexibility in order to retain and attract additional clients.

Public warehouses offer companies a range of labor solutions including picking, packing, inventory control software and a dedicated workforce. Public warehouses will also allow clients to bring in their own ERP or warehouse software so that the public warehouse becomes a satellite location with real-time data.

Criteria for Choosing a Public Warehouse

Because of the increasing competition between the public warehouse operators, potential clients should review the capabilities of each potential warehouse to identify which would be the best fit. Each client will have a number of factors that need to be considered when selecting a public

warehouse. Companies have a variety of reasons why they require an outside warehouse, as well as their short-term and long-term needs and the price they are willing to pay for the service. The majority of the following criteria is likely to be used by all companies comparing public warehouse sites.

- Geography
- Technology
- Expansion
- Company Network
- Flexibility

Geography

The location of the public warehouse can be important to some clients, and less to others. If a large volume of items is to be moved between the company warehouses and the public warehouse, a location closer to the company site may be more advantageous. Some clients may require a public warehouse to be closer to their customers if items are to be moved there from a number of company sites.

Technology

Although most public warehouses offer modern facilities and technology, the level of technology may vary, for example, one public warehouse may offer a warehouse management system that is not compatible with common ERP systems. This can be less attractive than a warehouse that allows clients a range of warehouse solutions or for clients to use their own systems.

Expansion

Depending on a company's needs, the amount of space required at a public warehouse is likely to change during the period that space is required. Although space requirements are often unknown at the beginning of a contract with a public warehouse, the agreement should include an expansion clause. This will guarantee that the public warehouse operator will accommodate any future space requirements a company may need.

Company Network

When a company negotiates for space in a public warehouse, future requirements for other warehousing needs would probably not be known. a public warehouse that is part of a warehouse network may be able to offer national or global supply chain management services that smaller public warehouse operators cannot.

Flexibility

The flexibility of the public warehouse operator is an important consideration. Clients can need warehouse functionality at short notice and warehouse operators that can guarantee rapid access to the facility, with trained staff and suitable technology are at an advantage.

Types of Public Warehouses

Generally, public warehouses are divided in three types as general merchandise warehouse, special commodity warehouse and cold-storage warehouse.

General Merchandise Warehouse

The warehouse where goods of imperishable nature such as raw materials, semi-finished, finished goods and other business commodities are kept is called general merchandise warehouse. Producers, wholesalers, and retailers keep their goods in such warehouses paying certain rent. In this warehouse, goods are kept safe from weather change. Such warehouses do not need arrangement of special temperature, humidity or any daily operation.

Special Commodity Warehouses

This type of warehouse is used to store the goods, especially agro-products and other special nature commodities. Special arrangement of warehouse is made for different nature goods. For example-separate arrangements are made to store agro-products like foodstuffs, wool, jute, cotton, tobacco, tea-coffee, and for fuels like petroleum, coal, chemicals and other special nature goods. Such warehouses are called special commodity warehouses.

Cold-storage Warehouse

The warehouse in which perishable goods are stored such as fish, meat, vegetables, fruits, eggs, cheese, butter and other dairy products, drinks, medicines etc. are known as cold-storage warehouse. Such goods are kept in cold-storage warehouse to protect them from heat, air, humidity, pollution etc. An arrangement of artificial chilling system is made in such warehouses. Nowadays, all types of perishable products can be kept safe in cold-storage warehouse and can be made available in market round the year. Such warehouse is also called refrigerated warehouse.

Advantages of a Public Warehouse

The advantages of a public warehouse are:

1. Storage facilities can be availed at desired locations as and when required, and at a known cost.
2. The goods can be despatched to the warehouses with the warehousemen as the consignee for the clearance of the goods at the railhead and transportation to the warehouse.
3. The goods can be delivered or despatched to the nominees/allottees of the depositor.
4. The warehouseman does entire inventory management, and the depositor is completely free from these costs and botherations.
5. The goods are handled properly and preserved scientifically by the trained technical personnel without any damage or deterioration during handling and storage.
6. The goods can also be insured against all risks like fire, flood, thefts, etc. at nominal cost and the depositor is indemnified against such losses.

7. The goods can be kept in the public warehouses till the market price is found remunerative enough for the disposal of goods and, thus, distress sale can be avoided.
8. Advance can be obtained against the pledge of the warehouse receipt from banks.
9. Uncertainties in the availability of raw materials or finished products due to supply dislocation are avoided.
10. Public warehouse helps in the physical distribution of goods like food grains, fertilizers, public distribution items, consumer goods, etc. and therefore helps in marketing of products.
11. The public warehouse can also be used for grading, standardization, and packing of goods if the arrangement is on dedicated and a long term usage basis.

Bonded Warehouse

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.

In case he wishes to export the goods, he need not pay customs duty. Moreover, a bonded warehouse provides all services which are provided by public warehouses. Goods lying in a bonded warehouse can be packaged, graded and branded for the purpose of sale.

Benefits of using a Bonded Warehouse

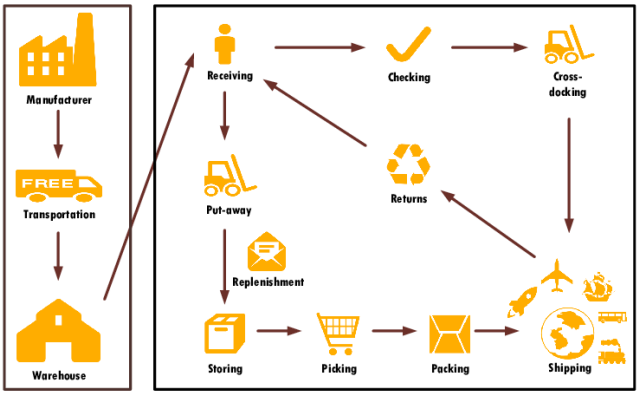
Companies use bonded warehouses to legally and safely deliver their products to customers. Bonded storage is a secure storage and is under customs laws. The bonded goods are well taken care of and documented. Exporters prefer bonded warehouse facility not just for security but for other benefits:

- No duty needs to be paid until the item is released for delivery to the buyer, giving full control of payment to the importer. And, if the goods go unsold, they can be exported without having to pay the duty at all, as VAT is only paid when you sell your products and not on re-exported goods from the bonded warehouse. Some businesses report saving 25% to 30% off taxes.
- Restricted items are allowed to be stored. These items can be safely stored in bonded storage until they need to be sent out.

