# DISTRIBUTION AND LOGISTICS MANAGEMENT

## CHAPTER ONE

## Introduction

### Logistics Defined

**LOGISTICS** can be defined as the process, art and science of planning, implementing, and controlling the efficient and effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customers requirements." Note that this definition includes inbound, outbound, internal ,and external movements, and return of materials for environmental purposes.

INBOUND LOGISTICS (MOVEMENT) is the management of goods and materials which are arriving at the business premises. The activities that accompanies the receipt of these materials includes; the preparation of the racks, shelf, ground floor and other necessary spaces before the arrival of the materials. On arrival of the materials, the inspection of the materials and all the documents that come with it, such as delivering notes, parcel way bills in case of rail transport, packing list etc are all part of inbound logistics activities. Inbound logistics is the opposite of outbound (or dispatch) logistics

OUTBOUND LOGISTICS (MOVEMENT) is the distribution of those product manufactured by a company to the retailer. Activities such as load planning, route planning, actual loading, recording of all details pertaining the materials loaded, vehicle tracking and monitoring of driver's behavior accompanies outbound logistics programme. INTERNAL MOVEMENT is the transportation of materials within the manufacturing plant with the use of folk lift, conveyors, wheelbarrows etc either from the raw materials warehouse to the production point or from the production unit to the finished products warehouse. EXTERNAL MOVEMENTS is the transportation of the finished product to the customer with the use of different types of carriage facilities through different means and mode of transportation.. Return of materials otherwise known as **reverse logistics** will be discussed in subsequent chapter.

### OBJECTIVES OF LOGISTICS SYSTEMS

We have three categories objectives which logistics tends to accomplish viz, The General objectives, specific objectives and Definite objectives

**The General objectives** of the logistics can be summarized as:

Cost reduction * Capital reduction * Service improvement

**The specific objective** of an ideal logistics system is to ensure the flow of supply to the buyer, the: *right product * right quantities and assortments * right places * right time * right cost / price , * right condition

This implies that a firm will aim at having a logistics system which maximizes the customer service and minimizes the distribution cost. However, one can approximate the reality by defining the objective of logistics system as achieving a desired level of customer service i.e., the degree of delivery support given by the seller to the buyer. Thus, logistics management starts with as curtaining customer need till its fulfillment through product supplies and, during this process of supplies, it considers all aspects of performance which include arranging the inputs, manufacturing the goods and the physical distribution of the products.

**Definite objectives of Logistics**

Having known that there are general objectives and specific objectives of logistics, it is also important to know that, there are some **definite objectives** to be achieved through a proper logistics system. These can be described as follows:

1. Improving customer service:

As we know, the marketing concept assumes that the sure way to maximize profits in the long run is through maximizing the customer satisfaction. As such, an important objective of all marketing efforts, including the physical distribution activities, is to improve the customer service. An efficient management of physical distribution can help in improving the level of customer service by developing an effective system of warehousing, quick and economic transportation and maintaining optimum level of inventory. But, as discussed earlier, the level of service directly affects the cost of physical distribution. Therefore, while deciding the level of service, a careful analysis of the customers' wants and the policies of the competitors is necessary. The customers may be interested in several things like timely delivery, continuous supply, price stability etc. In some cases, the raw material would be very cheap during harvesting season and very dear during off season. By stocking the raw material during the period of excess supply (harvest season) and made available during the periods of short supply. This can lead continuous supply and price stabilization.

2. Quality improvement:

The long—term objective of the logistical system is to seek continuous quality improvement. Total quality management (TQM) has become a major commitment throughout all facets of industry. Overall commitment to TQM is one of the major forces contributing to the logistical renaissance. If a product becomes defective or if service promises are not kept, little, if any, value is added by the logistics. Logistical costs, once expended, cannot be reversed. In fact, when quality fails, the logistical performance typically needs to be reversed and then repeated. Logistics itself must perform to demanding quality standards. The management challenge of achieving zero defect logistical performance is magnified by the fact that logistical operations typically must be performed across a vast geographical area at all times of the day and night. The quality challenge is magnified by the fact that most logistical work is performed out of a supervisor's vision. Reworking a customer's order as a result of incorrect shipment or in-transit damage is far more costly than

performing it right the first time. Logistics is a prime part of developing and maintaining continuous TQM improvement.

3. Life- Cycle support: A good logistical system helps to support the life cycle. Few items are sold without some guarantee that the product will perform as advertised over a specified period. In some situations, the normal value-added inventory flow toward customers must be reversed. Product recall is a critical competency resulting from increasingly rigid quality standards, product expiration, dating and responsibility for hazardous consequences. Return logistics requirements also result from the increasing number of laws prohibiting disposal and encouraging recycling of beverage containers and packaging materials. The most significant aspect of reverse logistical operations is the need for maximum control when a potential health liability exists (i.e.. a contaminated product). In this sense, a recall program is similar to a strategy of maximum customer service that must be executed regardless of cost. Firestone classical response to the tyre crisis is an example of turning adversity into advantage. The operational requirements of reverse logistics range from lowest total cost, such as returning bottles for recycling, to maximum performance solutions for critical recalls. The important point is that bound logistical strategy cannot be formulated without careful review of reverse logistical requirements.

4. Movement consolidation:

As the logistical system aims at cost reduction through integration, consolidation is One of the most significant logistical costs reduction strategy in transportation. Transportation cost is directly related to the type of product, size of shipment, and distance. Many Logistical systems that feature premium service depend on high speed, small shipment transportation. Premium transportation is typically high-cost. To reduce transportation cost, it is desirable to achieve movement consolidation. As a general rule, the larger the overall shipment and the longer the distance it is transported, the lower the transportation cost per unit. This requires innovative programs to group small shipments for consolidated movement. Such programs must be facilitated by working arrangements that transcend the overall supply chain.

# Lean Logistics

**The Concept.**

In line with the principles of movement consolidation is closely related, the waste reduction principle which in the long run lead to cost reduction as one of the general objectives of logistics.Organizations are stuck in a constant cycle that pushes them to improving their business in order to gain a competitive advantage. They consistently feel the stress to reduce costs, time and inventory One way that has proven to improve an organization substantially is supply chain process known as Lean Logistics.

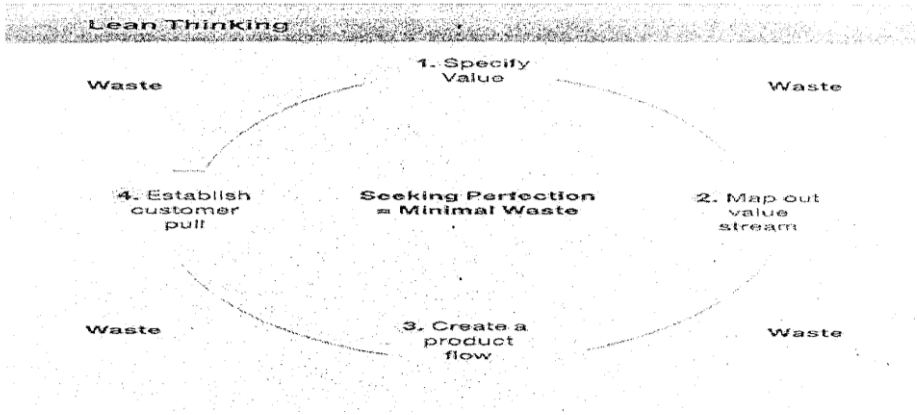
**The importance of Lean logistics**

Lean logistic simply put, can be described as a way to recognize and eliminate wasteful activities from supply chain in order to increase product flow and speed.In order to achieve Leaner Logistics; organizations need to implement leaner thinking. Organizations that incorporate lean thinking into their supply chain can benefit from improved customer service, reduced environmental impact by reducing waste and even overall corporate citizenship.

**Lean Thinking**

I.ean Thinking originated from manufacturing method used by Japanese automotive manufacturer. Due to minimal resources and shortages, they employed a production process that worked with minimum waste. This thinking soon spread to all manufacturing areas new product development and supply chain management .Lean Thinking involves a constant cycle of seeking perfection by eliminating waste and maximizing product value. This process means that end—customers don't pay for organization inefficiency and waste

**The Four principle involved in achieving minimal waste**.




1. Specify value: Customer value is identified and added along the supply chain network

2 Map out value stream: Identifying all processes along the supply chain network in order to eliminate the processes that do not create value to the overall product. This mapping helps us understand how the value is created into the product from the customer's perspective.

3.Create a product flow: Applying the factors outlined in order to make valuable processes to occur ii smooth system; minimizing Interruptions, inventories, downtime.

4.Establish customer pull: Manufacturing only in response from the customer that more is needed; implying that demand information is made available across the supply chain.

Each of these four processes seeks perfection to progressively improve every process; minimizing waste and maximizing value.

# Agile logistic or Supply Chain Strategy

Agile refers to the ability to react and adapt to the changes in demand and supply situations in a supply chain. To accommodate the inherent variations in demand and supply, supply chains need to react and adapt to such changes as they happen, to minimize the disruption and optimize the objectives, such as costs, fulfillment rates, inventory; and so on. So what does it mean to have an agile supply chain? An agile supply chain design will have redundancy built into its processes, allowing it to quickly respond to expected changes. This supply chain will be best to maximize the service levels for fulfilling demand, manufacturing personalized products, and providing excellent customer service. These objectives will drive the supply chain to keep higher levels of inventories to maintain order fulfillment targets, favor on time deliveries over cheaper shipments, and favor quality inputs and personalized services over mass produced, commoditize goods. These supply chains will have more flexible supplier contracts that enable them to change order quantities, destinations, need dates, and even cancel the orders altogether if the demand fails off a cliff. Suppliers will typically allow such flexibility for a cost. When demand suddenly rises and the primary suppliers cannot cope with the increased demand, an agile supply chain will go to a secondary set of suppliers that would have been established in advance For maintaining supplies for such au eventuality. As purchase volumes for the secondary suppliers will be low and ,demand uneven, the costs of such contracts is generally higher. However, having all these layers of extra inventories, warehousing, transportation, and suppliers will provide enough buffer to the supply chain to handle most variations in demand, supply, or laad—time while maintaining its state service level. Contrast this supply chain with the one based on lean as the driving principle and you will notice the contrasts. Agile supports the natural designs of supply chain — which exist to manage variability. However, the extent of variability in the demand, lead-time, and operations must determine the amount of agility (and hence the amount of redundancy) designed into the supply chain.

Also, most firms have a large assortment of material to be managed: Raw materials, WIP, finished goods, and retail assortments almost always consist of a mixed bag of products when it comes to their demand profile. Some of these products may have a stable demand profile, while others will be more volatile. This means that the enterprise supply chain that must be designed to cater to all these types of products must be lean (to best manage the products with a stable demand) and agile (to manage others with volatile demand) simultaneously. After all, you could not run a business with a lean supply chain with the lowest cost, but that cannot respond to any changes in demand or supply. Since all demand and supply has inherent variability, such a rigidly designed supply chain will quickly build up

unwanted and obsolete inventories as it is incapable of reacting to changes in demand and supply. To the same extent, one also cannot run a supply chain that is extremely responsive and manages the changes in demand and supplies precisely, because such a supply chain will have an unreasonably high cost to operate, quickly running out of working capital to support daily operations.

How can a supply chain be both lean and agile at the same time? A firm can regard both lean and agile strategies as process drivers for designing individual supply chain processes rather than as being all- encompassing strategies for developing a supply chain as a whole. In this context, they become the principles that practitioners can use to develop standard processes that leverage one of these attributes even as process exceptions leverages the other. For example, a firm may establish a store-based inventory policy using the lean principle to cover the supply lead-time from the primary warehouse to the store. While the lean design drives their standard replenishment to the store, the process to handle exceptions to manage stock-outs may leverage agile principles, allowing priority replenishments to the store from a set of alternate sources in order to avoid losing substantial sales revenues.

Successful supply chains are designed to be lean and agile at the same time: The example of Wal-Mart illustrates the complementary use of lean and agile design principles in designing a supply chain that is highly effective. Therefore, the question of whether a supply chain should be lean or agile becomes a rhetorical question. Any large enterprise cannot have a rigidly designed supply chain that is either lean or agile. Rather, both of these aspects of lean and agile are required in designing an effective supply chain.

# Definitions of Key Logistics Terms

**adjustment**s. Changes recorded when quantities of a product are issued to or received from other facilities at the same level of the pipeline. Also, sometimes used to explain administrative corrections—e.g., a physical stock count that is different from quantity listed on stock keeping records.

**aggregate summary report**. A summary report that combines data from different facilities at the same level,or may combine data from different levels, bin card. A stock keeping record that keeps information about a single lot of a single product.

**clients.** People who receive supplies. Used interchangeably with customers and users throughout this handbook.

**commodities**. Used interchangeably with stock, goods, products, supplies, and other terms in this handbook to refer to all the items that flow through a logistics system.

**consumption records**. Records kept on products consumed. See also stock keeping records and transaction records.

**customers.**People who receive supplies. Used interchangeably with users and clients throughout this handbook.

**daily activity register**. Record that gives the quantity of each product dispensed to a user by user name or user number and by date. Used only at service delivery points, such as clinics, hospitals or community-based distributors.

**demographic data. Information on populations**, such as the number of women of reproductive age or percentage of women receiving contraceptives from public and private sector sources.Usually collected through surveys and censuses.

**dispensed to user data**. Information on the quantity of products actually given to customers. Sometimes referred to simply as dispensed or consumption data. Also see issues data. distribution system capacity forecast. Forecast that measures the volume of the pipeline (i.e., storage facilities and transportation links) to determine the volume of supplies that can be transported and stored in the system. Generally recommended as a way to check on other forecasts.

**emergency order point.** The level of stock that triggers an emergency order, regardless of the timing within the review period, It is always lower than the min.

**essential data it feedback report**. A report that (a) informs lower levels about their performance, in some cases providing additional information about reporting from other facilities; and (b) informs managers at higher levels about how the system is functioning

**feedback report**. A report that (a) informs lower levels about their performance, in some cases providing additional information about reporting from other facilities; and (b) informs managers at higher levels about how the system is functioning

**forecasting**. Management function that estimates the quantities of products a program will dispense to users for a specific period of time in the future.

**goods**. Used interchangeably with stock, commodities, supplies, products, and other terms in this handbook to refer to all the items that flow through a logistics system.

**integrated system**. A logistics system that supplies and manages products for more than one program.

**inventory control card**.An individual stock keeping card that keeps information about all lots of a product.

**issue voucher**. Transaction record that lists the items and quantities of products issued to a facility.

**issues data**. Information on the quantity of goods shipped from one level of a system to another (not quantities given to customers or users).

**lead time**.The time between when new stock is ordered and when it is received and available for use. Lead time varies, depending on the system, speed of deliveries, availability and reliability of transport, and, sometimes, weather.

**lead-time stock level**. In a max-mm system, the level of stock used between the time new stock is ordered and when it is received and available for use.

**logistics data forecast**. Forecast based on dispensed to user data from the service delivery level. When these data are unavailable, issues data from the lowest possible level can be substituted.

**losses**. The quantity of stock removed from the pipeline for any reason other than consumption by clients (e.g., losses, expiration, and damage).

**maximum-minimum inventory control system**. A system to control supplies so that quantities in stock generally fall within an established range. Abbreviated in this hand book as max—min system.

**maximum stock level/maximum quantity**. The level of stock above which inventory levels should not rise under normal conditions. Abbreviated in this handbook as the max.

minimum stock level/minimum quantity. The level of stock at which actions to replenish inventory should occur under normal circumstances. Abbreviated in this handbook as min

**packing slip**. Transaction record sent with products that lists the names and quantities of each product shipped. Usually paired with a receiving record.

**physical inventory**. The process of counting by hand the total number of units of each commodity in a store or health facility at any given time.

**pipeline**. The entire chain of storage facilities and transportation links through which supplies move from manufacturer to consumer, including port facilities, the central warehouse, regional warehouses, district warehouses, all service delivery points, and transport vehicles.

**products**. Used interchangeably with stock, commodities, goods, supplies, and other terms in this handbook to refer to all the items that flow through a logistics system.

**pull system**. A distribution system in which the personnel who receive the. supplies determine the quantities to order.

**push system**. A distribution system in which the personnel who issue the supplies determine the quantities to be issued.

**rate of consumption**. The average quantity of stock dispensed to users during a particular time period.

**receiving record**. Transaction record that lists the names and quantities of items received. Usually paired with a packing slip.

**report and request report**. A report and request report in a pull system is a summary report that reports logistics data to the next higher level and requests new supplies.

**requisition and issue voucher**. Transaction record used in a pull distribution system that lists the items and quantities requested by a facility and the quantity actually issued.

**review period.** The routine interval of time between assessments of stock levels to determine if an

order should be placed.

**review period stock**. The quantity of stock dispensed during a normal review period.

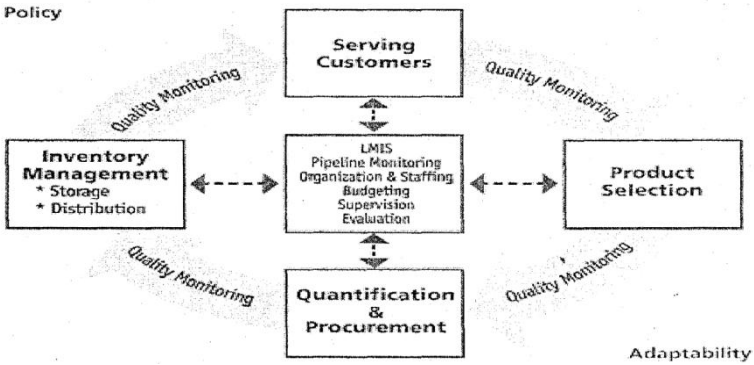
**safety stock**. The buffer, cushion, or reserve stock kept on hand to protect against stock outs caused by delayed deliveries or markedly increased demand.
**service delivery point**. Any facility that serves clients directly and where clients (users) receive supplies. Service delivery points are frequently clinics and hospitals, but may be district-level hospitals.
**service statistics**. Data collected about clients and their visits to SDPs. Used in a variety of ways, including for forecasting.
**shelf life**. The length of time a product may be stored without affecting its usability, safety, purity, or potency.
**simple report**. A summary report that lists the name of the facility, reporting period, beginning stock on hand, receipts, quantities issued or dispensed, losses and adjustments, and ending stock on hand for each product.
/**stock.** Used interchangeably with commodities, goods, products, supplies, and other terms in this handbook to refer to all the items that flow through a logistics system.
**stock card**. A generic name for either an inventory control card or a bin card.
**stock on hand**. The quantity of usable stock in inventory at a particular point in time. (Items that are unusable are not considered part of stock on hand. They are considered losses to the system.)
**stock keeping records**. Records kept on products in storage.
**stores ledger**. A stock keeping record that keeps information about all lots of a product.
**summary report**. Report that includes all essential data items for a specific facility and a specific time period (usually monthly or quarterly).
**supplies**. Used interchangeably with stock, commodities, goods, products, and other terms in this handbook to refer to all the items that flow through a logistics system.
**tick sheet**. Consumption record that records the quantity of each product dispensed to users without recording the day or client.
**transaction records**. Records kept on products being moved from one facility to another.
**users.** People who receive supplies. Used interchangeably with clients and customers throughout this handbook.
**vertical system**. A logistics system that supplies and manages products for only one program.

**LOGISTICS AND SUPPLY CHAIN FUNCTION AND THEIR PURPOSE**A variety of supply chain functions are part of the pipeline (see table I.)

It's clear that each supply chain function ultimately serves the customer's six rights. Remember that any one of the functions listed in table I could be divided into many additional functions. This document, however, focuses on a subset of supply chain functions. Figure 2 displays elements of the supply chain grouped into a logical logistics cycle.

| Supply Chain Function | …answers the following sample questions |
|---|---|
| Network design | How many warehouses do I need in my supply chain? How many trucks? How often should I deliver goods? |
| Demand forecasting | How much product will be consumed next year? |
| Supply demand planning | How much should I manufacture to meet demand? When should I manufacture to meet demand? |
| Product procurement | From whom should I source the product? |
| Transportation procurement | Who should transport my product? |
| Transportation planning | Can I group together different products into a single shipment? How should I route the trucks? What facility should I stop at first, last? |
| Transportation management | How much will transportation cost? Where is my shipment? |
| Trade compliance | What documents must travel with this shipment through customs? Are export licenses required? |
| Warehouse management | What product is available in my warehouse? Where is it located? |
| Inventory management | How much product should I store in my warehouse? How much product should I distribute around my network? |
| Order management | What is the status of my order? |
| Customer management | Am I providing good service to my customers? |

**The Logistics Cycle**




The circular shape is the first thing you notice about the cycle; this shows the interdependence of the various elements in the cycle. Each activity—serving customers, product selection, forecasting and procurement, and inventory management—depends on the other activities.

**Major Activities of the Logistics Cycle**

**Serving Customers**

Everyone working in logistics must remember that their job is to select, procure, store, or distribute products to meet customer needs. For example, storekeepers do not store drugs or other health products simply for the purpose of storing; they

store products to make them available for use when needed— contraceptives for family planning or drugs to treat illnesses. Each activity in the logistics cycle contributes to providing excellent customer service by ensuring the six rights. Clients in a health facility setting should expect to be served by well-trained, caring professionals who follow supportive policies and have the resources to deliver the necessary care and treatment. Because serving a customer is not a logistics activity (it could be a medical activity), this document describes all the logistics activities that ultimately serve the customer.

**Product selection**

Any logistics system that procures and distributes goods must select individual products. In a health logistics system, a national formulary and therapeutics committee, pharmaceutical board, board of physicians, or other government-appointed group make select those products. In a decentralized setting, health service delivery points may have a list of products based on the services they offer, but these selections are guided by national and professional standards.

**Quantification and procurement**

After products are selected, managers must determine the quantity needed for each product, for a specific time period—this is called quantification. This process ensures that product selections are made using standard guidelines and regulatory requirements that consider the cost and timing of procurements. Quantification depends on accurate forecasting. You may base your forecasts on the previous quantities of products dispensed or on services provided. You can also use population, service, or sales targets. To refine and improve forecasting over time, enter the data and assumptions you used to prepare a forecast and compare them to actual performance. Procurement regulations are often written in great detail; but there must be trained personnel and a system of documenting, maintaining, and auditing procurement records at every level of the procurement function.

**Inventory management**

After an item is ordered and received, it must be stored until the customer needs it. A program's inventory control strategy specifies how much stock to store and where to store it. Enough stock should be available to meet customer needs until a new order is received; but not so much that stocks expire or are wasted or that you exceed storage capacity. Storage has two purposes for products: (1) to ensure the quality or condition, and (2) to make them available for distribution. A transportation strategy is critical to managing inventory. For example, a transportation strategy may suggest larger loads less often, or smaller loads more often.

**Quality monitoring**

Quality monitoring appears between each activity of the logistics cycle. For example, you should ensure that you carefully monitor the quality of; *product decisions (Serving Customers a Product Selection) * proficiency (Product Selection a Procurement) * Forecast accuracy (Forecasting and Serving Customer)

* Products while they are being stored and distributed (Inventory Management a Serving Customers) * Product aging (Forecasting a Serving Customers) * Customer's experience (Inventory Management and Serving Customers)
Internal Influences For different supply chains, the logistics cycle may look the same, but how different groups and processes interact varies, depending on the supply chains requirements.

**Ordering**

In logistics, placing orders is a routine activity. In some logistics systems, the person placing the order determines the quantity to be ordered—this is a pull or requisition system. In other systems, the person who fulfills the order determines the quantity to be issued—this is a push or allocation system.You can use both push and pull approaches in one system. However, you should not combine two systems at the same distribution level, because the same personnel would need to rule on parallel sets of logistics decisions. You should use only one system within any given level. Imagine the confusion at the regional warehouse if some clinics are pulling supplies while other clinics need supplies pushed to them. However, between levels, you can use a pull system effectively: for example, between the central level and the regional level. At the same time, you can use a push system from the regional level to service delivery points. Select a system that is defined within your inventory control strategy; it must be supported by policies, personnel, and resources.

## INTEGRATED APPROACH

Haven determined the logistics cycle's function and customers' test/need ascertained then the company may adopt integrated approach in meeting the customers' needs. The approach to this task is dependent on whether the company is an international company or a global company. One area of significant change in recent years has been the increase in the number of companies operating in the global marketplace. This necessitates a broader perspective than when operating as an international company. In the latter, although companies may have a presence across a wide geographic area, this is supported on a local or regional basis through local or regional sourcing, manufacturing, storage and distribution .In this case the parent company franchises the right to produce its product to a local firm .In the former, the company is truly global, with a structure and policy that represent a global business. This may include, amongst others, attributes such as global branding, global sourcing, global production, centralization of inventories and the centralization of information, but with the ability to provide for local requirements, be these electronic standards for electrical goods, language on packaging or left-/right-hand-drive alternatives in the automotive industry.eg Coca cola assembling plant in Nigeria and all over the world. All of these aspects serve to emphasize the added difficulty of operating effectively in a global environment. Logistics and supply chain networks have become far more complicated and the need to plan and

manage logistics as a complete and integrated system has become far more difficult.

To service global markets, logistics networks become, necessarily, far more expansive and far more complex. Once again, the need is to plan and manage logistics as a complete and integrated system. As well as the attributes already mentioned, companies operating in a global market are often involved with the outsourcing of some manufacturing and the use of 'focused' factories that specialize in a limited number of products.

Linked closely to the globalization of business is the increase in the complexity of supply chain management.Globalization almost certainly leads to greater complexity. Complexity provides some significant implications for logistics operations. These include:

- extended supply lead times;
- production postponement with local added value;
- complicated node management;
- multiple freight transport options;
- extended and unreliable transit times; and
- the need for greater visibility in the supply chain.

It is probably clear from this that there is a direct conflict between globalization and the move to the quick response, just-in-time operations that are being sought by many companies. In global companies there is a tendency to see order lead times increase and inventory levels rise because of the distances involved and the complexity of logistics. In companies moving to the just-in-time philosophy there is a desire to reduce lead times and to eliminate unnecessary stock and waste within their operations. For those companies trying to achieve both goals, there is a clear challenge for logistics.

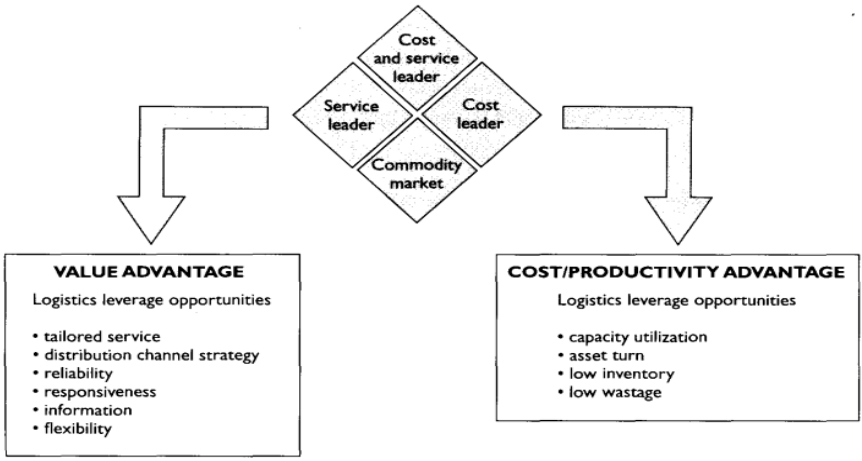
**Integrated systems**

To support the need to develop more integrated operations there have been a number of developments in logistics and distribution systems that have the concept of total logistics as their basis. Thus, quite revolutionary 'trade-offs' are now being practised. The major reason for this explosion of new ideas is twofold. The first is the realization of the importance, cost and complexity of logistics. The second is the progress made in the field of information technology, which has enabled the development of sophisticated information systems to support and enhance the planning and management of logistics operations, whereby very detailed data collection and analysis can be undertaken that was previously impossible.

**Competitive advantage through logistics**

Attitudes towards distribution and logistics have changed quite dramatically in recent years. It has been a long-held view that the various elements within logistics have merely created additional cost for those companies trying to sell products in

the marketplace. Although there is, of course, a cost associated with the movement and storage of goods, it is now recognized that distribution and logistics also provide a very positive contribution to the value of a product. This is because logistics operations provide the means by which the product can reach the customer or end user in the appropriate condition and required location.
It is therefore possible for companies to compete on the basis of providing a product either at the lowest possible cost (so that the customer will buy it because it is the least expensive) or at the highest possible value to the customer (e.g. if it is exactly where and how the customer wants it). Some companies may, indeed, try to achieve both of these objectives. This is particularly important because there are many products that are not sold on the basis of their brand name alone but that are, in fact, like commodities, sold on the basis of availability or price. This applies to many food products as well as technical products, such as mobile phones and personal computers. This shows that a company may compete as a service leader, where it is trying to gain an advantage over its competitors by providing a number of key service elements to differentiate itself. Or it may compete as a cost leader where it is trying to utilize its resources so that it offers the product at the lowest possible cost, thus gaining a productivity advantage. Examples of how this might be achieved are given in Figure below.




**The logistics implications of different competitive positions**

For a value advantage, this might include the provision of a specially tailored service or the use of several different channels of distribution so that the product is available in the marketplace in a number of different ways. It might include a guaranteed service level or a regular update on the status of orders. For a

cost/productivity advantage, this may include a number of different means of cost minimization, such as maintaining very low levels of inventory and ensuring that all manufacturing and distribution assets are kept at a high utilization.

It should also be emphasized that for many companies it is necessary to develop differently configured logistics structures to cater for the variety of service offerings that they need to provide. It is now appreciated that a 'one-size-fits-all' approach to logistics is usually to limited, because suppliers need to take account of a range of different customer requirementsand make sure that their competitive advantage is understood and applied in all market segments. As noted in a recent European Logistics Association (ELA) survey (2004): 'One size fits all policies will rarely work when applied to modern, diverse service offerings... Leading companies are segmenting their supply chains according to the service and cost needs of the customer.'

**ORDERFULFILLMENT AND STOCK REPLENISHMENT**

Order picking which represents a key objective of most warehouses is to extract from inventory the particular goods required by customers and bring them together to form a single shipment — accurately, on time and in good condition. This activity is critical in that it directly impacts on customer service, as well as being very costly. Order picking typically accounts for about 50 per cent of the direct labour costs of a warehouse.

Customers may require goods in pallet, case or unit quantities. In the case of pallet quantities, goods can be extracted from the reserve storage areas and brought directly to the marshalling area by the types of equipment described earlier (e.g. by a reach truck or a combination of stacker crane and conveyor). This chapter is therefore chiefly concerned with case and unit picking operations. For example, cases may be picked from pallets held in ground floor locations for specific customer orders or individual units may be picked from plastic tote bins held on shelving. These would then typically be checked, collated with other goods, packed (if necessary) and moved to the marshalling area to form vehicle loads ready for dispatch.

In general, picking still tends to be largely a manual operation. However, there are many technological aids in terms of information systems and equipment that may be used to provide high levels of productivity and accuracy. Thus, whilst advanced 'automated warehouses' can often work effectively without direct operatives in the pallet reserve storage areas, the case and unit picking operations tend to be manually operated with technological assistance.

**Order picking concepts**

There are three main picking concepts that may be applied. These are:

- *Pick-to-order*. This is basically where a picker takes one order and travels through the whole warehouse (e.g. on foot or on a truck) until the whole order is picked

- *Batch picking.* The main disadvantage of a pick-to-order regime is that pickers typically walk the entire pick face for a single order. In situations where a typical order may only have a few order lines (ie only a few different SKUs being ordered) and where the product range is very large, then this would be very inefficient. It is therefore common, particularly for small orders, to batch these together and pick the total requirement of all the orders for each SKU on a single picking round. This method can achieve great benefits in terms of picking time, but of course the goods then need to be sorted at the end of the picking run into the different customer orders. This sortation may be undertaken either manually or using automated sortation equipment.
- *Pick-by-line or pick-to-zero.* Under this concept, the exact numbers of cases or items are presented for picking. For example, they may be brought forward from the reserve storage area or they may be specifically ordered from suppliers for cross-docking. In both instances, the unit load of one product line is picked to waiting customer orders (hence pick-by-line) and the picking continues until that line is exhausted (hence pick- to-zero).

There are a number of factors that need to be considered in determining which of the above concepts to use, for example the product range, the size of order, the picking equipment, and the size of unit load or container into which orders are being picked.

In some situations it may be appropriate to make use of a combination of two or more of the above picking regimes within one picking system. A typical warehouse order will require just one or two slow-moving products, but a large quantity of fast-moving popular products. In this situation the picking area may be laid out with popular products near the dispatch area to minimize movement, with the less popular products, which require fewer picking visits, further away. If pick-to-order is used, the slow-moving products could add significantly to the distance travelled by the pickers. In this situation, the possibility of pick-to-order for the most popular products could be considered, with batch picking being used for the less popular slow-moving products.

**PICKING ARRENGEMENT FOR EASY ORDER FULFILLMENT**

**Zone picking**

This is where the warehouse is split into different zones with specific order pickers dedicated to each zone. This method may be appropriate where different equipment is used for picking different types of product, where a single order would be too great a quantity for one picker to pick, or where the dispatch times means that all the order lines must be picked quickly. It is also used where there are different zones for products, for example where products are separated for reasons of security, hazard or temperature regime.

Another approach to this concept is to pass a receptacle (eg a tote bin on a conveyor) from one zone to another. A picker would just pick the items required for an order from that zone and then pass the receptacle to the next zone. This would continue until the order is complete.

**Wave picking**

Orders may be released in waves (for example, hourly or each morning and afternoon) in order to control the flow of goods in terms of replenishment, picking, packing, marshalling and dispatch. The timing of the waves is determined by the outgoing vehicle schedule, so that orders are released to allow enough time to meet this schedule.

**Order picking equipment**

There is a very wide range of order picking equipment available, from simple trolleys that may be pushed around by pickers to fully automated dispensers. These may be classified under three main categories — picker to goods, goods to picker, and automated systems.

**Picker to goods**

This category involves the order picker travelling to the goods in order to pick them. As with all picking categories, consideration needs to be given as to what storage equipment the picker is picking from (e.g. shelving, flow racks or pallet locations), what equipment the picker is picking to (e.g. trolley or powered pallet truck) and what the picker is picking into or on to (e.g. wooden pallet or roll-cage pallet). The following is a list of common picking equipment types, based chiefly on what the picker is picking to:

- Trolleys and roll-cage pallets. With this method, the picker pushes the trolley (or roll- cage pallet) between shelving or pallet racking in order to access the goods. A trolley (also often known as a pick cart) normally has a shelf, or shelves, on which to place the goods or it may be in the form of a frame for holding plastic tote bins or cartons. Roll-cage pallets are normally taller and have wire mesh on three sides, with or without a mesh door on the fourth side. Roll-cage pallets may form a common unit load for both picking and transport, and are often used, for example, in the food retail industry for this purpose. The roll-cage pallets may therefore be moved directly to the marshalling area after picking ready for loading on to the vehicles. This type of picking is normally conducted at ground level or on mezzanine floors. Although these are manual methods, high pick rates can be achieved in appropriate circumstances and the whole picking operation can be very effective. In some warehouses, ladders may also be used particularly for locating slow-moving lines at high levels.
- Powered order picking trucks. These are electrically powered trucks that have forks, often carrying two wooden pallets or three roll-cage pallets, on to which picked goods may be placed.

- Free-path high-level picking trucks. Goods may be picked from upper levels of racking, or from high-level shelving, by means of free-path high-level picking trucks. These trucks have an elevating cab position so that the picker is lifted to the ideal height for picking. These typically operate in narrow-aisle environments, but some are also designed to operate in reach truck, or wider, aisles. Some narrow-aisle trucks can operate for both pallet put-away and retrieval as well as for order picking. There are other specialist designs, for example trucks with two masts that raise a platform so that two pickers can operate at high levels and pick large items such as sofas. High-level picking is suitable where, for example, goods may need to be picked from any pallet in the warehouse (e.g. where there is typically only one or two pallets per SKU). However, picking rates are lower than for ground-level picking and pick effectiveness may be further restricted by only one truck being able to pick in a narrow aisle at a time.

**Pick carts, used with voice Technology**

**Low-level order picking truck**

- Fixed-path high-level picking trucks. These are similar to free-path trucks, except that they run on a bottom rail and are also guided by a top rail — thus being similar to an AS/RS crane operation. These tend to be faster in operation than free-path trucks. They are suitable, for example, for picking from high-level shelving where a multitude of SKUs may be stored in small quantities.
- Conveyors. A number of picking operations make use of conveyors. For example, pedestrian pickers may select the required items from pallet locations, shelving or flow racks and place them on to conveyors to be taken away for subsequent packing and collation into customer orders. Systems are often classified as 'pick-to-tote', whereby the goods are placed in plastic tote bins on the conveyor, or 'pick-to-belt', where the goods are placed directly on to the conveyor belt.

It is not uncommon for travel time (i.e. the time taken for a picker to move from one pick location to another) to take up 50 per cent or more of the picker's time. The next largest element is often the actual picking of the goods, and a third element is carrying out the information requirements (e.g. ticking a paper pick list, placing a label on the goods, and bar-code scanning activities).

**Goods to picker**

It is inefficient for a picker to travel the whole length of a pick face if a relatively small proportion of the total product range is to be picked during that pick run. Various types of equipment have therefore been devised to bring goods to the picker rather than the other way round. These goods-to-picker systems are

normally computer controlled so that the precise SKUs are presented to the picker in the required sequence.
There is a wide range of equipment but some of the main types are as follows:

- Horizontal and vertical carousels. These are often arranged in modules of two or three carousels so that the picker can pick from one carousel while the other(s) is, or are, rotating. It should be noted that goods are presented at the ideal picking height for the picker in the case of vertical carousels Miniloads. These may be used for full carton picking or for presenting cartons, or tote bins, to a picker for the picking of individual units. The remaining goods are then returned to the miniload storage location .

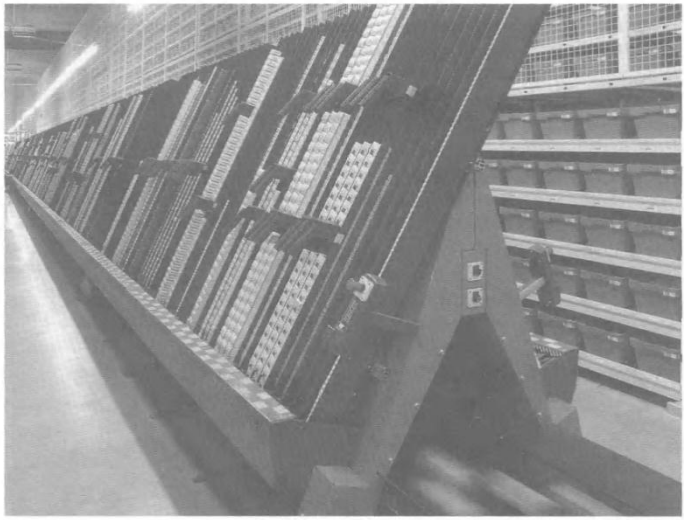
**Automated systems**

The picking systems described so far all require a person to pick the individual items that make up an order. This is not surprising, considering the range of items that may need to be picked and the different ways in which they may rest in the picking locations. However, there are automated picking systems available that are suitable for certain applications. These include the following:

- Layer pickers. Cases are normally stacked on to pallets in layers. In some industries, such as fast-moving consumer goods, price differentials are offered to customers based on whether they order in pallet, layer or case quantities. In such cases, it may be beneficial to automate the picking of layer quantities. Typically, a pallet is brought forward from the reserve pallet store (e.g. by AS/RS and conveyor) to a layer picking machine. This machine would lift the top layer off (e.g. by suction pads) and place it on to a pallet that is being assembled for the customer order. The product pallet would be returned to the reserve store and another pallet would be brought forward and the process repeated until the customer pallet was filled with all the layers required. The layer picking machine often has three sections: one for the product pallet; one for the customer pallet being assembled; and one for empty wooden pallets that will form the next customer pallets.

  Dispensers. These typically comprise two lines of near-vertical magazines positioned over a conveyor in the shape of an ‘A’ — hence, the common name of A-frame dispensers (see Figure 18.4). Each magazine contains a single SKU with the individual items or cartons stacked vertically. This equipment is well suited to small items of a regular shape or size (e.g. small pharmaceutical cartons, toothpaste in cartons, etc). The items may be dispensed automatically from the magazines into a tote bin as it passes on the conveyor below. This tote bin may represent a customer order and

then be conveyed directly to packing. Alternatively, the items may be dispensed directly onto the conveyor, either for subsequent Sortation



**A-frame dispenser**

**Sortation**

If goods have been batch-picked, then they will need to be sorted into the relevant customer orders. This may be undertaken manually (e.g. sorting to pigeon-hole or to roll-cage pallet) or by automated sortation equipment. Similarly, goods that have been zone-picked will need to be brought together into the relevant orders. This may be a much simpler operation (i.e. depending on the number of zones) but may still be undertaken either manually or with the assistance of some form of conveyorized sortation.

Sortation may occur immediately after picking so that items can be assembled into the appropriate orders ready for packing or dispatch. Where there is a separate packing operation, sortation may also occur after packing so that the packed goods can be assembled into vehicle loads (or into postcode areas ready for postal deliveries).

Mechanized sortation can be undertaken as an integral part of conveyor systems. For example, a conveyor may sort to different packing stations by means of pop-up wheels that are raised when the required case goes past a conveyor spur. The wheels are then powered at that moment and the case is diverted down that spur.

However, for high-speed sortation, conveyors normally feed into specialist sorters. These are normally set out in a loop so that product (eg individual items or cases)

move past numerous chutes or conveyors until they reach the one that they are destined for (eg representing a particular store or vehicle load). Product is normally identified by means of an automatic recognition system (eg bar code). Alternatively, there can be manual in-feed stations where goods are placed on to the conveyor and data concerning the SKU are fed in manually. If a particular item is not recognized, for example because of a defaced bar code, then that item would be diverted down a reject spur for manual intervention. Sorters may also be used for cross-docking . They can achieve very high throughput rates. There are a number of sortation systems available including:

- Sliding shoe sorters. There are 'shoes' located at the edge of the conveyor. When the goods reach the appropriate destination point, the shoes slide across to divert the goods down that spur. These are suitable for cartons and tote bins of regular shape and reasonable rigidity.
- Bomb-bay sorters. These hold goods in receptacles that have opening bottoms releasing the goods in the same way as a 'bomb-bay' on an aeroplane. These are suitable for goods that may be dropped vertically, for example, small packages into mail bags for postcode sortation. An advantage of this type of sorter is that less space is needed as there are no chutes or conveyors to either side of the sorter. A typical throughput rate is up to about 6,000 sorts per hour.
- Tilt-tray sorters. Tilting conveyors are usually laid out in horizontal carousel configuration, with a series of tilting trays or slats fitted to a conveying chain, and capable of tipping loads off to left or right to branch conveyors or to off-take chutes. The slats can be tilted singly or in multiples according to sizes of load being handled. Tilting conveyors are used for high-speed sortation operations, such as parcel distribution, and for some cross-docking installations. The effectiveness and speed of these applications depend on information technology and coding systems such as bar codes. Each load is identified as it enters the system, which then instructs the conveyor to discharge the load to its designated destination.
- Cross-belt sorters. These comprise a series of mini-conveyor belts aligned at 90 degrees to the direction of travel. The appropriate mini-conveyor belt starts up when the item reaches the required off-take destination point. This forms a positive movement and is therefore suitable for a wide range of items.

**Cross-belt sorter**

# Picking area layout

The layout of the picking area is critical to achieving high levels of productivity. One of the first decisions that needs to be taken is whether to have separate reserve inventory and picking locations for individual SKUs or to combine all the inventory into a single location. This will largely depend on the total amount of inventory for an SKU. For example, in the case of small electronic items the total inventory may fit in a small tote bin and therefore it would be sensible to have a single location, whereas there may be many pallets held of a particular retail food line and it would not be practicable to hold all of these pallets in picking positions.

The general principle is that picking stock should be concentrated into the smallest feasible area, so as to minimize travelling time between the SKUs. Reserve inventory therefore needs to be held separately in many instances. Where this is the case, a decision needs to be taken as to the amount of inventory to place in the pick location. This is a trade-off, as having small pick locations would reduce the pickers' travelling time (and pick location equipment costs), whilst having larger locations would reduce the replenishment effort to maintain product in the pick locations. One approach to minimizing the pickers' travelling time and, at the same time, reducing the replenishment workload is to use flow racks, so that a good depth of inventory can be held within a small picking face.

The separation of reserve and picking inventory may be vertical, e.g. pick from racking at ground-floor level with reserve stock on the higher racking levels, or horizontal, with reserve stock in one area and picking in another. In the latter instance, it is fairly common for picking activities to be conducted at multiple levels using mezzanine floors, so as to use the full height of the building.

Another approach is to construct 'pick tunnels' with, for example, two-deep pallet flow racks on either side (or a number of levels of carton flow racks) at ground level. Reserve stock is then stored above extending over the pick aisle to form a tunnel. This reserve stock may extend three or four pallets deep from either side,

and therefore push-back racking could be used. Frequently, a carton conveyor extends through the pick tunnel to take the picked cartons away for sortation.

## Pick routes

Another factor that affects picking productivity in picker-to-goods operations is the actual route taken around the pick face. For example, pickers could go up one side of an aisle and down the other side, or they could pick from both sides of the aisle on one trip. Specific route options include:

- Transversing the entire pick face in a 'snake' pattern, going up one aisle, down the next, etc, picking from both sides.
- Approaching all aisles from the same end, travelling up the aisle until all goods are picked and then returning to the same end.
- Approaching the aisles from each end in turn, i.e. picking all goods as far as the mid-point of the aisle and then returning to the same end, doing the same in the next aisle, etc and then approaching all aisles up to the mid-point from the other end.
- A more sophisticated refinement of the above is to proceed down an aisle picking all required items until it would be shorter to approach from the far end than to proceed to the next item. That item would then be approached from the far end in the second part of the pick route.

## Information in order picking

Although travel time is normally the most significant element of overall picking time, the time taken for information also needs to be considered. This may comprise reading which location to go to, reading how many items to pick, confirming that the picker is at the right location and/or picking the correct goods, and advising the system of any shortages at the pick face.

This information exchange is necessary for the picker to complete the task and also to ensure that the pick is completed accurately. The design of the information exchange therefore needs to achieve high productivity while ensuring high levels of accuracy. There are numerous alternative methods available, supported by varying levels of complexity in information systems:

- Paper pick lists. These are printed by the computer system and list all of the SKUs to be picked, together with their location and the number required. The system normally lists these in the sequence of the locations to be visited as per the pick route used. The picker proceeds to pick all the items, noting any discrepancies (e.g. owing to shortages at the pick face) on the paper pick list.
- Pick by label. With this method, the pick list comprises a series of gummed labels on a backing sheet, printed in the sequence that the items need to be picked. The picker sticks a label onto each item and returns any unused labels to the pick station in order to record any shortages at the pick face.

- Bar codes. Bar code scanning is the most common method to confirm pick accuracy. Bar codes may be placed at each location (e.g. on a shelf or on a beam in the case of racking) and the picker then scans this label to confirm that he/she is at the correct location prior to commencing a pick. If the individual products have bar codes, then the picker may be required to scan each label (or to scan the label on one item per SKU picked). This provides a more precise check than location labels as it also identifies any replenishment mistakes (i.e. where incorrect goods have been placed in a pick location).
- Radio data terminals. These can provide online communication between designated warehouse workstations and warehouse management systems, and are therefore often used in order picking. The terminals may be truck-mounted, waist-mounted, or fitted to the wrists of the pickers. They are often combined with bar-code scanners. For example, a wrist-mounted radio data terminal maybe attached to a bar-code scanner fitted as a ring on a finger so that pickers can move goods with both hands free.
- Pick by light. Normally, in these systems, every picking location is fitted with an LED (light-emitting diode) display panel, controlled by computer (see Figure 18.6). A common application is for a plastic tote bin, representing a customer order, to be taken by conveyor to a specific zone of the warehouse. The bar code on the tote bin is read, and the appropriate LED panels illuminate, showing the quantities of items to be picked for all SKUs required for that order. Having picked the items, the picker presses a cancel button and then uses the conveyor to pass the bin to the next zone. This process continues until order completion. This method can give high pick rates and very high levels of picking accuracy.
- Radio frequency identification (RFID). If cases or items are fitted with RFID tags, the accuracy of the pick can be confirmed by these tags being read at the time of picking (e.g. by using special gloves for reading tags or by placing a tag reader on the receptacle that the goods are being picked to).

## CHAPTER TWO

## THE ROLE OF INFORMATION TECHNOLOGY (IT)

## IN MANAGING AND CONTROLLING GOODS AND RESOURCES

### Introduction

There can be no doubt that the availability of cheap computing power has led to dramatic developments in the science of supply chain management. The ability to handle breathtaking amounts of data quickly and accurately has in the last 40 years literally transformed the way business is conducted. It has been described, with good cause, as the second Industrial Revolution. The ability to pass information between supply chain partners via mobile devices, satellite systems and electronic data interchange is being exploited by more and more companies daily. The advent of mass access to the internet has sparked off a boom in home and office- based shopping, to say nothing of the use of e-mail as a means of communicating with friends and business colleagues around the globe.

Information and communication systems along with the associated hardware used in supply chain management fulfill different roles. They may aid the decision-making process, help to monitor and control operations, create simulated systems, store and process data, and aid communication between individuals, companies and machines.

A great deal has already been written about this vast area; therefore it is not the purpose here to go into any great detail. What is intended is to highlight the most common features with respect to distribution and logistics, and to explain briefly what they are and how they work.

### Basic communication

### Satellite communication

The development of a network of geo-stationary satellites located in space has opened up possibilities for communicating with people, remote installations and equipment virtually anywhere on the Earth's surface. Where there are no mobile or fixed-line telephone facilities it is possible to use satellite telephones. Mobile assets such as road vehicles, ships and containers may be tracked through the use of satellites. It is even possible to send operating instructions via satellite to remote equipment. Access to the internet may also be achieved using this network. This ability to send and receive data via the satellite system has dramatically improved the ability of supply chain managers to manage their networks and assets wherever they may be located.

### Mobile data

Over the last 20 years or so the spread of the mobile phone throughout the worldwide business community has been almost universal and must be practically complete. It is hard to conceive of any individual involved in the logistics business

today that does not carry a mobile device of some sort or other. The ability to connect people via voice communication and short messaging systems has revolutionized the whole process of communication during this period. The more sophisticated mobile devices allow photos to be taken, stored and sent, access to the internet and e-mail facilities. This helps mobile staff stay in contact with their base offices wherever there is network coverage. Many delivery drivers carry ruggedized mobile devices that allow customers to sign electronically for the receipt of their goods. These devices then update the company system with the information that the delivery has been made. Many courier companies allow customers access to their consignment tracking systems via the internet so that they may check progress of urgent consignments.

**Electronic data interchange (EDI)**

EDI has been defined as: computer-to-computer exchange of structured data for automatic processing. EDI is used by supply chain partners to exchange essential information necessary for the effective running of their businesses. These structural links are usually set up between organizations that have a long-term trading relationship. For example, some multiple retailers will supply electronic point-of-sale (EPOS) data directly to suppliers, which in turn triggers replenishment of the item sold. As a consequence of this type of strong link, suppliers will be able to build a historical sales pattern that will aid their own demand forecasting activities. In this context, EDT has many benefits. It is providing timely information about its customers' sales, it is highly accurate and it is very efficient because it does not require staff to collate the information manually. EDI is used to send invoices, bills of lading, confirmation of dispatch, shipping details and any information that the linked organizations choose to exchange.

UN/EDIFACT is the standard that ensures that information may be sent and retrieved in an appropriate format by trading partners. The initials stand for: United Nations/Electronic Data Interchange for Administration, Commerce and Transport.

The main advantages of using EDI are:

- information needs to be entered on to the computer system only once;
- speed of transactions;
- reduced cost and error rates.

There have been developments in this field that use extensible mark-up language (XML) that helps users to connect different companies' systems via the internet without the need for expensive hardware.

**Bar codes**

A bar code is the representation of a number or code in a form suitable for reading by machines. Bar codes are widely used throughout the supply chain to identify and track goods at all stages in the process. Bar codes are a series of different-width lines that may be presented in a horizontal order, called ladder orientation, or a vertical order, called picket fence orientation.

For example, goods received in a warehouse may be identified by the warehouse management system and added to stock held in the warehouse. When put away, the bar code is used to associate the storage location with the bar-coded stock, and on dispatch the stock record is amended. The use of bar codes can speed up operations significantly. Problems can occur if bar codes are defaced or the labels fall off in transit.

**Radio frequency identification (RFID)**

RFID is a rapidly developing technology that allows objects to be tagged with a device that contains a memory chip. The chip has a read-and-write facility that is currently executed using a variety of radio frequencies. This means that a pallet of goods can have an RFID tag attached that contains a large amount of information regarding the pallet. This might include product details, the number of cartons, stock keeping unit number, the origin and the destination of the goods, the location in a warehouse and so on. One of the advantages over bar codes is that the information contained in the tag can be updated or changed altogether. The tags are less vulnerable to damage, as unlike the barcode label they are not easily defaced. Another advantage is that the tags may be read from a distance and in some cases do not require 'line of sight' visibility at all. It is also possible to read RFID tags through packing materials but not through metal. A mixed pallet of different products may be read simultaneously by one scanner, thus reducing the time significantly for this process. RFID tags may be used to track many different types of assets, people and animals included. As the cost of this technology reduces, so the take-up of its use is likely to become more widespread.

**Order Processing**

Customer order processing is often not the direct responsibility of a logistics department. However, the consequences of order processing in terms of the allocation of stock and the construction of picking lists are very important.

The main developments have occurred in two specific areas. The first of these is the information now provided to order takers. This includes the visibility of stock availability, which allows the order taker to identify immediately whether or not stock can be supplied 'off the shelf' to the customer. Also, the order taker is often required to provide the customer with an agreed delivery date at the time the order is taken. This means that delivery schedules must be clear and reliable. These developments not only help to allow a much better service to be offered to customers, but also, impose a new discipline on logistics operations.

Secondly, there has been an increase in the ability to place orders automatically and directly through EDI or through internet sites. This has been extended in some instances to allow customers to have automatic access to their order status, so as well as placing orders remotely via EDI or the internet they can track their progress through the supply chain.

**Supply chain planning**

**Enterprise-wide information systems**

An important development for many major companies has been the introduction of enterprise-wide information systems, often known as ERP or enterprise resource planning systems. These are transaction-based information systems that are integrated across the whole business. Basically, they allow for data capture for the whole business into a single computer package, which then gives a single source for all the key business information activities, such as customer orders, inventory and financials.

Proprietary names such as SAP, Oracle and Infor feature strongly whenever these systems are discussed, and many companies are using them to their advantage. It must be remembered that installation of such systems will entail widespread change within the organization and must not be entered into lightly. It will have implications in terms of organizational structure as well as the way in which individuals work. It is not a question of simply computerizing an existing paper-based system (with all its current flaws) but rather a matter of installing a completely new system. This must take place whilst the rest of the organization tries to keep the business running. It must be thoroughly planned and executed, which will require significant extra resources to achieve a successful outcome.

Many companies have benefited from using these systems, whilst some have experienced severe problems with their application. Generally, they are very expensive to purchase, require a lot of tailoring for each user company, and take a lot of expensive consultancy time to implement. A high degree of training for use at the operative level is also required. It is a logical extension of the principles of supply chain management to have one overarching computerized system that allows for the organization and support of the planning of the whole enterprise. Base ERP systems do not do this, although specialist planning modules are available. Frequently, ERP systems are linked to appropriate supply chain management and network strategy software so that the relevant planning can be undertaken.

In the future these linked systems are likely to be commonplace. For today, apart from implementation problems, it is necessary to be aware that IT is developing at such a speed that provision must be made for systems to be easily updated. Ideally, they should be ‘open’ systems that are linked to suppliers and customers alike to ease the flow of information up and down the supply chain. Significant provision must be made for disaster recovery in the event of system failure, because effectively all of a company’s eggs are placed in the one basket.

To be effective, these systems rely on the accuracy and real-time nature of the data that are fed into the system. Planners can then undertake ‘what-if’ analyses on the basis of the latest (or potential) customer orders, manufacturing capability, inventory disposition, etc. They rely on the appropriate algorithms embedded in the system to arrive at useful solutions. Such supply chain management software is

now being associated much more directly with some of the major ERP system providers.

**Supply chain management/advanced planning and scheduling (APS) systems**

Supply chain management systems are, very broadly, decision support and operational planning tools. They enable a company to plan and manage its logistics operations through the use of an integrated system-wide package. Such tools will use information such as real-time demand and/or forecasting, linked to production capacities and run rates, inventory holding levels and locations, supplier lead times, associated costs, etc, to help determine operational production and inventory requirements.

**Network strategy**

Network strategy systems consist of a variety of different strategic rather than operational decision-making tools. Typical of this type of package is the distribution centre (DC) location package, which attempts to optimize the number and location of DCs within a company's distribution network.

These systems allow for the analysis of data using various algorithms to arrive at an optimum solution for a given situation. For example, the problem may be to establish the optimum location to make a product within a network of production sites that themselves are spread across a wide geographical area. The system will enable the analysis of the costs of sourcing raw materials, the costs and availability of production capacity, and transport costs, to arrive at the optimum location.

**Warehousing**

**Warehouse management systems**

Warehouse management systems (WMS). They are used to control all the traditional activities of a warehouse and often include radio frequency (RF) communications with operators and fork-lift trucks. They may interface with equipment control systems, which control automated equipment such as automated storage and retrieval systems (AS/RS) and automated guided vehicles (AGVs).

A number of computer models have now been developed to assist in the planning of warehouse design and configuration. These are generally very sophisticated 3D simulation models that provide a graphic, moving illustration on the computer screen of the layout of the warehouse. They enable different design configurations to be simulated, depending on varying demand requirements, etc.

**Inventory**

**Forecasting and inventory management systems**

The area of forecasting future customer demand and associated inventory carrying requirements has been revolutionized by the use of customized computer packages. These packages contain many different algorithms that allow the forecaster to use various techniques, such as regression analysis, exponential smoothing and moving averages. These systems may be fed with information directly from sales order processing and inventory management systems to allow them to assess very quickly how customer demand is developing by individual stock- keeping unit.

Inventory management systems provide the ability to run the day-to-day detailed management and control of stock within a company. They are absolutely essential for the location of stock and in their ability, if used effectively, to control the levels of stock within a system. This type of expertise allows organizations to reduce their inventory carrying requirements, which improves stock turn and return on capital invested. Customer service is also maintained through the use of these systems by reducing the incidence of stock-outs.

**Transport**

**Vehicle fleet management**

These systems assist transport managers in the task of monitoring the effectiveness of their vehicle fleet. Information regarding vehicle activities will be collected, which are likely to include:

- mileage/kilometres travelled;
- vehicle details — age, gross vehicle weight, type of body, axle configuration, engine capacity, etc;
- tonnes carried;
- idle time;
- maintenance details;
- fuel used;
- driver details;
- tachograph details and analysis;
- details of deliveries made.

This information may be manipulated to produce key performance indicators (KPIs) for the vehicle fleet. The following are typical examples:

- miles/kilometers per gallon/litre;
- vehicle utilization in terms of time in use and vehicle fill;
- tonnes per mile;
- average drop size;
- average drop miles;
- costs per mile/kilometre;
- tyre costs;
- maintenance costs;
- fuel costs;
- costs per tonne;
- whole life costs of the vehicles.

Very often, computerized fuel monitoring equipment controls and records fuel dispensed to each vehicle. This information may be transferred automatically into the fleet management system. In a similar way, tachograph records can be analysed and the information downloaded into the main system.

Many modern heavy vehicles are equipped with engines that are controlled by computerized engine management. This information can provide a great deal of detailed information about the vehicles' activity. Also, reprogramming can enable

some of these engine management systems to change the horsepower rating of the engine itself.

The European Union has required the introduction of a digital tachograph that is fitted with a smart card rather than the outdated system of recording drivers' activities on a wax-covered disk. One of the advantages of this development is that it allows the smart card information to be easily downloaded into the fleet management system.

**Computerized routeing and scheduling**

**International trade management systems**

With the growth in global trade, there are now specialist software packages available to control the international movement of goods. These include features to assist with the complex documentation requirements, trade finance, dispute management and export/import compliance, as well as monitoring the progress of orders around the world.

**Supply chain event management systems**

Either linked to, or as part of the above, supply chain event management systems monitor the progress of orders and highlight any 'events' that the logistics managers should be aware of. These events normally relate to the late dispatch or arrival of orders at pre-specified milestone points (e.g. the container being shipped from a port). These events are notified to the relevant parties so that corrective action can be taken, and the event is continually monitored until the delay is rectified or the goods eventually arrive. For example, the software produces reports for management of locations or shipping lines where delays often occur

**Other applications**

**Electronic point of sale (EPOS)**

Now a common sight in most large retail stores in the developed world, this facility has revolutionized the process of paying for goods purchased. Equipment includes scanning facilities, electronic scales and credit card readers. Goods marked with a bar code are scanned by a reader, which in turn recognizes the goods. It notes the item, tallies the price and records the transaction. In some cases this system also triggers replenishment of the sold item.

One of the major advantages of an EPOS system is that it provides an instant record of transactions at the point of sale. Thus, replenishment of products can be co-ordinated in real time to ensure that stock-outs in the retail store are minimized.

Another advantage of this system is that it has increased the speed at which customers are served when large numbers of items are purchased. It reduces errors by being pre-programmed with the selling price and avoids staff having to add up purchase prices mentally.

Many companies offer loyalty card systems, which reward customers with small discounts for continuing to shop in their store. The advantage to the retailer is that loyalty cards with customers' personal details are linked to their actual purchases; this allows the retailer to obtain vital marketing information about these customers.

**Manufacturing planning and control systems**

It is worth pointing out that systems such as materials requirement planning (MRP) and manufacturing resource planning (MRPII) would not be possible without access to cheap computing power.

Many production plants use computers extensively to control and monitor operations.

**General applications packages**

It is easy to forget that it was not many years ago that desktop computers were not as common as they are today. This development has provided the business world with applications at their fingertips that have allowed them to be far more self-sufficient and flexible. For example, spreadsheets have allowed managers to manipulate information in a way that suits their individual needs. Word processing packages allow staff to produce letters and documents very quickly and to a high standard. Internal and external electronic mail has facilitated rapid communications between organizations and individuals across the globe. Most if not all of these applications are virtually standard specifications for desktop computers.

These standard tools, along with faxes and electronic calculators, contribute to creating fast, effective and flexible logistics operations.

**DEVELOPING A CUSTOMER SERVICE POLICY**

An appropriate customer service policy needs to be developed based on identifiable customer service requirements, and a suitable logistics operation must be established to provide this service. Because there are so many different elements of customer service, this policy must be very clearly and carefully defined. Also, there are many different types of customer even for the same product. A can of cola, for example, may be bought in a supermarket, a corner shop or a petrol station, or from a self-service dispensing unit. It is unlikely that a manufacturer of cola would wish to provide exactly the same level and style of service to all these very different customer types. This is why many companies segment their customers into different customer categories. It is also an additional reason for having a distinct customer service policy.

Many studies have been undertaken to measure the effects of poor customer service. These studies conclude, quite categorically, that, where stock is not available or where delivery is unreliable, many buyers will readily turn to an alternative supplier's products to fulfils their requirements.It is also important to understand what minimum requirements are necessary when identifying any particular service policy. A supplier is really working towards meeting customers' minimum requirements to cross the threshold of customer satisfaction. If these minimum requirements are not met, the supplier cannot even expect to be considered as a feasible supplier. Once these requirements are met and the supplier begins to exceed them, it then becomes possible to achieve customer satisfaction and begin to add value to the supply relationship.Once the positive need for a customer service policy has been accepted, it is useful to adopt a recognized

approach to determine the basic requirements and format of this policy. One such approach is outlined and described in the remainder of this section. As well as showing the major steps that should be taken, the figure also indicates how these steps can be carried out. This is a six-step plan to identify key customer service components and then to design and maintain a suitable customer service package.
The main steps are:

1. Identify the main elements of service and identify suitable market segments. The first step is to identify those elements of service that are most highly rated by customers. Only then can the company's resources be concentrated on these key factors. The main means of determining these key elements are by market research techniques. These processes might include:
   - — the identification of the main decision maker or buyer of the product;
   - — the use of personal interviews to determine the importance of customer service and the different elements within customer service;
   - — the use of group interviews to determine the same.

The importance of this stage is to identify relevant measures of service that are generated by customers themselves and not imposed arbitrarily by 'best guesses' from outside. A major output from this stage of the study is to enable an appropriate survey questionnaire to be designed.
In addition, it is important at this stage to identify the different market segments or customer types that exist. It is highly unlikely that a universal level of customer service will be appropriate for all customers. Most customer populations consist of a range of customers of different size and importance. Part of this preliminary stage is therefore, to try to identify broad customer categories and to ensure that any questionnaire is designed to enable the different requirements of these different categories to be identified.
Survey or questionnaire design is a vital part of the overall process, The major steps can be summarized as follows:

- — Clarify the purpose and objectives.
- — Identify any specific information required.
- — Select the most appropriate survey type.
- — Determine the resources required to undertake the survey.
- — Determine who should undertake the survey.
- — Determine who should complete the survey.
- — Identify key customer/market segments.
- — Identify key service elements to include.
- — Prepare the question and answer format.
- — Design the analysis and reporting format.
- — Determine the sample size and selection.
- — Pilot the survey.

Adjust and finalize.

2 Determine the relative significance of each service element. Recognized research techniques can be used within the questionnaire to enable measurement of the relative importance of the different service components identified. For a fairly small list of components, some form of order ranking (‘most’ to ‘least’ important) or rating scale (1 to 6 according to importance) can be used. A further technique is that of trade-off analysis. This provides a more sophisticated format for considering and measuring the relative importance of different combinations of service components, rather than just scoring them on an individual basis. Straightforward rating of the key elements is often sufficient.It is also possible at this stage to identify what the minimum requirements are for customer service — that threshold below which it is unlikely that a customer will consider a company as a feasible supplier

3 Establish company competitiveness at current service levels offered. Having identified the key service components and their relative importance to the customer, the next step is to measure how well the company is performing for each of these key components. This can also be achieved using the questionnaire. The list of key components can be rated by the respondent on perceived performance. This will provide an indication of where the company is both underperforming and over-performing and where it has got it about right.It is also important to be aware of the company’s own position compared to that of its major competitors. Respondents can be asked to rate each competing company in a similar way as a part of the questionnaire. The results will indicate how each competitor performs according to the key service components. The company’s performance can then be compared to the competition’s and also to the most important service elements as identified in the previous stage of the study. This will provide some very useful information on how well the company is performing compared to its competitors, but more importantly this can be related directly to the customers’ key customer service requirements.

**Customer service targets**

4 Identify distinct service requirements for different market segments. As already indicated, the needs of different customer types can vary quite substantially. This may be true in terms of product quality, method of ordering, level of service or any other of the many different service elements that can be identified. Within a total market, it is possible to identify distinct submarkets or segments. A typical example might be the supply of stationery items. These might be supplied to retailers for sale to the public, to wholesalers for further distribution or direct to public

service bodies or private companies for their own consumption. Each segment of the overall market may require a distinctly different level of service, or may react differently to certain deficiencies of service. The cola example discussed earlier in this chapter provides another example of different types of service requirement. Once different market segments have been identified, a number of specific customer service policies can be developed, each of which should suit the relevant groups or segments.

The determination of the detailed service requirements can be undertaken by what is known as 'gap analysis'. This is the practical means of enabling actual service policies.This is achieved by using the survey results to identify the major performance gaps for each market segment or customer group that is being considered. The key customer service elements should be ranked in order of importance to the customer (to identify the essential ones) and degree of change required (to identify the easy ones or 'quick wins'). Brainstorming and/or some form of process analysis can then be used to identify appropriate remedies

5 Determine monitoring and control procedures. It is vital to ensure that any service policy implemented is also monitored. This requires an effective focus on the measurement of the service provided, involving a systematic and continuous concentration on monitoring and control. In practice, it is rare for this to be adequately carried out: firstly, because companies do not have a recognized customer service policy and, secondly, because companies find it difficult to construct quantifiable standards that are capable of measurement..

**Levels of customer service**

It has already been stressed that there is a need to balance the level of customer service with the cost of providing that service. This balance is not easy to define, although it can be described quite easily as the point where the additional revenue for each increment of service is equal to the extra cost of providing that increment.

It is seldom possible to devise a policy that is absolutely optimal in terms of the cost/service balance. Some companies adopt a cost minimization approach where specific service objectives are laid down and met at a minimum cost. Others choose a service maximization approach where a distribution budget is fixed, and the 'best' service supplied within this cost constraint. The most appropriate approach to adopt will depend on particular product, business or market situations.

One factor that is clear, however, is the relationship between cost and service. The cost of providing a given service is markedly higher

**Measuring customer service**

There are many different measures of customer service that might be used. The most important message is that, whatever measures are used, they must reflect the

key service requirements for the customer in question. This is not always as obvious as it might seem. One particular example is that of order fulfillment. It is possible to measure this in a number of different ways:

- the number of orders completely satisfied, say 18 out of 20, over a period (90 per cent);
- the number of lines delivered from a single order, say 75 out of the 80 lines requested (94 per cent);
- the number of line items or cases delivered from a single order, say 75 out of the 80 lines requested, but only 1,400 of the 1,800 total line items (78 per cent);
- the value of the order completed, say #750 of the #900 order (83 per cent).

Any or all of these might be used, and there is no right or wrong one. The most appropriate is the one that best suits the operation in question

## Concept of total cost and trade off and application of these to: Distribution, customer service and value addition

There are several financial and cost advantages claimed because of the elimination of asset ownership. In particular, there are capital cost advantages through using third party distribution because the client company does not have to invest in facilities and resources such as distribution centres and vehicles as it would for its own operation. Thus, the capital can be invested in more profitable areas of the business, such as new production machinery, retail stores, etc.

Improved cash flow can occur when the service provider pays for existing assets that are owned by the client company but are transferred to the service provider at the start of the contract. The client can then use this cash input to help in other parts of the business.

Associated with the elimination of asset ownership is that the reduction of ownership and responsibility for plant, property and equipment means that these items can be taken off the balance sheet. This may make the company more attractive from an accounting perspective, as fixed costs are converted to variable costs.

A particular advantage for multi-user operations is the opportunity to benefit from cost savings through economies of scale. Many own account operations are too small to be run economically in their own right. If a number of operations are run together by a third party company, the larger system that results will be more economic because a single large distribution centre may replace the three or four sites used by the different smaller companies.

Linked closely to the previous point, and an advantage for multi-user distribution, is that third party operations may provide day-to-day operating cost savings. This is because the various labour and equipment resources may be run more efficiently at the operational level.

Third party distribution allows for a clearer picture of actual operating costs. Payments need to be made on a regular basis, usually every month, and this makes the actual distribution costs very visible. Reporting systems are generally more transparent than for own account operations.
It may be the case that the changeover costs of moving from own account to third party distribution are such that it does not make good financial sense. The most likely areas are the sunk costs of existing owned sites, any fixed low rents or, perhaps, any long-term leases on property that have to be paid. Also, some vehicles and equipment may be relatively new and of high value, but not usable in the operation that the service provider has planned. The point therefore is that ,the concept of total cost and trade off look into services or activities that are minute, consider their cost implication. If discovered thatthe activity is smaller than the cost involved then it will contracted to the third party whose major object is performance of activity. This will reduce cost for the company and enhance its efficiency.

The concept of total cost consideration and the trade off of activities that are cost involving can also be applied to customer service requirement.It is a question of some debate as to whether or not service levels are better or worse among third party distributors compared to own account operators, but as a general rule service levels should improve following a move from in-house to outsourced operations:

- For dedicated operations, there should be no significant difference in service level provision between an outsourced and an in-house operation because the outsourced operation is an exclusive one and will be undertaking exactly the same business as the in-house operation. However, service level improvement is often achievable through outsourcing because an in-house operation may suffer from inertia to change, making it difficult to identify and put into practice any potential service improvements.
- For multi-user operations, service should be better, because many third party distributors make frequent and regular deliveries to their varied delivery points, which is more difficult for in-house operators to achieve due to lower demand. This particularly applies in remote rural areas.

The use of a third party distribution operation should offer greater flexibility to the user company. This is apparent when a company seeks to develop new products and services, and new markets. A company that intends to launch its products into a new geographic area will find it far more economical to use a third party service provider rather than developing an expensive new logistics infrastructure in an area where initial sales are likely to be low and subsequent success for its products is not guaranteed. When a company introduces new products and services it may find

that they do not fit easily into their existing logistics structure. Third party operations may fill these gaps more effectively.
As indicated in a previous section of this chapter, third party companies are able to offer a number of value added services. These may provide a significant added attraction to user companies. For example, the use of a track and trace facility may be a competitive advantage that has a very positive impact for key customers.
It is often thought to be easier to initiate logistics service improvements via a third party rather than through an own account operation. This is because incentives for service improvement can be written into service contracts for third party companies. These are likely to be performance-related incentives.
Service level improvement may be achieved through a multi-user third party operation via more frequent delivery. As already indicated, the use of a third party can greatly improve service levels because deliveries are likely to be more frequent than can be undertaken by a small own account operation.

There are also many additional services offered by third party logistics providers, over and above the more traditional functions of logistics. These are often known as 'value added' services:

- Specialist or niche services
  Here the complete operational package is specifically designed for the distribution of particular product type. There are many examples in a number of different market sectors — automotive, electrical/electronic, hanging garments, high tech, etc.
- Time definite services
  These are set up to support the just-in-time operations of major manufacturers. Typical here are the sequencing centres that have been developed in the automotive industry to support line-side production.
- Production and assembly
  Here the final manufacturing or assembly of products takes place outside the manufacturing environment but within the logistics operation. The computer industry offers a number of examples where basic products, such as PC monitors or processing units are initially distributed to the relevant market before being finally made ready for the end customer.
- Repacking
  For some product offerings it may be necessary for goods to be repacked before they are ready for selling. A typical example is the need to blister-pack two different items that are derived from separate manufacturers or suppliers but are to go out as a distinct retail product — a torch together with a battery.
- Refurbishment
  In the light of current environmental legislation many manufacturing companies have endeavored to re-engineer their products so that parts

from some used products can be reused. This has provided an opportunity for third party companies to offer this return-and-refurbishment operation.

- Packaging returns
  Again linked to environmental legislation, 'producers' of packaging waste are legally responsible for the collection of packaging and packaging waste for reuse or disposal (see Chapter 36). Because this type of 'reverse logistics' is difficult to perform through traditional outward-looking logistics operations, a number of third party operators have set up reverse logistics systems, in particular for the large grocery multiples.
- Product returns
  Another issue that has arisen due to environmental concern is the recent legislation for the return of consumer products that have reached the end of their working life. In Europe, this is reflected in the Waste Electrical and Electronic Equipment (WEEE) Directive (see Chapter 36). This is extremely difficult to undertake through existing. logistics structures, so it is a prime opportunity for third party service providers to set up and run reverse operations to fulfill these legislative requirements.
- Inbound logistics
  The provision and movement of goods into a manufacturing company is also seen as an area for additional value added service. This involves the co-ordination of the raw material, component and packaging products that a manufacturing company requires. It typically might include not just the collection and transport of all these different products, but also the stock control, ordering and order progress chasing.
- Pre-retailing
  Here, products are prepared for immediate use in the retailing environment. This may involve removing goods from their outer packaging, labelling, etc. In the clothing industry, particularly for boxed items, additional services will include cleaning and pressing to make the garments shop-ready.
- Home delivery
  Many third party contractors have developed home delivery operations for products such as white goods and brown goods, covering delivery, installation, return and repair, refurbishment or disposal. They typically provide nationwide fulfillment for consumer electronic goods for manufacturers, retailers, insurance companies and service providers.
- e-fulfillment
  The rapid growth in online selling companies, such as Amazon.com, means that internet shopping is now very common and this has led to a similar growth in the demand for the fulfillment (or e-fulfillment) of these internet orders. Although internet access provides a direct and instantaneous link from the customer to the selling organization, the

actual physical fulfillment must still be undertaken by more traditional physical means. Very often this may necessitate the introduction of a new means of physical distribution, because traditional channels are not appropriate for the type of delivery to the home that is required.

- Information management
  Advances in information technology have produced a vast amount of detailed logistics and demand data and information. Detailed information can be made available for individual customers, concerning not just their product preferences but also any customer service requirements that are distribution-specific (delivery time preference, order size preference, invoicing requirements, etc). This has become another niche area of opportunity in which 3PLs and others may specialise.
- On-line communication systems
  Some third party operators have identified the area of logistics communication systems as one where there is an opportunity to provide added value. One typical example is that of the provision of on-line information concerning the status of collections and deliveries.

## CHAPTER THREE

## MOVING GOODS

The global transportation industry is reshaping itself in response to powerful technological, economic, and consumer forces. Traditional profit centers such as manufacturing and retailing are being squeezed. Consumer and commercial demand is increasingly focused on communications, safety and comfort. New patterns of freight and product distribution are emerging to take advantage of the e-commerce revolution. And there is a cross-industry response to the environmental and life cycle impacts of vehicles and transportation systems.

**Advantages of improved Transportation System**

Improved communication facilities have made the world smaller today than it was a few decades ago. These facilities have developed tremendously due to the vast strides in electronics and telecommunication, and consequently information technology, over the last few years. An improved transport system brings the following advantages:

1. Greater economies of scale in production, facilitated by:
(a) Better utilization of production facilities
(b) Specialization of labour.
(c) Selection of production sites with greater geographical advantage.

2. Reduced prices brought about by:
(a) Greater competition.
(b) Reduced costs in transportation, inventories, packaging etc.

3. Better customer service through competition, improvement in transportation time, more space and less cost.

**ASSESING AND SELECTING MODE OF TRANSPORT: Service Capacity of each Mode**

There are five basic inter-city modes of transportation, these includes
(1)rail
(2)road
(3) air
(4) water
(5) pipe),
Sometimes these modes interact with one another

**RAIL TRANSPORT**

Railways are composed of a traced path on which the vehicles are bound to ply. They have an average level of physical constrains linked to the types of locomotives and affected by the gradient. Heavy industries are traditionally linked with rail transport systems. Containerization has improved the flexibility of rail

transportation by linking it with road and maritime modes. With the passage of time newer types of vehicles like power tracks have been developed all over the world to carry/ferry all sorts of commodities and merchandise. Rising competition with other modes of intermodal transport have forced the railways system over the world to be more competitive in its services-viz, speed, handling, freight and improvement of overall efficiency.

Freight is one of the principal determinants of choice of the modes of transportation. The principle of freight fixation is generally the same the world over

**Railway Freight Structure**

The structure of the freight tariff in Railways does not have linear relationship either with tonnage carried or the distance hauled. This is due to the fact that the Railways, inspite of taking care of its financial viability, are a public utility concern with its own social obligations. In other words, two principles, namely, the value of services principle, which cannot be determined easily, which occurs on the demand side, is juxtaposed against the cost of services principle which is on the supply side**.**

**The considerations governing the freight structure, therefore, are:**

(a) 'Ability to Pay' Principle:
As the Railways cannot afford to forget its role as a public utility concern, the commodity carried should be able to bear the transportation costs. Items of common consumption like foodgrain, building materials, coal etc will not be able to bear the cost if they were to be charged the same rates as items like plant and machinery and other goods in the industrial sector. A strictly linear rate would negate the very purpose of using the Railways as the carrier for transporting essential commodities. Therefore, there is a differential in the rates for these items.

(b) Speed:
There is a premium on speed, and freight carried by faster trains would naturally cost more than that hauled by slower trains.

(c) Distance:
The longer the distance, the greater will naturally be the freight amount, but the relationship cannot be always linear.

(d) Liability of Risk:
Freight will transit risks carried by the Railways (Railway's Risk or RR), will be more than the owner's risk (OR)

(e) Frequency of Service:
Frequency of service affects the forces of demand and supply of the services and will have a bearing on the cost.

(f) Type of Wagon:

Special rates are applicable for different types of special wagons e.g. Closed, Refrigerated, Shock Absorbing.

(g) Nature of commodity — (Bulk and quantity):
'Quantity discount' is not a concept restricted to the purchasing scene. By virtue of the fact that the available space is booked in advance, the Railways do give some consideration for bulk bookings. Of late the Railways are offering advance booking of space by private parties.

(h) Nature of Commodity — Liability to Damage:
A premium has to be attached to the freight of a damage-prone commodity.