- Facilities are equipped to handle different types of storage. Good bonded storage can store any kind of product for as long as needed. A good example would be for perishable food items - there are freezers, dry containers, and other temperature controlled rooms available.
- You receive a bond on your items. When you store bonded goods, the warehouse authority will give you a bond which ensures that you won't face any monetary loss at the time of the release of the shipment after the payment of taxes, including VAT or GST.
- They offer additional logistics solutions. It's possible to have access to a complete logistics solution, as bonded warehouses are affiliated with freight forwarding companies who handle distribution, deliveries, and more.

Warehouse Process

Flow of materials through all kinds of logistics facilities is a strictly defined sequence of transformations performed on these materials. These transformations may involve transformations of time, place or form of handled materials. In the first case, it concerns buffering and storage of materials in logistic facilities. Place transformation is understood as a movement and transport of materials within warehouse. However, during the form transformation, materials are processed due to their physical form, i.e., co-packed, consolidated, unconsolidated, assembled, packaged, etc.



Warehouse process is a set of actions which are associated with receiving, storage, picking and shipping of material goods, in suitably adapted places for this purpose, and under certain organizational and technological conditions. Therefore, it can be concluded that warehouse process includes such sub-processes as receiving, storage, picking and shipping. Nevertheless, it is a very general approach, and warehouse process may take many different forms, and include multiple sub-components. Selection and appropriate connection of these process elements (sub processes) is determined by functions and tasks of logistics facility. In fact, production warehouses, distribution warehouses or cross docking warehouses usually perform variety kinds of transformations.

Each of these warehouse process components is characterized by an appropriate sequence of actions that have to be performed to complete a given goals and objectives. It is closely related to materials and information transformation by labour resources (labour resources include warehouse employees, transport means, warehouse equipment, tools for information flow management).

Table: The most common sub-processes and activities included in warehouse process.

Sub-process	Activity	Transformation
1	2	3
Receiving	• Unloading • Cargo identification and control • Buffering	• Place • Time • Time
Put-away	• Transport to storage area • Placing unit loads in storage location	• Place • Place
Storage	–	• Time
Replenishment	• Transport to order picking area • Transformation of unit loads to form offered in order picking • Replenishment to pick locations • Placing remaining unit loads in storage location • Placing in selected location empty bins (pallets)	• Place • Form • Place • Place • Place
Order picking	• Replenishment to pick locations • Preparing items for picking • Picking items • Sorting, packing, preparing picked unit loads for transport • Transport of prepared unit loads to selected place in order picking area • Transport of prepared unit loads to buffer	• Place • Form • Place • Form • Place • Place
Co-packing	• Co-packing Transport of unit loads to co-packing stations • Preparing items for co-packing • Creation new SKU (e.g. promotional SKU sets, combined SKU) • Packaging, labelling, tagging, foiling, etc. • Transport of prepared unit loads to selected place of buffer	• Place • Form • Form • Form • Place
Consolidation, deconsolidation, sortation	–	• Form (Quantity)
Shipping	• Buffering • Cargo identification and control • Loading	• Time • Time • Place
Crossdocking	• Transport from input buffer to output buffer	• Place

Warehouse Process Strategy Selection

Warehouse process can be implemented in many different ways (under different strategies). It means that materials can be processed by various components of warehouse process, in their various configurations as well as in various functional areas of logistics facility. Therefore, it can be assumed, that warehouse process strategy is a part of this process. It determines the sequence of warehouse operations. These operations are related to internal transport, cargo form transformation and cargo buffering between their input and output from the warehouse.

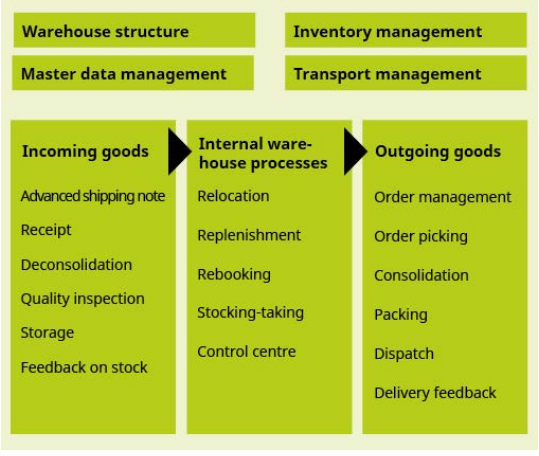
Selection of particular warehouse strategy usually depends on basic warehouse tasks, structure and size of customer orders, handled logistic units, costs of materials handling in particular sub-processes (both financial and time costs), availability of storage space and labour resources, etc.

The cost of handling cargo units by warehouse process strategy can be expressed both in money and time units. Implementation of particular warehouse operations absorbs as well money (correlated with engagement of labour resources, funds freezing, maintenance of infrastructure and suprastructure) as time required to perform them.

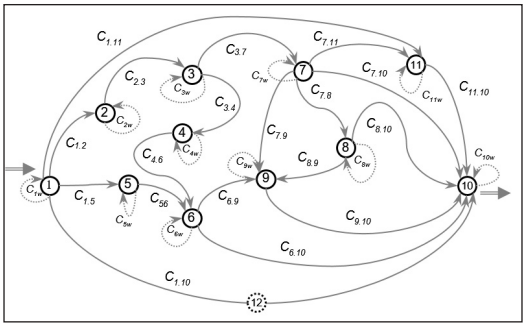
The total cost of material unit handling under particular strategy is the sum of the costs of individual activities (C_i) as well as the costs of movement between these operations and costs of delaying (C_{iw}). Costs of delaying are costs incurred when unit loads have to wait because some warehouse activities cannot be performed (eg. due to lack of storage space, lack of SKU to pick, lack of labour resource to perform the operations).

The total cost of material unit handling under particular strategy is the sum of the costs of performing each pair of consecutive operations and transport between them ($C_{i,j}$) and costs of unit loads delaying (C_{iw}). For example, total cost of material handling under s-th strategy (C_s) which includes operations {1, 2, 3, 4, 6, 10} can be presented as follows:

$$C_s = C_{1.2} + C_{2.3} + C_{3.4} + C_{3w} + C_{4.6} + C_{4w} + C_{6.10} + C_{6w}$$



Functional areas and sub-processes of warehousing.