(i) Nature of Commodity — Liability to Inflammation/Explosion:
Likewise, hazardous goods would also attract special freight rates.

(j) Nature of Commodity — Size and Packing of consignment:
Railways have stipulated packing conditions for various items of goods, and also dimensions and the freight charges applicable thereto.

**Classification of Railway Freight Rates**

The Railways freight rates have been evolved on the basis of these principles, and the different premises on which the freight rates have been worked out are as follows:

1. Class Rates
2. Wagonload Rates
3. Smalls
4. Risk Rates
5. Trainload Rates
6. Station to Station Rates
7. Special Rates

**Other Special Services**

1. Speed Link Express
   Speed Link Express or Quick Transit Service (QTS) involves movement of general goods traffic by point-to-point fast goods trains.The delivery of the goods is guaranteed within a specified timeDomestic Container Service

2 A door-to-door integrated service, started first in the United States in 1955 and in India in 1966, is the inland container service offered by the Railways. The containers usually are of 5 tonne capacity, and six containers can usually be loaded on each of the specially designed flats. Radios and television sets, soaps and detergents, plastic containers etc are regularly moved nowadays by container service. The containers are carried to the premises of the consigner by road vehicles, where they are loaded. The Railway receipt is given at the doorstep of the consigner.

**Procedure for booking and delivery of consignment by Rail**

For booking a consignment for transportation a prescribed form is to be filled and submitted to the Carrier giving the necessary details like description of the goods, dimensions, number of packages, packing conditions, value, destination, consigner's as well as consignee's address, risk rates and mode of payment of freight (pre-paid or 'to pay'). **This request is called the Forwarding Note**. No carrier will accept a consignment for affreightment without a Goods Forwarding Note which is the primary document for transportation.

Once the goods are accepted by the carrier, he gives the consigner a receipt which serves as the Contract of Affreightment. Two copies are handed over-one the Consigner's copy (which does not give him any ownership to the goods) and the other the Consignee's copy. In the case of Railways this document is called the Railway Receipt or RR (not to be confused with Railway Risk).

In the case of transportation by goods train, this receipt is called Railway Receipt, and in the case of transportation by passenger train (e.g. perishables, two-wheelers etc) the receipt given is the Parcel Way Bill (PWB).

The consignee's copy is an important document since it confers on the holder the title to the goods and hence it is used as a negotiable instrument, though as per the Negotiable Instruments Act, a Railway Receipt (or for that matter a PWB) can be endorsed in favour of another, transferring the title of the goods to the endorsee, and negotiated in the same way as any other negotiable instrument. It can be called a quasi-negotiable instrument. Goods can be consigned by the consigner in the name of the consignee, or to 'Self' (i.e. the Consigner himself). In the later case he himself has to arrange to take delivery of the consignment on arrival at the destination by surrendering the Consignee's Copy of the RR, PWB unless he has endorsed it in favour of someone else.

Booking of wagonload consignments involves payment of Wagon Registration Fee at the current rates. The wagons are supplied on first-come-first-serve basis, and keeping in view the priority schedule for the supply of wagons.

## Open Delivery

If the consignee perceives any threat of pilferage or damage en route, he can insist on 'open delivery' i.e. getting the packages opened in presence of Railway officials (usually the Station Manager) and recording and vouching for the contents. All present are required to affix their signature as witness of the fact of the open delivery, and the condition of the contents. **The document, called the Assessment Memo,** .is important for the Consignee/Consigner (whoever has ensured the despatch) specially, if he is required to file his claim from the Insurance Company in the event of transit loss or damage. The Insurance Company would insist on this, wherever there is external damage to the package or its condition warrants suspicion as to transit damage or loss.

## Demurrage and Wharfage

The Railways' wagons, coaches, locomotives have to be on the move all the time, since it would mean considerable loss if they are idle or detained for any length of time, Goods Wagons have, therefore, to be unloaded within the stipulated time and discharged, so that their turn-around is increased. The stipulated time for unloading a wagon is five daylight hours. The daylight hours are reckoned from 6 am to 6 pm. A wagon placed at 10 am should, therefore, be unloaded and released by 3 pm on the same day, and wagon placed at 3 pm should be released by 8 am on the next day. Failure to do so and detention of the wagon beyond the free unloading time of 5 daylight 'pours will cause the Railways to recover demurrage charges.

Wharfage is levied by the Railways when the consignee delays in affecting delivery of a Parcel from Railway sheds. Wharfage is generally charged on hourly basis beyond the Permissionable Transit time of seven days.

To avoid demurrage/wharfage charges, the RR/PWB is required to be produced every day till delivery of the Goods Carried by the Railways are affected.

In case the RR/PWB is dispatched through Bank, the designated Bank has to be contacted forthwith. Payment/Formalities cleared and the PWB/RR are then taken Possession of and subsequentlypresented to the Railways.

**Railway claim**

Claims for loss incurred due to failure of the Railways to provide adequate service-for consignments not insured or unguarded by the consignee can also be preferred when:

(a) Lesser number of packages is received than booked
(b) It is evident that seals have been broken and there is evidence of theft/pilferage
(c) Visible damage of the consignment due to the fault of the Railways

The claims to be made on the spot and a representative of the Railways must be present and authenticate the claims subject to detailed investigation. It does not mean acceptance of the claim as in the case of insurance claims.

**Insurance claims**

Once the claim is accepted, the insurer has to execute a Letter of Subrogation in favour of the Insurance Company. 'Subrogation' means 'Substitution'. The Insurance company having agreed to accept the claim, gets into the shoes of the insurer in respect to the title to the lost/damaged goods. If the lost goods are found subsequently, or if the damaged goods are repaired or salvaged, or disposed of as scrap, the proceeds thereof will accrue to the benefit of the Insurance Company.

**Relative Advantages of Railways**

**Economy**

Railways generally offer very low cost transport, particularly for transportation of bulky goods over long distances.

**Efficiency of Energy**

Railways have an inherent energy efficiency compared to motor transport.

**Reliability**

Railway traffic in general is not seriously hampered by weather conditions or competitive tariff.

**Disadvantages**

(a) Rail tariff is comparatively uneconomical for small shipments and for haulage over short distances.
(b) Terminal handling facilities are costly.
(c) The inflexibility of terminals (rail yards) renders it unsuitable for haulage to remote stations.
(d) The time schedules are inflexible.
(e) In many terminals, such handling facilities are not even available, which adds to the cost.

## The strengths and weaknesses of rail transport

***Strengths***

1. High average speeds for journeys in the range of 50 to 300 miles.
2. Rail in the majority of cases runs from city centre to city centre, which can cut journey times.
3. The railway effectively utilizes land space. Over any strip of land of a given width, the railway can carry more passengers and freight than any other land-based system.
4. The general public perceive railways as being less environmentally adverse, both visually and as regards physical pollution, than other forms of transport.
5. The bulk-handling capacity of the railway means they are very cost effective when handling bulk materials in coupled train loads thus relieving the road system of large numbers of heavy trucks.
6. The railways are energy flexible and energy efficient. The use of electric traction relieves the railway of reliance on oil for energy.
7. The safety record of railways is good especially for the carriage of hazardous cargo.
8. There is great scope for the full automation of the rail network including the possibility of driverless trains.
9. Of all the land-based modes of transport the rail system is the least affected by bad weather.

**Weaknesses**

1. The financial viability of any rail network is vulnerable to downturns in economic activity. In recessionary times the volume of traffic using the system may reduce sharply whereas the fixed costs of operating the infrastructure will remain.

2. As the railway has a fixed and therefore inflexible infrastructure it is economically vulnerable to major changes in the industrial and social activity of a given geographical area.
3. The railways suffer from the need to trans-ship from rail to other modes of transport for some part of the journey. The result is that rail is efficient over longer journeys when the costs of trans-shipment can more easily be absorbed and where the time element may be less significant.
4. As a labour intensive and often unionized industry any rail network is susceptible to industrial action. Where industrial disputes occur regularly and with little warning this has the effect of discouraging clients from using these services.

**ROAD TRANSPORT**

Road infrastructures are large consumers of space with the lowest level of physical constraints among transportation modes. However, environmental constrains are significant in road construction. Road transportation has an average operational flexibility as vehicles can serve several purposes but are rarely able to move outside roads. Road transport systems have high maintenance costs, both for the vehicles and infrastructures. They are mainly linked to light industries where rapid movements of freight in small batches are the norm..
Road Transport is an essential element in the infrastructure of all facets of economic activity. Farmers' produce, dairy products, etc find a ready market in the urban and semi-urban areas, thanks to a network of rural roads in the backward and hitherto unaccessed areas. It has increased movement as well as productivity and opened up the market at national and international levels. Basic amenities like medical facilities and primary education have been made available to remote villages.

At this juncture it must be noted that throughout the underdeveloped world a concerted effort has been taken by all governments to develop roads through the length and breath of each country. Four-lane, six-lane, eight-lane roads are required for uninterrupted traffic flow across countries and adjoining nations for economies on:

(a) More haulage
(b) Reduction of waiting/breakdown/downtime.

**Road Freight Index (RFI)**
Every Country has developed a system for determining day to day Road Freight Index.
The Nigerian Road Freight Index is an index of weighted average freight rates complied across various routes, similar to a stock market index.

It displays past and present freight rate trends. By analyzing these trends, future forecasts of freight rate trends can be made accurately. It indicates of various economic variables that affect the freight rates and shows the relationship that exists between freight rates and these variables.

**FORMS OF ROAD TRANSPORT**

**Common Carriers**

Common carriers operate vehicles on hire basis over the road. They take responsibility for safe transit and for loss or damage while the goods are in their possession. They have a particular lien (as distinct from a general lien) over the goods until the freight and other charges are paid. In other words they have the same rights and responsibilities as a bailee in respect of the goods handed over to them for transport

There are three modes of paying the freight, i.e. pre-paid, to pay, and to be billed subsequently. The third arrangement is in effect a credit facility for the freight amount usually extended to the consignor as a regular customer, but it has to be borne in mind that in this case, the lien is lost once the goods are handed over to the consignee.

The shipment can be made as smalls, They can also be full truckloads. LTL shipments are picked up from a number of customers, or are delivered by customers at transporters premises/terminals. The normal capacity of a full truckload is 10 tonnes. Naturally, the extra handling of LTL consignments increases the unit rate of transportation compared to that of full truckloads.

**Local Cartage**

The typical activities of a local cartage operator include.

(a) Picking up shipments of size varying from a single parcel to truckload quantities, from a plant or warehouse and delivering them to local customers.
(b) Interlinking with other modes of transport, like rail or air.
(c) Providing dedicated trunks for certain customers.
(d) Providing special equipments, like trucks with hydraulic tailgates, trucks with booms, float trailers for carriage of heavy equipment etc.

**Private fleet**

Any organization owning its own vehicles can restrict it to carrying its own goods and operate it at a lower cost provided there is sufficient volume. Apart from lower costs other intangible benefits of private fleet are timely delivery, responsive service, low product damage, better customer service, publicity etc.

**Booking of goods by road**

As in rail transport, the owner has to first declare his intention to get his goods transported by executing a document called the Forwarding Note. The document of title to the goods or the Carrier's Receipt is called in this case Goods Consignment Note (GC Note or simply CN) or Lorry Receipt (LR).

The consignor gets the Consignor Copy of the LRCN. The consignor's copy, which is a quasi-negotiable instrument, is sent by the consignor or negotiated through the bank. The details of the procedure involved in retrieving the documents and taking delivery of the goods are similar to those followed in the case of rail.

**Dedicated Carriers of small consignments**

All over the world a transportation system has developed wherein not to speak of a business in- house, but a common householder is not required to go to the railway station or airport to book small consignment/parcels of lesser weight. These organizations have grown and have made their marks in the field by providing yeomen service.

These organizations perform inter-metro, inter-city, inter-district transportation within a state and country as well as air cargo.

**Dedicated Carrier for our dimension cargo**

Like small consignment and Parcel there lies a challenge to the LSCM Practioner when it comes to carriage of over dimensional Cargoes to be carried.

**Important terms and conditions for transport**

The following are some of the important terms and conditions for the transport of goods by road:

(a) A carrier is not bound to move goods by any schedule or vehicle, or guarantee that the goods will reach in time for any particular market.

(b) In the event of delay in the receipt of goods at destination, the carrier cannot be held responsible for loss to the Consignor or the Consignee as a consequence of this delay.

(c) The value of the claim payable is restricted to the actual value of the goods.

(d) The carrier can refuse to carry certain goods or certain classes of goods tendered for despatch.

(e) During the period of transit, the responsibility of the transporter is that of a common carrier, and he is fully responsible for the loss, damage, deterioration etc except when such loss, damage or deterioration occurs due to an Act of God, or other Force Majeure conditions.

(f) Again, at the destination, while the goods await delivery, the responsibility of the transporter is that of a bailee.

(g) If, after termination of the transit, the goods are not removed within the free time, they may be removed at the owner's risk.

(h) If the goods are of perishable nature, and if their delivery is refused by the consignor or the consignee for over 48 hours, the carrier may dispose of the goods by private or public auction.

(i) If the goods are non-perishable, and if the consignor or consignee refuses to take delivery within 30 days, the carrier, may sell the goods by public auction after giving due notice.

(j) The delivery of the goods can be effected only after the surrender of the GC Note, duly discharged by the holder (generally the person to whom the consignment is meant to be delivered ultimately.)

(k) The carrier has the right to reweigh and re-measure the goods at destination if it is found that some error has been committed at the originating station.

**Claims**

The following important conditions must be borne in mind with regard to settlement of claims arising out of road transport:

(a) The claim must be made in writing within seven days after taking delivery of goods.

(b) In case of non-delivery, the claim must be filed within sixty days after a reasonable time for delivery has elapsed.

(c) Upon disallowance of a claim, a suit can be filed in the appropriate court generally within months.

(d) In deciding claims for damages, the carrier gets the benefit of any insurance that may have been taken by the owner of the said goods in transit.

(e) The value of the goods to be paid is equal to the actual value or their invoiced value, or that written in the despatch document.

Pursuit of claims with insurance company has been described already in the context of Railway claims.

**Advantage of Road freighting**

1. **Through movement**
   The most important advantage is the possibility it affords for through-movements, from consigner to consignee, which obviates the necessity of transhipment, excessive handling and possibility of theft, thereby reducing the costs.
2. **Flexibility**
   The operation is more easily controlled. Routes and loading routines can be more easily altered than in any other form of transport. One can arrange one's own schedules, operate night and day, arrange for a multi-drop delivery, and at all times be in complete control of the movement.
3. **Less capital costs**
   This is particularly relevant when one thinks of going in for setting up one's own private fleet.
4. **Fast turn-around**

The use of articulated vehicles, i.e. tractor units with detachable semi-trailers contribute to the advantage of road freighting. The relatively inexpensive trailers and de-mountable bodies can be used as standing storage during loading and unloading, while the more expensive tractor or rigid vehicle is kept fully employed. In order to derive the maximum benefit from this idea of "spotting" the trailer, each tractor should generally have the assured availability of a minimum of three semi-trailers - one at each end of the route and one in transit.

5. **Immunity from industrial action**
   When a company operates its own road transport, it is not affected by strikes etc as in the other modes of transport like Railways, Airways etc.
6. **Adaptability in inter-modal operations**
   The growth of Roll-on/Roll-off (RO/RO) services has provided another advantage in the through-movement of road vehicles without the need for intermediate handling. The RO/RO ships are specially designed to allow the largest vehicles to drive on board and drive off again at the port of destination.

**Disadvantages**

1. Susceptibility to weather and road conditions.
   The most obvious disadvantage is that road freight can be affected by road conditions, inclement weather etc.
2. Unsuitability for very heavy loads
   Secondly, it is more economical to use rail transport for haulage of bulky goods.
3. Unsuitability for long distances
   The telescopic rates offered by the Railways make it more advantageous to use them for haulage over long distances.

**AIR TRANSPORT**

Air routes are practically unlimited. Air transport constraints are multidimensional and include the site (a commercial plane needs about 3,300 meters of track for landing and take off), the climate, fog and aerial currents. Air activities are linked to the tertiary and quaternary sectors, notably finance and tourism that require movements of people. More recently, air transportation has been accommodating growing quantities of high value freight.

Air freighting is regularly used whenever the benefits of fast delivery more than compensates the increased transportation cost. For instance:

High Value Products: These products require less protection because the handling is less rough. The reduced packaging costs and the reduction in in-transit inventory can offset somewhat the increased transport cost.

Perishable Products: Because of the short shelf life of the products such as strawberries and cherries, air-freight is the only means of getting them to distant markets.

Emergency products: Medical supplies and spare parts which are critical for the repair of machinery are transported by air, as they are vital for saving lives and preventing financial losses.
Live Animals: Race and show horses are often air lifted
Fashion Items: Items which have a short sales life must be brought to market before a shift in the demand takes place, dictated by a change in fashion. Air transportation is the solution.
The Carrier Receipt in air transport, corresponding to Railway Receipt and Lorry Receipt in rail and road transport respectively**, is called the Air Way Bill (AWB) or Air Consignment Note (ACN)**. The advent of Unit Load Devices (ULDs) has increased air cargo productivity. An ULD is any unitized freight, or standard container ranging from pallets to special containers or Igloos designed to fit the internal contour of the aircraft. ULDs increase the aircraft cube utilization and reduce cargo-handling time. Because of this, almost half of the air-freighting costs incurred earlier have been saved.

## The Role of IATA

The majority of airlines operating scheduled cargo services are members of International Air Transport Association (IATA). IATA is best known as the medium through which airlines fix a common tariff.

## Air Cargo Tariff Structure

As far as the domestic tariffs are concerned, these are based on the capacity available, market demands, operational economics etc. These are generally approved by the Government.
However, the rating structure in international traffic exhibits a number of complexities. There are different pricing concepts within the tariff structure, and any rationalization, new concepts, changes in rates etc are normally negotiated through IATA machinery, with the exception of rates which are introduced as a result of bilateral agreements between governments.
The major constituents of the current IATA rate structure are the following:

(a) General Cargo Rates (GCR) are applicable to shipments weighing below or about 45 kgs, and constitute the normal rates for cargo transportation. Though they fetch for the airline a reasonable profit, they have become somewhat obsolete now, in the light of the new marketing concepts and the leap-frog improvements in communications and transportation.
(b) Class Rates are surcharged or discounted rates for certain classified items, e.g. valuable cargo, live animals, newspapers, catalogues etc.
(c) Specific Commodity rates (SCR) are heavily discounted rates applicable directionally between two points, such as Lagos to Calaber. SCRs, also called co-rates, account for 70% of the cargo carried out of Nigeria. These rates are market oriented and take into account demand requirements. This approach results in indiscrimination, and is not always related to the cost of transportation. SCRs permit carriage of only the commodities

specifically approved by the IATA carriers, and as such do not render the commodities capable of consolidation.

(d) Freight-All-Kind-Rates (FAK) are different from SCRs in that, they carry a combination of different commodities, and hence favour consolidation. Though this approach is simple to develop and apply, it is not acceptable to many airlines since it implies the virtual sale of the entire capacity to freight forwarders.

(e) Government Mandatory Rates are the rates introduced by the Government by mandatory orders to offer incentives to the export of certain commodities.

## Clearance of Inland Cargo

Since air transport is very fast, there will not be the kind of time available for receipt of despatch documents, and surrendering them against receipt of goods, as in the case of road, rail or ship consignments. The despatch is advised by fax or Email to the consignee and the despatch documents are sent by air along with the goods themselves.

## Consolidation of Freight

In this the freight .forwarder collects a number of consignments from various consigners, books them by air in bulk and passes on a good part of the benefit in freight costs caused by the difference in rates between the unit loads and the LCL to individual consigners. This way the airlines gets assured bulk business and the consigner incurs less freight cost.

In international freight consolidation, the freight forwarder prepares a House Air Way Bill (HAWB) for each individual shipment that he handles. Then he consolidates them, and hands them over to the airline for transportation. The airline issues a single Master Air Way Bill (MAWB) for the consolidated cargo

**Advantages of Air Transport**

(a) Faster mode
(b) Reduction in cost in other logistics components like inventory
(c) Broad service range
(d) Increasing capabilities

**Disadvantages**

(a) High cost
(b) Effect of weather conditions on flight schedules
(c) Limitations in respect of extremely heavy consignments.

**WATER TRANSPORTATION**

Main maritime routes are composed of oceans, coasts, seas, lakes, rivers and channels. However, maritime circulation takes place on specific parts of the maritime space. The Atlantic Ocean is very important since it accounts for 78% of the global trade, 68% of its value and for 75% of the maritime trade. The

construction of channels, locks and dredging are attempts to facilitate maritime circulation by reducing discontinuity. Comprehensive inland waterway systems include Western Europe, the Volga/Don system, St. Lawrence/Great Lakes system, the Mississippi and its tributaries, the Amazon, the Panama/Paraguay and the interior China. Maritime transportation has high terminal costs, since port infrastructures are among the most expensive to build, maintain and improve. High inventory costs also characterize maritime transportation. More than any other mode, maritime transportation is linked to heavy industries, such as steel and petrochemical facilities adjacent to port sites.

**DIVISSION WATER TRANSPORT**

Water transportation is generally divided into inland waterways (rivers, canals, great lakes), domestic coastways and seaways. Water transport is resorted to for high bulk, low value commodities because of low cost per tonne kilometer, which is of greater importance than speed of delivery. Basic bulk commodities and raw materials such as iron ore, coal, chemicals, petroleum products, cement etc are extensively transported by this mode.

**Ships**

Water transport majorly makes use ships in conveying goods. There are two kinds of shipping services:

(1) Liner, and
(2) Tramp.

The types of ship used are given below:

- Container Ships/ box boats
- Tankers
    - Crude oil
    - Product
    - Chemicals
- Bulk carriers
- General cargo ships
- Cable layers
- Offshore supply vessels
- DP (Dynamically Positioned) Ships
- Ferries/RORO (roll on- roll off)
- Gas carriers
- Car carriers
- Tugboats
- Dredgers
- Barges

**Liner conference**

A liner conference is a group of two or more vessel-operating carriers which provides international liner services for the carriages of cargo on a particular route or routes within specified geographical limits on uniform or common freight rates

and on other mutually agreed conditions. There are over 360 liner conferences all over the world. The advantages of liner service are that it provides:

(a) Regularity of sailing to scheduled ports of call
(b) Stability of freight rates for a relatively long period of time which enables shippers to quote CIF prices
(c) Uniform rates for all shippers
(d) Coverage of a wide range of ports, and
(e) Rebates on freight rates based on loyalty arrangements.

**Freight Rates**

Conference Rate Making: One of the most important activities of a conference is the preparation, publication and revision of conference tariffs. The tariff usually contains a list of rules and regulations regarding proper application of the tariff. Rate-fixation is a complex process, which has to consider factors like character of the cargo, volume of the cargo, its value, availability, distance, packing, susceptibility to pilferage, storage, density, competition, handling costs, insurance charges, direct and indirect costs, fixed costs, port facilities, port regulations, port dues, possibility of return haul etc.

Apart from the above, the two main factors (which always govern the fixation of any freight rate) which must inevitably be considered are

(a) Competitiveness and the ability for the cargo to bear the cost on the one hand, and
(b) Economic viability of the proposition, from the carrier's point of view, on the other.

**Loyalty Arrangements**

While the conference specifies the freight rates through rate agreements which specify the conditions under which the signatories to the agreement have to charge the freight rates, "loyalty arrangements" are possible whereby certain rebates can be allowed by the Conference to the shippers for their exclusive patronage of the Conference members. There are three rebate systems in practice for this purpose:

(a) Deferred Payment System: A shipper who utilizes exclusively the vessels of the member lines of the Conference for the carriage of cargo between the ports covered by the Conference will receive a certain percentage (usually 10%) of his freight payments. The rebate is computed for a designated period called "Shipment Period" which is usually three to six months but is paid after a certain period called "deferred period" of the same duration following the shipment period, on the condition that the shipper has given his exclusive support to the conference lines, both during the shipment period and the deferred period.
(b) The dual rate system: Shippers who sign an exclusive patronage contract with the conference get the benefit of lower rates compared to those applicable to the shippers who are not on such contracts.

(c) Immediate Rebate system: In contrast to the Deferred Rebate System, shippers under the Immediate Rebate System are given cash or immediate rebate (usually 9.5%) of freight on payment of freight for their cargoes. This rebate varies from conference to conference.

**Tramp Shipping**

The term Tramp Shipping refers to chartering of ships on an 'ad hoc' basis. Tramp ships operate in all parts of the world without a fixed shipping route and sailing schedule in search of primarily bulk cargo carried generally in shiploads. Ships are chartered in one or other of the following forms:

(a) Voyage Charter: The ships are chartered for a specific voyage. Traders normally opt for this type of charter.

(b) Time Charter: The ships are chartered for a specific period of time, e.g. from 1st January to 31st December of a calendar year. This charter may employ the ship in voyage according to his requirements. The time charterer is a long-term rate, whereas the voyage charter is a short-term rate.

(c) Demise Charter: In both types of charters mentioned above, the consideration includes the rates for the crew, fuel and other operational requirements, which are provided by the owner of the ship. In the case of the demise charter, also called Bare Boat Charter, the charterer himself equips the ship with floating personnel, fuel and other necessities and operates the ship. Normally a ship owner or prospective ship owner may prefer this method.

**Cargo shipment by ships**

(a) General Cargo: General cargoes are of high value, not requiring carriers of any special dimensions. These form the mainstay of international trade. These cargoes are carried generally on liner terms by break-bulk conventional vessels. Developed countries like USA, European countries, Japan etc have recently gone in for unitization and pressed unit loaders into service, notably cellular container ships, i.e. ships designed to carry containers, to carry such cargo, because of scarcity of labour and high cost of operation. This is a capital intensive method which increases the productivity and saves costs in the long run, though the initial investment is bound to be heavy for the building of necessary infrastructure, including large container parks, port equipment like gantry cranes, construction of proper roads, strengthening of bridges, designing of special rail wagons for inland transport etc.

**(b)** Containerisation: will be explained later.

**PIPELINE MOVEMENT**

A pipeline is an ideal means for transporting large quantities of liquids and gases over long distances. They have also gained importance in the transportation of

solids), particularly of coal, iron ore, limestone, copper concentrates etc. Pipelines are now the main mode of transport for petroleum products, gases, crude etc.
Major advantages of this mode over other modes are as under:

(b) Energy consumption is least in Pipeline transportation and it is most suited mode of transportation for conservation of energy.
(c) Cost of transportation is least, for large volumes and over long leads.
(d) Pipeline transportation is highly environment friendly. Its impact on environment during the stages of construction, operation and maintenance is negligible, compared to other modes.
(e) Safety is an intrinsic feature of pipeline transportation. Vagaries of nature like floods, breaches etc. do not disrupt pipeline transport systems.
(f) In pipelines, the carrier is stationary. Thus, the wasteful use of energy and infrastructure for transportation of empty carrier (as happens in the case of rail and road transportation) is totally avoided.
(g) Petroleum products are volatile in nature. Thus, handling of products results in evaporation losses. In the case of rail and road, such losses are as high as 0.3 to 0.5% of the volumes transported. In comparison, transportation losses in pipeline are only about 0.1%.
(h) While railways need different types of wagons for different classes of products, a single pipeline can transport a large number of products. The developments in technology would also allow transportation of propane and butane in the same pipeline making this mode still more versatile.
(i) Increase/decrease of transportation volume can be effected in pipelines with lower time delay. diturbance and cost. Quantity variation within certain limit is possible without compromising on safety, economic and operational considerations.
(j) Pipelines can traverse highly difficult terrain where laying railway lines would be almost impossible.

**Disadvantages**

(a) The most obvious disadvantage lies in the fact that this means cannot be used for transportation of all solids, heavy equipment etc.
(b) The initial costs of laying the pipeline are very high
(c) Prone to sabotage in disturbed areas.

**INTENODES TRANSPORT**

This is the transportation or movement of raw materials or finished goods from one holding facility (say warehouse) to another holding facility with the aid of appropriate carriage facility (say Train, Ship or Lories).It involves moving of materials between two node in the warehousing echelon .This movement may be between the central warehouse and the regional warehouse or between a regional warehouse and another regional warehouse. For the movement of the materials to

be executed in according with the planning LEAD TIME of delivery, it is necessary to use some international intermodal equipment that facilitate easy transfer of container from one carriage facility to another. These equipment are discussed below.

## INTERMODAL EQUIPMENT

The following section is designed to provide an overview of the various types of equipment specifically used in intermodal transport. The list is not exhaustive but the most common equipment will be identified and described briefly.

### Intermodal containers

### ISO containers

ISO containers are so called because the International Standards Organization has standardized the design of containers to allow for the widest possible use of this equipment around the world. Containers are usually rectilinear boxes constructed of steel. Open-topped versions, which are covered by a fabric curtain, these are available for loads that may not fit into a standard container. Another common variation is the tanktainer, which is a steel frame that conforms to the ISO dimensions but has a tank container fixed inside the frame. This allows bulk loads of liquids or powders to be carried by intermodal carriers. Refrigerated and flat-rack options are also available.

The most common sizes of container available are 20 feet, 40 feet and 45 feet in length. The height and width dimensions are the same for all lengths at 8 feet wide by 8 feet 6 inches high, although high-cube containers at 9 feet 6 inches high are becoming increasingly common. As with most rules, exceptions do exist, but these are the most commonly used dimensions.

Two acronyms used widely in intermodal circles are TEU and FEU. The initials stand for 'twenty feet equivalent unit' and 'forty feet equivalent unit'. They are often used as definitions of cellular container ship capacities. A ship may be described as being able to carry 6,000 TEU. The twenty feet equivalent unit refers to the 20-feet container.

### The swap-body

This is a type of container used primarily on bimodal intermodal operations, which use the road and rail modes of transport. The swap-body is a self-supporting body that has supporting legs that may be folded away when not required. Swap-bodies conform to different international standards. There are three standard lengths of 7.15 metres, 7.45 metres and 7.82 metres. These lengths are used because the swap-body will be carried by road transport for part of its journey and must conform to the strict requirements pertaining to vehicle dimensions The swap-body is transferred from road vehicle to rail wagon by means of an overhead straddle

crane, which has four arms that locate into slots permanently fixed to the bottom of the swap-body.
A further version of the swap-body is the caisse mobile. This is 12 metres or 13.6 metres long, which conforms to European Union dimensions for articulated semi-trailer lengths. Caisse mobiles do not usually have self-supporting legs but very often are able to be top-lifted in the same way as ISO containers. Unlike ISO containers, most swap-bodies cannot be stacked.

**Road-Railer trailers**

Road-Railer is the brand name for a method of effectively converting a road-going articulated semi-trailer into a rail-going rail wagon. This is achieved by placing a railway bogie under the rear of a specially designed road semi-trailer. This same bogie attaches itself to the kingpin of the following road trailer. This process is repeated until the train is complete. The road wheels of the semi-trailer are mechanically retracted to prevent them from interfering with the movement of the train. This system does not require specially adapted rail wagons and allows for a more rapid transfer of vehicles from road to rail. It does require that the road vehicles are specially designed for the purpose.

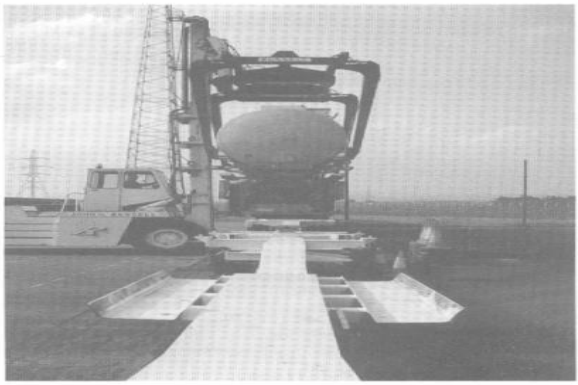
**Unaccompanied trailers**

Unaccompanied road semi-trailers may be used to send goods by roll-on roll-off sea ferry (RORO). This method does not require any adaptation of the road trailer and avoids the added cost of sending the tractive unit and driver with the trailer. This is important, as tariffs on shipping services usually relate to the length of the vehicle. Therefore unaccompanied trailers will be shorter and cheaper. The unaccompanied trailers are moved on and off the ferry by means of a motive unit (often called a tug) fitted with a hydraulic mechanism for attaching to the front of the trailer and lifting the semi-trailer without the need to raise the landing legs. This speeds up the operation at both ports.

Another effective use of unaccompanied trailers is called piggyback. This uses the same principle as the road—sea version but applies the principle in a road—rail context. In this situation, unaccompanied semi-trailers are carried on specially constructed rail wagons. Because articulated road semi-trailers tend to be higher at the front than at the rear, a specially constructed well in the rail wagon allows the landing legs to sit at a lower level than the rear wheels. This has the effect of making the trailer sit on the rail wagon with the roof at an overall even height to the ground. The French have dubbed this method ‘ie kangarou’ because of the well being likened to a kangaroo’s pouch.

The problems caused by the landing legs and the road wheels are effectively overcome by a recent development known as the spine rail wagon (see the Figure below). In this system road trailers are loaded on the rail wagon with the road

wheels and landing legs either side of a central spine on the rail wagon. This allows the semi-trailer to sit squarely on the rail wagon and reduces the overall height. The spine wagon is also able to carry ISO containers. In the figure below, the twist locks for securing ISO containers are visible, which demonstrates the versatility of the system.



**Spine wagons being loaded by a reach stacker equipped with a grappler**

These methods of unaccompanied transport have been in use for some time and are not always thought about when intermodal transport is discussed. However, they do fit the strict definition of intermodal transport above and use effectively the road, rail and sea modes.

# Intermodal handling equipment

## *Ship to shore gantry crane (SSGC)*

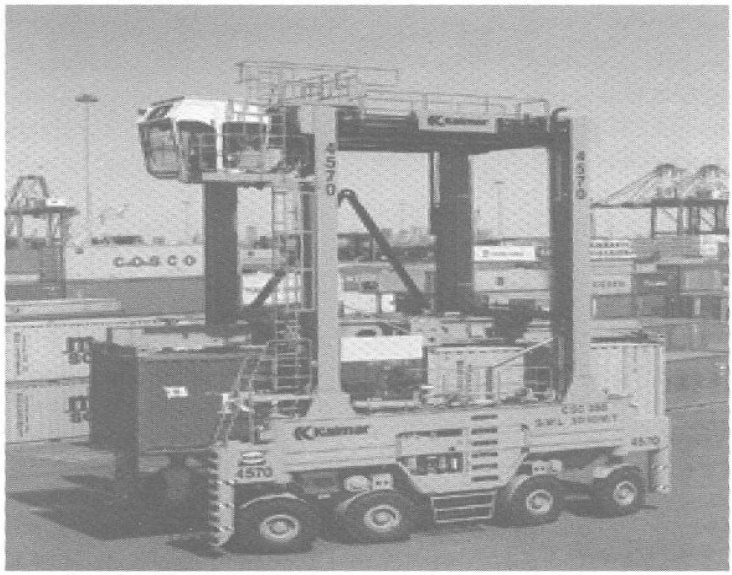
These are large devices mounted on rails, which are able to speedily transfer containers from the sea-going vessel to trucks or rail wagons. A large boom spans the distance between the ship's cargo holds and the quayside. The ship to shore gantry crane is capable of moving along the quayside parallel to the ship's side to aid positioning

***Grappler lift***

This is a similar handling vehicle to the gantry crane except that it is fitted with four arms and is designed specifically to handle swap-bodies. The arms locate in the special slots built into the bottom of every swap-body. The grappler lift straddles the vehicle, positions the four arms and then lifts the swap-body.

***Gantry (or portal) crane***

Sometimes referred to as a straddle carrier, this is a crane designed to lift containers and swap- bodies (see the Figure below ). It has four legs, one at each corner, with wheels at the bottom of each leg. It has the ability to straddle rail wagons and road vehicles. It is able to transfer containers and swap-bodies quickly from road vehicles to rail wagons and vice versa. It is equipped with a spreader beam that has a twist-locking device at each corner, which locates in the corner casting of the container. The spreader beam is able to move in several directions to aid accurate location either of the spreader beam prior to picking up the container or when positioning the container on a road vehicle or rail wagon.




**Gantry crane moving ISO containers**

**Reach stacker**

This is a heavy-duty material handling truck that is fitted with a lifting arm and a spreader beam. It is capable of lifting containers and swap-bodies (only if the swap-body is equipped with twist locks on top). It can be used to load and unload road and rail wagons (see the Figure above). It can also be used to stack containers one on top of the other and to reach over a row of stacked containers. Empty containers can be stacked up to eight high using specially equipped lift trucks.


**Reach stacker handling an ISO container**

# Intermodal vehicles

# Sea

## *The cellular container ship*

This is a custom-built sea-going vessel for the carriage of containers. The containers are loaded one on top of the other and guided into position by the means of vertical guides at each corner of the container, This aids the process of loading, as the guides position the container accurately enough to preclude the need for any further manoeuvring once the container is released by the overhead crane, It also eliminates the potential problems caused by the vessel listing or the crane not being accurately positioned. Once in position, the containers are secured together by means of a twist-locking device. The stacks of containers are also secured by means of deck lashings for added stability during the sea journey. Containers may be stacked four or more high above deck level. This ability is limited by the structure and stability of the vessel, Owing to the cubic nature of the container load, which is at odds with ship design, some vessels carry other cargo in the spaces in the holds created by the squaring- off effect. The service provided by these vessels is sometimes referred to as LOLO (lift on lift off)

***The roll-on roll-off ferry (RORO)***

This type of sea vessel is designed to carry road vehicles. The vehicles are either driven on to the vessel by the driver or, as in the case of unaccompanied trailers, by port-based vehicles. This allows unaccompanied vehicles or trailers to be delivered

to the port of departure and then collected from the port of arrival. International freight using the RORO system has grown significantly in recent years..

**River barges**

On large inland waterways such as the Rhine/Danube in Europe and the Mississippi river in the United States, there is considerable use made of the water as an artery of transportation. Roll-on roll-off facilities and container transport as well as break-bulk cargo facilities are available and cannot be forgotten when considering long journeys using different modes of transport. This type of transport is useful for non-urgent freight, as it is by definition slower than other modes.

# Rail

It should be noted that a movement of freight that uses both road and rail to complete the journey is sometimes referred to as combined transport.

***Rolling motorway***

This is the rail version of the roll-on roll-off sea ferry. Vehicles are driven on to specially designed rail wagons by their drivers. In some cases the drivers stay with their vehicles and in others they are accommodated in a passenger car for the duration of the journey.

***Ferrywagon***

This is a conventional rail wagon that is capable of being loaded on to a train ferry.

# Road

***Skeletal trailer***

This is an articulated semi-trailer that is designed to carry ISO containers. It is fitted with twist locks at various points on the trailer to allow the carriage of different sizes of container. It is called a skeletal trailer, as it does not have any loading platform as such. It is a framework designed to support containers alone. In effect the containers become the body of the vehicle when loaded on to the trailer.

Some skeletal trailers are equipped with hydraulic rams to facilitate the tipping of the container. Some granular and powder products may be carried in ISO containers. The product is loaded through the top of the container via a special hatch, and the product is retained by means of a plastic liner inside the container. At the point of delivery the container is tipped up by the hydraulic ram and the product is allowed to flow out of another hatch set in the rear of the container. In some cases this process is assisted through the use of pneumatic conveyance.

***Extendable trailers***

These trailers are sometimes called ‘slider’ trailers because of their ability to be extended or shortened depending on the size of the container to be carried. In all other respects they resemble skeletal trailers.

**CHAPTER FOUR**

# CONTAINERISATION

Containerisation, which today comprises 85% of the general cargo market in the world, made its humble beginning using a modified World War II T-2 tanker. It provides today the most cost-effective and efficient service and has constantly adapted itself to the needs of the shipping world. During the 60s and 70s the liner cargo trade was constantly modernized to exploit the economies of scale through high capacity tonnage, resulting in cellular vehicles of various capacities such as 75OTEUs, I500TEUs, 3000TEUs, 4000TEUs, 6000TEUs. For ship owners today, containerization is the only means of survival.

TEU = Twenty Equivalents Units

**UNIT LOAD**

Acontainer which comprises different unit of load ranging from a single unit to a carton (charaterised by dozens of units),a pallet load (characterized by dozens of carton ),a fully loaded container (charaterised by dozens of pallet load) are all seen as a unit load.The act of systematically bringing these different unit of load together to form one large unit of load is called **consolidation of loads.**

To save time and handling costs, cargoes are consolidated into as large a unit as possible such as 5 tons, 10 tons, 20, tons etc. This helps productivity in cargo handling by displacing labour which is scarce in certain countries.

**CONTAINER**

The container is an equipment used to store and carry goods. According to the International Organization for Standardisation (ISO) freight container is defined as an article of transport equipment which is:

(a) of a permanent character and can be repeatedly used,
(b) can be carried by one or more modes of transport,
(c) should be fitted with ready handling devices, particularly for transfer from one mode of transport to the other,
(d) easy to fill and empty,
(e) have an internal volume of 35.3cu.ft or more.

**CONTAINER CLASSIFICATION**

Though most containers are made of steel, aluminium or GRP (glass fibre reinforced plywood), almost 65% of the entire fleet presently consists of steel containers.

Regarding dimensions, containers are defined in multiples of feet. Presently 20ft and 4Oft containers are used predominantly, with 2Oft comprising 65-70% of containers. Most containers have width of 8ft whereas height varies between 8ft

and 8.5 ft. It is now globally acceptable practice to account to containers Twenty Equal Units (TEU).

There are three types of 'classification by use' viz

(a) The General Cargo Container — does not require temperature control.
(b) The Thermal Container — requires refrigerated or insulated storage.
(c) Special Containers — prominent types among these are bulk containers, tank containers, open top containers, side open containers, flats, car containers, pen containers (to carry livestock).

# Leasing

Containers are taken on lease by carriers from container manufacturers or owners. There are four types of leasing arrangements:

(a) Trip lease or short term lease,
(b) Long-term lease (3years to 5 years),
(c) Financial Lease — a hire-purchase or installment purchase scheme,
(d) Master lease — a deal between ship owner and leasing company for 1-2 years wherein the ship owner guarantees a container leasing company that a minimum number of containers will always be under his lease.

**MULTIMODAL TRANSPORTATION**

In today's logistics operations Multimodal Transport has assumed a newer dimension as a result of the far reaching impact of containerization. In simple terms, multimodal transport means transportation of cargo from the consigner's premises to the contracted place of consignee by more than one mode of transport under a single contract evidenced by a single transport document, a through freight rate and a through liability. When the multimodal operator issues his own documents he assumes responsibility for the execution of the entire chain of transport by using different modes till the cargo is finally delivered at the final destination. He is the one who will be entering into a separate contract with different carriers, transport operators/airlines etc. This modern concept in transportation is very much in demand in almost all the developed countries and in keeping with the liberalization for boosting the economy. The entry on expanding scale in international transport of goods, of operators who are not carriers themselves, represents a major institutional change in the traditional transport process and impels one to pause and ponder. This could happen after the U. N. Convention of Multimodal Transportation of Goods in 1980 which stated: "International Multimodal Transport means the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country at which goods are taken in charge by the multimodal transport operators, to a place designated for delivery." Intermodal or multimodal is a relatively new concept in LSCM Process and undoubtedly goes hand in hand with containerization. The international multimodal transport system functions

through one company offering combined, or multimodal transport services. It can be characterized as:

(a) The transport operation is international in that it crosses the boundaries of two countries or more.
(b) The transport operation utilizes at least two modes of transport.
(c) The transport operation is from the exporter's stores to the consumer's stores.
(d) The responsibility for the whole transport operation in all its stages is shouldered by the multimodal transport operator.

Multimodal transport is not an entirely new idea. Owners and receivers of the cargo in the course of international trade have always used two or more modes of transport. What is new is the recognition that a systems approach was required for achieving the efficiency of movement and the overall economics of transport through considerable savings in transit time and prevention of pilferage and damage to goods on route. It would also mean that the requirements of the individual mode of transport have to be subordinated to those of the integrated transport system.

The basic objective of multimodal transport is to move cargo from the origin to the destination in the minimum possible time at the minimum cost, using combined modes of transport and resorting to trans-shipment of transfer links which can contribute toward the achievement of the objective. Thus, it is not only a mechanical exercise of transferring goods from one mode of transport to another, or from one carrier to another carrier, but implies a coordination of their various functions, the willingness to abide by the rules of the game, to accept liability in case of damage or loss of goods, to deliver the goods in time or pay suitable compensations for delays, and in short, give total integrated transport service to the shipper. The multimodal transport services are by no means cheap. The charges can be fairly high but taking into consideration the cost of time and the total economy in transport, the shipper feels it is still preferable.

Multimodalism makes it possible to ship the goods from the inland centers, right under the supervision of the exporter or the consignor. It enables quicker realization of the sale proceeds because the combined transport document which is in the nature of a Bill of Lading, can be encashed as soon as the goods are handed over to the MTO. It ensures safer movement of goods because the good are packed according to the needs and requirements of the consigner and the consignee, and sealed in the container. Chances of pilferage or damage during transit are minimized, and last, but not the least, there are several savings in the total cost of transportation, including the cost of packaging and the cost of time.

Multimodal transport basically needs a set of conditions and a conducive environment to succeed. The volume of the international trade of the country should be large enough and the composition of the goods in the export/import basket suitable to justify the setting up of Inland Container Depot/Container

Freight Station facilities in the hinterland, away from the gateway ports. The transport infrastructure of the country should be modern, efficient and capable of expanding and modernizing along with the growth of multimodal transport, and handling equipment should be compatible to facilitate interchangeability. The procedure should be simple and uncomplicated to facilitate quicker clearance of goods. The laws and rules governing multimodal transport should be fair and equitable to all concerned and compatible with the international rules, conventions and practices.

Multimodal transport system is best suited to Nigeria conditions on the first two counts, Its exportimport basket is varied and consists of hundreds of commodities. Only a few bulk commodities like minerals and ores, petroleum products, cement and iron and steel of long lengths and heavy lifts are not immediately suitable for containerization. But the rest of the general cargo, both imports and exports comprising machinery, components, intermediates, tools, products of agro-based industries and the wide range of manufactured goods now being exported are suitable for containerization.

**Advantages of Multimodal Transport**

The immediately visible advantages of multimodal transportation systems are:

(a) Reduction in loss of time and risk of loss, damage and contamination incidental to segmented transportation.
(b) To the buyer, the timely arrival of goods would reduce the disadvantages of large inventory.
(c) Cost savings because of single point responsibility.
(d) The through rate' offered by the Multimodal Transport Operator (MOT) makes it easier for the seller to negotiate sales contracts with the buyers on the basis of delivered price.
(e) The M. T. documents issued by the multimodal operators are negotiable at an inland point, thus saving time and money.
(f) Insurance cost can be considerably reduced as the MTO is made accountable for most of the lapses based on the present Act.

**Freight Rate Structure and Shipping Regulations**

Every container transport is governed by the freight rate structure and shipping regulations established by each trade route or by each line conference. The structure of rates and regulations for sea and land transport are well formulated.

1. **Land transport system for containers** — Selection of inland transport operator. In general the inland transport services are provided by the following operators:

- Rail, truck operator
- Forwarder
- Sub-carrier of shipping companies providing services as ancillary to sea transport or land transport operator approved by the conference rules.

- International multimodal operators

Selection of proper operator has to be made considering user's cargo volume, capability of the operator to arrange inland transport etc. There may be certain constraints from administrative systems or policies on domestic transport in each country or from the nature of relative liner conferences or various terms of their container rules. These should be considered while selecting the operators.

**2. Freight structure on land transport**

As a checklist commonly applicable to rail and truck transport the following points are to be noted:

**Checklist for land transport**

- Check the details of charges for empty container haulage and the contents of the interchange agreement applicable in the exchange of containers between the carriers
- Whether or not the freight is assessed on the tare weight of container

**Checklist for rail transport**

- Whether or not discount system is available and if so its contents (volume discounts, or frequency discounts).
- Method of loading container onto rail car. Availability of trailers in the case of "Trailer or Flat" car.
- Arrangements for connecting road transport (pickup and delivery.) Availability of such pickup and delivery services by road before or after the rail transport.
- Who is to absorb the drayage charges between the ship side and the rail car
- Maximum payload of rail car.
- Maximum payload of container.

**Checklist for road transport**

- Free time allowed for trailers and detention charge.
- Whether the driver or his assistant perform loading or discharging of cargo to or from trailers or whether the shipper is to make the arrangement.
- Relationship between the trailer rental and the road transport charges
- The weight or height of container as against the limitations under the road transport regulations.

**WHAT IS PACKAGING?**

There are overall two types of packaging: consumer packaging or interior packaging; and industrial or exterior packaging. The marketing manager is mostly concerned about the former because consumer or interior packaging provides information important in selling the product, in motivating the consumer to buy the product, or in giving the product maximum visibility when it competes with others on the retail shelf.

On the other hand, industrial or exterior packaging is of primary concern to the LSCM manager. This packaging protects goods that a organization will move and store in the warehouse and also permits the organization for effective use of transportation and economical use of vehicle space. It also has to provide information for handling ease.

## CHAPTER FIVE

## TRANSPORTATION OF HAZARDOUS GOODS

**Scope**

This guidance addresses security considerations that are relevant to the transportation of hazardous materials. This guidance generally applies to all modes of transportation (highway, rail, marine, air, and pipeline) and to the shipments of all hazardous materials, including chemical waste.

**Transportation Security Guidelines 1**

Analysis of security threats, vulnerabilities, and consequences builds on current industry activities taking place through the implementation of the Responsible Care Distribution Code and the Responsible Distribution Process. For example, Distribution Code activities call for evaluating chemical distribution risks and provide a framework to implement risk reduction measures, while this document looks at these same items from a security perspective.

The implementation of the guidance will vary according to the chemical being distributed, the mode and route of transportation, the activity involved, and the current practices of the company. This guidance does not attempt to provide an all-inclusive list of transportation security considerations for chemical companies, but does provide examples of types of activities companies may wish to pursue in evaluating and implementing transportation security measures. Furthermore, it is important that companies coordinate and communicate security procedures with their carriers and others involved in the safe and secure transportation of their products.

Chemical transportation encompasses activities that take place both inside and outside of chemical facility gates.

**Benefits of a Chemical Distribution Security Effort**

By investing resources in security efforts, managers can help their companies enhance safe and secure hazardous materials transportation. Maintaining good security protects employees, the environment, and the community; provides operations integrity and effectiveness; improves relationships with local authorities; and provides a mechanism for personnel control and accounting in the event of an emergency.

**Sensitive information**

Given that some of the material generated as part of security assessment efforts can be extremely sensitive, care should be taken to ensure that appropriate precautions are taken to protect the information. This could include items like restricted distribution of the information, secure e-mail, secure phone conferences, etc.

**Transportation Security Guidelines 2**

**RISK-BASED TRANSPORTATION SECURITY ASSESSMENT**

Risk management is the key to an effective transportation security program, and is not a new concept for the chemical industry. Since 1990, the Responsible Care Distribution Code of Management Practices has called for each Nigeria Chemistry Council member and each Responsible Care Partner to have an ongoing chemical distribution risk management system. Since then other associations have adopted similar initiatives. Various tools have been developed to address transportation risk management, and the concepts contained in those tools can be extended to transportation security issues, including threats posed by deliberate acts of sabotage and terrorism against products while enroute transportation network.

Since chemical companies routinely perform many different evaluations and assessments, this guidance attempts to build on those existing practices to provide a tiered approach to risk-based assessment. A tiered, risk-based approach is the most effective and efficient way to evaluate, identify and prioritize potential security threats. A tiered approach starts with simple evaluation techniques, usually qualitative in nature, and identifies areas in which more information would be useful to reach a risk-based conclusion. A tiered approach also helps identify the proper resources that should be directed to transportation security based on the identified threat level.

Distribution risk management programs can be divided into two primary components:

- Risk Assessment — evaluation of chemical distribution risks; and
- Risk Reduction-- identification, development and implementation of risk reduction measures that are appropriate for the level of risk.

The transportation security guidance contained in this document is based on a seven-step process that addresses both components. This process describes one way companies could perform a risk-based transportation security assessment. Many practices performed by companies on a regular basis could easily be incorporated into this approach. This is not a prescriptive approach; instead, it is a suggested flow of thought and information. It is entirely conceivable that one or more steps would not apply based on a company's existing programs.

**Transportation Security Guidelines 3**

It is up to the assessor to use professional judgment and determine the appropriate areas to be addressed. The process includes:

1. Chemical listing
2. Chemical hazard ranking
3. Exposure ranking
4. Prioritizing risks
5. Conducting risk reviews

6. Developing and implementing risk reduction alternatives and preventative measures
7. Updating the process

Steps 1-4 relate to shippers evaluating their activities in terms of chemical hazard and exposure potential to prioritize areas for more detailed security risk reviews. Steps 5-7 relate to outcomes based on the security risk reviews. These steps will be discussed in detail in the sections that follow.

**Step 1: Chemical Listing**

To begin the process, the shipper should compile a list of transported chemicals for evaluation.

**Step 2: Chemical Hazard Ranking**

Once the list is completed, a hazard ranking process can be used to identify and rank those chemicals that may have the potential, due to their inherent nature, to adversely affect people and the environment, or be prone to deliberate attacks or acts of sabotage.

The approach to chemical hazard ranking can be as fundamental as using existing classification systems such as those established by the U.S. Department of Transportation. Other ranking systems can be developed based upon multiple factors such as:

- Flammability Vapor Pressure
- Explosivity Reactivity
- Toxicity. Corrosivity/.
- Asphyxiant

Potential diversion and misuses of products, as weapons, or in chemical or biological warfare agents, should also be considered. Special attention may also be given to highly hazardous products, e.g. materials that are regulated as poison inhalation hazards, flammables or explosives.

**Transportation Security Guidelines 4**

The purpose of this process is to facilitate a relative hazard ranking, which can be as simple as sorting chemicals into low, medium and high hazard groups.

**Step 3: Exposure Ranking**

This next step is to consider and rank the exposure potential of product movements to the public and the environment, focusing particularly on those shipments that may be prone to deliberate acts of sabotage or terrorism. Factors that may be considered, singly, or in combination, in the ranking include:

- Predictability of shipments
- Proximity to significant landmarks
- Proximity to public events
- Number of trips
- Chemical volume per shipment
- Trip distance
- Population centers traversed Environmental considerations

- Bulk vs. non-bulk
- Placarded vs. non-placarded loads
- Proximity to very high population densities

It is usually not necessary to develop considerable detail in this step. As with the hazard ranking (Step 2), the goal is to establish a simple relative ranking of exposure potential.

**Transportation Security Guidelines 5**

**Step 4: Prioritizing Security Risk**

Once the chemical hazard ranking from Step 2 and the exposure ranking from Step 3 are complete, they can be used to prioritize security risk reviews by categorizing these risk to either low, medium or high risk level and attention focused accordingly.

**Transportation Security Guidelines 6**

Chemical Hazard

LOW, MEDIUM AND HIGH

Based upon the type of chemical, professional judgment should be used to determine if some chemicals that rank as a low priority may warrant higher priority considerations, due to extenuating circumstances.

In setting priorities for risk reviews, the frequency of future reviews should also be considered, with the higher priority categories receiving reviews more often. Companies are encouraged to use these guidelines to develop and implement a program of risk reviews that are performed on a regular basis (see Step 7, Updating Risk Management Processes).

**Step 5: Conducting Security Risk Reviews**

The objective of risk reviews is to better anticipate and ultimately prevent incidents that have the potential to cause damage to physical assets, personnel, the public, or the environment. The prioritization steps covered in the previous section help to narrow the focus to those chemicals and movements that are of the greatest concern. The risk reviews themselves involve more detailed assessments of the hazards and exposure potential, and consider the vulnerability of shipments to significant events. They serve to collect and evaluate information on current risk control and security measures, and are used as the basis for development of risk reduction alternatives.

Risk reviews are generally focused on current activities and practices. Questions asked during security risk reviews could include:

- What are we doing now?
- What could go wrong?
- Are there hot-spots of concern?
- What could we do differently?

**Transportation Security Guidelines 7**

A security risk review will benefit from a multi-disciplinary team, since expertise in several different areas is usually required. As an example, the team composition

might include knowledgeable representatives from manufacturing/technology, distribution safety, logistics, equipment design, emergency response and security. Security risk reviews generally include the following types of activities:

- Hazard Assessment
- Exposure Assessment
- Threat assessment
- Vulnerability assessment

**HAZARD ASSESSMENT**

This activity develops a greater understanding of the potential impact that might result from an incident while the product is in distribution. This includes not only the hazardous properties of the material itself, but also the shipment characteristics. Examples to consider may include:

- Poison Inhalation hazard
- Other Inhalation hazards (asphyxiant)
- Explosivity or Reactivity
- Flammability
- Vapor cloud potential
- Drinking water contamination
- Environmental damage potential
- Any unique hazards
- Container volume
- Container content pressure
- Container content temperature
- Any unique conditions
- Attractiveness of chemical (public perception/fear factor)
- Acute dermal contact hazards
- Vapor pressure and density

Estimates of possible impact areas under different release scenarios (from published sources of dispersion modeling) may also be helpful in this assessment.

**Transportation Security Guidelines 8**

**EXPOSURE ASSESSMENT**

This activity evaluates the degree of potential exposure to incidents, considering factors that might make certain shipments more attractive targets, such as:

- Number of containers (e.g., tank cars)
- Volume shipped per shipment
- Number of trips
- Predictability of shipments
- Number and size of population centers along the route
- Very dense population areas along the route (“hot-spots”)
- Number of municipal water supply reservoirs along the route
- Proximity to landmarks
- Proximity to public venues

- Storage in transit (rail yards, leased track)

This list is not all-inclusive

# Threat Assessment

The following is a partial list of threats and events that a transportation specialist may take into consideration:

- Attack on physical assets (examples could include the container, infrastructure, physical facilities such as terminals, storage yards, transportation power unit etc.)
- Theft (including hijacking)
- Product contamination/Product tampering
- Container tampering

Additionally, while not specifically directed toward the chemical or container, the following threats should be considered in terms of possible impacts on the security of the shipments being reviewed.

- Attack/breach of information systems and technology (including access to and/or destruction of confidential or critical data)
- Disruption of communication systems
- Disruption of the transportation process



# Vulnerability Assessment

This activity considers characteristics of the shipments that may cause them to be more or less vulnerable to events identified in the threat assessment. Examples include:

- Degree of attendance to shipment in transit
- Degree of attendance to shipment in temporary storage (including leased track)
- Degree of attendance and access to shipment at pickup and delivery points
- Ease of access to shipment by unauthorized persons
- Equipment design
- Special equipment used (e.g., tamper resistant fittings)
- Special procedures or controls employed
- Special training completed
- Communication mechanisms between carrier, shipper and customer
- Security trends for mode, carrier or route used
- Security processes of carrier, customer and others involved in the transportation of products
- Ease of ability to change routes (mobility)
- Mode-specific vulnerabilities
- Ability to mitigate consequences if an event occurs
- Any intelligence information obtained

**Step 6: Developing and Implementing Risk Reduction and Preventative Measures and Alternatives**

Once the security risk review is complete, the next logical step is to consider how to reduce the risks, where deemed necessary. Several alternatives or possible risk reduction and development of preventative measures include:

- Collaboration
- Communication
- Management Issues
- Employee Training and Awareness
- Compliance
- Carrier Safety
- Mode/Route Selection
- Emergency Preparedness and Crisis Communication
- Customers

These alternatives are detailed below. While they are organized into specific categories, it should be understood that many of the alternatives overlap.

Shippers should consider the outcome of the risk-based transportation security assessment, as well as their current security practices, operations and resources, when choosing which of these preventative measures and alternatives should be implemented.

**Transportation Security Guidelines 10**

Please note that while these are written for chemical shippers, they are also useful security considerations for all those involved with the transport of chemicals.

**COLLABORATION**

*Communication and coordination with law enforcement agencies:* Shippers should consider establishing partnerships with local law enforcement officials, emergency responders, and other public safety agencies along selected transportation routes. Through these relationships shippers can more easily learn of threats, trends, and successful and unsuccessful security measures. These partnerships can be accomplished using outreach activities, boosting relationships, and utilizing available programs such as Trans CAER (Transportation Community Awareness and Emergency Response)

**COMMUNICATION**

Effective communication should be established between the shippers, carriers, customers and others to help improve transportation security before an incident occurs. Communication topics related to security could include:

Communication mechanisms: Carriers, shippers and consignees should have a process in place to communicate information on events, patterns, technologies, security plans, modifications, discrepancies such as improper bills of lading and identification, etc.

These mechanisms could include fax machine, cell phone, satellite phone, etc.

Consistent communication of problems, such as tampering with security seals or equipment, will allow for the identification of commonalities and trends.
Tampering: Consider developing procedures that will help the customer determine whether the product and container have arrived without tampering. This could include using number seals on valves and closures and matching these against documentation prepared by the shipper.
Receiving products: Consider having a system where the customer alerts the shipper if the product is not received when expected. When products arrive, have the customer check the carrier's identification with the shipping documents received from the shipper and look for discrepancies such as improper bills of lading and identification.
Carrier expertise: Shippers should keep in mind that carriers interface with multiple shippers and customers and may be able to provide useful information not normally available to a single shipper or customer.

**Transportation Security Guidelines 11**

**MANAGEMENT ISSUES**

Shippers should assess their internal situations and practices to enhance the secure transportation of hazardous materials. Considerations include:
*Technology:* Shippers may explore technological solutions to enhance security. These may include communication systems, tracking systems, inventory controls, sensors, and vehicle access control systems.
*Event monitoring, reporting, and analysis:* Keep records of security incidents. Reviewing these incidents can help identify trends and potential vulnerabilities.
*Internal communication:* Have a communication mechanism in place to communicate events, facts, trends, etc. internally. These mechanisms may include fax machine, cell phone, satellite phone, etc. This can also be accomplished by developing a security information network for all company employees including local, national, and international employees at all levels within the organization. Bulletin boards, network communications, e-mail, intranet sites, etc. are some of the communications tools available. Because Internet communications may be accessed by others, consideration should be given to communicating sensitive information by other means or by secure Internet connections.
*Delivery and pick up:* Ensure that appropriate levels of security exist around all entrances and exits involving the transportation of hazardous materials, including back gates, 24 hours a day/7 days a week. As appropriate, monitor transportation equipment entering and leaving facilities.
*Shipment securement:* The proper loading, unloading, and securement of transportation containers (including packages, cylinders, truck trailers, railcars, barges, deep-sea containers and vessels) is a critical measure for the shipper and carrier to perform and enhance the safe and secure transport of hazardous materials.

The proper securement of transported products should be addressed during loading and unloading procedures. One example is to include minimum securernent requirements in checklists as part of the loading and unloading procedures. Pre-inspection procedures to determine if proper loading, unloading, and securement requirements were followed is also important. They should also be updated with respect to any changes and interpretation of new and existing transportation regulations, legislation, and industry standards.

Shippers should also consider the need for tamper-resistant or tamper-evident seals and locks on cargo compartment openings.

*Accessibility:* Assess the accessibility of the public to the plant and transportation loading and unloading areas. Consider methods to monitor these areas. Examples include the use of a video surveillance system and frequent patrols.

**Transportation Security Guidelines 12**

**EMPLOYEE TRAINING AND AWARENESS**

It is critical to ensure that employees are properly trained and aware of security measures. This includes:

*Security policy:* Management should support security policies. It is important that employees see security as critical to the company's mission.

***Security awareness program***: Implementation of an internal security awareness program for the distribution of hazardous materials. Employees should be encouraged to report incidents or events that occur in transportation. Implement routine security inspections using appropriate materials and subsequent reporting mechanisms.

*Communication plan:* Establish an effective communications plan to keep employees aware of security issues. The plan should be updated, modified, and communicated with all employees within the company and industry as appropriate.

**COMPLIANCE**

The safe transportation of hazardous materials demands thorough and continuous knowledge of new and existing transportation regulations, legislation, and industry standards. This includes:

*Knowledge of new and existing regulations for shippers, carriers and others:* Shippers should have a process for monitoring and implementing changes and interpretations of new and existing transportation regulations, legislation, and appropriate industry standards. Applicable rules and regulations should be identified and implemented as they are promulgated. This can be done through a specific group in the company, specialized consultants, membership in trade associations, etc. Suggestions for assessing training, implementation, and etc. can be found in the Responsible Care Distribution Code of Management Practices.

Shippers should have a process to evaluate whether the carrier is up-to-date on changes and interpretation of new and existing transportation security regulations, legislation, and industry standards. Carriers may stay up to date on changes and interpretations by utilizing site staff, specialized consultants, membership in trade associations, etc. Shippers and receivers of hazardous material must ensure that all employees that offer or receive hazardous materials for transportation receive all required training. Packaging and loading should be based on regulations and the nature of the product (and on hazard class if applicable), proper packaging should be used, In addition, items should be loaded as called for by current regulations, with sensitivity to the compatibility of the different types of chemicals being transported together.

**Transportation Security Guidelines 13**

***Hazard Communication***: It is important that all shipping papers, labels, placards, markings and other hazard communication information be correct, and that this is provided to the appropriate parties.

***Company requirements and training***: Have a process to ensure that all company and contract employees as appropriate who perform distribution activities receive the company's security training and/or are advised on any new security requirements.

**CARRIER SAFETY**

Open, effective, and meaningful dialog between the shipper and carrier is "a must" to enhance the secure transportation of hazardous materials. Shippers should consider the following when working with carriers:

*Carrier qualification:* Shippers should implement a process for qualifying carriers of all modes and types that the company uses to transport hazardous materials. Carrier safety ratings, assessments and/or safety surveys may be used. (The Responsible Cared Distribution Code Carrier Safety Protocols may be used for this purpose.) The shipper may also request that information relating to security measures the carrier has implemented be shared or results communicated in some manner.

*Carrier employee hiring and review practices:* Verify that the carrier implements an appropriate employee hiring and review process, including background checks as appropriate. This can include background checks using state departments of motor vehicles for records of traffic violations among other sources. This may also include verification of the applicant's social security number, previous employment history, and CDL licenses. Shippers should note that, in some cases, the ability of a trucking company to perform comprehensive background checks of drivers (and driver applicants) might be restricted by state and Federal privacy laws. For example, access to criminal record databases is sometimes limited. Some states are more sophisticated than others in providing detailed records of traffic and motor vehicle violations. In other cases, the motor carrier employer might be precluded from providing copies of an employees photo image, date of birth, social

security number, etc. In these cases, the shipper and carrier may consider some alternative method to confirm that the driver that arrives at the plant site is the proper carrier employee.

*Carrier evaluation:* Determine whether the carrier has the appropriate route, training, programs, and checks in place for the secure transportation of hazardous materials. Consider the security mechanisms available to the carrier. The carrier and shipper may coordinate to develop the appropriate security precautions.

Carrier and product location: The shipper and carrier should work out a way to exchange information on the location of the carrier and product at the appropriate times during the distribution cycle.

**Transportation Security Guidelines 14**

Designation of a contact person for both the shipper and carrier. This may also include access to a means of communication 24 hours a day/7days a week. Consideration should be given to the fact that, due to delivery schedules and federal hours of service limitations, the driver who picks up a load may not be the same driver who delivers the load to the consignee. It is important that shippers communicate with the carrier for guidance on this matter.

Shippers, carriers and receivers should work together so that any discrepancies in expected delivery times, based upon the normal operating procedures of the carrier, are communicated. This can alert those involved to the possibility of a security issue.

Shippers and carriers should also discuss security on leased track

*Product security en-route:* Shippers should coordinate with the carrier and determine if the appropriate level of security is applied, and that the carrier checks for continued proper securement when stopped en-route. Security measures may include the use of team drivers or avoiding layovers of certain products as defined by vulnerability. If a layover must occur, determine if the carrier is capable of holding the material in a secure area and takes security precautions such as securing and locking the vehicle when unattended (e.g. a carrier owned terminal location could be used).

**MODE/ROUTE SELECTION**

Shippers should be aware and informed of designated routes for hazardous materials transportation. Shippers may also want to perform a route and risk analysis on hazardous materials and work with carriers to determine routing. Some considerations when selecting mode of transportation and routes include:

Assess modes: Assess the various modes, combination of modes, and options within those modes available for the transportation of the chemical. This may be done during the vulnerability assessment. Keep in mind that the ability to change routes is dependant upon the mode of transportation chosen.

Assess routes: Shippers and carriers should work together to identify preferred and alternative routing, including acceptable deviations. Planning in advance for

mutually agreeable alternate routing is a very important security measure. Also, shippers should know that information regarding designated routes may be available through state transportation agencies.

When assessing mode or route changes, risk should be considered. Such assessments should consider factors other than solely population density, such as number of trips (for mode changes), road/track type and quality, carrier training, emergency response capabilities, potential increased handling and transit (exposure) time, etc., so that risk due to normal operations is not inadvertently increased. The degree of changes to mode or routing should depend on the vulnerability assessment of the product, as well as the perceived threat level. Shippers and carriers should review and communicate routing information and preferences.

**Transportation Security Guidelines 15**

**EMERGENCY PREPAREDNESS AND CRISIS MANAGEMENT**

Emergency response and crisis management measures are critical to the safe and secure transportation of hazardous materials. Some considerations when implementing these measures include:

Emergency response plan: Develop an emergency response plan that fits the needs of the facility, nature of the product, transportation mode, offerors and receivers of hazardous materials for transportation, and the carriers.

Shippers should assess and understand the likely events possible for product and mode when shipping the product. Shippers should have knowledge of the mitigation process and needed resources. In the event of an emergency, pre-established emergency response plans to mitigate the likely events as determined by the vulnerability risk assessment should be in place.

Shippers and carriers should also have emergency response resources available to respond to events. Emergency response systems can consist of plans and procedures, internal teams, or contractors. While protection of people, property and environment are top concerns, care should be taken, where practicable, to preserve evidence that may be of use to investigations. Shippers should verify that carriers have emergency response systems in place.

Crisis communications: Implement a crisis communication system for those involved in an event (this could include company or contractor media relations, finance, legal, technical, emergency response personnel). This may include a primary and back-up means for the affected party/parties to signal for assistance and a means to quickly contact the appropriate personnel needed to manage the event.

Protections: In some cases, shippers and carriers should consider the need for security escorts, tractor & trailer anti-theft devices, and established pre-designated safe zones (restricted access, guarded areas away from population centers where cargo can he taken in the event of a crisis).

Backup systems: Shippers should develop a back-up plan in the event of loss of the services of a significant carrier. This may be useful if a carrier decides to discontinue handling/transporting hazardous material.

Shippers should assess and determine if alternative arrangements for the transportation of hazardous materials in case of an event is possible and plan accordingly. This is to enhance the safety of affected parties and the environment and to maintain the fluidity of the supply chain.

**Transportation Security Guidelines 16**

**Customers**

When working with customers, shippers should consider the following security items:

*Be aware of suspicious activity:* Those involved in hazmat transport should be aware of their surroundings and advise others as appropriate of noticed suspicious activity. This could include an approach from a new customer whose identity is not clear, customer's use of evasive responses, reluctance to explain how the product will be used, inability to provide clear answers to technical questions, request for excessive confidentiality, unusually favorable terms of agreement, etc. This could also include noticed suspicious activity upon arrival at the destination.

Service providers: Shippers should work with their customers to examine closely situations when customers choose the service provider for product pick-up and to ensure that the service provider chosen can appropriately handle the product. For truck hauls, a DOT number and state Motor Carrier Operating Authority numbers can provide safety and other information to the shipper.

*Increase communications with customers:* Consider having procedures where the customer can be assured the product and container have arrived without tampering. This could include the use of number seals to ensure valves and closure have not been operated.

Consider having a system where the customer alerts the shipper if the product is not received in a timely manner. Have the customer check the carrier's identification with the shipping documents received from the shipper.

**Step 7: Updating Security Risk Management Processes**

Effective transportation risk management should be considered a continuing process for risk reduction and security assessments. Since many of the factors involved in the overall risk management are dynamic and changing, this process should be repeated at regular intervals. In addition, as more pertinent information becomes available, it should be used to improve this process. It is suggested that higher security risk movements receive more frequent reviews.

## CHAPTER SIX

## MANAGING THE DISTRIBUTION FUNCTION

### Function and objective of distribution.

(As discussed under logistics function and objective)

### SALES ORDER PROCESSING

Sales order processing is an important step in a series of processes that leads directly to revenue for companies. And the way company handles its sales orders says a lot about it. Traditionally, most sales orders arrive via fax, and processing these can be a costly, manual and time-consuming process. But if orders are could be processed quickly, efficiently, and correctly, every time, you would not only generate revenue more quickly, you would also promote better customer satisfaction, which leads to repeat business.

To process orders correctly and reduce customer inquires about order status, you need a tool that can both automate your processes and integrate with your existing enterprise systems.

Order processing is a fast-paced operation involving multiple people, departments and critical transactions. Rush orders need to be identified and expedited. Complex orders may need to be routed to specialized staff. And your customers want to know when their orders have been received, are in-process or are routed for fulfillment. But the processes that support sales orders such as auditing and customer feedback — are often manual.

The Kofax Solution for Sales Order Processing addresses these issues by providing an automated system for capturing incoming sales orders regardless of the delivery format (fax, paper, email, EDI, and so on), and automatically integrating that data with your hack-end systems. It can help manage rush orders, automate customer communications regarding order receipt and progress, and properly route fax communications that were intended for another department. It can even help you better up-sell and cross-sell by delivering automated messages suggesting additional purchases based on the current order.

**Solution for Sales Order Processing Delivers**

- Faster order processing
- Better management of rush orders
- Reduced manual labor Reduced cost per sales order
- Integration with your existing enterprise systems.
- An auditable sales process
- Automatic customer notifications during key phases of processing
- More satisfied customers

This solution is built on Kofax Intelligent Capture & Exchange(KICE) a highly automated solution that links back-office information processes, front-office knowledge workers, and customers and partners around the world, enabling organizations to exchange information automatically with anyone, anywhere, in any format.

**THIRD PARTY DISTRIBUTION**

It is not all function that can be performed by the company efficiently. For the sake of efficiency and cost reduction, it is important to contract or outsource some these functions to third party logisticians(3PL)or Distributor(3PD) who are experts(SPECIALIST) in such functions.

The management of outsourcing arrangements is fundamental to the success of the relationship between the Third Party Logistics Provider (3PL) and the customer. All too often both the service provider and/or their client do not fully appreciate the need for sound management. Their roles in ensuring a successful relationship are essential. Although it is, of course, the responsibility of both parties to make the relationship work, each organization must play its own part.

This chapter discusses the need for managing an outsourced contract, including the causes and implications of failure, looking at the responsibilities of each party. The key factors required in managing a successful relationship are then examined, including partnership and collaboration, engagement, continuous improvement, the sharing of benefits and communications. For almost all new outsourcing arrangements, the initial issue after the contract has been successfully negotiated is the successful implementation of the operation.

Whether running a logistics operation as an in-house manager or as a third party contract manager the basic reasons for monitoring the operation are very similar, and that is,to measure whether the operation is meeting set service levels at an acceptable cost.This final part of the outsourcing process is, therefore, to ensure that the contractor is adequately managed. This is a key consideration that is sadly neglected by some users. The signing of the contract should not be seen as the end of the outsourcing process. It is vital to continue to control and monitor the 3PL to ensure that the overall business and operational objectives are achieved. As will be stressed during this chapter, the 3PL has a very active role to play in this process.

**The need for management**

***Client and 3PL relationships***

In a Third-Party Logistics study across 1,091 companies from a variety of industries, as many as 77 per cent of those surveyed indicated that their relationship with their service provider could not be described as extremely successful (Langley J C and Capgemini, 2005). The study concluded that the key factor in determining a successful relationship was whether client expectations were properly aligned with the 3PL business model and relationship structure. Thus, there is still much to be done between user and supplier. For both parties, a

more collaborative and strategic relationship is important — and sound management of the relationship is vital to success.

***Why 3PL relationships fail***

A Warehousing Education and Research Council report (2006) has shown that 55 per cent of logistics outsourcing relationships are terminated after three to five years. Study of the potential reasons, as shown in the Figure below, illustrates that these reasons are varied and the responsibility of the 3PL, the client and indeed in some cases both parties. A further global survey reported in 2009 a number of continuing problem areas with 3PLs. The main ones were unrealized service level commitments (51 per cent of companies), lack of continuous improvements (42 per cent), insufficient IT capabilities (38 per cent) and unrealized cost reductions (36 per cent).

| **Customer** | **Third Party Provider** |
|---|---|
| Inaccurate operational and volume information from customer | Too passive during negotiation, design and implementation phase |
| Inappropriate resources to manage 3PL | Over-promising |
| Not setting clear or realistic expectations | Not understanding customer's requirements |
| Poor implementation | Poor implementation |
| Relationship focused entirely on cost reduction | No continuous improvement |
| No clear SLA in place | Poor service levels and performance |
| Outstanding 3PL performance not rewarded | Lack of IT or technical support or commitment |
| 3PL just thought of as another supplier | Not behaving as part of the customer's supply chain |
| **Both Parties' Responsibility** | |
| Unclear contract | |
| No performance measurement programme | |
| Poor implementation | |
| Poor communication | |

**Why 3PL relationships fail**

**Managing the relationship**

***Partnership and collaboration***

The 3PL/client relationship is a relationship where 'partnership' can provide the basis for the business relationship. Good partnerships will encourage the sharing and joint development of a strategic vision. Not only does a client get the benefit of

the 3PL's thoughts and experiences, it also achieves their buy-in for the realization of the vision.
To develop a true partnership requires a high degree of trust and collaboration. It is believed that the degree of trust in a relationship determines the level of flexibility a client will allow the 3PL in operating to the best of its capability. Flexibility makes it easier for the 3PL to deliver best-in-class processes and solutions and in turn achieve the required performance and cost objectives.
Clearly, moving to an outsourced service cannot happen overnight, although some companies may think that it does! It is more of a journey that starts with the implementation itself and then goes through a series of maturity phases. Although working in a collaborative manner during the definition of the initial road map from the existing to the desired vision is important, this approach is equally important as the relationship matures. A good collaborative approach will support business change and challenges, allowing both parties to review continually the current state against the vision and to agree actions to be taken to stay on course.

There can be a temptation, when outsourcing, to think that all problems with logistics or supply chain activities become the responsibility of the 3PL. Although this is true of many problems, others still remain firmly the responsibility of the client and indeed there will be new issues related to how the relationship is managed. Certainly it is important that clients stay involved but they should focus on managing the 3PL and not controlling them, The client should not need to be involved in every decision taken by the 3PL — that is what the 3PL is paid to do. However, a good client will want to collaborate around those activities that directly impact on service and where there is a direct interaction with their business — for example, in the transfer of customer orders from the client's ERP system into the logistics provider's warehouse management system, clients will want to ensure that there is a full audit trail and exception reporting. They will expect to be notified immediately of any issues. They will also require regular meetings and reports against which they can monitor the 3PL's performance.

**Engagement between the 3PL and the client**

***Account management***

Account management is important for two reasons:

- Firstly, executed correctly, it can help in the retention of clients.
- Secondly, it can lead to more business with the client, potentially leading to improved profits for the 3PL.

However, good account management also focuses on identifying benefits for the client. By helping the client to improve performance in operations, cost control, or sales, the 3PL is adding value. Part of account management is ensuring that staff are aligned across the various levels of the organization. In addition to the tactical staff to run the operation, the relationship also needs strategic thinkers who can

demonstrate what is often called 'thought leadership'. To do this the senior 3PL management need an understanding of the account's long-term business needs.

***Implants***

3PLs have adopted the practice of imbedding implants into their clients' operations for some time now. These are 3PL staff who work directly with the client on the client's premises. There is no better way to understand the main drivers for a client's business than to provide an implant working side by side in a planning or other supply chain role. The implant is also in a good position to identify issues and concerns before they become problems between the 3PL and the client. The major drawback of implants is that they can 'go native' and associate themselves too closely with the client. They, too, need to be well managed and motivated. Implants are also ideally placed to identify further business opportunities for the 3PL.

***Integrated information systems***

Part of the engagement between a 3PL and its client is how the data flows between them, and integrated information systems should be used wherever possible. It is essential in operations of any scale to integrate tightly the 3PL systems (usually warehouse or transport management systems) with the client's ERP system. Many 3PLs have invested in integration software that allows them quickly and reliably to connect the various systems. High levels of integration allow not just high volumes of data to be passed between companies, but also at a very high speed. The process is extremely reliable, with leading integration platforms having audit techniques that can alert if messages leave one system but are not received or processed in the other.