Graph of warehouse strategy costs.

Selection of the appropriate warehouse strategy will therefore be dictated by finding such a variant of material flow, in which the cost will be the lowest. At the same time it must be acceptable according to feasibility of the given logistics task (e.g. total time of transforming materials under a given strategy cannot exceed time of order processing, acceptable by customer).

However, selection of warehouse strategy depends not always on costs of its implementation. The main factor influencing this choice may be the availability of labour resources or, for example:

- In case of deliveries: Free space in buffer and storage areas, the need to replenishment order picking area,

- In case of shipments: Availability of ordered materials in different functional areas.

Therefore, probability of selecting the particular strategy is dependent on technical and organizational factors. Of course, selection of strategy that reflects a standard process is more likely than the other. If in some functional area is lack of the requested material or it will not be available in the expected picking time, the probability of choosing strategy that supports this area is 0. Similarly, probability will be equal 0, if in a particular functional area will not be enough space to store, buffering or handling received materials.

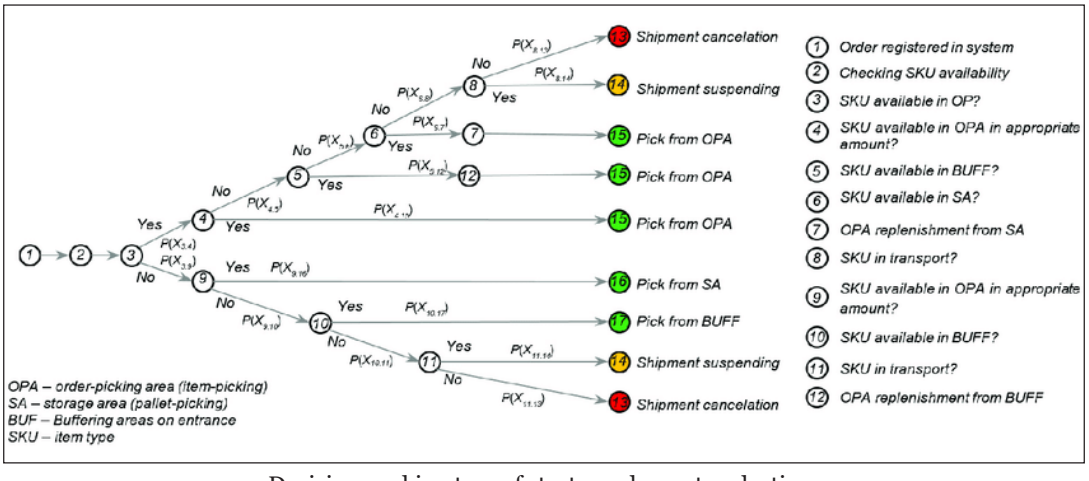
For each task of shipping or receiving it is possible to determine the decision-making tree, according to which could be selected, with a certain probability, strategy of warehouse process. Example of such a tree for a single shipping task is shown in figure.

In the example shipping task implementation may cause with picking of material (green colour) shipment suspending (delay treated as an error handling–orange colour) or cancellation of task (causing losses, customer dissatisfaction–red colour). Selection of successive strategy components in decision tree is done with a certain probability, e.g.: path selection, taking into account the ability to pick from order picking area (relation 1–15) will take place with probability $P(X_{1.15})$:

$$P(X_{1.15}) = P(X_{3.4}) \cdot P(X_{4.15}) + P(X_{3.4}) \cdot P(X_{4.5}) \cdot P(X_{5.12}) + P(X_{3.4}) \cdot P(X_{4.5}) \cdot P(X_{5.6}) \cdot P(X_{6.7}).$$

The probability of completion shipping tasks on time (P_R) can be determined based on the equation above:

$$P_R = P(X_{3.4}) \cdot P(X_{4.15}) + P(X_{3.4}) \cdot P(X_{4.5}) \cdot P(X_{5.12}) + P(X_{3.4}) \cdot P(X_{4.5}) \cdot P(X_{5.6}) \cdot P(X_{6.7}) + P(X_{3.9}) \cdot P(X_{9.16}) + P(X_{3.9}) \cdot P(X_{9.10}) \cdot P(X_{10.17})$$



Decision-making tree of strategy elements selection.

Determination of probability values to assign individual operations to warehouse strategy is based on a series of data analysis concerning logistics processes in a particular logistics facility. Estimating costs of whole warehouse process (taking into account specified warehouse organization, equipment, technology, labour resources availability, etc.) is possible by knowledge about material flow volumes, probability of selection particular strategy, and costs of handling one unit loads under particular strategy.

In addition, it is possible to predict losses that logistics facility may incur with a certain probability as a result of:

- Shipment suspending P_S:

$$P_S = P(X_{3.4}) \cdot P(X_{4.5}) \cdot P(X_{5.6}) \cdot P(X_{6.8}) \cdot P(X_{8.14}) + P(X_{3.9}) \cdot P(X_{9.10}) \cdot P(X_{10.11}) \cdot P(X_{11.14})$$

- Shipment cancelation P_C:

$$P_C = P(X_{3.4}) \cdot P(X_{4.5}) \cdot P(X_{5.6}) \cdot P(X_{6.8}) \cdot P(X_{8.13}) + P(X_{3.9}) \cdot P(X_{9.10}) \cdot P(X_{10.11}) \cdot P(X_{11.13})$$

Probability of selecting the particular strategy variant can be modified by e.g., investments and modernization increasing technological potential of functional areas (performance, capacity) as well as by organizational activities related to allocation labour resources to tasks. It should be noted that, e.g. increasing capacity of order picking area–OPA will increase probability of finding needed SKU at this area. At the same time it can cause a prolongation of picking paths, and consequently leads to decreasing efficiency of shipping process. This indicates that all reorganizations, investment and technological changes in logistics facilities should be multifaceted analysed. Any such change may significantly affects the other components of warehouse strategy, the probability of strategy selection and thus the productivity and costs of warehouse process and whole facility.

Warehouse Management

Warehouse management is the act of organizing and controlling everything within your warehouse – and making sure it all runs in the most optimal way possible.