**Continuous improvement**

Clients want to see continuous improvement in the way that 3PLs run their operations over time. These may benefit both cost and service. Clients also seek innovative solutions from 3PLs to enhance their operations.

**Sector expertise**

One of the factors that 3PLs bring to their clients is expertise in the industry sector concerned. This provides the opportunity to help clients understand industry best practices and to provide benchmarking data. Also, it is often expected that 3PLs should continuously look at what they learn from other industries to provide ideas for their clients. The issue of client confidentiality can sometimes hinder 3PLs from sharing such information.

**Process improvement**

Clients look to see continuous improvement in processes because process improvement is one way to enhance a relationship and to identify more efficiencies in a client's supply chain. The more familiar a 3PL becomes with a supply chain, the easier it should be for it to identify opportunities to drive down cost or improve service levels. In some instances, the expectation of such improvements may be written into contract agreements.

**Innovation**

As already indicated, clients seek innovative solutions from 3PLs to enhance their operations. Innovations such as voice picking and Radio Frequency Identification (RFID) are recent examples of this.

**Communication**

Almost certainly the key ingredient for ensuring a good relationship between provider and client is good communication. Of course, communication is the responsibility of both parties in the relationship and to ensure good levels of communication they both need to provide channels for this to happen.

Regular meetings provide a forum for discussing key operational issues, but also give both parties the opportunity to discuss areas for additional work outside the explicit services included in the contract. These opportunities should emerge as the relationship matures. It is especially important for 3PLs to communicate regularly with their clients in order to understand how the client's business might be changing and how that might impact on the operations and services that are being provided.

**Implementation planning**

***Importance of implementation***

For almost all new outsourcing arrangements, the initial issue after the contract has been successfully negotiated is the successful implementation of the operation. As with any large business project it is essential to identify and agree on a project plan to ensure that responsibilities are clear and that there is a feasible timetable for implementation. A typical implementation plan will need to identify the tasks for both the user and the contractor organization, including contingency planning. The aim is to effect a smooth transition from the old to the new contract. From the user perspective it is vital to ensure that there is clear visibility of the implementation process. A team that includes both user and contractor staff needs to be established and this team needs to meet on a regular basis to monitor and discuss progress. Detailed project plan activity charts should be used. It is often said that the real work begins once the contract has been signed, and the work required for the creation of a practical operation from a conceptual document is not to be underestimated.

An appropriate provider representative or representatives should be included in all client planning meetings, especially where strategy and performance is reviewed and this may impact on the new operation. By the same token, the provider should be responsive to any changes that are requested by the client, and should communicate and discuss any implementation issues as they arise. There are a number of potential pitfalls that might occur during the implementation process,

and some major examples are shown below. Note that these can originate from the client as well as the provider!

**Potential pitfalls that might adversely impact the successful implementation of an outsourcing operation**

| Client initiated problems | Contractor initiated problems |
|---|---|
| Unrealistic goals at start-up | Failure to manage expectations |
| Delaying or failing to finalize the contract | Not having executive support |
| Making last-minute requests, setting up new expectations, moving up the start date | Making last-minute decisions and changes |
| Poor decision-making mechanisms | Delaying or failing to finalize the contract |
| Maintaining a hands-off attitude | Not dedicating the implementation team to a sole project |
| Poor internal employee communications | Not developing agreed start-up and steady state metrics |
| Not accepting any responsibility in the implementation process | Not measuring performance accurately (or at all) during start-up |
| Misinterpretation of the service agreements and the associated metrics | Not communicating metrics to employees |
| Using metrics as a whip rather than a tool for managing the relationship | Not being proactive with communication, thus forcing the client to initiate meetings, etc |
| Reacting too severely to the first quality breakdown | Failing to adjust processes and retrain staff as operational changes and quality issues arise |
| Expecting total adherence to the contract agreements on the first day of implementation | Lack of awareness of regional HR issues, such as employee quality, availability and cost |
| Internal team not capable or not totally committed to the implementation | Moving to steady state operation before implementation phase is fully completed |

***Client perspective***

One key issue that can arise, from the client perspective, is the adoption of unrealistic goals for the start-up of the operation. There are always going to be teething problems as the operation beds down, so the provider cannot be expected to hit all the key targets and achieve all the key metrics from day one. Suitable

goals need to be determined with a gradual, but agreed, timetable to meet full operational requirements. Poor decision-making can also have an adverse effect on successful implementation. This might include delays to the contract finalization, last-minute changes, the moving of the start date or inappropriate mechanisms for making decisions. Clients can also be prone to sitting back and letting implementation take place without providing sufficient input or taking appropriate responsibility. This is a classic problem, and one that re-emphasizes the need for a client to work together with the 3PL to make sure that the contract is implemented successfully. Finally, the metrics that are used to measure the operation can be a problem if the client misinterprets them or uses them as a whip to punish the contractor rather than as an aid to help manage and improve the operation.

**Contractor perspective**

There are also a range of contractor initiated problems, as illustrated above. A classic communication issue is the failure to manage the client's expectations. If problems, errors and delays occur, then it is essential that the client is made aware and kept up to date with any changes and developments. Failure to do this is exacerbated if there is an insufficiently high level of executive support from the provider to help explain and alleviate problems. Similar to some of the client issues are poor decision-making, which might include delays to the contract finalization or last-minute changes to the physical or operational processes. The lack of appropriate metrics can, of course, be an issue, as can the failure to measure performance accurately for feedback to the client.

Part of the implementation process is likely to include the preparation of new administrative, safety and service procedures, which will be incorporated in an operations manual. It is also strongly recommended that prior to, or during, the implementation phase the 3PL and the client go through the contract in detail to ensure that each operational requirement is being suitably addressed. The transition plan should reflect these requirements, and any issues that cannot be agreed at operational level should be taken up during regular discussions between the senior management of the client and the provider.

Another important aspect, as already indicated, is to develop and agree suitable metrics that enable accurate measurement of the operation. These should include measures that are relevant to the transition from the existing operation to the new one. Ideally, metrics for implementation and for the finalized operation should be developed and agreed during the contract negotiation period, although this is not always undertaken in time! These metrics are, in any case, likely to need some adjustment during the implementation phase because it is virtually impossible to derive a completely suitable set of metrics for an operation when it is only in its planni

## CHAPTER SEVEN

## FLEET MANAGEMENT

### Purchase or Lease of Fleet

It has been shown that the process of vehicle selection is one that requires a good deal of thought and analysis to ensure that the most suitable vehicles are acquired. Having determined the vehicle requirements, the next task is to ascertain the most appropriate means of acquiring the vehicle. There are several options available outright purchase, rental, lease or contract hire. Vehicles may also be acquired by outsourcing the whole operation to a third- party contractor. Indeed it is often when large numbers of vehicles need to be acquired and large amounts of capital have to be approved that outsourcing is considered.

The traditional means of vehicle acquisition is that of outright purchase. This gives the operator unqualified use and possession, together with the choice of when and how to dispose of the vehicle. Discounts for cash may well be available, and possibly tax allowances for capital purchases. A major problem is likely to be the lack of capital available for purchases of this nature. Other ways of obtaining finance include bank overdrafts, bank loans, hire purchase and lease purchase. These have a clear cost associated with them and in some countries capital expenditure may be set against tax. Investing capital in rapidly depreciating assets such as vehicles rather than in other investments with higher rates of return is a major concern for business managers. This has helped fuel the trend towards outsourcing transport operations to third- party providers.

The leasing of vehicles is a popular alternative. Here, operators do not actually own the vehicles. With fixed-term leasing, operators make regular payments over an agreed period and have full use of the vehicles. The payment covers the cost of borrowing the capital (to purchase the vehicle) and may cover maintenance if required. Finance leasing means that operators cover the full cost of the vehicle over the leasing period and so may be given the option of extending the period of use at a significantly lower lease cost. The main advantages of leasing are that the standing (fixed) cost of vehicles is known and that the company does not use its own capital to purchase the vehicle; the disadvantage is that operators must keep the vehicles for a prescribed period in which time, for example, operational requirements may alter. In addition, accounting practice means that vehicles acquired on finance leases have to be shown in the balance sheet, so the rate of return on capital employed is reduced.

Owing to the changes in accounting practice previously mentioned, the contract hire of vehicles has become a much more attractive option. Contract hire

arrangements can vary from the supply of the vehicle alone, through maintenance, insurance and drivers to the provision of a complete distribution service. Thus, there has been a rapid growth in third-party distribution companies offering a variety of services. The financial advantages of contract hire include the release of capital and the easier, more predictable costing of operations.

Vehicles can also be acquired via rental agreements. The vehicle does not become the user's property, but can be operated as required. Agreements may include maintenance and driver. Costs are generally higher than for the other alternatives, but rental periods are often very short-term, allowing the user greater flexibility, particularly providing the means to accommodate temporary peaks of demand. Costs are predictable and can be treated as variable for specific jobs.

## TYPE OF VEHICLE AND THEIR OPERATING CHARACTERISTICS

There is a variety of vehicle types. It is important to be clear as to the precise definition of each type, because these definitions are typically used throughout the transport legislation laid down by different governments. The main types described in this section reflect Nigeria government definitions and are therefore provided as examples.

The motor vehicle is a mechanically propelled vehicle intended for use on roads. Mechanical propulsion covers all those methods that exclude the use of human or animal power. If a vehicle is driven by petrol or diesel, by gas turbine, by electric battery or by steam generation, it is classified as a motor vehicle.

A goods vehicle is a vehicle or a trailer adapted or constructed to carry a load. The term covers all such vehicles, but there are also distinct definitions that relate to the different weights of goods vehicles.

A trailer is a goods vehicle that is drawn by a motor vehicle. There are two main types of trailer: 1***) a draw-bar*** trailer that has at least four wheels and actually supports its load of its own accord; and 2***) a semi-trailer***, which is a trailer that forms part of an articulated vehicle. This trailer does not support the load on its wheels, but only when it is standing with the use of legs or jacks at one end.

As previously indicated, an articulated vehicle is a combination of motive unit (tractor) and semi-trailer. Thus, the trailer carries the load and the motive unit pulls the trailer.

**An articulated vehicle comprising a tractor and semi-trailer**

A rigid vehicle is a goods vehicle where the motor unit and the carrying unit are constructed as a single vehicle.


**A six-wheeled rigid vehicle fitted with a lifting rear axle**

The term ‘heavy goods vehicle’ (HGV) is still in common parlance. However, since 1 April 1991 the term has been replaced by ‘large goods vehicle’ (LGV) for legal purposes when referring to driver licensing categories.

There are two main reasons why these definitions have been outlined so carefully. The first is to provide a clear definition of the main types of vehicle available. The second was mentioned earlier. It is to differentiate between vehicle types for the purpose of interpreting some of the legal requirements for transport.

**Types of operation**

Goods vehicles are required to undertake a wide variety of jobs. For each of these different jobs, it is important that the most appropriate type of vehicle is chosen. Some jobs or operations may require a vehicle with a powerful engine; others may necessitate a good clutch and gearbox because of high usage. Consideration must therefore be given to the work that the vehicle will be doing for the majority of its working life, and also to the conditions within which it must operate. The most important classifications are described below.

Vehicles that are required to travel long distances tend to be involved in trunking (line-haul) operations. A trunking (line-haul) operation is one where the vehicles are delivering full loads from one supply point (e.g. a factory) to one delivery point (e.g. a warehouse or distribution depot). Such long-distance journeys tend to include a large amount of motorway travel; thus the vehicle is often involved in carrying heavy loads at maximum permissible speeds. Further to this the vehicle may be used throughout a 24-hour, seven-day duty cycle. Clearly, for this duty cycle a very high specification is required if service failures are to be avoided. Professional operators usually deploy their newest vehicles on this duty cycle early in the vehicles' life before 'retiring' them to less critical work. These vehicles are often large articulated or draw- bar combinations, given that the loads are often full loads moving from point to point and maximum loads bring the best vehicle economy.

In places like Nigeria, Ghana, North America, Australia and the United Arab Emirates it is not unusual to see articulated vehicles with more than one trailer. Where there are two semi-trailers and one motive unit this is called a double bottomed articulated vehicle or road train. Especially in Australia, road trains may consist of more than two trailers. In the UK, serious consideration is being given to their use on motorways.

Increasingly for loads with a low weight but a high volume, draw-bar combinations are favoured, as they provide a higher cubic capacity for loading within the legal limits. Articulated semi-trailers with two decks may also be used for loads that fall somewhere between the two extremes in terms of weight and volume.

**A high cubic capacity draw-bar combination**


**An articulated vehicle featuring a double-deck trailer**

## VEHICLE NEEDED FOR MIDDLE DISTANCE JOURNEY

Vehicles involved in middle-distance runs (i.e. 100—200 miles/150—300 kilometres per day) are probably delivery vehicles making one or two drops per day from a depot to large customers. Typical journeys might involve a mixture of motorway and major and minor roads. The specification of vehicles on this duty cycle must also be reasonably high to avoid in-service breakdowns.

There are a number of duty cycles that require trucks to travel relatively short distances in a day. The main example is local delivery work or what is often known as van deliveries. A vehicle involved in this duty cycle will probably be making a large number of deliveries in the day and so maybe covering only 40—100 miles/60—150 kilometres. Indeed, in some city centre areas the mileage may on occasion be even less. This type of operation tends to be concentrated in urban or city centres, although some of the delivery areas may involve rural settings.

Amongst the additional problems that this type of operation encounters are the many constraints on vehicle size. Because of the problems of narrow streets, congestion, bans on large trucks, and limitations on access at some delivery points, it is possible to use only smaller vehicles. The size constraints, the relatively short distances and the ‘stop and start’ nature of urban driving are the main factors that influence vehicle choice for this duty cycle.

As a consequence, the main vehicle type used is a rigid one with good gearbox and clutch mechanisms. Increasingly, more operators are using urban artic combinations for this duty cycle because they offer a higher payload potential with the bonus of being more manoeuvrable than certain rigid vehicles. They also reduce the likelihood of overloading the front axles in a diminishing load situation, i.e. where goods are progressively unloaded from the rear without the load being redistributed, which has the potential for overloading the front axle of a rigid vehicle.

Combination running concerns operations that constitute a mixture of features. A typical example is that of the urban delivery vehicle working out of a regional depot. Such an operation might involve a vehicle making a medium-distance run to a given town or urban area and then making six or seven deliveries in that area.

There is a need to balance the requirements of distance running and local delivery, so a vehicle must have strong engine power, together with a chassis that does not violate any delivery size constraints. A small articulated vehicle, or 'urban arctic', may be the most appropriate in this instance.

Multiple deliveries are made by vehicles where the distribution operations are concerned with the handling and delivery of many different types and sizes of commodities and packaging. They are sometimes known as composite delivery operations. Typical examples are haulage contractors or third-party operators that run their businesses by handling and moving other companies' produce. Thus, they may get a wide variety of loads and may have to run short and long distances as well as making single or multiple deliveries. In this case, it is difficult to suggest any one type of vehicle that is the most appropriate. It is necessary to take account of all the different jobs undertaken and then select multi-purpose vehicles that can best cover them all, or provide for a mixed fleet of vehicles.

Quarry, mining and construction work is included as one of the main types of operation because there is a very high movement of sand, gravel, mineral ores, rubbish, etc to and from construction sites or other facilities. Vehicles that undertake this duty cycle are usually only travelling short distances, but the conditions in which they work are amongst the worst of all the different types of operation. Many operators choose an eight-wheeled rigid vehicle for this type of work.

International operations also present some particular problems that need to be taken into account. It is likely that all types of terrain may be encountered — flat, hilly and mountainous distances will clearly be very long. In addition, it is important to minimize the likelihood of breakdowns occurring in remote areas where it may be very expensive to complete repairs.

Vehicles undertaking international operations need to be very powerful and very reliable. Such vehicles tend to represent the expensive end of the goods vehicle market. With the relaxation of trade and political barriers in Europe, North America and other continents it is likely that this category of operation will become significantly more important.


**An eight-wheeled rigid tipper vehicle**

As we have seen when vehicles are being selected, many factors need to be taken into consideration before any choices are made. Prior to selecting a specific type of vehicle, it is worth making a checklist of the requirements the operation demands. The following list is not exhaustive but does serve to illustrate the potential complexity involved:

- Product characteristics:
  - size;
  - weight;
  - unitization;
  - susceptibility to damage;
  - hazardous;
  - frozen;
  - liquid;
  - powder;
  - hygiene requirements (food);
  - live animals.
- Method of loading or delivery:
  - by fork-lift truck;
  - by manual handling;
  - by overhead gantry (height limitations);
  - by straddle carrier (containers);
  - from the side, rear, front, top or bottom (oil tankers).
- Restrictions at the point of delivery or loading:
  - narrow roads;
  - low bridges;
  - weight restrictions;
  - night-time restrictions because of noise;
  - lack of material handling equipment;

— low or limited building access.

- Terrain to be covered:
  — motorways;
  — urban roads;
  — low-quality rural roads, lanes or graded roads;
  — mountainous;
  — flat geography;
  — extremes of temperature: extreme heat or cold.
- Fuel type:
  — diesel;
  — petrol;
  — LPG;
  — natural gas (CNG or LNG).
- Vehicle configuration:
  — articulated tractor and trailer;
  — two-, three- or four-axle rigid vehicle;
  — draw-bar combination;
  — small goods vehicle.
- Body types:
  — curtain-sided;
  — platform;
  — skeletal suitable for carrying containers, demountable bodies or swap-bodies;
  — van bodies;
  — tankers;
  — tipping body;
  — Road-Railers suitable for transfer to rail wagons;
  — bulk carriers.
- Legal requirements:
  — gross vehicle weight limits;
  — vehicle dimensions;
  — mandatory equipment;
  — vehicle licences;
  — insurances.
- Vehicle economy:
  — fuel consumption;
  — tyre wear;
  — whole life costs;
  — residual values;
  — ease of maintenance;
  — availability of manufacturer's support and spare parts.
- Drivers' cab types:

  - sleeper;
  - day cab;
  - crew carrier.
- Ancillary equipment required:
  - self-loading cranes;
  - blower units;
  - refrigeration systems;
  - fork-lifts carried with the vehicle;
  - tail-lifts;
  - fire extinguishers;
  - load winching systems.
- Vehicle security:
  - locks;
  - alarms;
  - sealing devices;
  - tracking devices using satellites, GSM or GPS.

This list may appear to be lengthy, but it is by no means exhaustive. These days, vehicle manufacturers are able to use computing power to aid the decision-making process. They can feed the details of vehicle dimensions, weights and terrain into computerized models, which then produce anticipated performance figures for the proposed vehicle. These might include the ability of the vehicle to turn in a given area, potential fuel economy for different-sized engines and driveline combinations and potential axle loading under different load situations.

**Load types and characteristics**

The particular load to be carried is another vital factor when choosing a vehicle. Once again, it is essential to consider the alternatives with the prime objective of selecting the best chassis and the best body suitable for the load. The principal load features are described below.

## LIGHT LOADS

Light loads are those loads that consist of lightweight commodities that are extremely bulky. There are a large number of examples from the different industries. Some of these are:

- breakfast cereals;
- tissues;
- polystyrene products.

The important point is that light loads such as these require a large cubic capacity in relation to the weight of the goods being carried. This is known as having a 'high cube factor'. The consequence is that, although a vehicle may have high cubic capacity utilization, it will have very low weight utilization (i.e. it is not carrying as much weight as it could).Where a light load is carried, the consequent low weight means that the motive unit of the vehicle does not have to be a particularly powerful one. It is important not to over-specify vehicle requirements, as the use of high-quality, powerful equipment is very expensive.Two additional points concerning the selection of vehicles for light loads are, firstly, that it is often possible to operate by using a large rigid vehicle coupled with a draw-bar trailer and, secondly, that a double-decked semi-trailer could be used.

## HEAVY LOAD.

Very heavy loads pose problems for vehicle choice because of the gross vehicle weight restrictions on roads and also because of axle weight restrictions. In Nigeria,vehicles specifically designed to carry loads heavier than the maximum permissible gross weight are covered by the Special Types General Order (STGO) and fall into three categories, with a maximum of 150 tonnes permissible. Some loads are even likely to require special vehicle construction, although special low-loader vehicles are available.Not all heavy loads are necessarily abnormal loads. For example, machinery that has a total weight within the legal limit can be carried on a standard trailer providing the weight is adequately spread over the axles.


**A heavy haulage vehicle**

## MIXED LOAD

The problem of mixed loads — where quite heavy products are mixed on the same vehicle as quite light ones — would not appear to indicate the likelihood of any constraining factors. The indication is that the mixture of light and heavy products would result in a balanced load where the total weight and the total cubic capacity are both about right for the vehicle, and this is indeed often true.

The problem that can occur, however, arises when a vehicle has to make a number of deliveries on a journey. What can happen is that the removal of parts of the load can change the spread of weight over the vehicle and thus over the individual axle weights. These changes can mean that the vehicle suddenly has an illegally high weight on one of its axles — this is often referred to as '**the diminishing load scenario'.**This scenario can lead to vehicle imbalance, which consequently lead to road accidents and materials damage.

This effect can occur on any delivery vehicle. When there is a mixed load of light and heavy goods, it can be much worse because of the variable spread of the load within the vehicle. 'Where this effect is likely to be a problem, it is important to select the most appropriate vehicle chassis and body from the outset, so that the problem can be overcome. A simple solution may be to equip the vehicle with a manual pump-up truck to assist the driver in quickly redistributing the load.

All valuable loads represent some sort of security risk. Vehicle selection must, therefore, take this into account. There may be a need for a special chassis or body construction. It should be appreciated that valuable loads are not just the more obvious ones such as money or jewellery. Many consumer products, when made up into a large vehicle consignment, represent a very high value. Examples include wine and spirits, electrical goods, clothing, etc. Thus, it is very often important to select vehicles that can be easily but securely locked during the course of daily delivery work. There are many anti-theft devices available on the market, including satellite tracking, intruder alarms and immobilizers. Drivers need to be trained to deal with various situations where criminal activities may be a problem.

## LIQUID AND POWDER LOADS

Liquids and powders in bulk have to be carried by road tankers that are specially constructed. They are subject to the construction and use regulations. They may also be subject to other specific regulations such as Pressure Systems Regulations or ADR. These regulations are related to the type of commodity that is to be carried. It is also important in vehicle selection to ensure that the correct input and output mechanisms are provided. For example, some products may be handled by gravity alone, whilst others require a variety of loading and discharging mechanisms for pumping products on to and off the vehicle. These mechanisms can create a lot of noise, so consideration needs to be given to noise attenuation and ear defence for the drivers.

The bulk movement of hazardous goods by road is often carried out by road tanker, so the particular considerations for liquids and powders mentioned above apply automatically. In addition, the fact that hazardous substances are of a high risk means that care must be taken to select the correct material or lining for the tanker

so as to avoid any potential chemical reaction. Another point to note is that special fitments may be necessary to prevent electrical flashes from the vehicle's engine igniting flammable goods. Some vehicles also need to be equipped with earthing points to neutralize the adverse effects of static electricity.

**An articulated fuel tanker**

**Main types of vehicle body**

Decisions regarding the selection of the most suitable body type for a vehicle should be based on both the operating and the load requirements. Various body types have particular advantages and disadvantages according to the work to be undertaken and the products to be carried. Nearly all of the different vehicle bodies considered below may be fitted to either a rigid or an articulated vehicle, A box is an enclosed body that normally has a sliding door at the rear, often known as a box van. As an alternative, some box vans maybe fitted with side doors instead of, or as well as, doors at the rear. One common feature is the hydraulic tail-lift. This enables the load to be moved from the bed height to the ground automatically by lowering the tail-lift.

Box vans are by far the most common body type for urban delivery vehicles, especially for those delivering consumer products, food and packaged items. Their advantage lies in the protection to be gained from all types of weather, and also from the reduced risk of pilferage, because they are enclosed and so can be made secure. Increasingly, curtain-sided bodies are being used because of the ability to gain side access to the load if required. Large box vans are also now in very common use for trunking (line-haul) operations. The reasons are similar to those given for urban delivery vehicles. This additional popular usage has come about because of the great increase in the use of the wooden pallet as a unit load, and the fact that box vans with reinforced floors can be readily loaded by fork trucks.


**An articulated combination featuring a box trailer, which in this case is refrigerated**

The platform or flat bed is the traditional body type. It consists merely of a wooden or metal floor above the skeletal chassis, with a possible range of heights. It is sometimes fitted with drop sides and rear to help secure the load. It is, of course, uncovered. It is still in common use for many raw materials and products that are unaffected by inclement weather. The majority of loads need to be roped and sheeted, a skilled but time-consuming occupation. It is for this reason that curtain-sided bodies are used more extensively in Europe than flat beds.

The road tanker is another very common vehicle. The tank body can be used to carry a variety of liquids and powders. The tilt body is quite a recent innovation. The tilt is a curtain-sided vehicle that broadly consists of a fabric cover over a framework secured to the platform of a lorry. This fabric cover can be drawn together to cover the load completely and then fixed by lacing or strapping down the length of each side of the vehicle. A cord may be fed through all of the securing buckles and sealed by customs officials.


**A platform or flat bed rigid vehicle with drop sides, which in this case is fitted with its own crane to assist loading and unloading**

In appearance, a tilt body is very much like a box van, although the sides of the tilt van are made of a combination of drop sides and flexible curtain fabric. The introduction of the tilt body was to eliminate the need for loads to be roped and sheeted and facilitate faster customs order clearance. If the tilt superstructure has to be stripped down to allow loading from above by crane, or even from the side, this can be very time-consuming as compared to the curtain- sided vehicle.

Curtain-sided bodies have become very popular in recent years. They are different from tilt bodies in that they have a rigid roof, and one movable curtain each side of the body. This is a very flexible and effective vehicle body that eliminates roping and sheeting and the problems associated with stripping out tilt bodies.

'Tipper' is the description that applies to vehicles that have the capacity to tip loads directly. These can be open-topped bulk carriers or tankers. They are normally worked hydraulically and are used to discharge a variety of bulk materials. Typical loads include grain, gravel, sand, cement and plastic pellets. They may be covered, depending on the particular characteristics of the product carried. The inherent dangers of tipping tankers falling over are being overcome through the introduction of non-tipping tankers that use bottom discharge systems. These vehicles have the added advantage of being able to carry a higher payload.

**A curtain-sided trailer giving ease of access for loading**

There are several other vehicle bodies used to carry certain types of product. These are basically self-explanatory, but in their construction they do reflect the special needs and requirements of the products concerned. Typical examples are those bodies used for livestock, furniture, hanging garments, transportation of cars and refrigerated products.

The final vehicle body to be considered is also a fairly recent alternative. This is the demountable box van or body, which is used in a similar way to a standard

container. The demountable body can be carried directly on the platform or flat bed of the vehicle or can be mounted on the skeletal chassis. In direct contrast to the container, however, the body is removed by the use of jacks, which are positioned at each corner of the demountable body and then raised, allowing the vehicle to drive away.

There are a number of ways of removing the body. These may include screw-type jacks, power- or hand-operated hydraulic jacks, electrically operated portable jacks or power-operated lifting equipment fitted to the chassis of the vehicle. Demountable systems provide an increased flexibility to distribution operations by improving vehicle utilization and fleet economy.

The swap-body is a body used by intermodal operators. It combines the features of a tilt body but it is detachable like an ISO container. These swap-bodies conform to standard sizes and may be used by both rail wagons and road vehicles.


**A rigid vehicle fitted with a high cubic capacity body for high volume/low weight cargo, which in this case are household goods**


**A car transporter**

**The wider implications of vehicle selection**

There are several additional points that should be considered when choosing a vehicle. Some of these are clearly associated with those factors and features that have already been discussed; some reflect quite dearly the wider implications of vehicle selection, and others show how it is possible to use knowledge and experience to help in decision making. These associated factors can be summarized as follows.

Is there a proven model or make of vehicle that is known from experience will be good at the job in question? This knowledge may be obtained from looking at other depots and their fleets from within the same company, or it maybe available from studying similar types of operation that are undertaken by other companies, or by reference to the trade press.

Also, it may be possible to assess the reliability of certain models and types of engine, etc by analysing the history of similar vehicles. Thus, various measures of performance can be produced and studied to give useful data on fuel economy, breakdowns, cost of maintenance, etc. Where information is not available from own-company records, it is still possible to use a variety of published data, which are available from the commercial press and other sources. Some companies now use fleet management computer packages to provide this historical information.

In selecting a vehicle, it is important to be aware of the need to undertake maintenance and repairs. If a depot has its own maintenance facilities available then this is not a great problem. The likely difficulties can and do arise for companies that do not have their own facilities and discover that the nearest dealer or garage with appropriately trained mechanics for their make of truck is situated at a great distance from the depot itself. With the new levels of vehicle technology, it is becoming increasingly difficult for own maintenance facilities to justify the investment in the necessary equipment needed to maintain these modern vehicles. Manufacturers' geographical spread and level of support have major implications for vehicle selection.

One area that is difficult to cater for, but must nevertheless be borne in mind, is that of likely future transport legislation that might affect the choice of vehicle. There are a number of factors that may be of importance, such as the construction and use regulations, drivers' hours, maximum vehicle weights, environmental issues, new levels of vehicle technology, etc.

Another point concerns drivers. It should be remembered that it is drivers who have to work with the vehicles every day of their working lives. They will understand many of the particular operational problems involved with the work that they have to do, and they will undoubtedly have an opinion on the 'best' type of vehicle from their point of view. It makes good sense to listen to this viewpoint. At least, it is important to consider the safety and comfort of drivers at work.

The final factor for which allowance must be made is, in many ways, one of the most important. It has been emphasized that there is a need to balance a variety of operational and economic aspects to ensure that the truck is efficiently run. Another vital factor to take into account is that, as well as loading at the depot or warehouse and travelling legally on the roads, the vehicle also has to access the delivery points. Thus, the accessibility at the delivery interface is a very important consideration. It is essential to be able to provide a vehicle that is fit for purpose.

## CONTAINERS AND PALLET MANAGEMENT

The wooden pallet is the most common unit load used in warehouses. It is a convenient-sized load for moving goods around the warehouse and for the storage of goods. The goods often arrive already on pallets, but even where this is not the case, as occurs frequently with loose- loaded ISO containers, then the goods may be palletized at the goods receiving area ready for put-away to storage. The use of wooden pallets enables standard storage and handling equipment to be used, irrespective of the nature of the goods on the pallet. The exact nature of the equipment will be determined by such factors as the throughput levels, inventory holdings, and the requirements of the wider supply chain. The various types of

storage and handling equipment available for palletized goods are explored in this chapter.

## Pallet movement

There is a wide range of equipment available for moving pallets around a warehouse, from simple manual aids to sophisticated computer-controlled equipment. Some of the most common types are as follows:

- Hand pallet truck. This is a truck with two forks that will fit into the slots of a pallet. The forks can be raised slightly by a simple pump action to lift a pallet off the floor. The truck can then be pulled manually and the pallet deposited at the required floor location in the warehouse. It is useful for infrequent movements over short distances.
- Powered pallet truck. This is similar to the above, except that it is battery-powered. The trucks may be pedestrian-controlled or may have a platform or a seat for the operator to stand or sit on.
- Tugs and tractors. For long horizontal movements, a tug may be used, towing a number of trailers. This reduces the number of journeys that need to be performed.
- Conveyors. There are a number of possible conveyor types, with the simplest being gravity roller conveyors. These conveyors comprise a series of rollers inclined at a slight angle. When the pallet is positioned on the conveyor, it rolls forward to an end stop (or to the pallet in front). Braking rollers may be fitted to slow the momentum of the pallet down the slope. For longer and more controlled movement, powered roller conveyors are used. Chain conveyors, comprising two parallel chains running in tracks, are often used for short transfers between roller conveyors and as a diversion mechanism from one conveyor to another. Turntables may be incorporated for 90-degree turns, and lift mechanisms may be used for vertical movement between conveyors at different levels.
- Automated guided vehicles (AGVs). These are battery-powered computer-controlled trucks and hence do not require a driver. In warehouses, they are normally used for moving pallets but can be used for a variety of unit loads or goods (e.g. paper reels).

Typical applications are for the horizontal movement of pallets from the goods receiving area to the reserve storage system, or from the latter to the marshalling area. They normally have a short conveyor on top and can thus transfer the pallet from and to a standing conveyor at each end of the journey. Some AGVs also have forks and can stack pallets. Data may be transmitted to the AGVs by infrared or radio frequency signals, whilst guidance of the trucks may be by a variety of

means. A common method is a wire-guidance system, whereby a wire is buried in the warehouse floor and sensors in the AGV can follow the magnetic field generated by the electric current flowing through the wire and steer the AGV accordingly. Other systems include magnets buried in the warehouse floor and optical guidance by strips or painted lines. Many modern systems now use laser guidance. For this type of system, retroreflective strips are placed on walls and equipment around the warehouse and these are detected by a laser scanner on the AGV. Based on predetermined routes on a digital map, the AGV can then guide itself through the warehouse. The vehicles also have obstacle detectors (e.g. sound, infrared, laser and/or bumper) on board so that they stop if they detect a person, truck or other obstacle in their path.

In general, the above types of equipment are used solely for horizontal movement. For placing pallets into storage positions, some form of lifting mechanism is required. These trucks are described in the following section. However, it should be noted that many of these lifting trucks are also commonly used for horizontal movement around the warehouse.

## Pallet stacking

The effective storage of goods in a warehouse normally involves the stacking of pallets, either one pallet on top of another or, more commonly, the placing of pallets into some form of racking. In order to achieve this, the truck must be capable of lifting a defined load. Manufacturers normally define the maximum load that can be lifted (e.g. one or two tonnes) at a specified load centre (e.g. 500 or 600 millimetres). The load centre represents the centre of gravity of the load at a specified distance from the heel of the forks. It is thus normally equivalent to about the centre of the load being lifted .If a longer load is lifted then the maximum weight that can be carried must be ‘derated’ in accordance with the manufacturer’s specifications.

A lift height will also be specified by the manufacturer and this is the height to which the forks can be raised carrying a specified load. The maximum permitted load may reduce at greater heights. The vertical mast of the fork-lift truck may be simplex, duplex, triplex or quad. This refers to the number of vertical columns in the mast. Thus a simplex mast would need to be at least the total height of the specified lift, whereas a triplex mast would be much lower when closed but would be able to reach higher when the three columns are extended. Another consideration is the ‘free-lift’ height of the mast. This is the height that the forks can be raised before the mast starts to extend upwards. This is important for stacking in low enclosed spaces such as when loading or unloading shipping containers. Fork truck masts also incorporate a tilt facility; forward tilt of about 5

degrees for picking up and setting down loads, and backward tilt of about 5 to 12 degrees for travelling, lifting and lowering.

**Stacker trucks**

These are probably the least expensive fork-lift trucks available and tend to be used for infrequent lifting or in confined spaces. The trucks are battery-powered and variations include pedestrian operated, ride-on, stand-in and seated. They tend to be lightweight in nature (although 2,000 and 3,000 kilogram stacker trucks can be found) and tend to be limited in height, up to about a six-metre lift height. The front wheels are normally in front of the load to provide stability but this means that, when stacking, the bottom pallet must be supported on a beam, so that the front legs can extend underneath. This front-wheel configuration is suited to open-base pallets (eg Europallets) but is not suited to perimeter-based pallets (e.g. as are typical in UK pallet pools). There are also straddle stackers where the front legs are set further apart so that the legs can extend either side of a ground floor pallet, thus overcoming this constraint. Counterbalanced stackers are available and these tend to be pedestrian-operated versions of counterbalanced trucks

**Counterbalanced fork-lift trucks**

These are very common and versatile trucks found in a wide variety of warehouses. They can be used for loading and unloading vehicles, as well as moving goods around the warehouse and lifting goods into pallet racking. They are normally powered by electric battery, diesel, liquefied petroleum gas (LPG) or compressed natural gas (CNG). Hybrid trucks that combine diesel engines and batteries are also available. There are two front wheels and one or two rear wheels, the latter being used for steering. They may have pneumatic tyres for working in yards outside or solid/cushion tyres that are more suitable for inside warehouses.

The load is carried forward of the front wheels and therefore the weight of the load needs to be counterbalanced by a steel or iron casting and/or by the weight of the battery or engine itself . This configuration results in the truck being fairly long and therefore requiring a wide aisle (of about 3.5 metres) in which to work. Thus, although counterbalanced forklift trucks are very versatile, they do require considerable aisle space. within warehouses. They are built to a wide range of specifications, typically from 1,000 kilogram payload upwards. Lift heights for warehouse trucks are normally up to about 11 metres (i.e. the height of the forks above the ground when raised).

Battery powered trucks are normally used inside warehouses and diesel trucks outside, owing to their emissions. Gas trucks can be found in either situation and are commonly used for the side-unloading of vehicles under a canopy outside a warehouse .and then bringing goods through level-intake doors into the warehouse itself. In the case of battery powered trucks they can normally operate about an eight-hour shift before the battery needs recharging. Facilities are therefore needed in the warehouse for charging and for changing batteries (i.e. for loading a spare battery into the truck in the case of multi-shift operations).

Technology such as regenerative braking and lowering extends the charge cycle of batteries by returning power to the battery during these activities.
Note that certain mechanisms are available to facilitate the handling of pallets by fork-lift trucks. These include side shift, which enables the forks to be shifted laterally by about 75 millimetres at right angles to the direction of truck travel so as to facilitate the accurate positioning of loads, for example during loading pallets into ISO shipping containers. A further mechanism allows for the two forks to be spread into a total of four forks so that two pallets can be moved at a time. This may be used, for example, for the rapid side-unloading of vehicles at goods receiving.
Although most fork-lift trucks have rear-wheel steering, there are some trucks that are articulated so that the truck body 'bends' in the middle during turning. These trucks can be used for loading and unloading vehicles and are designed to operate in aisles of as little as 1.7—1.8 metres. They are therefore proving popular, particularly where this type of versatility is required and where there is a need for some pallet racking in confined spaces.
Instead of having a mast there are some counterbalanced fork-lift trucks that have a telescopic boom that extends from alongside the driver. These telescopic fork-lift trucks are typically used at construction sites and on farms but can also be useful for loading trucks and rail wagons as they can extend far enough to load from one side, thus saving warehouse yard space.

**Palletized storage**

There are many storage systems available for palletized goods, ranging from simple block stacking to advanced computer-controlled systems. As well as representing a range of technologies, these systems offer various compromises between the very dense storage of pallets with limited accessibility to each pallet and, at the other extreme, individual accessibility to every pallet but taking up a large amount of warehouse space. These alternative systems are described below.

**Block stacking**

This is simplest form of storage with pallets being placed one on top of another .It is very cheap as there is no need for any racking. However, the height of the stack is limited by the crushability and stability of the loads. Crushability is important not only because of possible damage to the goods at the bottom of the stack but also because any crushing of the lower loads may present a risk of the stack toppling over. Pallet posts or collars (e.g. wooden boards that go around the pallet) may be used to prevent crushing, but these of course have a cost and need time to be inserted and dismantled.
Block stacks are normally arranged in rows of a fixed depth (e.g. two, three, four or more deep) running 90 degrees to the aisle. The first pallet is placed on the floor at the back of the row and the next pallet placed on top. The third pallet would be placed on top of these or if the stack were only two-high, then it would be placed on the ground in front of these. In this way, the row is filled up to a specified depth

and height of pallets. The pallets are extracted in reverse sequence and therefore this is a 'last-in first-out' system.

As the lift-trucks must be able to drive between the rows and access the back of any row, then the rows of pallets must be positioned slightly apart (typically about 100 millimetres between each row). Also, about 50 millimetres is normally planned as the gap between pallets in the same row. Typically, block stacking is carried out by counterbalanced fork-lift trucks.

To avoid double-handling rows should only contain one Stock Keeping Unit (SKU). Once filled the row should then be completely emptied before any other pallets are placed there, as otherwise the back pallets will become 'trapped' and may stay there for a very long time. In practice, more than one row is normally allocated to an SKU so that one row can be filled with new pallets arriving whilst another row is being emptied. As a result, many rows are likely to be only partially full at any moment in time and this is often referred to as 'honeycombing'. Typically, only 70 per cent of pallet positions are utilized at any point in time. For example, if three rows are used for a particular SKU, then one ma and One may be used for dispatching be on average half-full), one may be full with stock, goods (and thus be on average half-empty). In such a situation, only about twothird5 of the locations would be occupied by pallets. Similarly, if four rows are used for an SKU, then about three-quarters of the locations are likely to be occupied on average. Thus, if a block stack area is required to store 1,000 pallets then about 1,430 pallet locations may need to be provided (i.e. 1,000/0.7), depending on the number of rows per SKU.

For easy and safe fork-lift truck driving, the front-to-back depth of any row should not normally exceed six pallets in from the truck access aisle, which means blocks of a maximum 12 deep, back to back. In practice, layouts may well incorporate rows of different depths to accommodate SKUs with different inventory levels. Thus, in a four-high block store, for example, SKUs with typical inventory levels of 48 pallets and above may be stored in six-deep rows, whilst SKUs with 24-plus pallets may be stored in three-deep rows.

Block stacking is suitable for that part of the product range where there are few product lines, each with a high inventory level, and where very strict first in first out (FIFO) movement of inventory is not required. The advantages are good use of area (although not necessarily of building height), flexibility to change the layout of the blocks, quick access to inventory for rapid throughput operations, and low capital cost (as no racking is needed).

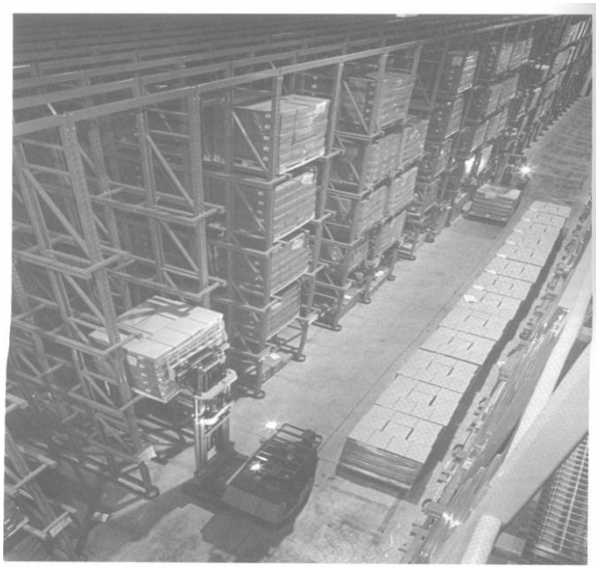
**Drive-in and drive-through racking**

In order to overcome the problem of crushability, drive-in racking may be used .With this type of racking, metal uprights are positioned on each side of every row in a block stack area and horizontal metal flanges extend along these uprights at right angles to the aisle in order to support the upper pallets. Fork-lift trucks drive between the columns into each row in order to position the pallets either on the

floor or on the metal flanges. Operationally, the racked area is used in the same way as block storage, with the same benefits and drawbacks, except that the rack height is not limited by the crushability of the product. It is thus a 'last-in, first-out' system and suffers from low location utilization (again about 70 per cent). However, it is a dense storage system and is suitable where there are high numbers of pallets per SKU.
Driver strain can be an issue as the fork-lift trucks need to travel down between the column uprights into the rows and must carry the pallets at the height at which they will be positioned (i.e. just above the metal flanges on which they are placed). Although the racks may be used for fast-moving goods (as these generally have many pallets per SKU), travel speed within the racks tends to be relatively slow.

The pallets are positioned onto the cantilevered metal flanges at the appropriate height on each side of the row. The pallets therefore need to be of a high quality in order to support the weight of the goods without cracking in the centre.

Drive-in racks are generally built up to about 10 or 11 metres in height and to about six pallets deep, although they can be much deeper. As with block stacks, they may be positioned back-to-back, with access to separate rows from each side. Where fork-lift trucks can pass completely through the rack into another aisle then this is known as drive-through racking. This is less common than drive-in racking and tends to be used in staging areas, rather than for storage.



**Drive-in racking, being served by reach truck**

**Push-back racking**

Push-back racking is another form of dense storage system but has the advantage that each level in the 'block stack' can be accessed individually. Push-back racking is typically constructed between three and five pallets deep. The fork-lift truck stays in the aisle and positions a pallet onto a wheeled frame at the appropriate height in the rack .The next pallet of that SKU is then lifted in front of the first pallet and is used to push the latter back into

**Push-back racking, being served by reach truck**

the rack. This second pallet is then placed onto a wheeled frame of its own. The procedure is then repeated with a third pallet being used to push the first two further back and so on. When a pallet is required the last pallet is then extracted and the earlier pallets roll back down under gravity to the front of the racking. It is thus a 'last-in first-out' system. The frames nest into each other as they return to the front of the rack.

As each level (i.e. 'lane') can be accessed independently, there is no need for the whole row to be of the same SKU, as with block storage and drive-in racking. It is therefore suited to SKUs with lower levels of inventory, e.g. SKUs with eight-plus pallets in a four-deep system.

**Adjustable pallet racking (APR) — reach truck operation**

Adjustable pallet racking is the most common form of racking and is widely used in warehouses, factories and workshops. Pallets are placed single-deep onto horizontal beams, running parallel to the aisles, which are fixed to vertical frames. The uprights of the frames are bolted to the floor, whereas the beams can be moved to different heights on the frames (hence the name 'adjustable'). However, in

practice, beams are only moved infrequently as the integrity of the structure needs to be recalculated each time and the racking needs to be emptied of pallets.
APR may be served by counterbalanced fork-lift trucks. However, because of the very wide aisles needed for such trucks, reach trucks are commonly used .The racking is very versatile and can be configured to accept different kinds of loads (eg drums or paper reels) and thus trucks with specialist attachments may also be used within such racking systems.
As with all racking systems, safety is of paramount importance, as any rack collapse can have very serious consequences. A single upright failure can lead to a 'domino' effect of collapses across an entire warehouse. Metal barriers are therefore often installed to protect uprights at the ends of aisles from truck collisions. Regular inspections are important and any damaged metalwork requires immediate attention.

**Adjustable pallet racking, being served by reach truck**

## CHAPTER EIGHT

## DISTRIBUTION PLANNING

## STRATEGIES OF DISTRIBUTION

Pre-positioning of the product in a logistics node nearer to the customer and ultimately learning to handle the consumers' request, calls for the need of warehousing, i.e keeping sufficient stock to meet customer demand.
A Logistics Professional must understand the value, warehousing contributes to the Logistics and Supply Chain process.

### STRATEGIC WAREHOUSING

**Purpose**

Everyone is aware of the existence of the Federal Government Storage/ Warehousing Corporations in Nigeria where food grains, sugar, potatoes, etc are kept mainly for the following purposes:

(a) Public distribution system - Serving public need for distribution of subsidized food grains etc. to citizens of low income group,
(b) Serving public need for disaster management.
(c) Protecting the interests of the farmers against low procurement prices.

### WAREHOUSE LOCATION

In the context of reaching the market, i.e. retail outlet, or consumers direct earlier than the competitors, determination of ideal location of a warehouse generally depend on the following factors.

(a) Proximity of market: This location is based on the center of gravity of the area. Here the warehouse is ideally located at the geographical centre of the area of the market it intends to serve.
(b) Availability of warehouse/land for warehouse near the market and suitability of its place.
(c) Distance of railhead/highway/air or seaport consisting:
    (i) Lesser distance
    (ii) Approaches/connectivity by different modes of transport including trailers for containers
    (iii) Material handling facilities
    (iv) Uninterrupted supply of electricity and water (when so required for the purpose of warehouse operations),
    (v) Industrial Relations climate
(d) Stability or will of Local Government Administration

Before deciding on location of a warehouse or hiring a warehouse or outsourcing the warehousing activity to a third party service provider besides stability and will of local govt-political/social disturbances and other factors discussed above,the following cost parameters are to be examined:

a) Warehouse Rent, or ROI on capital invested on warehouse.
b) Cost of operations or inventory carrying cost:
   (i) Cost of HR
   (ii) Cost of Insurance
   (iii) Cost of electricity/water
   (iv) Computer installation and utilization cost
   (v) Cost of loss/pilferage! Insurance
   (vi) Cost of inventory holding
c) Cost of transportation to and from a warehouse to customers, customers to warehouse or turnaround time and cost relating to transportation and material handling.
d) Variable cost due to change of volume of sales or distribution.
e) Areas free from insects, termites etc.

**Functionality of Warehouse**

Largely it has been put across in the paragraph above that a warehouse should be cost effective. No warehouse should be included in Logistics and Supply Chain System unless it is justified in providing an affirmative combination of service and cost. Let us examine the benefits;

1. Economic/Financial Benefits: A warehouse should be able to generate the following economic/financial benefits:
   (a) Reduction of overall cost of transportation.
   (b) Consolidation of bulk break.
   (c) Assortment of products.
   (d) Postponement of delivery.
   (e) Stockpiling to avoid stock-out condition in retail market.
   (f) Reverse logistics (of unsold/unwanted materials)
2. Cost Reduction and Service Improvement: For improvement of service to customers, a warehouse is established / rented / outsourced. A large amount of capital in establishing / renting a warehouse is required to meet all expenses on operations of the warehouse or rather - 'carrying cost' of inventory, and / or reducing cost of transportation. A warehouse is not viable if efforts are made to offset the cost of operation by economizing on cost of transportation by reaching higher sales volumes, when the capital cost and operation cost cannot be earned.
3. Consolidation and Break Bulk: Let us see what is consolidation. A consignee requires materials from three different sources at the same time, say for production. The quality/volume does not combine for economic load. If each material component part is sent on a truck load, then there are chances of overloading of one or two types of materials. There may even be under- loading for small spares. In such

a situation it will be worthwhile to sent truckloads (load economical to the consignee and to the warehouses), consolidate the material / spares /accessories r economic load and despatch these on 'as-required' basis:

(a) Realization of lowest possible freight rate.
(b) Timely and controlled delivery.
(c) Less break bulk inventory holding at consignee's end.

4. Break bulk: Break bulk concept is just the opposite of consolidation. Here a particular manufacturer sends a load of product which is economically justifiable.
5. Stockpiling: Stock piling or stock build up is done in the following business situations:
   (a) To draw benefits of large scale productions, and public distribution system manufacturer
   (b) To stock seasonal/agricultural products viz., potatoes, food grains, pulses, tomatoes, fruits etc.,
   (c) For the purpose of disaster management,
   (d) To waive off uncertainty and reduce risk, (i.e., to stock lead time requirement)
   (e) When bulk shipment is received (as in cases of iron ore, coal)

Agricultural products like 'potato', 'tomato', 'jute', 'paddy', 'rice' need to be stock piled because of the nature of seasonality and their ultimate use throughout the year. But products like 'iron ore', 'crude oil' etc have to be imported or drawn from source within the country for enforcing the economics of purchasing/transport vis-à-vis warehousing/carrying costs.

**SERVICE BENEFITS**

It has been stressed that warehouses should only be established / rented or warehouse operations delegated to a service provider, provided increased volume of sales generate additional revenue commensurate to return on investment and reduce operating cost of warehouses. Establishing a warehouse to serve a specific market may increase cost but at the same time it should also increase market/sales revenue and should have potential of increasing gross profit margin. Warehouses can provide better service and generate revenue as a result of any one or a combination of the following techniques/procedure.

**a.Spot stocking b. Full line stocking.**

a)Spot Stocking: This practice supersedes pre-positioning of select inventory for a selected market. In other words, this calls for stocking in an area nearer to a local market warehouse in anticipation of meeting customer needs during critical sales period. For example, garment manufacturers spot stock their products to meet market demands for the festive season, eg Christmas. Fertilizer manufacturers spot stock fertilizers to meet the demands of farmers during sowing season.

b)Full Line Stocking. It provides one stop shopping, in that wholesalers/retailers stock different, items from different manufacturers, thus providing assortments to meet customers' demand. Here warehousing and retailing get combined

**DIFFERENCES**

Functional differences between spot stocking and full line stocking are the following:

(a) Full line stocking is for a longer duration, whereas spot stocking is for a limited duration in a localized atmosphere,

(b) In spot stocking, assortment is limited to products and manufacturers, whereas full line stocking could be for a number of manufacturers producing multiple products.

**COMPETITIVE ADVANTAGES**

Full line stocking helps improvement of service by reducing the number of suppliers that a customer may deal with. Combined assortment contributes to more economical, larger shipments. As depicted in mixing different manufacturers, a supplier from one place or even different places may obtain services of a service provider to distribute to different customers through full line stocking. These may be:

(iv) Home delivery
(v) Inventory control
(vi) Kanban
(vii) Customer reference
(viii) Kitting
(ix) Lot control
(x) Returnable container management
(xi) Reverse logistics or returned/unsold/repairable materials handling

## ROUTE PLANNING

Vehicle routeing and scheduling problems are relatively complicated

**Different types of routeing and scheduling problem**

These different problem types can be categorized in four main ways:

1. strategic;
2. tactical;
3. interactive;
4. planning.

**Strategic problems** are concerned with the longer-term aspects of vehicle routeing and scheduling, in particular where there is a regular delivery of similar products and quantities to fixed or regular customers. Typical examples are most retail delivery operations such as grocery multiples, bread delivery and beer delivery to 'tied' houses.

The main characteristic is that of a fairly regular demand being delivered to virtually the same locations. Thus, it is possible to derive vehicle schedules that can be fixed for a certain period of time (e.g. three to six months). Some changes will be necessary as shops open or close, or as new products come on to the market, but in general the schedules can be maintained for a reasonable length of time. These schedules are drawn up on the basis of past or historical data. Strategic scheduling is now often undertaken by using computer software.

**Tactical problems** are concerned with routes that have to be scheduled on a weekly or a daily basis. This type of scheduling is typically undertaken by parcels delivery companies, by companies supplying spare parts and by contract haulage companies that work for a number of different clients. The major factor of importance is that either the demand (quantity) of goods cannot be estimated (e.g. it is 'random' demand) or the location of delivery points can vary, or that both of these occur.

Thus, for tactical scheduling it is impossible (or very difficult) to plan delivery schedules based on historical information. It is necessary to look at each series of orders on a daily (or weekly) basis, and plan vehicle routes and schedules according to this ever-changing demand. This type of scheduling is often still undertaken manually by a load planner in a depot, but now computer applications are available that allow for 'live' scheduling.

Many delivery operations are now planned on an interactive basis that allows the scheduler to use the computer to derive the most effective routes. Actual demand data are used rather than historical demand, and these 'real-time' data provide the basis on which routes are scheduled. Thus, much more accurate routes can be formulated. A rather obvious question might therefore be asked. Why aren't all sets of routes derived in this way? The answer is that the cost of setting up and using a routeing and scheduling package on a daily basis can be very expensive — both in terms of the cost of buying the package and also the time and cost of providing the demand data every day. Also, of course, when such packages are used for planning purposes, historical data are perfectly adequate.

Schedules produced interactively can result in very varied routes day by day. This is because the computer is able to reappraise demand requirements and come up with a completely original result each time it is used. One of the major benefits of an interactive approach is that the scheduler is in a position to make changes to routes as they are required. For example, should an urgent order be received after the initial routes have been planned using the computer, the scheduler can manually input the order into the package and assign it to an existing route. The computer will then check the route to see if the new order can be accepted. It may be rejected for a variety of reasons — insufficient capacity left on the vehicle, insufficient time available, etc. Thus, the scheduler can use the package to ensure that the order is only placed on a vehicle that is in a position to complete the delivery both legally and within the allotted service constraints.

Some software packages now also allow for multi-depot routeing so that deliveries are made from the depot that has the available resources. Thus, resources at all depots can be utilized more effectively, enabling the maximization of asset utilization.

The final type of routeing and scheduling problem concerns the planning and measurement of the effect of change. This use of routeing and scheduling has really come into its own as a result of the development of computer-based techniques. Computer models may be used to test or simulate the effect of changing demand, new vehicle availability, legislative changes, etc. This is often known as 'what-if planning. Some examples include:

- Third-party contractors typically use routeing and scheduling packages to help them respond to invitations to tender for business. The package will allow them to identify fleet and driver requirements and thus cost out the operation accordingly.
- A large manufacturer of soft drinks uses a routeing and scheduling package to help it to identify the implications of adopting different minimum order/drop sizes for its various products to its many different customer types. Any reduction in minimum order size will bring an increase in revenue for the products, but will be associated with an increase in delivery costs, because many smaller orders have to be delivered. The routeing and scheduling package is used to test and identify these potential cost increases.
- Own-account operators use routeing and scheduling packages to help them identify the implications of changes in transport legislation. An increase in maximum vehicle weights is a case in point, as this will impact on the size of loads that can be carried, the buying policy for the fleet, etc.

**Data requirements**

It has already been noted that there are many different factors that need to be taken into account when planning the delivery operation of a road transport fleet. These factors require a great deal of data and information to be collected and collated.

The major areas for data are:

- demand data;
- distance factors;
- customer and service constraints;
- vehicle restrictions;
- driver constraints;
- route factors;
- product/unit load constraints.

**Demand data** should ideally be for daily, weekly or annual demand by customer at the point of delivery. This can often be difficult to collect, is usually time-consuming and will often require the most manipulation and clarification prior to

use. It may be necessary to undertake additional analyses (and collect additional data) to take account of peak demand periods, because they are likely to require different schedules.

There are several ways in which demand data can be represented. The key requirement is for the data to be representative of the main measure of vehicle capacity constraint. This might be weight-, volume- or unit-related. Examples include:

- weight (per product type delivered or as a total delivered tonnage figure — in kilograms or tonnes);
- cube or volume (in, say, cubic metres or cubic feet);
- carton/case/parcel (numbers to be delivered — common in retail distribution);
- unit load (eg numbers of pallets or roll cages — again common in retail distribution);
- value in revenue or sales (rarely appropriate because of the problem of interpreting value as a physical measure);
- product item (generally too detailed);
- product group.

Demand data must also be classified by location, and this can be represented in a variety of ways. Certain computer packages are more amenable to some classifications than others. The best (and often only) option is the classification that is in general use within the company. This will usually be drawn from electronic files of customer orders that record the customer delivery address and postcode (or zip code). The main alternatives are:

- postcodes or zip codes — the most common classification;
- Ordnance Survey codes, or any other type of map referencing system;
- 10-kilometre grid squares — a useful simplification if there are many delivery points;
- gazetteer (main town or city) — rather imprecise, but easily recognizable;
- latitude and longitude — again, may not be sufficiently precise;
- population-based — can be a good approximation of geographic demand if there are no other data available.

**Distance**; for routeing and scheduling analysis, there are various methods for estimating or measuring the distance travelled by the vehicles as they go about the distribution operation. Distances include those from the depot to the many delivery locations and those between the different delivery locations. The three main alternative methods of measurement are:

1. True distance method — where all the actual distances are physically measured on a road map. This is very time-consuming and could not be undertaken for large applications.

2. Co-ordinate method — where the depot and customer delivery points are located (on a map) by grid reference, and the straight-line distances are measured (sometimes called the 'crow fly' or 'aircraft' methods) and factored up to an approximate road distance. Typically, the factor that is used is 1.2 (this is sometimes called the 'wiggle factor'). This method uses 'barriers' to represent practical constraints such as rivers, railways, etc. This is often used for manual scheduling.
3. Digitized road network — most computer scheduling systems now use a special digitized road network of the country concerned, which usually consists of the major roads and junctions of the national road network. These provide a very accurate representation of travel distances. They also make allowances for different road types (e.g. motorway, trunk, etc) and for land use (e.g. city centre, town centre, etc), which allows for variable speeds to be used when calculating the time taken to travel.

**Customer Service Constriant**; There are a number of customer and service constraints that may need to be taken into account during the scheduling process. These relate to the ability to make a delivery to each destination point. They may be concerned with physical aspects or be time-related. Some of the more detailed ones cannot be used for manual routeing because of the difficulty of taking so many variables into account at the same time. The most common customer and service constraints are:

- specified times for delivery (eg 8 am);
- specified delivery windows (eg between 10.15 and 11.00 am);
- early closing days;
- lunch breaks;
- access restrictions (eg only vehicles of a certain size can deliver);
- unloading restrictions (eg no fork-lift truck available to unload pallets);
- drop size limitation (eg only a certain number of packages/pallets can be received);
- parking problems (eg cannot park or unload in the main road);
- paperwork problems (eg all goods must be checked by the driver and signed for).

**Vehicle Restriction;** Certain vehicle restrictions will also need to be taken into account. Typical examples might include:

- the type of vehicles available;
- the number of vehicles available;
- the need to pre-load trailers;
- mixed fleets (ie rigid and articulated vehicles);
- vehicle capacities (in weight or volume);
- use of compartmentalized vehicles.

**Driver constraints** will also be relevant, the major ones for consideration being:

- drivers' hours legislation;
- shift patterns and hours of work;
- the number of drivers available;
- different types of licence and training;
- the need for a second person to assist with deliveries.

**Route factors** refer to the different constraints that apply to the make-up of individual vehicle routes. These include:

- the road infrastructure;
- maximum number of calls per route;
- multiple trips (ie more than one journey in a day by one vehicle);
- two-day trips (ie the vehicle and driver do not return to the depot every night);
- simultaneous delivery and collection.

**Product**; There is a variety of factors that may need to be considered with reference to the product or unit load that is being distributed. Typical examples are:

- the weights and dimensions of the different products;
- the weights and dimensions of the different unit loads;
- •variable unloading times (different products or unit loads may vary in the time it takes for their unloading);
- separation of products within a vehicle because of potential contamination or fire hazard;
- the need to collect empty containers;
- a requirement for special handling equipment.

**Manual methods of vehicle routeing and scheduling**

In this section a manual system for day-to-day scheduling and a manual system for long-term planning are described. Because of the detailed nature of such an exercise, only a broad picture of what actually takes place will be painted.

**A daily (manual) scheduling system**

This example describes the daily routeing and scheduling system and procedure undertaken by a load planner for a depot situated in Lagos. The company is a contract haulier with a few large and several small clients for which it undertakes delivery. This particular depot covers Lagos, Akure and the south-east of Nigeria. Although some locations are visited quite often, there are no regular deliveries made and new locations occur quite frequently.

Procedures at the depot are relatively straightforward. The majority of orders are received from the head office by fax or electronic transfer, although some may come directly to the depot. The orders give information relating to the delivery address, delivery date, product, quantity, packaging, gross weight and any special delivery instructions. The deadline for receipt of orders is midday. This leaves the afternoon for the load scheduling and preparation of order picking notes for the following day's work. It also provides for some time allowance for the adjustment

of the existing planned loads to take account of urgent orders that are required for delivery the next day.

On the day following the receipt of order, the goods will be picked and marshalled by the warehouse staff and then loaded on to a vehicle by the driver on returning in the late afternoon. Delivery takes place the next day.

A copy of every order is date-stamped, and then order types are categorized according to delivery status. These different categories are as follows:

- Forward orders (ie delivery required at a later date) — these are placed in a forward- order tray one week ahead, two weeks ahead, etc.
- Normal delivery — these are to be delivered according to the company's standard service level (say within five days). These orders are used as the prime basis for making up loads.
- Urgent orders — these occasional orders are for delivery within 24 hours. They are also used for making up full vehicle loads, but outside contractors are brought in if this is not feasible.

**Vehicle tracking**

The most basic function of strategic distribution and fleet management systems, is the vehicle tracking component. This component is usually GPS-based, but sometimes it can be based on GLONASS or a cellular triangulation platform. Once vehicle location, direction and speed are determined from the GPS components, additional tracking capabilities transmit this information to a fleet management software application. Methods for data transmission include both terrestrial and satellite. Satellite tracking communications, while more expensive, are critical if vehicle tracking is to work in remote environments without interruption. Users can see actual, real-time locations of their fleet on a map. This is often used to quickly respond on events in the field.

Principle of geolocation is based on the GPS for the position determination and the GSM/GPRS or telecommunication satellites network for the data transmission Mechanical diagnostics .Advanced fleet management systems can, connect to the

vehicle's onboard computer, and gather data for the user. Details such as mileage and fuel consumption are gathered into a global statistics scheme....

- Driver behavior
- By combining received data from the vehicle tracking system and the on—board computer, it is possible to form a profile for any given driver.
- Fleet management software

Fleet management software enables people to accomplish a series of specific tasks in the management of any or all aspects relating to a company's fleet of vehicles. These specific tasks encompass all operations from vehicle acquisition to disposal. Software, depending on its capabilities, allows functions such as driver and vehicle profiling, trip profiling, dispatch, vehicle efficiency, etc. It can provide remote control features, such as Geo-fencing and active disabling. Current vehicle diagnostic information can also be related to a management site, depending on the type of hardware installed in the vehicles. New platform, based on Fleet management software, is fleet controlling with higher amount of information available for both drivers and dispatchers of a fleet. At this time (2012) online software platforms are very popular.

**Management of ships**

- Fleet management also refers to the management of ships while at sea. Shipping fleet management contracts are normally given to fleet management companies that handle aspects like crewing, maintenance, and day—to—clay operations. This gives the ship owner time to concentrate on cargo booking.

**Fleet Security and Control**

Recent advances in fleet management allow for the addition of over-the-air (OTA) security and control of fleet vehicles. Fleet Security and Control includes security of the vehicle while stopped or not in operation and the ability to safely disable a vehicle while in operation. This allows the fleet manager to recover stolen or rogue vehicles while reducing the chance of lost or stolen cargo. The addition of Fleet Security and Control to a fleet management system gives a fleet card manager preventative measures to address cargo damage and loss.

**Remote Vehicle Disabling systems**

Remote vehicle disabling systems (RVDS) provide users at remote locations the ability to prevent an engine from starting, prevent movement of a vehicle, and to stop or slow an operating vehicle. Remote disabling allows a dispatcher or other authorized personnel to gradually decelerate a vehicle by downshifting, limiting the throttle capability, or bleeding air from the braking system from a remote location. Some of these systems provide advance notification to the driver that the vehicle disabling is about to occur. After stopping a vehicle, some systems will lock the vehicles brakes or will not allow the vehicles engine to be restarted within

a certain time bound. Remote disabling systems can also be integrated into a remote panic and emergency notifications' system. In an emergency, a driver can send an emergency alert by pressing a panic button on the dashboard, or by using a key-fob panic button if the driver is within close proximity of the truck. Then, the carrier or other approved organization can be remotely alerted to allow a dispatcher or other authorized personnel to evaluate the situation, communicate with the driver, and/or potentially disable the vehicle.

**Fleet management replacement and lifecycle management**

The timely replacement of vehicles and equipment is a process that requires the ability to predict asset lifecycles based on costing information, utilization, and asset age. The industry standards for asset lifecycles are produced annually by Mercury Associates, Inc. which are calculated using the CARCAP modeling resource. These numbers are used to establish the expected date for a type or class of equipment, which can then be used to identify replacement dates and funding requirements. Funding requirements are also an issue, because many organizations, especially government, purchase vehicles with cash. The ad hoc nature and traditional low funding levels with cash has put many operations in an aged fleet. This lack of adequate funding for replacement can also result in higher maintenance costs due to aged vehicles.

**Duty of care**

The Corporate Manslaughter Act was strengthened to target company directors as well as their drivers in cases of road deaths involving vehicles used on business. The Police have said they now treat every road death as an unlawful killing' and have the power to seize company records and computers during their investigations. They will bring prosecutions against company directors who fail to provide clear policies and guidance for their employees driving at work. Directors and business owners may not be aware that privately owned vehicles used for business journeys are treated exactly the same as company owned vehicles. Directors have an equal responsibility under the law to ensure these vehicles are also roadworthy and correctly insured. It is vital that every company has a 'Driving at Work' policy in place covering every element of their business vehicle operation, no matter how few vehicles are involved and who owns them. Every employee driving for business be required to sign up to the policy. In this way the directors can reduce the risk of being prosecuted and a possible custodial sentence.

TOOLS USED IN DISTRIBUTION PLANNING

## ELECTRONIC DATA INTERCHANGE (EDI)

What is Electronic Data Interchange (EDI): Electronic Data Interchange is a technology which involves computer-to-computer transfer of commercial and administrative transactions using an agreed standard to structure the data pertaining to that transaction. The data transfer takes place without the least manual intervention.

**1. Elements.**

**There are three key elements in the EDI System:**

**(a)** ***Hardware (Computers):*** Under the EDI system the computers provide the physical interface which enable and facilitate the electronic transfer of messages between two or more trading partners.

**(b)** ***Telecommunication Network:*** These consist of telephone lines through which information can be electronically transmitted between sending and receiving computers. The connection can also be made via satellite.

**(c)** ***Communication software and transfer software:*** Communications software enables messages to be transmitted and received between computers. Translation software enables messages to be encoded and decoded into a format which both computers can understand.

**2. Methods of EDI Communication: There are two main methods of computer-to-computer transactions:**

(a) Direct Method: by this method it is possible to send information from one computer directly to another via a telecommunication line. But the links between the computers are limited by the capacity of the telecommunications network.

(b) Indirect Method: The indirect method involves the passing of electronic messages between computers using a third party 'Value Added Network' (VAN), which makes it possible for any number of computers to link up.

(c) Options: Trading partners on a value added network who wish to communicate with other trading partners belonging to another value added network, have the option either to:

(i) subscribe to the value added network of the trading partner or pass messages via that network, or

(ii) persuade the two value added net providers to connect with each other, so that the messages can pass between one value added network and the other.

**3. EDI Standards:** EDI standards define the techniques for structuring data into the electronic message equivalents of paperbourne business documents. They define the acceptable contents of message and the characters of codes used to delineate the entries. Once the rules have been defined and ratified as standards, it is then up to industry sectors and other potential EDI users groups, like customs, excise etc. to develop EDI messages appropriate to their needs. These EDI messages may subsequently be enshrined as 'EDI Standards' which cover five inter-related topics:

(a) Message: the smallest unit of business information which if pruned on its own, becomes meaningful.

(b) Segments: made up of 'strings' of 'data elements' separated by de-limiters.

(c) Data elements: Data elements are the vocabulary of EDI.
(d) Syntax: defines the rules by which data elements and segments can be put together to build messages.
(e) Message designs and guidelines: gives directions as to how to build messages to respond to the particular business needs within a given industry.

**SALIENT FEATURES FOR EDI**

**Import**

1. **Declaration:** Under the EDI system the importers, instead of submitting documents for assessment, provide a declaration in electronic format and assessment sheet containing all relevant information to the service centre.
2. **Examination and scrutiny of declaration:** Before it reaches the service centre the declaration is examined and passed by the scrutinizing officer. The service center operators enter the data in the system and generate a check list which is given to the importer. for verifying the signature and return to the operator. The operator then generates a number and inscribes the number with the checklist. A copy of the checklist is handed over to the Importer. (No original documents are taken at this stage.)
3. **Limitation:** However, the system will not accept such data unless they are also entered in e cargo manifest of the vessel/aircraft. An import rotation number also needs to be entered to the system. This is termed as noting of Bill of Entry.
4. **Group Appraisal Mode (GA) Role:** After noting, the bill is electronically forwarded to e Group Appraiser (Appraiser's mode), who checks the declaration, value, classifications, notifications, prohibitions, restrictions, licence aspect, documents/information in support of beneficial assessment.
5. **Checking by GA:** While the Assessing Officers (Group Appraiser) process the cargo declaration on screen, all the calculations of duty, including exemption of duty notifications are done by the system itself. If the appraisal is satisfactory, the appraiser gives the clearance (Group Appraisement); otherwise he raises queries which are transmitted to the service centre and given to the party to meet up.
6. **Examination by shed appraiser:** Under the EDI system, the Bill of Entry, after assessment by the group of appraisers need not be presented at the counters for registration and examination in the Import shed. A declaration of correctness of entries and genuineness of the original documents needs to be made at this stage. After registration the Bill of Entry is passed on to the Shed Appraisers for examination of the goods.
7. **Preparation of final appraisement Bill:** The Shed Appraiser enters the report in the system and transfers final appraisement Bill of Entry to the

group and gives "out of charge" in case of already assessed Bill of Entry. Following this, the system prints bills of entry and order clearance (in triplicate). All these copies carry the examination report order of clearance number and name of the shed appraisers. Two copies each of Bill of Entry and the order are to be returned to the party after the appraiser signs them. One copy of the order is attached to the Customs copy of the Bill of Entry and retained by the shed appraiser.

**Export**

1. **Declaration:** Under EDI system, declarations in prescribed format are to be filled through the service centers of customs. A checklist is generated for verification of data by the Exporter.After verifications, the data is submitted to the system by the service centre operators and the system generates a shipping bill number which is endorsed on the printed checklist and returhed to the party.
2. **Quota allocation:** The quota allocation and other certification are required to be pasted on the export invoice and this is to be entered in the system at the time of shipping Bill entry.
3. **Check List and other declaration:** The goods brought for the purpose of the examination is allowed entry to the dock on the strength of the checklist and other declaration, filed by the exporter in the service centre.
4. **Endorsement:** The custodians (port authorities) have to endorse the quantity of goods actually received on the reverse of the checklist.
5. **Settlements of doubts:** In many cases the shipping bill is processed by the system on the basis of declarations made by the exporters without any human intervention. In other cases where the shipping bill is processed on screen by the customs officers, he may call for the samples for confirming the declared value or for checking classification under drawback schedule.

## DATA CAPTURE

### (Bar Coding, Optical Character Recognition (OCR), Radio Transmission)

**Bar codes**

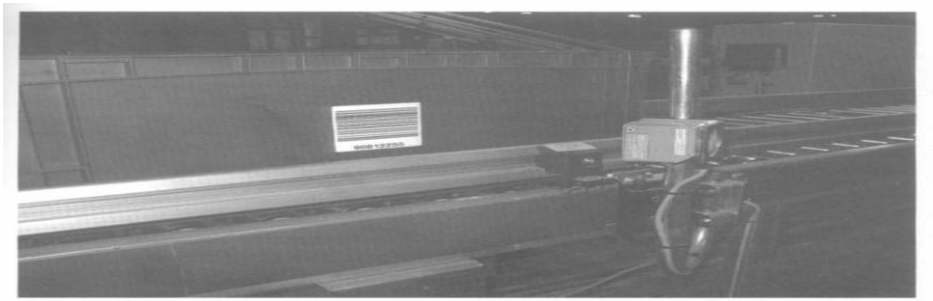
Bar codes are the most common form of capturing data by automation. A bar code comprises a number of vertical (or sometimes horizontal) bars of varying thicknesses. Each combination of bars represents a letter or number. There are a number of 'symbologies' established by different organizations for varying purposes (eg for retail sales, outer packaging or for use in specific industries). The codes are normally structured, so that, for example, the first few bars indicate the 'symbology', then the next few bars may indicate the national coding authority, the manufacturer, then the product number, and, often, finally, a check digit. The bar codes are read by scanners for direct input into the computer system. Common

applications are to check bar codes on locations within pallet racking, to confirm products when picking, and to read labels automatically on sorters. Bar code labels are inexpensive and normally conform to internationally recognized standards so that they can be read throughout the supply chain. However, normal bar codes can only provide a few digits of data, such as a product code or a pallet identification code,

There are two-dimensional bar codes available and, as the name suggests, these are scanned in two directions simultaneously. These can hold hundreds of numbers or characters, but their use is not widespread, as special scanners are required at each stage in the supply chain and common standards are not fully established. They are, however, used in 'closed-loop' situations.

**Optical character recognition (OCR)**

OCR labels can be read by both humans and text scanners. However, this technology tends to be less reliable than bar coding and data formats are limited. OCR technology is more common in document handling.



**Automatic bar code scanning of plastic tote box**

passive tags. These tags rely on incoming signals to provide power and are thus limited in range to between about 1 and 4 metres. This is because they need very strong signals to provide the power and because the power they can emit is very weak. The reader and tag therefore have to be in close proximity. The real interest is in their low and falling costs, which means that it is becoming increasingly cost-effective to place these tags on pallets or cases or even to integrate them into individual products. However, there are still issues to be overcome fully in such areas as standards, technical feasibility, operational robustness, financial business cases and, in some instances, civil liberties.

**Error rates**

Error rates in automatic identification systems tend to be very low. For example, the US Department of Defense conducted experiments some years ago and found that bar coding (Code 39 symbology) resulted in errors for one in three million

characters while transponders (as used in RFID) gave one error in 30 million characters. In fact, a more common problem is the non-reading of data, for example, because of defaced bar code labels or the non-receipt of radio waves (eg owing to metals or liquids) in the case of RFID.

One study into the resultant pick accuracy provided by different technologies showed that a 99.8 per cent pick accuracy was achieved by item-level bar code scanning, compared to a 96.5 per cent accuracy when paper pick lists were used. This study was conducted in an auto-parts after-market warehouse and obviously factors other than the actual identification played a role. Interestingly, the accuracy achieved by voice picking was 99.5 per cent, slightly lower than item-level bar code scanning and this was due to the voice check being of the location which did not pick up any errors in the putaway operation. However, voice technology did offer a 17 per cent improvement in productivity as location checking can be conducted in parallel with the travelling and picking tasks (Ludwig and Goomas, 2007).

**Radio data communication**

Automatic identification systems are often supported by radio data communication. Typically, a number of base stations are located around a warehouse and these provide a means of two-way communication between the warehouse management system and computer terminals. These terminals may be static or mobile — for example, fitted to a trolley or fork-lift truck.

In this way, real-time information is provided for management and for the operators. Thus, an order picker can be provided with information for the next pick (eg location and quantity) as soon as he/she is ready to do this, and can interrogate the system if there is a problem. Radio data terminals may also be hand-held or wrist-mounted, and are often fitted with bar-code scanners. In the case of wrist-mounted terminals, the scanners may be located on a ring on a finger, thus keeping both hands free for picking.

This sort of technology facilitates major improvements in communication between the operator and the warehouse management computer, resulting in much greater speed of response within warehouse systems and more efficient and productive utilization of people and equipment. Specific benefits of such systems include:

- paperless operation;
- real-time information and prioritization (e.g. so that pick faces can be replenished just as they are becoming empty);
- high levels of accuracy (e.g. through bar-code scanning and WMS interrogation);
- dual cycling (e.g. a truck may be tasked with two or more activities during one visit to an aisle, such as put-away, replenishment and full pallet picking).

## CHAPTER NINE

## CONTROLLING INVENTORIES IN THE DISTRIBUTION CHANNEL

### Distribution Center Decisions

When deciding upon locational decision a manager basically decides upon suppliers, plants, warehouses and markets. There may also be other facilities such as super stockists, consolidation centers or transits points. Besides locating the facilities a manager must also decide how market may be allocated to warehouses and how warehouses will be allocated to plants. The allocation decision can be altered on regular basis as different costs change and markets evolve. When designing the network, both location- and allocation decisions are made jointly. In some cases, companies want to design Supply chain networks, in which a market is supplied from only one factory. This s commonly known as the capacitated plant location model with single sources. Companies may impose this constraint because it lower the complexity of coordinating the network and requires less flexibility from each Facility.

A much more general form of the plant location model needs to be considered if the entire supply chain network from the supplier to the customer must be designed. Consider a supply chain in which suppliers send materials to factories that supply ware houses that supply markets. Location and capacity allocation decision has to be made for both factories and ware houses. Multiple warehouses may be used to satisfy demand at a market, the multiple factories may be used to replenish warehouses. Supply chain design decision should be evaluated for a variety of future scenarios that reflect the underlying uncertainty. Accounting for uncertainty relieve the managers to built extra capacity in to supply chain network and make the available capacity more flexible in terms of the markets that can be served. If capacity is flexible, demand can be reallocated within the supply chain network to react best to changing demand, prices, costs, and / or exchange rates. If capacity is inflexible, production cannot be changed in response to change in condition. The presence of flexibility thus increases potential profits.

**Customer/market— to be served from each distribution center**

Firms must consider the response time customers desire when designing their supply chain methods. Firms that target customers who can tolerate a large response time require few locations and can focus on increasing the capacity of each location. In contrast, firms that customers who value short response time need to locate close to them these firms must have many facilities, with each location having low capacity. First, a decrease in the response time customers desire increases the number of facilities required in the network. For example customers

are unlikely to come to a convenient store if they have t travel a long distance to get there. It is thus best for a convenient store chain to have many stores distributed in an area so that most people have convenience stores close to them. In contrast, customers shop for larger amount at super market and are willing to travel longer distances to get to one. Thus, super market chains tend to have stores that are much larger than convenient stores and not as densely distributed. If a firm is delivering product to customers, use of rapid means of transportation allows it to build fewer facilities and still provide a short response time. However, this option increases transportation cost. Moreover, there are many situations in which the presence of a facility close to a customer is important. For example a coffee shop is likely to attract customers who live or work nearby. No faster mode of transport can serve as a substitute and be used to attract customers that are far away.

**Distribution Requirement Planning (DRP)**

**Distribution Requirement Planning (DRP)** is a more sophisticated approach that considers multiple distribution stages and the characteristics of each stage. It is a logical extension of **Material Requirements Planning (MRP),** although there is one fundamental difference between the two.