This includes:

- Arranging the warehouse and its inventory.
- Having and maintaining the appropriate equipment.
- Managing new stock coming into the facility.
- Picking, packing and shipping orders.
- Tracking and improving overall warehouse performance.

Most high growth retailers would use automation tools (like some form of Warehouse Management System) to control this part of their supply chain.

Warehouse Management Fulfilment Strategies

1. Choosing an optimal picking system:

   Picking may seem like a simple concept at first. And it is when you only have a few orders to deal with.

But this becomes a much different story once you're dealing with hundreds (or even thousands) of multiple item orders each day.

Research recently conducted on 20 Veeqo retailers found that 70% of labour time when processing an order is spent on just picking the products. And 60% of a picker's time is taken up by simply walking around the warehouse.

So getting a solid picking system in place can have a major impact on overall distribution productivity.

These are the four main picking systems or methods used by medium to large retailers:

Single Order

This is the most basic picking method–typically only used by those just starting out. Quite simply, a picker will pick one order at a time in its entirety before moving on to the next.

Retailers just starting out who aren't yet big enough to gain the benefits of more complex picking methods.

You ship more than 20 customer orders a day (or plan to in the near future).

Batch Picking

The picker is assigned a batch consisting of a number of orders, picks them all in one go and then returns to a packing desk. The picker will then get assigned a new batch to pick.

The number of orders allocated to each batch is generally between 10 and 30. But this really depends on the physical size of your products and average order size.

High number of orders with single or low number of products per order.

You have a high number of products per order (or are aiming for this in the near future).

Zone Picking

This sees each picker assigned their own area (or zone) of the warehouse with them only picking products stored in that specific zone. An order is passed through all areas to have any required items added to it by pickers in that zone before being returned to a packing desk.

Great for preventing multiple pickers getting in each other's way, but it can also create a slight delay in shipping as each order needs to be passed around the warehouse.

Retailers typically shipping a high volume of multiple item orders.

You typically ship single or low item orders or have very few pickers.

Wave Picking

Similar to zone, but all zones pick at the same time. The various items are picked in the according zone and are then given to a packer who will consolidate all the separate picks for each order.

This is faster than zone, but labour costs increase due to the packer needing to spend more time combining orders at the end before needing to be shipped.

Retailers typically shipping a high volume of multiple item orders and still wanting to maintain a super-fast process.

You typically ship single or low item orders, have very few pickers or cost is more important than speed of dispatch.

Picking Method	Order Volume	Items per Order	Best For	Setup Cost
Single order	Low	Med-high	Startups	£
Batch	Low-high	Low-med	High volume of single item order	££
Zone	High	Low-med	High volume with a lot of products per order	££££
Wave	Med-high	Med-high	High volume with multiple items per order	££££

2. Optimising your packing process:

   There's more to packing than just throwing items in a box as quickly as possible.

   It's an opportunity to make completely sure that you're sending the right products to the right customers and in the most efficient way.

Things to be considered:

Box Size

More and more shipping companies are incorporating package dimensions into their pricing–rather than it being based solely on weight.

Meaning box sizes could be having a direct impact on costs.

Having 50 different box size options is a great way to overwhelm packers and severely slow down warehouse operations. So there's a balance that needs to be struck here.

Of course, it depends on your individual business needs.

If you know every order is the same physical size then having one box size makes sense–and it's a lot easier for the packer.

But a typical retailer will usually do best with around 3-5 size options. This keeps things manageable for packers while still allowing room to minimise courier costs.

Packaging Material

Another element to the packing process is choosing the most appropriate packaging material.

This is all about striking a balance between:

1. Keeping the goods protected during transit.
2. Minimising the overall weight of the package (and therefore courier costs).
3. Keeping the cost of the packaging material itself down.

Shipping a Faberge egg is going to warrant a better (and more expensive) packaging material than if shipping a book.

So it's worth analysing your product catalogue (and track record of delivering damaged items) to determine the range of packaging materials you need to have available.

Packaging	Description	Protection Rating
Bubble wrap	Two layers wrapped around products using sell tape to hold.	75%
Packaging peanuts	Biodegradable or recycled foam peanuts.	90%
Shredded paper	Cheap and lightweight, but limited protection.	50%
Crunched paper	From paper dispenser and crunched by packer, limited protection.	50%
Shredded wool	Loose fill wool which is lightweight but limited shock protection.	60%
Air pillow	Plastic bags filled with air, very lightweight and good protection but require work to inflate.	90%

3) Shipping your orders:

The next few steps in your warehouse management process are pretty straightforward:

1. Weigh the package.
2. Print out relevant shipping label (and invoice, if not already done so).
3. Mark the order as 'Shipped' on the relevant sales channel or Order Management System.
4. Send out 'shipping confirmation' and 'tracking' emails to the customer.

Measuring Warehouse Performance

Tracking performance and working to improve it is essential when it comes to all parts of supply chain management.

And it's no different when it comes to warehouse management.

In general, this is all about two things:

1. Accuracy of fulfilling customer orders (without damage).
2. Speed of fulfilling customer orders (without damage).

Receiving Efficiency

This is quite simply how long it takes for your team to complete the receiving and putting away of a newly delivered purchase order.

It's a good idea to record exact timestamps for:

- New stock being delivered.
- When this stock is ready for putting away.
- Then again once the stock has actually been put away.

You can then calculate the difference in time between each point and work out an average for the month–allowing you to see how performance is trending in this area of your warehouse operations.

Rate of Return

An order being returned isn't always down to a problem in the warehouse–a customer may have just had buyer's remorse.

So the key to getting best use out of this is to segment by reason for return. This way, the warehouse or operations manager can start looking at exact reasons why this KPI may be high and put into place strategies to resolve.

Determine several different return reasons and use the following equation to analyse each one:

$$\text{Rate of Return} = \frac{\text{No. of Units Returned}}{\text{No. of Units Sold}}$$

Picking Accuracy

Tracking and segmenting rate of return properly lets you also analyse picking accuracy – a particularly key piece of data.

To calculate picking accuracy, use your total number of orders in a period along with data from the rate of return KPI in the following equation:

$$\text{Picking Accuracy} = \left(\frac{\text{Total No. of Orders - Inncorrect Item Returns}}{\text{Total No. of Orders}} \right) \text{x } 100$$

Order Lead Time

Order lead time (or average order processing time) is quite simply how long it takes for a customer to receive an order.

You may want to divide this into various categories. For example, international orders, Amazon Prime orders or orders for special or larger products.

But generally, the lower you can get order lead time, the happier your customers are going to be–so long as it arrives in perfect condition.

Warehouse Management System

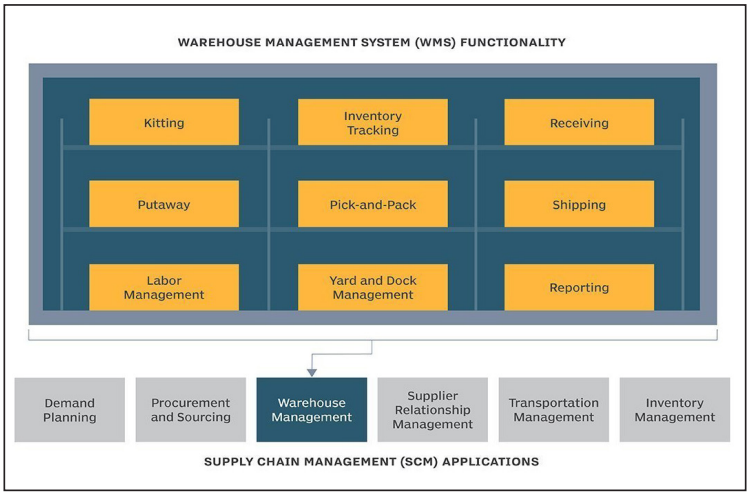
A warehouse management system (WMS) is software and processes that allow organizations to control and administer warehouse operations from the time goods or materials enter a warehouse until they move out. Operations in a warehouse include inventory management, picking processes and auditing.

For example, a WMS can provide visibility into an organization's inventory at any time and location, whether in a facility or in transit. It can also manage supply chain operations from the manufacturer or wholesaler to the warehouse, then to a retailer or distribution center. A WMS is often used alongside or integrated with a transportation management system (TMS) or an inventory management system.

Types of Warehouse Management Systems

Warehouse management systems come in a variety of types and implementation methods, and the type typically depends on the size and nature of the organization. They can be stand-alone systems or modules in a larger enterprise resource planning (ERP) system or supply chain execution suite.

They can also vary widely in complexity. Some small organizations may use a simple series of hard copy documents or spreadsheet files, but larger organizations from small to medium-sized businesses (SMBs) to enterprise companies use complex WMS software. Some WMS setups are designed specifically for the size of the organization, and many vendors have versions of WMS products that can scale to different organizational sizes. Some organizations build their own WMS from scratch, but it's more common to implement a WMS from an established vendor.



A WMS can also be designed or configured for the organization's specific requirements; for example, an e-commerce vendor might use a WMS that has different functions than a brick-and-mortar

retailer. Additionally, a WMS may also be designed or configured specifically for the types of goods the organization sells; for example, a sporting goods retailer would have different requirements than a grocery chain.

Uses of Warehouse Management System

A warehouse management system is used to control and track the transfer and storage of materials in a warehouse. The system involves a number of processes that are important when shipping, receiving, or even putting away materials and integrates with other systems in the supply chain to ensure data transparency throughout your enterprise.

Receiving Goods

The WMS provides a simple process that is to be followed when handling a shipment that has arrived at the warehouse. The process can be customized to suit different users' requirements but its core function is to ensure that all shipments are handled properly to minimize on losses and also save on time.

Tracking Inventory

A WMS enables warehouse owners to keep a tab of all the stock in the warehouse. This is important because it ensures that the warehouse management team is able to know when there is enough stock in the warehouse and know when to order for more stock to prevent shortages. This saves on space as overstocking is prevented and also ensures that resources are well distributed to ensure a smooth warehouse management.

Slotting for Efficiency

A WMS enables users to model an efficient way of storing different products in a warehouse depending on different factors like demand and weight. This ensures that the warehouse is arranged in such a way that products that move faster or are heavier are stored close to the door for faster processing of orders, and products that are used together are stored in close proximity. This makes running the warehouse easy and efficient.

Labor Visibility

The WMS system eliminates the need to get more labor to undertake some of the functions that are managed at a central point in WMS. Probably the biggest labor savings is eliminating full inventory counts which can often happen monthly or even weekly. A WMS can allow you to do periodic cycle counts without interfering with day to day operations. Reducing on labor can obviously greatly cut back on expenditure simply because the system is not labor intensive.

Document Preparation

A WMS automates most of the different processes, eliminating the need for paper documents that are bulky, and eat up quite a huge chunk of money when it comes to purchasing them and storing them appropriately. By giving visibility to the system to everyone simultaneously, everyone has the data needed to do their job at their fingertips.

Picking and Shipping

A proper WMS ensures that the right product is picked based on your business rules (LIFO or FIFO). A good WMS will make sure that the right orders are shipped to the right people at the right time. With this accuracy, the mistakes that can arise when transporting goods are avoided and ends up as a more efficient and less costly transport system.

Customer Service

A WMS improves the overall customer service by ensuring that orders are received and processed on time, and the right products are delivered to all customers when and where they need them. The quality of products is maintained enabling users to retain their customers and attract new ones.

Tracking and Visibility

For industries that require advanced tracking capabilities, a WMS will allow you to track lot information, expiry dates, UPC, and serial numbers. Each data point adds to the cost to maintain, but often comes with great returns when advanced visibility is required. Recalls and warranty issues are quickly resolved by solving the root problem through trace back instead of just a payout to the customer.

Reporting

The best Warehouse Management Systems will be in an easy to use database, like Microsoft SQL and include many reports out of the box. One hidden advantage to having systems is the ability to look at data in new and exciting ways.

Warehouse Management System in Supply Chain

In a fully integrated solution you will have your raw materials received into your Warehouse Management System, be consumed by your Material Requirement Planning system and the finished goods be deposited back into the WMS. The WMS will facilitate the tracking of the product through moves and cycle counts while in the warehouse, then finally be picked and sent to either the shipping system or Transportation Management System to route your trucks. The entire time your Enterprise Resource Planning system will be tracking the values, orders, sales, and invoices with all of the systems.