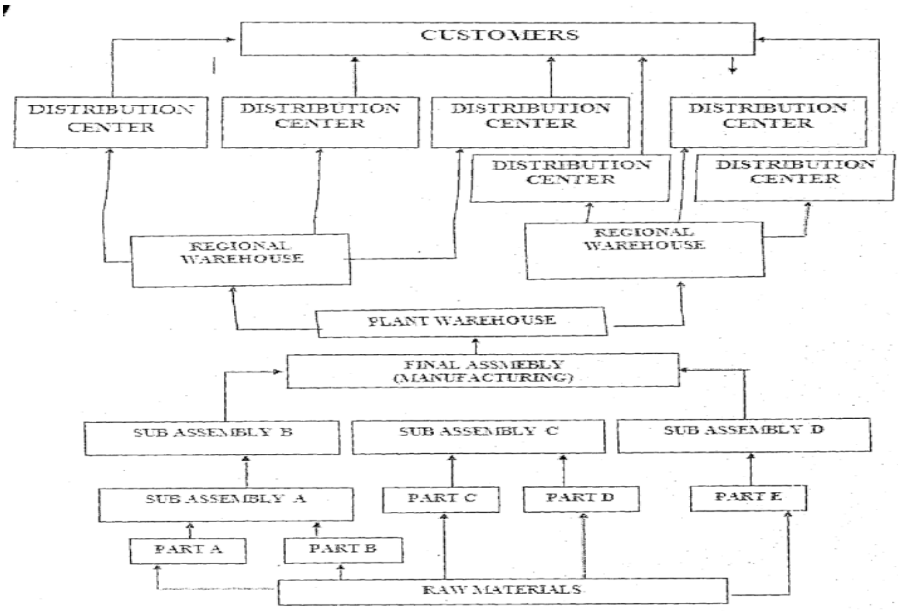
- MRP is determined by a production schedule that is defined and controlled by the enterprise. On the other hand, DRP is guided by customer demand, which is not controllable by the enterprise.
- So, while MRP generally operates in a dependent demand situation, DRP operates in an independent environment where uncertain customer demand, determines inventory requirements. The manufacturing requirements planning component coordinates the scheduling and integration of materials into finished goods.
- MRP controls inventory until manufacturing or assembly is complete. DRP then takes coordination responsibility once finished goods are received in the plant warehouse.

The fundamental DRP planning is the schedule, which coordinates requirements across the planning horizon. There is a schedule for each SKU and each distribution facility. Schedules for the same SKU are integrated to determine the overall requirements for replenishment facilities such as the plant warehouse. The schedules are developed using weekly time increments known as ‘buckets’. The schedule reports current on-hand balance, safety stock, performance cycle length and BOQ.(Balanced Order Quantity)

**Distinction between DRP and MRP**

| | MRP | DRP |
|---|---|---|
| **Guiding factor** | Guided by production schedules | Guided by customer demand |
| **Control of the firm** | Under control of the firm | Not under control of the firm |
| **Demand situation** | Operates in dependent demand Situation | Operates in independent demand situation |
| **Area of operation and Coordination** | Coordinates scheduling and integration of materials into finished goods | Coordinates demand between outlets and Supply sources |
| **Stage of functioning** | Controls inventory until manufacturing and assembly is complete. | Controls and coordinates inventory after manufacturing and assembly of finished goods |

The figure below shows the areas of functioning of MRP and DRP. MRP plans the procurement of raw materials as per their requirements, right from the first stage till the final assembly.



After the goods have been manufactured, DRP plans the distribution of finished goods from the plant warehouse to the wholesalers and retailers till it reaches the customer. The integrated model seeks to combine these two areas. Taking into consideration the requirements of both MRP and DRP, it provides integrated planning.

**DRP Benefits and Constraints**

An inventory management system such as DRP offers a number of benefits for management. The major organizational beneficiaries include marketing and logistics. The major marketing benefits of DRP are:

- Improved service levels that increase on time deliveries and decrease customer complaints
- Improved and more effective promotional and new product introduction plans.
- Improved ability to anticipate shortages so that marketing efforts are not expended on products with low stock.
- Improved inventory coordination with other enterprise functions, since DRP facilitates a common set of planning numbers.
- Enhanced ability to offer customers a coordinated inventory management service.

The major logistics benefits of DRP are:

- Reduced distribution center freight costs resulting from coordinated shipments.
- Reduced inventory levels, since DRP can accurately determine what product is needed and when.
- Decreased warehouse space requirements because of inventory reductions.
- Reduced customer freight costs as a result of fewer back orders.
- Improved inventory viability and coordination between logistics and manufacturing.
- Enhanced budgeting capitability, since DRP can effectively simulate inventory and transportation requirements under multiple planning scenarios.

The constraints of DRP are:

- Inventory planning systems require accurate and coordinated forecasts for each distribution center. The forecast is necessary to direct the flow of goods through the distribution channel. To the extent that this level of forecast accuracy is possible, inventory-planning systems operate well. However, this requires forecasts for each distribution center and SKU as well as adequate lead-time to allow product movement. However there are 3 potential sources where error exist. The forecast itself may be wrong, it

may have predicted demand at the wrong location, or it may have predicted demand at the wrong time.

- Inventory planning requires consistent and reliable performance cycles for movement between the distribution centers. While variable performance cycles can be accommodated through safety lead times, performance cycle uncertainty reduces planning system effectiveness.
- Integrated planning is subject to system nervousness and frequent rescheduling, because of production breakdowns and delivery delays. The system nervousness leads to 'fluctuations in capacity utilization, rescheduling cost, and confusion in deliveries. This is intensified by the volatile operating environment characteristic of distribution. Uncertainties such as supply transportation performance cycles and vendor delivery reliability can cause an extremely nervous DRP system.
- DRP is not the universal solution for inventory management.

## THE INTERFACE OF THE OTHER PLANNING AND CONTROL SYSTEM

As noted earlier, materials management is an important and integral part of logistics management. This lesson aims to give the reader an overview of some of the most common forms of manufacturing planning and control techniques. It is not intended to examine these systems in great depth but rather to explain the basic principles of the various approaches and explain some of the terminology.

The following approaches will be covered:

- just-in-time;
- manufacturing resource planning (MRPII), incorporating material requirements planning (MRP);
- flexible fulfillment or, as it has come to be known, postponement.

Before we look at these planning and control systems in detail, it is worth explaining a few terms that are often used when production scheduling and control systems are discussed.

### Push and pull systems

A 'push' system of manufacturing is one where goods are produced against the expectation of demand. In other words, goods are not produced specifically to order but are produced against a forecast demand. Demand forecasting has to be carried out where raw material suppliers' lead times for delivery have to be considered. If there is a one-month lead time for a given raw material then it will be necessary to estimate what the level of production will be in one month's time

to satisfy forecast demand for the product. These forecasts are usually based on historical sales information. The difficulty arises when either there is a higher level of demand than expected and sales are lost, or there is a lower level of demand and finished product stocks grow too large. Lost revenue from missed sales opportunities is the result on the one hand, and higher inventory carrying costs or product obsolescence costs are the result on the other. MRPII (incorporating MRP) is a 'push' system.

A 'pull' system of manufacturing is one where goods are only produced against known customer orders. This is because only actual orders from customers are being produced on the production line. None of the goods are being made to keep as finished product stocks that may be sold at a later date. Therefore firm customer orders are 'pulling' all the materials through the process from the material suppliers and culminating in the delivery to the final customer. Just-in-time is a 'pull' system.

**Manufacturing resource planning (MRPII)**

Although MRP pre-dates MRPII, it is easier to see MRP in the context of MRP1I rather than the other way round.

As the name implies, manufacturing resource planning deals with more than simply production scheduling. Whilst the basic material requirements planning system is incorporated into MRPII, the wider system brings other activities into the picture. The objective is to harmonize and control more of the activities within the production plant. Areas outside an MRP system but included in an MRPII system usually are:

- maintenance management;
- cost accounting;
- stock management;
- sales orders;
- procurement;
- personnel levels.

MRPII requires considerable computing power to operate because of the inclusion of virtually all the activities within a production plant. Implementation of such a sophisticated computer- based system is an enormous task and should not be undertaken lightly.

## Material requirements planning (MRP)

This principle of production scheduling is based on the premise that if one knows what product needs to be produced then one should also know how many constituent parts are required in order to make the product. A useful analogy is the preparation of a meal. Let us say that the meal in question is a traditional cooked breakfast. Depending on taste you may choose two rashers of bacon, a fried egg, some mushrooms, tomatoes and toast. Whilst describing the contents of the breakfast, we have also prepared a list of the constituent parts. If we needed more than one single breakfast then we would simply multiply the quantities of ingredients by the number of breakfasts required. We now have our 'bill of requirements'. This would allow us to go shopping for the ingredients and also allow us to purchase accurately only the ingredients required to avoid wastage through having too many ingredients or disappointment through not having enough ingredients to meet the demand. The success of this system relies on us knowing how many breakfasts are required and how many diners actually turn up for the meal. In other words, success relies on matching the forecast with actual demand.

If we were building a complex piece of machinery rather than our meal then we could apply the same principles. The numbers of different machines could be broken down into the numbers of sub-assemblies required, which in turn could be further broken down into components. Orders could be placed with suppliers for the required quantities and delivery times agreed. These orders would be mack in the light of any existing stock of parts already available for use. This sounds very simple but in practice is an enormously complicated process. It usually requires the assistance of a computer package because of the number of transactions required in a short space of time for the schedule to be of any use. In fact the whole system was developed as computer software for scheduling production.

The situation is further complicated when orders are cancelled at short notice or increased without warning. The adjustments will need to be made quickly to avoid failing to meet customer requirements or conversely being left with an excessive amount of component stock.

## The MRP system

The following is a simple explanation of the basic structure of an MRP system.

## The master production schedule (MPS)

The MPS is a list of all the products or services to be supplied within a specific period of time. This period of time must be sufficiently long to allow for the ordering and delivery of required sub-assemblies and parts, as well as allowing

sufficient time for manufacturing the product in question. The schedule may be made up of both forecast and known demand, ie customers' orders. It also lists all the required outputs from the system and when the goods and services are required through the use of a 'due date'. Therefore the contents of the schedule will dictate the contents of the bill of requirements.

**The bill of requirements**

This is also referred to as the bill of materials (BOM). As explained earlier, this will list all the sub-assemblies, components and parts required in total to produce all the goods listed in the schedule. It will also show the different levels at which these constituent parts are put together in order to produce the finished goods.

For example, the finished product may contain two sub-assemblies that together complete the product. The finished product is said to be at level 0. These assemblies will be numbered sub-assembly 1 and sub-assembly 2. Together these sub-assemblies are said to be at level 1. Both sub-assemblies are made up of one component and one further sub-assembly each. This level is described as level 2. Owing to the fact that the two major sub-assemblies at level 1 themselves contain one further sub-assembly each at level 2 then a further level is created at level 3. At level 3 it can be seen that one of the sub-assemblies at level 2 contains two components and the other contains four components.

This process (sometimes referred to as netting) is continued until all the constituent parts are broken down and listed at different levels. It can be quickly seen that, if the bill of requirements for each product is viewed from the opposite direction to the finished product, ie the highest-level number first, then one is looking at a sequence for assembly. The components are put together to form sub-assemblies, which in turn are put together to form the finished product.

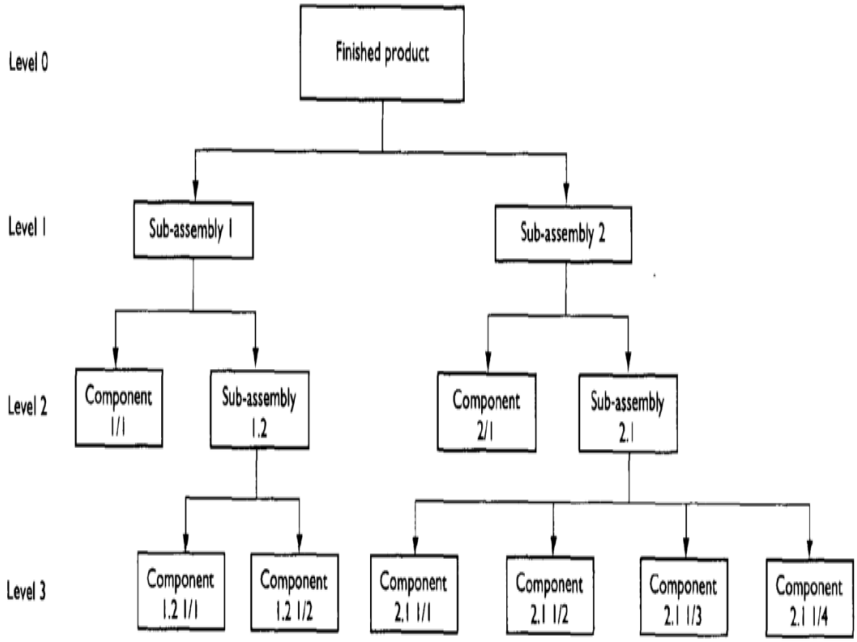
This bill of requirements, having detailed all the required parts and sub-assemblies, will allow the MRP program to create the required orders to be placed with suppliers. One important thing to remember is that it also lists in detail the order and timing when these parts are required.

Noting the level of detail in the bill of requirements for just one product described above, it may be easier to understand the level of complexity involved in scheduling many different products that may contain many more components. It will also underline the complexity involved in changing the master schedule due to cancellations or additional orders. For anything more than a very basic schedule, a customized computer program will be required to deal with the large number of transactions required to effect the most straightforward of changes to the schedule.

**Opening stock**

The master schedule and the bill of requirements together form the framework of what is required and when it is required, but two other factors must be fed into the computer program at the same time. The first of these will be the current level of unallocated stocks of parts, components and sub-assemblies available for immediate use. There will be in total larger stocks on hand but these will already have been allocated to production via the system and are therefore unavailable. This information will, of course, modify any orders for raw materials placed on suppliers.

**A Bill of Requirements for one product**



**Opening capacity**

The final fundamental factor required by the MRP program is the current level of available unallocated production capacity for not only the finished product but any components or sub-assemblies that are manufactured in-house.

All of the above information — the master schedule, the bill of requirements, the opening stock and the opening capacity — will be fed into the MRP computer program. The program will then produce as required the following:

- a list of purchase requirements, which will list what needs to be purchased and when;
- a manufacturing schedule, which will list what will be made and when it will be made;
- the closing stock of parts, components and sub-assemblies after the master schedule has been completed;
- the closing capacity available after the master schedule has been completed;
- a list of anticipated shortfalls in production — these may be due to shortages of parts or capacity.

The whole MRP process is interative and therefore must be repeated periodically. This may be done on what is known as a 'regenerative' basis or a 'net change' basis.

The **'regenerative'** basis involves assuming that no previous MRP calculation has taken place. Therefore known or forecast demand is used to create a new bill of requirements, with available parts of stock and available production capacity being allocated disregarding any previous calculations. For the purposes of this approach, all parts and capacity are assumed to be unallocated, as existing orders and work-in-progress will be covered by the new master schedule. This approach tends to be used where demand and therefore output are fairly consistent. This method also has the advantage of not perpetuating any previous computation errors as each new calculation starts from fresh current data.

The '**net change'** approach concentrates on changing only those parts of the production plan that have changed rather than recalculating the whole plan. Thus, if changes are made to the master schedule then only those parts of the plan that are affected will be changed. This method tends to be used more in situations where demand is more volatile and so changes are more frequently needed.

**Flexible fulfillment (postponement)**

Flexible fulfillment is a method of manufacturing that attempts to delay the final definition of a product to the last possible stage in the supply chain — hence the popular description of 'postponement' for this system.

The advantages gained from this method can be dramatic, especially where companies trade on a global scale. Consider the problems raised by the different voltages available around the world for the use of portable electrical goods. If the manufacturer supplies goods around the globe, then stocks of finished products

might have to be kept for each different type of power supply, very likely in or close to the particular market in question. This will increase inventory carrying and, especially in the electronics business, the possibility of product obsolescence. However, if it were possible to have a number of different power supply packs that all fitted the same product then it would be necessary to have only one 'global' product, which could be quickly adapted by changing the power module alone to suit the market concerned. This would mean that there would no longer be country- or market-specific products, and products could be transported and sold anywhere in the world at short notice.

This method has considerable implications for product design in that products need to be designed so that any variations dictated by markets can be adapted by changing modules only. Different keyboards for laptop computers are required to allow for the different alphabets to be found around the world. Manufacturing a laptop with a keyboard that is not easily substituted for another creates large inventories of language- or alphabet-specific stocks in those countries. Postponement means that the bulk of the laptop is produced and shipped around the world, but the final definition of the product only takes place when the alphabet-specific keyboard is attached.

Other examples of postponement can be seen when promotions of a product such as 'Buy product A and get product B free' occur. The attachment of product A to product B creates a third product, C. This product can be produced by wrapping the two products, A and B, together in some form of outer. This operation can be undertaken in the distribution centre prior to final delivery, which will avoid the necessity of forecasting and shipping stocks from further up the supply chain. The product C could almost be made to order via the wrapping process. If the promotion goes well then only increased levels of products A and B need be shipped.

**Deciding Stocking Point**

**What is Stock**

Stock is part of an inventory maintained by any business organization. In fact stock represents the value of raw materials, work in process and finished goods in possession of the organization. The demand and supply method of stock control technique determines stock levels viz., maximum level, minimum level, reorder level, danger level, average level etc.

**Maximum stocklevel** represents the quantity of inventory above which it should not be allowed to be kept. This quantity is fixed keeping in mind the disadvantages of overstocking.

**Minimum stock level** represents the quantity below which stock should not be allowed to fall below the required level. This is known as safety or buffer stock. The main purpose of this level is to ensure that production is not held up due to shortage of any material. This level is fixed after considering (1) average rate of consumption of materials and (2) lead time.

**Reorder level** (or order level) is the point at which if stock of the material in store reaches, the store keeper should initiate the purchase requisition for fresh supplies of the materials. This level is fixed between the maximum and minimum stock levels in such a way that the difference or quantity of the materials between the reorder level and the minimum level will be sufficient to meet the requirements of production up to the time the fresh supply of the material is received.

**Danger level** means a point at which issues of the material are stopped and issues are made only under specific instructions. This level is generally fixed below the minimum stock level. When stock of materials reaches the danger level the officer in charge of purchase department should take special arrangements to get the materials at any cost.

It is a common belief that external lead time should be controlled and reduced but it has been found in actual practice that internal lead time constitutes a considerable part of total lead time and offers ample scope for reduction. The management must make a determined and deliberate effort to reduce lead time by selectively delegating powers, better paper work procedures, and fixing targets individually •for all activities. It is worth mentioning here that appropriate records should also be kept at variations in lead time and it should be revised from time to time. Obviously, in order to receive supplies before the stock reaches zero level, it is necessary to order the materials much in advance i.e. when the stock available is sufficient to last during the lead time.

**The following is the formulae for determination of stock points:**

a) Maximum level = reorder level + reorder quantity — (minimum consumption x minimum reorder period)
b) Reorder level = maximum consumption × maximum reorder period
c) Minimum level = reorder level - (normal consumption x normal reorder period)
d) Average stock level = maximum level + ½ of reorder quantity

e) Danger level = maximum delivery time x maximum rate of consumption.

## ADDED VALUE

Value Added Services: In the days when competition is intense, a large spectrum of value added services have come up aimed at cost reduction and improved customer service. The Logistic Service Provider catering for warehousing services / facilities are rendering certain value added services. Besides the ones discussed above, following additional services are being offered in implementation of ERP:

**(a) Packing for Retailing:** A few FMCG organizations think it is easy to ship a particular product of their range to the warehouse of Logistics Service Provider in wrapped but unpacked condition. These are then packed by the service providers as per the needs of the customers. At times, as packaging poses disposal problems, it may enable the core products-like toilet soap, talcum powder-to be delivered in quantity in

replaceable baskets. One organization producing ready-to-cook noodles are following this method.

**Advantages:**

(i) Savings in retail packing cost worth dozens / gross / tens / hundreds etc.

(ii) Environment friendliness.

(iii) Reduction in accurate market forecasting and production planning by economizing saving cost of space the retailer through production/distribution of Lot Size Inventory.

Customer receives desired quantity without depending on the nearest packaged quantity.

**(b) Postponement of specialized packaging requirement:** This can be done in the warehouse by removing specialized packages of appliances. Thus, relieving the customer/user from the problem of disposing of large quantity/volume of protective packaging. It may also happen that stretch wrapping is introduced or pallets changed. This allows the manufacturer to standardize by using one type of package while postponing commitment to specialized packaging requirement.

**(c) Re-Assembly:** It is not uncommon for replacement of defective parts on the body ensemble, re-fit or retrofit parts or unit assembly in warehouse itself.

**(d) Change in packaging characteristics:** A warehouse operator may receive bulk in refrigerated condition and can then repack in suitably sized smaller containers and deliver them to customers. This type of value added activity minimizes inventory risk, reduces cost of transportation and damage (in case of containers). It is similar to postponement.

**(e) Climatization of Products:** This happens in case of fruits and vegetables where fruits can be ripened and delivered. Large-scale frozen fish/poultry/products can be delivered as per market requirement by de-freezing the products.

**(f) Labeling / Re-labeling:** A product may be imported from leading exporter abroad at a cheaper rate, unbranded. The importer may have his own label fitted confidentially and get these delivered to the designated distributor / customer. This is happening in the case of import of edible oils, or for that matter electronic spares.

# CHAPTER TEN
# INTERNAL DISTRIBUTION

## Introduction

Both the receiving and the dispatch areas of a warehouse are critical to its successful operation. Receiving is important, as it forms the basis for all the subsequent activities of the warehouse. For example, goods need to be passed through receiving rapidly so that they quickly become available for picking customer orders, and this must be carried out with a high degree of accuracy to ensure that the correct goods are received and located in their assigned locations. The dispatch activity is critical, as it is the customer-facing aspect of the warehouse and therefore it must operate effectively to ensure that all goods are dispatched to the customers on time. Operational failures in either of these areas will quickly result in service level failures, which may be damaging to the company and may be costly to rectify.

## Receiving processes

The receipt of goods into a warehouse needs to be a carefully planned activity. In most large warehouses, incoming vehicle loads are booked in advance so that the appropriate resources can be allocated to the activity. On arrival, drivers report to the gatehouse, where staff check the vehicle documentation and direct the driver where to go, either directly to an unloading bay or to a parking area.

The vehicle, or container doors may be sealed, particularly in the case of imported goods. Where this occurs, the seal number needs to be checked against that advised by the sender so that it can be ascertained whether the doors have been opened during transit (and hence there may be the possibility of loss).

On unloading, the goods are normally checked to ensure that they are the correct items and of the required quantity and quality. This may be undertaken by cross-checking against purchase orders, but this can be very time-consuming. An alternative method is for the sender to transmit an advance shipping notice (ASN) by EDI and for this to be related automatically to the appropriate purchase order. The goods can then be checked specifically against the ASN for that vehicle. For approved and trusted suppliers, it may be that the quantity and quality can be assumed to be correct as per the ASN, in which case the goods can be unloaded and transferred immediately to storage.

If goods are to be quarantined (eg stored until quality control results are available), then this can be undertaken by placing the goods into the normal reserve storage area and using the warehouse management system to ensure that the goods are not picked for any customer orders.

Some packages may require some form of processing, such as applying bar-code labels (eg attaching license plate numbers (LPNs) to identify each pallet or sticking labels to each case), palletizing (eg for goods received loose as cartons, as is common in the case of containerized shipments), re-palletizing (eg if the pallets are

of the wrong type or of poor quality) or placing into tote bins (eg to be put away into miniload storage).
The unit loads then need to be checked, particularly if they are to be put away into an automated storage and retrieval system. For example, pallets maybe weigh-checked on a conveyor and then passed through a dimension checking device, which would register any protrusions outside the permitted dimensions by means of photoelectric cells. Any pallets that do not conform (eg because the cartons have shifted in transit) are then sent to a reject spur on the conveyor for manual rectification.
When the goods are ready for placing into storage, they may be put away and the computer system advised of the location number or, more normally, the warehouse management system would identify the most appropriate location and issue a put-away instruction (eg on a paper put-away sheet or transmitted to a truck driver's radio data terminal).
A key objective in designing the receiving process is to enable the goods to be put away to the required location in the warehouse with the minimum handling and minimum delay possible. This often requires close co-ordination with suppliers, in terms of procurement agreements and the timing of deliveries.

**Dispatch processes**

After order picking, the goods for a particular order need to be brought together and made ready for dispatch. This may involve added value activities, such as labelling, tagging, assembly, testing, and packing into cartons. Where production postponement is undertaken, these activities may be quite extensive.
The goods then need to be sorted to vehicle loads and placed in, or onto unit loads ready for dispatch. This may be a conventional operation (eg loading into roll-cage pallets and then using a powered pallet truck to take the goods to the marshalling area) or it may be automated (eg using conveyor sortation and automatically loading tote bins on to dollies, ie wheeled plat-forms). In the case of goods being dispatched on pallets, then the whole pallet may be stretch-wrapped, or shrink-wrapped, so that the goods do not move during transit. The goods are then transported to the appropriate marshalling area, which will have been allocated based on the outgoing vehicle schedule. There may be one or more marshalling areas associated with each loading door. Particularly where large items are required for a customer order, the goods may in fact be brought together for a customer order for the first time directly in the marshalling area. The goods are then loaded on to the vehicle and secured.
Loading is often an activity that needs to take place within a short period of time (ie most of the vehicles may need to leave at about the same time of day). This can be alleviated by pre- loading drop trailers, or swap-bodies, during the hours leading up to the dispatch times. In this situation, the vehicle fleet is designed to have more articulated trailers than tractor units, and similarly more swap-bodies than vehicles.

The extra trailers or swap-bodies can thus be pre-loaded whilst the vehicles are still delivering the previous loads,

If a customer plans to collect the goods, then the vehicle load will need to be assembled and held in the marshalling area, awaiting collection. Good co-ordination is necessary in such instances to avoid the load taking up valuable marshalling area space for longer than necessary.

In the case of temperature-controlled goods, it is important to consider how the dispatch activities are managed, particularly when loading vehicles that are compartmentalized and thus capable of transporting goods at different temperatures. For example, loading the vehides at three different loading docks (eg at ambient, chill and frozen temperatures) may be very time-consuming, whilst loading at a single loading dock will require close control to ensure that the temperature chain is maintained,

**Cross-docking**

Cross-docking is an activity whereby goods are received at a warehouse and dispatched without putting them away into storage. The goods may thus be transferred directly from the receiving bay to the dispatch bay. This normally involves some form of sortation.

Goods for cross-docking need to arrive by a strict time schedule linked to the vehicle departure times. The outgoing vehicles may be taking a mix of cross-docked goods (eg fresh goods) and stocked goods (eg long-shelf-life items), and thus a great degree of co-ordination is required to ensure that the operation can occur smoothly. If sortation is required, then a pick-by-line technique may be used to pick individual products from incoming pallets and place them on outgoing customer pallets. This may be undertaken manually or by using automated sortation equipment.

There are a number of variations of cross-docking. For example, in some instances the goods may be pre-labelled for particular stores or customers, whereas in other situations the goods may just be sorted by product line, with or without a label being applied during the cross- docking operation.

Cross-docking has a number of advantages in that it facilitates the rapid flow of goods through the supply chain and can be used as a technique to reduce inventory levels. It is particularly common for fresh and short-shelf-life goods, as well as for goods that are pre-allocated and need to be ‘pushed’ out to stores, as in the fashion industry.

Whilst there can be substantial benefits from cross-docking, it may not be suitable in every situation, for example:

- The introduction of cross-docking at a warehouse may just move inventory upstream in a supply chain, as suppliers may need to hold more inventory themselves to supply the warehouse on a just-in-time basis. A

holistic view therefore needs to be taken to ensure that total inventory in the supply chain is reduced.

- Goods may be transported in less than pallet load quantities or less than vehicle load quantities, thus increasing transport costs.
- Considerable handling space may be required at the warehouse for the sortation activities.
- Close co-ordination is required with the suppliers (plus high levels of reliability), and this becomes increasingly complex with greater numbers of SKUs and suppliers.

For these reasons, it may not be beneficial to cross-dock in many situations, for example for thousands of SKUs from hundreds of suppliers. A total supply chain view thus needs to be taken, as with all logistics decisions, to identify when cross-docking may be advantageous.

**Equipment**

The equipment types required for unloading and loading tend to be similar in nature for both receiving and dispatch, and these are therefore described together.

Common types of handling equipment include:

- Boom conveyors. Goods are frequently shipped in loose cartons in ISO containers to save on space in the container, to comply with wood regulations affecting pallets, and to save the cost of pallets that will not be returned. Similarly, packets are frequently transported loose to parcel carriers, as they will be individually sorted to destination on arrival at the parcel hub warehouse. In these instances, a boom conveyor may be used to extend into the vehicle or container. The warehouse staff then just need to lift the goods on to, or off, the conveyor, which transports the goods from, or to, the appropriate area of the warehouse.
- Pallet trucks. Where loading and unloading takes place from the rear of the vehicle, then it is normal for a pallet truck (either hand or powered) to be used.
- Fork-lift trucks. For side-unloading (eg of curtain-sided vehicles), a counterbalanced fork-lift truck is normally used. These may be fitted with side-shifts so that the pallet can be accurately positioned on the vehicle. Another form of attachment that is often used is one that enables two pallets (side by side) to be lifted at a time. Fork-lift trucks with telescopic booms are also sometimes used so that vehicles can be loaded from just one side, thus saving on warehouse yard space. Conventional counterbalanced fork-lift trucks may also be used for end-unloading and -loading, particularly if pallets are stacked two high on a vehicle. In this case, trucks with a maximum free lift are required, so that the truck mast does not rise whilst inside the vehicle. Another common use is for slip-sheets to be used to separate unit loads in a container, and special attachments can be fitted to unload and load these.

- Automated loading/unloading systems. There are automated systems available that can unload and load all the pallets on a vehicle simultaneously. These require special trailer units (eg fitted with rollers or tracks) and are therefore best suited to shuttle journeys, for example between a manufacturing plant and its associated distribution centre.
- Automated tote bin loaders. This equipment is particularly applicable where goods are dispatched from a warehouse in tote bins; for example, in the case of stores being supplied with small items. Tote bins may be moved from picking, or packing, on conveyors and then brought to an automatic loading machine for stacking onto pallets or dollies (ie wheeled platforms) ready for dispatch to the stores. The pallets or dollies are then moved (eg by powered pallet truck) to the marshalling area.
- Pallet scissor lift tables. Once the pallets have been unloaded, they may be brought to unpacking stations where, for example, goods may be extracted and placed into tote bins ready for storage in miniload systems. In order to present the goods at the correct height for this work, pallets may be placed on scissor lift tables which would be at a low level for the start of the operation and then could gradually be lifted as the pallet is emptied (so that the operator does not need to stoop to pick up the lower items left on the pallet) — see Figure 19.2. This type of equipment is becoming more common with increased awareness of manual handling health and safety issues.

**Automated loading/unloading system**

**Pallet scissor lift tables**

**Raised dock loading bays**

The loading bays themselves are normally equipped with a number of features, including:

- Dock levellers. These are normally permanently fitted at each bay and form a gentle slope up or down to match the bed heights of each vehicle. A truck, such as a powered pallet truck, can then be driven directly on to the vehicle for end-unloading or -loading. As vehicle bed heights may vary considerably, the dock leveller needs to be long enough to accommodate all vehicles that may be expected on that bay. The dock leveller is sunk into a pit and operated by a hydraulic ram.
- Doors. These often retract above the opening when in use. They are frequently fitted with windows so that warehouse staff can see whether there is a vehicle on the bay.
- Dock shelters and seals. Some form of weather protection is common to prevent draughts and dust from entering the warehouse around the vehicle.
- Bumpers. These are used to reduce the shock load exerted on the building structure when vehicles reverse up to the bay.

- Lighting. Lights on swivel arms are required to provide adequate illumination inside the vehicles, particularly at night.
- Warning lights. Red and green lights may be fitted to the outside and inside of the loading bay. These act as an indication to the driver as to whether the vehicle is ready to be driven away, thus reducing accidents of trucks being driven into the vehicle at the exact moment that the driver decides to pull away.
- Vehicle restraints. Some warehouses are fitted with an even more positive system in that the wheels of the vehicle are restrained until the warehouse staff decide that it is safe for the vehicle to be driven away.
- Wheel guides and bollards. These are used to assist the driver to park centrally on the loading bay.

**Layouts**

The receiving of goods on to the warehouse site begins at the gatehouse. The layout thus needs to include all the external areas within the perimeter fence, such as:

- Vehicle roadways. Roadway markings and signage are essential. The vehicle flow may be one-way around the site or two-way to and from the loading bays. In the latter case, access still needs to be provided for emergency vehicles, such as fire tenders, to all sides of the building. In the case of one-way flows, a clockwise direction may be better for right-hand-drive vehicles to allow drivers to reverse a trailer on to a bay more easily, whereas anticlockwise is more suitable where left-hand-drive vehicles are the norm.
- Parking areas. Adequate vehicle, trailer and swap-body parking needs to be provided. Power points may be needed where temperature-controlled units are to be parked. The car park for staff and visitors should be separated from the heavy goods vehicle areas for safety reasons, as well as for security reasons (ie keeping cars away from direct access to the warehouse).
- Ancillary areas. Many such areas may be needed, for example fuel points, vehicle washing facilities, weighbridge, generators, empty unit load area, waste compactors, sprinkler tanks and fire assembly points. In addition, landscaping to shield the warehouse and vehicles from the local environment may be required.

The unloading and loading bays may be at opposite ends of the building, to enable a through- flow of goods, or may be adjacent to each other on the same side of the building, to enable a U-flow. Other options include an L-flow, or some mix of these.

A through-flow may offer a better flow of goods within the warehouse itself, although in practice, with goods moving from receiving to reserve storage and then

to picking, sortation, packing and dispatch, it is not always the case that this flow is any better than a U-flow.

Through-flow is often used when the number of unloading and loading bays required is too great to fit on one side of a building, as in a warehouse handling a rapid turnover of goods. A through-flow layout is also particularly suited to a cross-dock warehouse, such as a parcel sortation centre, where a long thin building may be appropriate, with incoming vehicles along one of the long sides and outgoing vehicles on the opposite side. However, in an inventory holding warehouse, a U-flow may be more suitable for cross-docking, as the distance that the goods need to travel will be far less than with though-flow. A major benefit of U-flow is in situations where the receiving and dispatch activities occur at different times of the day. For example, in many warehouses, receiving occurs during the morning and dispatch in the afternoon and evening. In this situation, the doors, marshalling areas and equipment may be used for both receiving and dispatch activities. It is also easier to divert equipment and staff between the two activities as peaks and troughs arise, even when the two activities are occurring concurrently. A further advantage is that when the same vehicles are used for incoming and outgoing goods (as with back-hauling) then the vehicle can remain on the same dock for both activities.

The actual vehicle bays themselves may be:

- Level intake. This is where the warehouse floor is at the same level as the external roadway. It is suitable for the side-unloading of vehicles by lift truck. Vehicles may be unloaded outside (eg under a canopy) or brought into the building, although, with the latter option, care must be taken with fume extraction and maintaining the required temperature in the warehouse.
- Raised dock. With a raised dock, the warehouse floor is at the same level as the bed of the vehicle, so that a pallet truck or lift truck can drive directly on to the vehicle by means of a dock leveller. This is normal in the case of end-unloading (eg of box vans or containers). Raised docks are normally at 90 degrees to the building, but may also be set out in a ‘saw tooth’ or ‘finger’ configuration. In the latter instance, side-unloading may also be possible.

Normally a mix of level intake and raised docks is needed. For raised docks, it is often necessary to build a depressed driveway leading down to the docks. In this case, a gentle slope is required from the roadway level (ie less than 10 per cent), but the vehicle should be on the level at the loading bay, to facilitate truck movement on the vehicle and to avoid the top of the vehicle fouling the building. Frequently, level intake and raised docks are placed on the same side of the building, in which case they should be separated by a crash barrier.

**Different approaches to cost and performance monitoring**

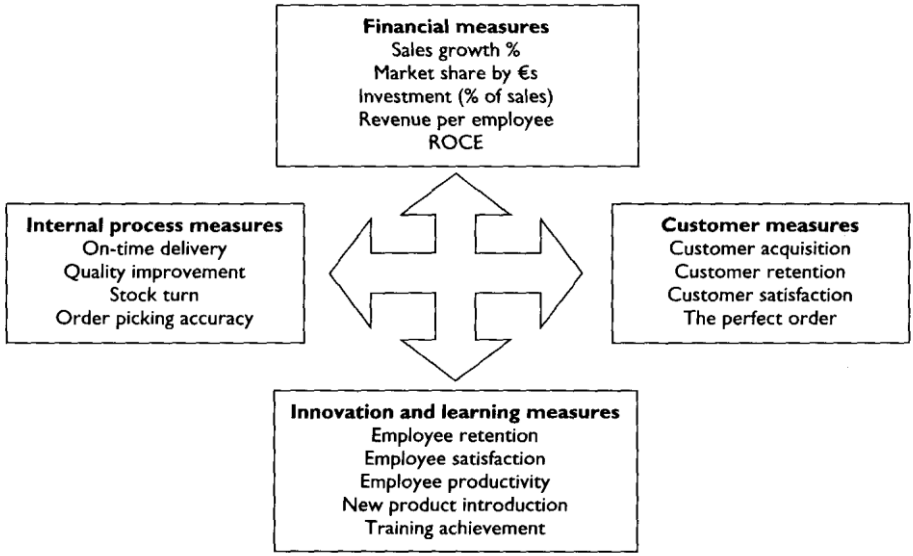
The monitoring and control of logistics and distribution operations are often approached in a relatively unsophisticated and unplanned way. Control measures are adopted as problems arise, almost as a form of crisis management. It is important to adopt a more formal approach, although this should not necessitate a complicated format. There are several systematic approaches that have been developed and these have a varying degree of sophistication and detail. There are some very obvious similarities between these different approaches, as can be seen from the key ones that are described below.

**Balanced scorecard**

The balanced scorecard was initially put forward by Kaplan and Norton in 1996. This is a broad business approach that translates the strategic mission of a business operation into tangible objectives and measures. These can be cascaded up and down the enterprise so that realistic and useful key performance indicators (KPIs) can be developed to support the business. These should represent a balance between external measures for shareholders and customers, and also internal measures of critical business processes, innovation and learning.

The financial perspective concerns the relationship with shareholders and is aimed at improving profits and meeting financial targets. The customer perspective is designed to enhance customer relationships using better processes to keep existing customers and attract new ones. The internal element is to develop new ideas to improve and enhance operational competitiveness. Innovation and learning should help to generate new ideas and to respond to customer needs and developments. A series of critical success factors is identified that relate directly to the main business perspectives. These are then used as the basis for creating the critical cost and performance measurements that should be used regularly to monitor and control the business operation in all the key areas identified.

**The balanced scorecard**




**Balanced scorecard: typical measurements**

## SCOR model

The SCOR model (Supply Chain Operations Reference model) is an important approach that has been developed as an aid to cost and performance monitoring. It is a hierarchical model, consisting of four different levels: competitive advantage, strategy implementation and process definition, detailed process elements, and implementation. It is very much a process-oriented approach, where the initial aim is to benchmark, refine and improve key operational processes, and then to identify and introduce key measures that monitor set cost and performance targets. Eventually, the major company performance attributes are identified and the appropriate metrics are developed.

| Performance attributes | Attribute definition | Metrics |
|---|---|---|
| Supply chain delivery reliability | The performance of the supply chain in delivering against the perfect delivery criteria | *Delivery performance *Picking accuracy Perfect order fulfillment |
| Supply chain responsiveness | The speed at which the supply chain provides products to the customer | *Order fulfillment lead time *Ease of order placement |
| Supply chain flexibility | The agility of the supply chain in responding to marketplace changes to gain or maintain competitive edge | *Supply chain response time *Production flexibility |
| Supply chain costs | The costs associated with operating the supply chain | *Cost of goods sold *Supply chain management costs *Value added productivity |
| Supply chain asset management | The ability to manage assets to support customer satisfaction | *Capacity utilization *Equipment utilization |

**SCOR: typical performance metric development**

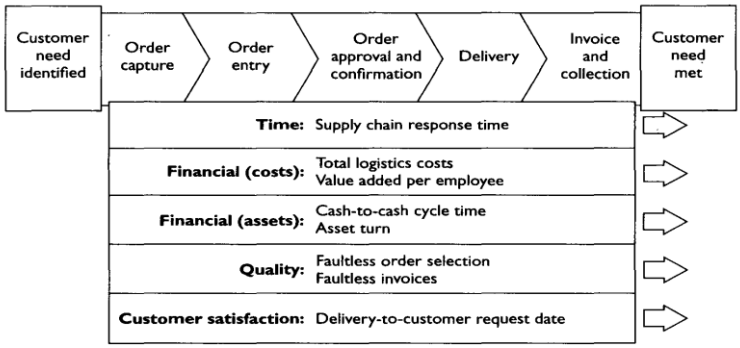
SCOR metrics are generally arranged under a number of categorizations. There are many different individual measures that come under the different categories. The main categories are:

- assets (such as capacity utilization, equipment availability);
- cost (inventory holding, invoicing);
- data (forecast accuracy, visibility);
- flexibility (order, returns);
- inventory (availability, obsolescence);
- orders (fulfillment accuracy, invoice errors);
- productivity (direct versus indirect labour, vehicle subcontracting);
- time (order cycle time, on-time delivery).