Requirements for Warehouse Management System

There are different types of WMS ranging from simple uncomplicated systems to more complex ones that are more suited for large warehouses. When looking for a WMS system for your warehouse, there are different factors you need to consider before you can settle on one WMS. Some of the things to consider include:

Functions

Different WMS can perform different functions and are built for different industries. Look for a warehouse management system that is configurable and able to scale past where you are, but to where you plan to be in five years.

Warehouse Size

Larger warehouses require more detailed systems than smaller ones. This is because more activities and functions are carried out in a large warehouse and all such activities and functions require a more detailed system. The larger the warehouse, the higher the cost of travel between locations, and therefore the more important detailed tracking is.

Customer Needs

By identifying the loopholes in your current system, you will be in a position to determine the functions you require in a WMS, and select a WMS that will ensure that you are able to serve your customers better and increase their satisfaction with the services you provide.

Cost

The cost of installing a WMS system differs greatly depending on the complexity of the system and the system vendor. Choose a WMS system that will serve your warehouse better by fulfilling all the required functions, and also one that your business can afford. Choosing a system that is way too expensive for you will only put your business in trouble and end up compromising the quality and efficiency you so much want to improve. Choosing a basic WMS system on the other hand might not serve you sufficiently, especially, if you have many functions in your warehouse. You have to find the right balance between cost and functions when choosing the right WMS for your business. Don't get caught thinking what your business needs are today, think of where your business needs to be in 5 years and choose a product that can take you there and beyond.

WMS Software Tiers

Below is an overview of the three most common WMS tiers, with a specific focus on shipping, receiving and put-away and inventory replenishment capability:

Tier 3 – Basic

At the entry level, a tier three WMS program's data collection tools will help you automate your warehouse. By assigning grid numbers to locations and bins in your warehouse, your computer can record where every item is located. But that is the cap on the level of complexity your system can handle.

Since the WMS only verifies an item's location, put-away is unguided and seemingly random. Order picking is based on packing slip and managed without any built-in logic. Inventory record quantities are based on receipts from purchase orders and inventory replenishment is calculated from simple minimum and maximum order level algorithms.

Tier 2 – Intermediate

WMS programs at this tier offer directed pick and put away logic to allow you to optimize your warehouse space and employees' time. For example, instead of simply verifying where material has been placed, tier two warehouse inventory software will use slotting optimization to evaluate a combination of item, location, quantity, unit of measure and order details to tell you where you

should be stocking the inventory. Due to their greater depth of functionality, tier two WMS programs are typically implemented by medium to large enterprises.

WMS packages at this level offer directed task monitoring to help you determine where to stock materials, where to pick and even the sequence in which to pick something. When inventory is received, a tier two WMS offers guided put away based on the speed of movement of the inventory to help eliminate expired materials.

Tier two WMS also supports more complex picking (task interleaving and milk runs for JIT pick up), including advice on optimal pallet and carton configurations based on unique customer requirements. Shipping is predetermined by the customer and can be better managed with staging and dock scheduling tools.

Tier 1 – Advanced

Only the largest and most complex fulfillment centers or warehouses (think Amazon) benefit from tier one WMS software. Unlike the previous two tiers, which are designed more for "captive" warehouses that manufacturer on site and only distribute for themselves, Tier 1 WMS programs are for wholesale distributors and warehouses that store and ship product from multiple companies.

Tier one systems offer robust versions of the tools in a tier two WMS, plus the added benefit of interacting with automated material handling equipment such as conveyor belts, sorting equipment, and automatic storage and retrieval systems. Tier one WMS software support wave picking, allow for queuing subsystems and handle complex yard management.

Advantages of Warehouse Management System

Zero Information Errors

A WMS can eliminate warehouse and customer service errors using several methods.

The first method is 100-percent information verification. A warehouse receives, stores, picks, and ships goods. When a product is initially received, it is verified, barcoded, and entered into the control system. All future movements are tracked against this barcode. The product has now been uniquely identified and the likelihood of tracking errors has been eliminated.

Customer service errors are eliminated through system-directed operations. Every receiving, put away, picking, and shipping operation is system-directed. A product will only move if it is system-directed, and the operator can only complete the move and go on to the next operation if the previous operation has been verified as correct. Operator errors associated with misplaced inventory and operator carelessness are eliminated.

Another way in which a WMS eliminates customer service errors is by continuous cycle counting. Because every operation in a WMS is system-directed, the system knows the status of every location. When the system directs a pallet to a location and that location is not empty as expected, the system will flag that location for an inventory review.

Inventory errors will be caught at the first opportunity. As a result, backorders due to inventory discrepancies will be virtually eliminated.

Zero Information Lead Times

Total information verification results in quality information. Once quality information is attained, the information lead time will decrease and eventually approach zero.

There are two types of information lead times: customer-oriented and warehouse-oriented. Customer-oriented lead time is the time it takes to send and receive customer information in the warehouse. This information includes customer orders, vendor shipments, carrier manifests, and shipment notices. Warehouse-oriented lead time is the time it takes to send and receive operational information. This information includes receiving, put away, picking, packing, and shipping transactions.

In both cases, zero lead times are achieved by moving from paper-based to electronic transmission. Electronic data interchange (EDI) and radio frequency (RF) communications are two tools used to achieve zero lead times.

Achieving zero lead times for customer and warehouse information generates significant synergies that go straight to the bottom line. For example, electronically captured pick and put away transactions can be merged with customer-oriented information. This allows a variety of calculations to be performed, such as plans for loading trucks, freight rating, personnel requirements, and order prioritization.

Maximum Labor Productivity

A well-designed WMS increases labor productivity by managing worker tasks. It will select tasks from a queue of all pending activities and, if directed, prioritize the tasks.

In addition to directing labor, the WMS also provides labor planning feedback to management. Based on the expected order loads, the WMS can estimate the number of personnel hours needed to complete the day's expected activities. Management can use this estimate to help plan for peaks and valleys in product activity.

Maximum Space Utilization

A superior WMS can improve space utilization in the warehouse. The system tells an operator where to put an item and attempts to maximize the utilization of each slot by selecting a storage location that best fits the product.

Improved Capacity

An excellent WMS improves warehouse capacity. It does this by allowing goods to move more quickly through the facility.

Companies carry safety stock and active surplus inventory because the existing inventory information is inaccurate or operating information is slow or inaccurate. Because a WMS provides quality information and zero information lead times, it allows you to reduce inventory levels and thus increase the inventory turn rate. This increase in turn rate will ultimately allow you to reduce inventory and increase the dollar value of goods processed per square foot of warehouse space.

A WMS also uses cross-docking techniques to reduce handling and storage requirements. The proper application of cross-docking can be instrumental in achieving continuous flow through the facility. Only a WMS that is able to anticipate receipts, customer orders, and material movements can maximize these cross-docking opportunities.

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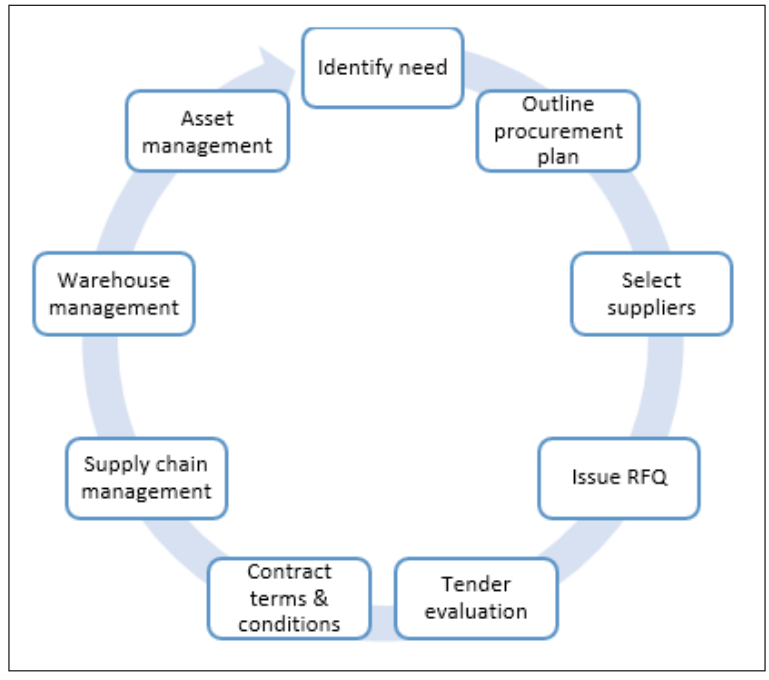
6

Purchasing Management

The process of a business or organization attempting to acquire goods or services to realize its goals is referred to as purchasing. The management of the process of purchasing and related aspects in an organization is termed purchasing management. This chapter discusses in detail the objectives and concepts related to purchasing management.

Purchasing

Purchasing is the first phase of Materials Management. Purchasing means procurement of goods and services from some external agencies. The object of purchase department is to arrange the supply of materials, spare parts and services or semi-finished goods, required by the organization to produce the desired product, from some agency or source outside the organization.



The purchased items should be of specified quality in desired quantity available at the prescribed time at a competitive price. In the words of Alford and Beatty, “Purchasing is the procuring of materials, supplies, machines, tools and services required for equipment, maintenance, and operation of a manufacturing plant”.

According to Walters, purchasing function means “the procurement by purchase of the proper materials, machinery, equipment and supplies for stores used in the manufacture of a product

adopted to marketing in the proper quality and quantity at the proper time and at the lowest price, consistent with quality desired."

Thus, purchasing is an operation of market exploration to procure goods and services of desired quality, quantity at lowest price and at the desired time. Suppliers who can provide standard items at the competitive price are selected.

Purchasing in an enterprise has now become a specialised function. It was experienced that by giving the purchase responsibility to a specialist, the firm can obtain greater economies in purchasing. Moreover purchasing involves more than 50% of capital expenditure budgeted by the firm.

Importance of Purchasing

1. Purchasing function provides materials to the factory without which wheels of machines cannot move.
2. A one percent saving in materials cost is equivalent to a 10 percent increase in turnover. Efficient buying can achieve this.
3. Purchasing manager is the custodian of his firm's is purse as he spends more than 50 per cent of his company's earnings on purchases.
4. Increasing proportion of one's requirements is now bought instead of being made as was the practice in the earlier days. Buying, therefore, assumes significance.
5. Purchasing can contribute to import substitution and save foreign exchange.
6. Purchasing is the main factor in timely execution of industrial projects.
7. Materials management organizations that exist now have evolved out or purchasing departments.
8. Other factors like:
    - Post-war shortages,
    - Cyclical swings of surpluses and shortages and the fast rising materials costs,
    - Heavy competition,
    - Growing worldwide markets have contributed to the importance of purchasing.

Objectives of Purchasing

The purchasing objective is sometimes understood as buying materials of the right quality, in the right quantity, at the right time, at the right price, and from the right source. This is a broad generalization, indicating the scope of purchasing function, which involves policy decisions and analysis of various alternative possibilities prior to their act of purchase.

The specific objectives of purchasing are:

1. To pay reasonably low prices for the best values obtainable, negotiating and executing all company commitments.

2. To keep inventories as low as is consistent with maintaining production.
3. To develop satisfactory sources of supply and maintain good relations with them.
4. To secure good vendor performance including prompt deliveries and acceptable quality.
5. To locate new materials or products as required.
6. To develop good procedures, together with adequate controls and purchasing policy.
7. To implement such programmes as value analysis, cost analysis, and make-or-buy to reduce cost of purchases.
8. To secure high caliber personnel and allow each to develop to his maximum ability.
9. To maintain as economical a department as is possible, commensurate with good performance.
10. To keep top management informed of material development which could affect company profit or performance.
11. To achieve a high degree of co-operation and co-ordination with other departments in the organization.

Purchasing Management

Procurement Management as the act of obtaining or buying goods and services. The process includes preparation and processing of a demand as well as the end receipt and approval of payment. A business will not be able to survive if its procurement price is more than the profit it makes on selling the actual product.

Objectives of Purchasing Management

Reducing Costs

Getting the lowest price for a particular product or service may not be necessary, but purchasers strive to save money for their businesses by getting the best prices and terms overall. Capitalizing on incentives and discounts that supplier's offer is important. So too are negotiating favorable contract terms that improve cash flow by prolonging payment and reducing long-term costs by cutting waste and avoiding defective products.

Diversifying Supply

Spending too much with one supplier is risky. If that supplier should have trouble fulfilling their obligations or raise their prices significantly, the company that depends on them may have to delay delivery of goods to their customers or raise their prices, which could cost them business. So, ensuring the security of supply by expanding the supplier base is a key objective for purchasing management.

Fulfilling Business Requirements

Doing business with the right suppliers can matter as much as pricing and supplying. For example, companies may want to ensure that they support small businesses by allocating a certain percentage of their purchasing budgets accordingly. They also may want to avoid suppliers with bad reputations or business practices. Purchasing management can support the achievement of such objectives.

Sparking Innovation

Purchasing professionals can support their company's growth by obtaining innovative solutions to business problems and opportunities. They do so by working closely with vendors, sharing their company's needs and exploring how suppliers can help. Together, they can develop better technologies and products for customers, and refine processes that allow them to deliver goods and services more efficiently.

Managing Relationships

Purchasing professionals can work with just about anyone in their companies. They may deal with representatives from marketing, finance and logistics departments to name just a few. Given the broad range of goods and services that they buy and the impact that their decisions have on their company as a whole, you can see how purchasing connects departments and aligns their efforts in pursuit of the company's general goals.

Spending Wisely

Purchasing often accounts for more than half of a company's spending. Investing purchasing dollars correctly can help a company expand market share and increase its sales by allowing it to bring quality products to market first. Purchasing management also can improve profitability by efficiently developing those products and services through collaboration with suppliers who are similarly invested in the company's success.

Purchase Order Cycle

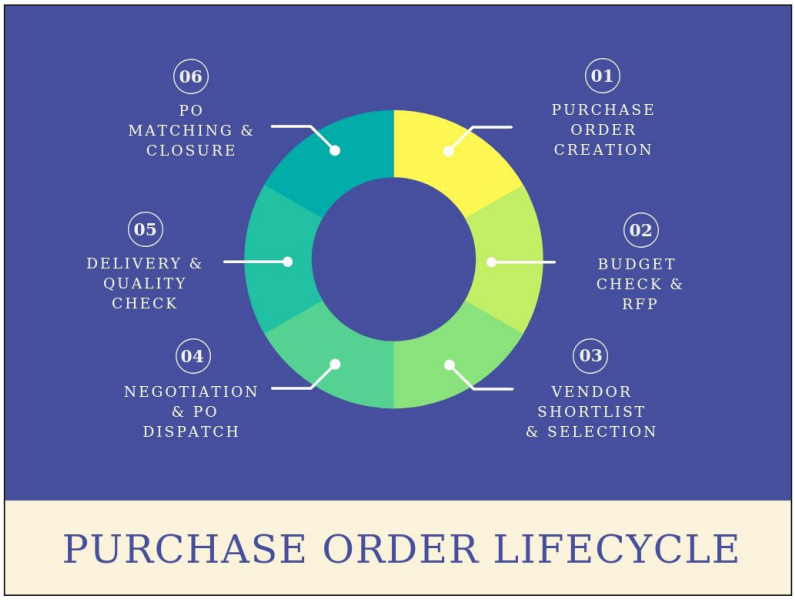
The purchase order life cycle is the set of key steps involved in processing a purchase order. It begins with an approved purchase requisition, which is then converted to a new purchase order and sent through the purchase order approval process. The PO life cycle includes steps that range from cross-checking budgets to PO matching and closure.

Purchase Order Cycle Steps

Listed below are the steps involved in a typical purchase order life cycle:

1. Purchase order creation,

2. Budget check and RFP,
3. Vendor qualification and selection,
4. Negotiation and PO dispatch,
5. Delivery and quality check,
6. PO Matching and closure.



Purchase Order Creation

The first step of the purchase order life cycle is creating a purchase order. Once a purchase request is approved and authorized, it is converted to a purchase order. In case of multiple line items, each item will be transferred to a new purchase order.

While purchase requests can be raised by employees, purchase orders can only be created by the procurement team in an organization. In case of small businesses, this authority may reside with the finance head, or the business owner/CEO.

Budget Check and Requests for Proposal

Once the procurement team creates the purchase request, the finance team carries out a budget check. After this, there is a standard search for existing purchase contracts. If such a contract exists, the purchase order will be sent to the respective vendor.

If not, then the procurement team will have to send requests for proposals (RFP) to a list of prospective vendors with the intention to elicit quotations for a product or service.

Vendor Qualification and Selection

After receiving commercial quotes from suppliers, the purchasing team will compare their business

requirement with the vendor proposal. To arrive at a unified vendor selection decision that is in the best interest of the organization, the procurement team will conduct a thorough investigation and also seek input from all stakeholders.

Negotiation and PO Dispatch

Once a vendor is selected, it is time for contract negotiation. This is the time where suppliers and buyers discuss and address issues that will forge a better business relationship. Typically, purchasing negotiations will cover the following items:

- Time constraints,
- Delivery expectations,
- Quality benchmark,
- Payment terms,
- Potential liabilities and risks,
- Confidentiality of purchase,
- Dispute resolutions,
- Change in requirements (if any).

Once the negotiation is complete, the purchase order is forwarded to the vendor for approval. The vendor's approval and acknowledgment will activate a legally binding contract between the vendor and the buyer.

Delivery and Quality Check

Vendors usually send an advance shipment notice to the purchaser once the order is shipped. This notice includes shipping date, shipping agency details, tracking number, a copy of PO and invoice, etc.

After receiving the product/service, the buyer checks the packaging slip and PO information and acknowledges the receipt. Then, the purchaser performs a standard quality check and notifies the vendor or rejects products in case of damage or defect in the delivered item.

PO Matching and Closure

In this step, three important purchasing documents—the purchase requisition, purchase order, and vendor invoice—are lined up and evaluated to make sure there are no discrepancies, and to verify the accuracy of information. Discrepancies need to be addressed according to the dispute resolutions mentioned in the purchasing contract.

Once this three-way document match is complete, the invoice is approved and forwarded to payment processing depending on organizational norms. Next, the purchase order is formally declared as closed and stored for the purpose of bookkeeping or audits.

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