**Integrated supply chain approach**

An integrated supply chain approach recognizes that a total systems approach can be adopted for the whole business or supply chain and that any performance metrics should be developed on this basis. This, again, is a process-oriented approach that attempts to enable cost and performance monitoring to be based on a horizontal view of a business rather than the traditional, vertical, silo-based functional structure that is traditionally used.

This type of framework can be used initially to help to identify required outcomes that need to be measured, and then subsequently for establishing any relevant diagnostic measures. Suitable and accurate diagnostic measures are essential to enable the reasons for any problems to be identified and then rectified. This is a vital element of good cost and performance monitoring that is often neglected.




**Integrated supply chain metrics framework**

| Metric type | Outcomes | Diagnostics |
|---|---|---|
| **Customer satisfaction/ quality** | Perfect order fulfilment<br>Customer satisfaction<br>Product quality | Delivery-to-commit date<br>Warranty costs, returns and allowances<br>Customer enquiry response time |
| **Time** | Order fulfilment lead time | Source/make cycle time<br>Supply chain response time<br>Production plan achievement |
| **Costs** | Total supply chain costs | Value added productivity |
| **Assets** | Cash-to-cash cycle time<br>Inventory days of supply<br>Asset performance | Forecast accuracy<br>Inventory obsolescence<br>Capacity utilization |

**Integrated supply chain metrics**

**Operational approach**

A simple and straightforward operational approach is sometimes the most appropriate to follow for small to medium-size companies. This is as follows:

1. Determine the scope of logistics activities.
2. Identify the organization and departmental objectives.
3. Determine operating principles and methods.

4. Set productivity and performance goals (using standards, etc).
5. Measure and monitor performance (develop MIS).
6. Take corrective action if necessary.

The scope of distribution and logistics activities will, of course, vary from one company to another, as will the extent of integration. Because of this, it is impossible to identify a standard system that can be adopted generally. A company must first determine the scope of activities that need to be considered, taking into account the overall logistics requirements and objectives as well as the traditional components of the functional subsystems (primary transport (line-haul), distribution centre operations, local delivery, etc).

More detailed departmental objectives should be defined. These will include such areas as stock-holding policies by individual line or product group, customer service levels by product, by customer type or by geographical area, delivery transport costs, utilization and performance.

Operating principles and methods need to be clarified with respect to the different logistics components, such as primary transport (line-haul) and delivery transport, warehousing resources and usage, together with implications for seasonality, etc. These factors will provide the basis for establishing realistic and relevant measures. Productivity and performance goals should then be set in relation to the detailed operational tasks that are performed and with respect to the overall output requirements for the integrated logistics system as a whole. These should cover all the essential aspects of the physical distribution system. It is often easier to categorize these under the major subsystems of warehousing (order picking performance, labour utilization, cost per case, etc), transport (vehicle utilization, cost per mile/kilometre, fuel consumption, etc) and administration/stock-holding (customer orders received, stock-outs, percentage of orders fulfilled, etc).

Goals should be set based on some acceptable standards or comparative information. There are several different approaches used by organizations, and these are discussed below. They include:

- measuring cost and performance against historical data;
- measuring against a budget plan;
- developing physical or engineered standards;
- using industry standards;
- benchmarking against ‘best practice’.

Finally, key indices and ratios need to be developed to allow for appropriate monitoring and control to be undertaken (eg actual work against planned work, cost per case, cases per hour, tonnes per journey, etc). These need to be representative of the distribution operation, and they should be capable of clearly identifying why a deviation has occurred as well as if a deviation has occurred.

## CHAPTER ELEVEN

## INTERNATIONAL DISTRIBUTION

The changing nature of logistics and the supply chain, particularly the move by many companies towards global operations, has had an obvious impact on the relative importance of the different modes of transport. In a global context, more products are moved far greater distances because of the concentration of production facilities in low-cost manufacturing locations and because companies have developed concepts such as **focus factories**, some with a single global manufacturing point for certain products. Long-distance modes of transport have thus become much more important to the development of efficient logistics operations that have a global perspective. Thus, the need to understand the relative merits of, say, sea freight as against air freight is crucial although, for many localized final delivery operations, it is still road freight transport that offers the only real option. All of these developments serve to emphasize the need to appreciate the many different facets of transport modal choice for international logistics.

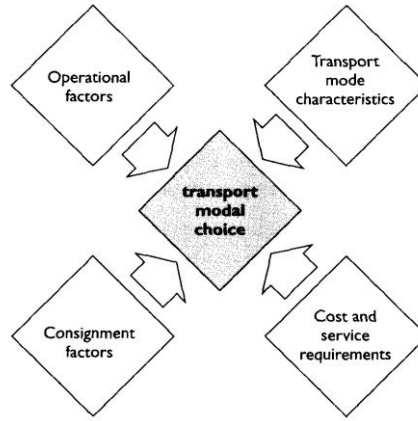
For continental movements, road freight transport continues to be the dominant mode of transport. A look at recent European statistics confirms this, and same trend is now in progression in Nigeria. The upward trend in the use of road transport has continued for many years, and it seems unlikely that the importance of road freight transport will diminish in the near future. Rail freight has remained relatively static for some time in some part of the globe, but has however increased slightly in recent years. Inland waterways are used and pipelines are still important for certain specialized movements.

The importance of road freight transport is also emphasized when the modal split is compared for freight transport movements within individual countries.

.

**Method of selection**

In this section the process for selecting a suitable mode of transport is introduced. The broad approach is split into four key stages, covering operational factors, transport mode characteristics, consignment factors, and cost and service requirements. Many of these considerations are relatively obvious ones, but the problem lies with the large number of different aspects that need to be taken into account. This is why a methodical selection process is required.




**Modal choice: selection process**

There are a large number of associated operational factors that need to be considered as a part of the modal selection process. These have been categorized as those that are external to the direct distribution operation, customer characteristics that need to be taken into account, physical product characteristics and other logistics components. The different transport mode characteristics also need to be understood and assessed. Clearly, some transport modes are more suitable to certain types of operational requirements than are others. A series of consignment factors also need to be addressed to ensure that the particular choice of mode is appropriate. For example, an urgent order or consignment should be moved via a fast transport mode. Finally, there is the ever-present and important logistics trade-off between cost and service that needs to be included in the selection process.

**Operational factors**

**External factors**

Encompassing the many operational factors that may need to be considered are those that are external to direct distribution-related factors. These are particularly relevant when contemplating the international context of modal choice because from country to country these factors can vary significantly. They include:

- The basic infrastructure in the country. In particular, the transport infrastructure is likely to be important. For example, opportunities to use rail will be significantly affected by the rail network that exists within a country. Many countries have limited track availability, whilst others may

have mainline track but an insufficient number of railheads or railheads in inappropriate locations for industrial or commercial use.

- Trade barriers. These might include, for example, customs duty, import tariffs or quota payments. These can have a big impact on the overall cost of a product, and this may affect the decision concerning the most appropriate mode of transport for cost reasons.
- Export controls and licences. With these, there may be implications for the quantity of product that can be shipped in given periods of time.
- Law and taxation. Clearly, legal requirements in both a general and a specific context are likely to differ from one country to another. There is, for example, some very different road transport and environmental legislation that can affect the use of vehicles in terms of size restrictions, load restrictions and time restrictions,
- Financial institutions and services, and economic conditions. Elements such as exchange rate stability and inflation, for example, can influence modal choice. Where financial changes occur at a dramatic rate in a country then speed of delivery may be important.
- Communications systems. These can have an impact, for example, on the supporting processes and paperwork of freight movements. Delays can be more likely with some modes of transport. For example, sea freight can have particularly lengthy and onerous procedures.
- Culture. Differing cultural aspects may influence how trade and commerce are under-taken. For example, the choice of transport mode may rest on ownership rather than cost- effectiveness
- Climate. Extremes of weather, temperature and humidity can have a major impact on some products. Thus, modes of transport must be selected carefully to ensure that prevailing climatic conditions do not badly affect freight whilst it is in transit. Suitable protection must be guaranteed.

This list can be a long one, and the relevant inclusions will vary according to the country under consideration.

**Customer characteristics**

The particular customer characteristics may also have a significant effect on the choice of transport mode. Most of the characteristics will need to be considered for both national and international modal choice, that is, they are not specific to overseas distribution. The main characteristics to take into account are:

- Service level requirements. Some service level requirements can have a significant impact on choice of transport mode. Delivery time constraints can mean that certain relatively unreliable modes cannot be considered. This may occur when there is a need for delivery to be at a certain time or

on a certain date, or when a specific time delivery window is stipulated. It is very common in retail delivery operations.

- Delivery point constraints. This factor is a very important one. It refers particularly to the physical aspects of delivery, including the location of the delivery point, any access constraints concerning the size of vehicle that can make the delivery, and any equipment requirements for unloading. Once again, these are common problems in retail delivery.
- Credit rating. The credit rating of a customer may help to impose a limit on route selection and modal choice. New customers and existing customers with a poor credit rating mean that a company will want to be sure that payment is confirmed before delivery is made. Thus, commercial arrangements may override any logistical preference for a particular transport method.
- Terms of sale preference. There are a number of different terms of sale that can be used, ranging from ex works (at the supplier factory) to delivered duty paid (at the customer's delivery point). The terms of sale preferred by a customer therefore have a very large implication for the choice of transport mode — and of course who makes that choice, the supplier or the customer. The different terms of sale (Incoterms) are outlined later in this chapter.
- Order size preference. The physical size of an order clearly has an impact on modal choice, as some modes are more suitable for small orders and others for large ones. There may be significant cost implications here.
- Customer importance. Most suppliers have 'A' rated customers who are deemed to be their most important and who really must be given a delivery service that does not fail. For these customers, service reliability is essential and so certain routes and transport modes will be preferred.
- Product knowledge. Some products or orders may necessitate some knowledge transfer to the customer at the time of delivery. This may relate to the need to assemble the product in some way, or how to use the product. It is not likely to be an element that affects many orders, but would be important to route and modal choice where it does.
- Physical nature of the product
- The physical nature of the product is as important in determining modal choice as it is with all the other logistics functions. The main factors that need to be considered include:
- Volume to weight ratio — which concerns the relative amount of cubic capacity taken up by a given weight of product. For example, 1 tonne of paper tissues takes up far more space than 1 tonne of bricks. This is relevant when considering the different charging structures of the different transport modes — whether charged by weight or by cubic volume. For example, 1 tonne is normally charged the same as 1 cubic

metre for sea freight, but the same as 6 cubic metres for air freight. Heavy goods are thus relatively more expensive by air freight.

- Value to weight ratio — which takes into account the value of the product to be transported. The relative transport cost of a high-value, low-weight product is likely to be so insignificant to the overall value of the product that the choice of mode from a cost perspective is irrelevant (eg jewellery or computer chips).
- Substitutability (product alternatives, etc) — whereby, if a product can be substituted by an alternative from another source, it may be worth while using a fast but expensive mode of transport to ensure the order is accepted by the customer. Where no substitute is possible, a slower and less expensive mode can be used.
- Special characteristics (hazard, fragility, perishability, time constraints, security). A hazardous product may be restricted in how it is allowed to be transported (eg some chemicals), and a time-constrained product may have to be moved on a fast and expensive mode of transport to ensure it does not miss its time deadline (eg newspapers and promotional products).

**Other logistics components**

The final series of important characteristics that need to be considered when determining modal choice concerns the other logistics components. These are the elements concerned with the classic logistics trade-offs. In any company's distribution structure there will be a number of factors that are interrelated. These may be fixed and unchangeable, and seen as sacrosanct by certain sections of the company. They may be subject to change — providing overall benefits can be identified from any change. These factors need to be known. There is no point in designing a system or choosing a mode that fails to allow for these other factors. It is important to be aware of the constraints that any fixed factors impose on any newly devised system, as the cost implications may well indicate that a trade-off would produce a better overall solution. The main characteristics may include:

- Supply points. The location of raw material or component suppliers will clearly impact on route and modal choice. This applies particularly where supply is sourced from abroad. Modal choice issues often arise where a raw material or component is vital to a manufacturing process or where inventory levels are relatively low at the point of production.
- Production plants. The location of manufacturing and production plants will impact on route and modal choice. This applies particularly where supply is sourced from abroad, as shipment delays may be unacceptable.

- Warehouses and storage facilities. Finished goods warehouses are often located adjacent to production points and factories, but they may be some distance away and thus involve regular movement of finished product from factory to warehouse.
- Depots. Inventory and stock-holding policy will usually determine where depots are located. The location of depots with respect to their supply points (usually production or warehouse facilities) in terms of distance and geography will have an impact on the choice of transport mode.
- Marketing plans and policies. These may affect transport choice because some plans and policies call for a very fast response time to customer orders, so, depending on depot location, a fast method of transport is essential. A good example is where new products are marketed or where there is a promotion of a particular product. Fast transport may often be required to support any marketing-related surges in demand.
- Existing delivery system. There may be elements of the existing delivery operation that need to be retained. This often applies where there are sunk costs in a transport fleet, which means that it is a cost imperative to keep all or some of the vehicles.

**Transport mode characteristics**

The modal choice selection process described so far has been concerned with the various operational factors that might need to be taken into account. The next main set of considerations involves the various attributes of the different modes themselves.

Of the main alternative types of sea freight, both the conventional load and the unit load are relevant. The unit load (container) is considered later. For conventional sea freight, the main points to note are:

- Cost economies. For some products, the most economic means of carriage remains that of conventional sea freight. This particularly applies to bulk goods and to large packaged consignments that are going long distances. Where speed of service is completely unimportant, then the cheapness of sea freight makes it very competitive.
- Availability. Services are widely available, and most types of cargo can be accommodated.
- Speed. Sea freight tends to be very slow for several reasons. These include the fact that the turnaround time in port is still quite slow, as is the actual voyage time.
- Need for double-handling. Conventional sea freight is disadvantaged by the slow handling methods still used. This is especially true when compared with the more competitive ‘through transport’ systems with

which sea freight must compete. The problem is particularly apparent on some of the short sea routes.

- Delay problems. There are three major delay factors that can lead to bad and irregular services, as well as helping to slow up the transport time itself. These are over and above the journey time. They are pre-shipment delays, delays at the discharge port and unexpected delays due to bad weather, missed tides, etc.
- Damage. The need to double-handle cargo on conventional ships tends to make this mode more prone to damage for both products and packaging.

**International road freight**

As already indicated, road freight transport is the most important mode for national movements within most individual countries. In the context of international distribution, road freight transport is also important, even where there are fairly significant geographic constraints such as sea crossings. In the UK for example, road freight is viable via the use of roll-on roll-off (RORO) ferry services and the Channel Tunnel route. These allow for the through transport of goods from factory or warehouse direct to customers' premises abroad.

Compared with the other forms of international freight transport, the major advantages and disadvantages of road freight transport services are as follows:

- They can provide a very quick service (ferry and tunnel schedules can be carefully timed into route plans if they are a necessary part of the journey).
- For complete unit loads with single origin and destination points, they can be very competitive from the cost viewpoint.
- There is a greatly reduced need to double-handle and trans-ship goods and packages, and for direct, full-load deliveries this is completely eliminated. This saves time and minimizes the likelihood of damage.
- Packaging cost can be kept to a minimum because loads are less susceptible to the extreme transit 'shocks' that other modes can cause.
- The system can provide regular, scheduled services due to the flexibility of road vehicle scheduling.

## Rail freight

There have been many recent developments in rail freight systems, especially the development of intermodal containerized systems using ISO containers as the basic unit load and the introduction of the swap-body concept of transferable road—rail units. More conventional rail freight systems have the major benefit of being a

relatively cheap form of transport. This is particularly true for bulky and heavy consignments that require movement over medium to long distances and where speed is not vital.

## Air freight

The use of air freight as an alternative transport mode has grown rapidly in recent years. Major developments in the areas of integrated unit loads, improved handling systems and additional cargo space, together with the proliferation of scheduled cargo flights, have increased the competitiveness and service capability of air freight.

The major attributes of air freight are as follows:

- Air freight compares very well with other transport modes in terms of speed over longer international movements. This is because it has very rapid airport-to-airport transit times over these longer distances.
- Although air freight is very quick from airport to airport, there can be occasions when this speed factor is diminished because time can be lost due to airport congestion and handling, paperwork and customs delays.
- One particular advantage of air freight is known as 'lead-time economy'. The ability to move goods very quickly over long distances means that it is unnecessary to hold stocks of these items in the countries in question (spare parts, etc). The short lead time required between the ordering and receiving of goods, and the resultant saving in inventory holding costs give this benefit its name of 'lead-time economy'.
- The air freighting of products allows for a great deal of market flexibility, because any number of countries and markets can be reached very quickly and easily. This is particularly advantageous for a company that wishes either to test a product in a given area or to launch a new product. The flexibility of air freight means that a company need not necessarily set up extensive stock-holding networks in these areas.
- The movement of goods by air freight can result in a marked reduction in packaging requirements. The air freight mode is not one that experiences severe physical conditions, and so its consignments are not prone to damage and breakages.
- Air freight transport is very advantageous for certain ranges of goods, compared to many of the alternative modes. This includes those commodities with high value to
- weight ratios (a lot of money is tied up, therefore an expensive freight on-cost is not significant), perishables (where speed is vital), fashion goods (which tend both to be expensive and to have a short 'shelf life'),

emergency supplies (speed again is vital) and finally spare parts (the lack of which may be holding up the operation of a multimillion-pound project).

- For the vast majority of products, air freight is a very expensive form of transport. This is by far its greatest disadvantage. In some instances, and for some products, cost is of very little consequence, and it is for these types of goods that air freight tends to be used.
- Air freight has suffered to a certain extent due to security concerns. This is one reason for the increasing trend towards all-freighter aircraft, rather than freight being carried in the belly hold of passenger aircraft (which has generally been the predominant means of air freight).

**Container systems**

Container systems can be viewed as a specialized mode of freight transport, although the **consort tamer** is now a fundamental feature of all the major national and international transport modes — road, rail, sea and air. Containerization makes possible the development of what is known as the 'intermodal' system of freight transport, enabling the uncomplicated movement of goods in bulk from one transport mode to another.

The main attributes of containers and container systems are as follows:

- They enable a number of small packages to be consolidated into large single unit loads.
- There is a reduction in the handling of goods, as they are distributed from their point of origin to their point of destination.
- There is a reduction in individual packaging requirements, depending on the load within the container.
- There is a reduction in damage to products caused by other cargo.
- Insurance charges are lower due to the reduced damage potential.
- Handling costs at the docks and at other modal interfaces are reduced.
- There is a quicker turnaround for all the types of transport used. Port utilization also improves.
- The all-round delivery time is speedier, and so raises service levels.
- Documentation is simpler.
- The concept of 'through transit' becomes feasible, and allows for a truly integrated transport system to be developed.
- In the early days of containerization, the systems that were developed tended not to be well integrated across the different transport modes. This has considerably improved in recent years.

- There is a need for special facilities and handling equipment, and these are very costly. Thus, there are a limited number of transfer points available.
- The initial cost of the containers themselves is very high.
- The return of empty containers can often be an expensive problem. Trade is seldom evenly balanced, so return loads may not be available.
- Containers may leak, thereby causing damage due to rain or sea water.
- Loads may be affected by their position of stow, eg above or below deck.

**Consignment factors**

There are important consignment or route factors that may have an impact on the final decision concerning the best mode of transport for each individual shipment. These are specific elements related to the order or load that may influence the choice of transport mode. Often only a few of these factors will apply, but sometimes several need to be taken into account at one time. The main factors include those that are noted below:

- Routeing and through transit responsibility:
  - — Is a direct route stipulated by the customer?
  - — Are there countries through which the shipment may not travel?
  - — Who is responsible for the through transit?
  - — Who is paying for the freight costs?
- Distance:
  - — What is the distance to be moved?
  - — Does distance restrict the options that are available?
- Type of cargo:
  - — If it is bulk or general cargo, will a certain specific route be preferable?
  - — If it is bulk or general cargo, are certain routes cheaper?
  - — Does the cargo have specific features that make certain routes more attractive (perishable, high value)?
  - — If hazardous, are all routes available?
- Quantity:
  - — full load;
  - — part load;
  - — small size, etc.
- Unit load:
  - — Will unitization help?
  - — Is it a small or large unit load?
  - — Is containerization feasible?
  - — Is groupage an alternative?

- Priority:
  - How soon must the goods reach their destination?
  - Does ‘Urgent!’ really mean ‘Urgent!’?
  - Who pays the freight costs for an urgent order?
- Commodity value:
  - How important is the transport cost element?
  - If it is import/export, how is the commodity rated?
  - Will a fast, expensive mode enable reduced inventory holding and associated cost savings?
- Regular shipments:
  - How often will these shipments be made?
  - Should a contract be negotiated or is ‘spot hire’ adequate?

**Cost and service requirements**

The ultimate decision for modal choice is the familiar logistics trade-off between cost and service. This must be considered in relation to the relevant operational factors, transport mode characteristics and consignment factors that have been outlined previously. In theory, the volume of freight (or size of load) to be moved and the distance to be travelled dictate the choice of mode based on relative costs.

On one extreme there is the small parcel that has to go a short distance. This is likely to be routed via road transport or perhaps post if a very small parcel. At the other extreme there is the 100-tonne-plus load going thousands of kilometres. This is most likely to go via sea freight.

In practice, other elements such as the speed of delivery required or the reliability of service may override these purely economic factors:

- Speed of delivery. Orders may be required quickly for a number of reasons that override the cost factor — such as urgent orders for spare parts. Air freight is often used instead of sea freight because the additional transport costs can be offset against inventory savings/stock availability.
- Service reliability. Some customer service policies are based on orders reaching customers to meet tight delivery windows, so control and reliability are important. Rail is often cheaper than road for long-haul, but some aspects of the industry have been beset by service issues, so many customers have switched from rail to road after suffering service interruptions.

| Size of order/load | Short | Medium | Long | Very long |
|---|---|---|---|---|
| 100T | Road | Road/rail | Rail/sea | Sea |
| 20T | Road | Road | Road/rail | Rail/sea |
| Pallet | Road | Road | Road/rail | Air/sea |
| Parcel | Post/road | Post/road/air | Post/road/air | Post/air |

**Modal choice matrix**

**Aspects of international trade**

In this section, some key elements of international trade that are important to logistics and to the choice of international transport mode are considered. These major elements cover:

- trade agreements and economic unions;
- financial issues;
- terms of trade;
- documentation;
- the use of freight forwarders.

**Trade agreements and economic unions**

This is a particularly exciting period for the development of logistics in a global context. The establishment of a number of international trade agreements and economic unions, such as the European Union, the North American Free Trade Association (NAFTA) and the Association of South East Asian Nations (ASEAN)

Economic community of West African States(ECOWAS) amongst others, has had a major impact on the globalization of trade. Many products are produced and distributed across regions and continents, and there has been a significant impact on transport opportunities. As these changes have taken place, they have been a major influence on the structure of distribution and logistics systems throughout Africa and the rest of the world as trade barriers have broken down and new transport networks have been initiated.

In Africacontext, for example, major barriers to trade have been or are being overcome. They include:

- physical barriers — removal of customs control, introduction of the single administrative document and removal of immigration and passport control;

- technical barriers — removal of all barriers to trade between member states, free movement of goods, capital, services and workers, harmonization of technical standards, common protection for intellectual and industrial property, and opening up of public procurement;
- fiscal barriers — approximation of indirect taxation (VAT and excise duties), and consequent removal of fiscal frontier checks;
- access to Central and Eastern European countries;

Those provisions and changes that are particularly relevant to logistics can be summarized as:

- Goods and services can be bought anywhere in the community.
- Customs barriers have been virtually abolished.
- Documentation has been simplified and standardized.
- Operating (transport) permit restrictions have been removed.
- Testing standards are acceptable in all community states.
- There is free movement of capital.

There remain certain policy areas where there are still some important differences between member states that have an impact on transport and logistics. These include:

- environmental issues (some countries ban road freight movements at certain periods during the week);
- rail subsidy (providing some advantage to move products by rail in some countries);
- labour laws (important in a number of ways, making it more attractive and cheaper to employ labour in some countries).

Some significant opportunities have arisen for transport and distribution companies resulting from the development of economic unions. These have encouraged companies to increase the scope of their services across the wider geographic areas. They include the following:

- There is more competition between third-party companies because of the increased market.
- Transport and third-party distribution companies can give a more comprehensive wide service,
- There is easier and faster movement of goods across borders.
- Distribution and transport can be bought in any country — there is more cross-trading and cabotage (transport companies moving goods in other member states).
- Increased opportunities for joint ventures with other Africa and international operators enable Africa wide and global integrated logistics and transport organizations.

- New depot locations and consequent transport flows can be determined to suit both sources and markets.

**Financial issues**

Identifying the most cost-effective opportunities in international transport and logistics requires a very sophisticated understanding of some of the key financial issues involved. There are many different elements that need to be taken into account when trying to identify the most cost-effective solution from a myriad of alternatives. The main factors include:

- Types of payment. These can include, in order of risk, an open account (where terms of payment are pre-arranged with the buyer), a draft (where title of the goods is retained until payment is received), a letter of credit (where the bank will authorize payment for an order once the precise conditions of the letter of credit have been met) and cash in advance (money paid up front — which few customers are happy to accept).
- Taxes and duties. These can have a big impact on the overall cost of a product. They may include import tariffs, value added tax or quota payments.
- Transport costs. These will include costs related to any of the different modes.
- Associated transport charges. These can include port fees, bunker adjustment fees or fuel charges.
- Other charges. These can include insurance, break-bulk, storage and handling.

**SHIPPING DOCUMENTATION AND FINANCIAL REQUIREMENT**

Ninety per cent of the world's international trade is transported by sea. The customs and practice associated with this form of transport have been refined over centuries of worldwide trade. Sending cargo by sea is ideal for high-volume cargoes that are not necessarily time sensitive or have long lead times for delivery. However, this mode of transport is slow and fraught with possibilities for delay. As globalization has increased and sources of manufacturing moved eastwards to India and China more companies have outsourced their manufacturing to this part of the globe. As a consequence, due to the elongated supply lines and slowness of this form of transport, higher levels of in-transit inventory need to be accounted for.

The use of shipping containers has revolutionized the way that cargo is handled and transported.This chapter aims to give a general overview of maritime transport or, as it is often called, sea-freight. The reference to maritime transport as 'shipping' has been avoided to prevent confusion as many people often use the term 'shipping', in the context of dispatching cargo from its origin, whatever the mode of transport used.

**Structure of the industry**

**Liner conferences**

Liner conferences are formal groups of shipping lines that operate on certain shipping routes. They were first set up to control the trade between colonial powers and their colonies. Today they are seen by many as being a very controversial anachronism(cartelism) as they work together to agree tariffs for certain routes. They work fundamentally for the interests of the member shipping lines to help to avoid destructive price competition (as they see it). For their part the shipping lines would argue that there would be much more price and capacity volatility without the stability that the liner conferences provide. The shipping lines have invested huge amounts of capital in the ships themselves and the conference system provides a way of managing forward revenue streams.

The European Union (as well as many of the conference's customers) has criticized them for anti-competitive actions and is examining ways of changing the status quo. As a matter of record the liner conferences are the only industry that is currently exempted from anti- competition laws in Europe and the USA (it is called anti-trust legislation in the USA). There is a huge body of opposition to these price fixing organizations and it is very likely that further legislative action will be taken against them.

**Shipping lines**

They own and operate the various types of ships in their fleets. Their role is to provide the physical means by which cargo may be safely and efficiently transported by sea.

**Ships' agents**

They provide services to the shipping lines in the ports where the ships call. A ship's agent will deal with many important and diverse matters on behalf of the shipping line. These services may include: provisioning with food and spare parts, arranging any necessary repairs for the ship, dealing with local port and customs authorities, organizing berths, captains, tugboats (if required), crew change and refuelling.

**Freight forwarders**

Often referred to as freight management companies these days their role is to oversee and manage the movement of the freight from the point of origin to the point of destination. Freight management companies provide integrated door-to-door solutions for their customers that may include arranging different modes of transport, customs clearance and documentation, arranging port handling and generally supervising all aspects of the movement. In order to do this effectively they usually have worldwide networks of offices and agents in many countries.

# Common shipping terms

As with many specific areas of industry sea-freight has developed a whole plethora of terms and abbreviations over a period of time that spans centuries. In fact there

are so many that it is not possible to outline them all in this chapter. The terms that are listed below are the ones that most commonly cause problems for the newcomer to the trade. The list is a very long way from being exhaustive and many useful websites exist with very detailed lists for those who may need more information.

**1.Full container load (FCL)**

As the term implies, this refers to a load that will fill a given container.

**2.Less than container load (LCL)**

Once again, as the term implies, this is a shipment that will not fill a container and therefore will require to be consolidated with other LCLs in order to economically fill a shipping container.

**3.Hook to hook**

This term is used by many shipping lines when quoting prices for break-bulk sea freight. It means that the shipping line's price includes loading the goods on to the vessel and unloading the goods at the destination port. It also includes the cost of transporting the goods between the origin and destination ports. It is important to note that this price does not typically include insurance nor does it include the stevedoring cost at both ports to attach or detach the cargo from the ship's lifting gear. In addition it does not include other port handling costs.

**4.Full liner terms**

This means the same as hook to hook.

**5.Liner in**

The shipping line is responsible for the cost of loading the cargo on board the vessel.

**6.Liner out**

The shipping line is responsible for the cost of unloading the cargo at the destination port.

**7.Free in and/or Free out**

In effect this is the opposite of hook to hook. Many purchasers of sea-freight who are new to the industry make the mistake of interpreting 'free' as meaning free to them. Whenever the term 'free' is used in this context it means free to the shipping line. Therefore the party purchasing the sea-freight will be responsible for the cost of loading and unloading the goods on and off the ship.

**8.Break bulk cargo**

This is a general term for non-containerized loose freight. Out-of-gauge cargo and heavyweight items that are unsuitable for containerization fall into this category. Bulk cargoes such as crude oil, loose grain or bulk powders, and iron ore would not be classified as break bulk.

**9.Weight or Measure (W/M)**

This is a common method used by shipping lines to price sea-freight for break bulk shipments. It is important to understand that this method considers that one metric

tonne is equal to one cubic metre and that the price quoted applies to the higher of the two numbers. Rather confusingly this system can also be referred to as Freight Tonnes or Revenue Tonnes.

**10.Stackable cargo**

Another very important note to remember is that not all cargo is stackable. In other words it does not lend itself to having cargo loaded on top of it. Therefore if we continue with the example above and consider how much ship's volume capacity is required to carry 7,500 cubic metres we can reasonably assume that we will require a ship with a volumetric capacity somewhat in excess of 7,500 cubic metres. If a cargo is non-stackable it will mean by definition that any space above it will be lost as loading capacity. In addition to this problem the shape of the cargo or the contours of the ship may also result in lost loading capacity. These issues will be dealt with by the shipping company who will prepare a stowage plan. Some cargo may be suitable for securing on deck exposed to the weather and seawater.

**11.Stowage plan**

This is a plan prepared by a representative of the shipping line which will clearly show where each item to be loaded will be placed in the ship's holds or on the open deck. The plan will be based on a detailed packing list (see below) provided by the consignor.

**12.Lost slots**

A slot is a term used to describe the space taken up by an ISO shipping container on a cellular container vessel. If certain types of specialist container are used to transport the goods such as flat-racks or open-top containers then there is the possibility that the cargo will protrude outside the normal cubic dimensions of a standard shipping container. For example a piece of machinery may fit inside the confines of an open-top container but protrude through the top of the container. In this case the carrier will be forced to either load the container on the top of the stack or lose the potential for loading on top of this particular container. This will lead to a request from the shipping line for the consignor to pay for the 'lost slots'. In other words pay for the slots that cannot be used by the shipping line because the cargo is protruding into another slot's space. In some cases where flat-racks are used the number of lost slots could be quite high if the cargo protrudes in several directions.

**13.Port rotation**

This refers to the order and names of the ports at which the ship is planning to call.

**14.TEU**

This stands for 20 foot equivalent unit and is equal to one 20 foot ISO shipping container. Cellular container ships are usually described by the amount of TEUs they can carry.

**15.FEU**

This stands for a 40 foot equivalent unit and is equal to one forty foot ISO shipping container.

**16.Surcharges**

When international sea-freight prices are being quoted anywhere in the world as a matter of custom and practice, as well as convenience, all prices are generally quoted in US$ or Euros. In addition to the basic cost of sea-freight there are a number of other surcharges that may be applied.

**a.)Bunker adjustment factor (BAF)**

BAF is a common surcharge applied to sea-freight rates by shipping lines. It is designed to take account of the variations in the price of marine fuel in different parts of the world. The BAF being charged on certain trade routes by the shipping lines working this route is determined by the liner conference whose members work on this route. The BAF is changed from time to time

**b.)Currency adjustment factor (CAF)**

CAP is another common surcharge that is applied to take account of any differences in cost incurred by the shipping line due to currency exchange fluctuations for services bought by them in foreign currencies in the execution of their services on the customer's behalf. All sea- freight rates are generally priced in US$ or Euros but local services purchased by the shipping company will be in the local currency of the country in which the goods or services are bought. The surcharge is designed to compensate the shipping line for this and is usually charged as a percentage of the basic freight charge.

**c.)Peak season surcharge (PSS)**

PSS is a surcharge that is applied to both airfreight and sea-freight originating in the Far East. Due to the rapid growth in exports from countries such as China, and the lag in the provision of commensurate infrastructure to handle this unprecedented growth backlogs occur at certain times of the year. A shortage of transport carrier capacity and an imbalance in trade flows means that carriers can apply this surcharge which customers are forced to pay. The surcharge may be a considerable uplift on the normal freight rates.

**d.)Repositioning charge**

This is a surcharge that is sometimes applied by the shipping line to cover the cost of returning an empty container to a location where it maybe loaded with revenue-earning cargo. The cost of handling, shipping and trucking the empty container is a loss to the shipping line. In addition, because an empty container is repositioned by being transported on one of its ships, there is the lost opportunity cost associated with utilizing this space. This type of charge is most likely to be applied where there is an imbalance in trade volumes on a given route.

**e.)War risk surcharge**

This surcharge may be applied to any mode of transport in a war zone as well as an area around the actual war zone. It is applied to take account of the increased possibility of incidents that could result in the partial or total loss of the company's assets.

# Documentation

One very important aspect of moving goods internationally by sea is the associated documents required by various government agencies, financial institutions and trading partners at both origin and destination. The following contains a brief overview of some of the major documents used.

***Bills of lading**

A bill of lading is issued by the shipping line as a receipt for the cargo being transported on its ship. It is also a contract of carriage to deliver the cargo to a named destination. In addition it lays out what has been loaded and in what condition. A bill of lading is a negotiable document unless it states otherwise. This means that the goods may be bought and sold during the sea voyage using the bill of lading as title to the goods. Therefore the legal bearer of the bill of lading is the owner. There are several different types of bills of lading to suit differing circum stances.

***Letters of credit**

Although these documents are not necessarily required to facilitate the actual international transport of goods by sea or to fulfill the customs authorities' requirements they are nevertheless crucial to facilitating the exchange of goods for money across international borders. They act as a protection for both the buyer and seller. A letter of credit (LC) issued by a bank in one country (the issuing bank) on behalf of a buyer names the seller as beneficiary to the funds outlined in the LC provided certain terms are clearly met by the seller. The LC is then sent to the seller's bank in a different country, which is known as the advising bank. This method is used to guarantee that the seller gets his payment in time and in full, and the buyer does not release funds until the goods are received in full and in good condition. This is an extremely complicated financial area and the above description is intended as a general guide only.

***Certificate of origin**

This is a document issued by a certifying body that establishes the origin of the goods being transported. This is often required by Customs authorities at the final destination due to trade tariffs, international trade treaties or embargoes on trade with certain countries.

***Commercial invoices**

The commercial invoice produced by the seller establishes among other things the weight of the goods, the number of items, a description of the goods, and the price of the goods being sold. Where LCs are also being used there should not be any

discrepancy between the details contained in the two documents. The cost of the goods being imported assists the customs authorities to arrive at a customs duty tariff. However, it should be noted that they are under no obligation to accept the value on a commercial invoice if they disagree with the value stated.

***Packing lists**

A packing list is a detailed list of all the items to be transported. A packing list typically contains as a minimum a brief description of the items; their weight, the length, width, height of each item, and how many items are contained in each package. This allows a cubic capacity to be calculated for each item. In addition the shipping line will ask the consignor to identify which items on the packing list may be stackable and which items could be loaded on deck exposed to the elements. It is very important to understand that items loaded on the open deck will be exposed to extremes of temperature, salt and water from sea spray or rain, and the possibility of being lost overboard in the sea. Packing lists are required for customs formalities as well.

**Other documents**

Depending on the nature of the goods, the originating country and the final country of delivery, various documents may also be required. These may include documents such as:

- insurance certificates;
- certificates stating that the goods meet a certain safety or engineering standard;
- data sheets relating to the management of certain hazardous chemicals;
- certificates verifying that pallets or packing materials have been fumigated to avoid the importation of biological pests.

This list is by no means exhaustive and requirements often change very quickly and with little warning.

# Vessel classification

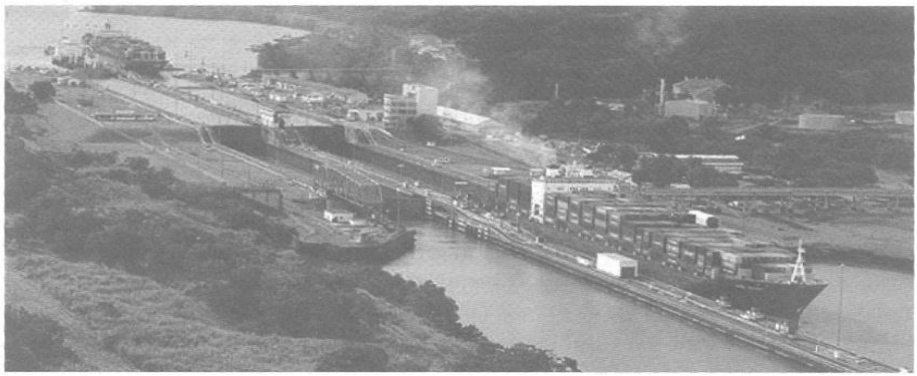
Ships are classified by organizations that survey and classify vessels. They are licensed by governments who issue ship certificates for ships registered in their country. This is commonly known as being registered under a certain 'flag'. Classification Societies are licensed by these governments to issue these certificates on their behalf.

Ship's certificates are often required by insurance companies and shippers when engaging the services of a shipping line. This helps them establish the class, age and minimum standard of maintenance related to the ship being used to carry the cargo. As a general rule insurance companies would increase their insurance premium for older vessels.

**Handysize**

This is a smaller sized ship used to carry bulk commodities or crude oil. It will have a size of between 10,000 dwt (dead weight tonnes) and 30,000 dwt.

**Handymax**
This is a vessel used to carry bulk commodities or crude oil of a size between 30,001 dwt and 50,000 dwt.
**Aframax**
A crude oil tanker of between 80,001 dwt and 119,000 dwt which is capable of remeasurement to a deadweight of 79,999 long tons. This is the largest crude oil tanker in the Average Freight Rate System (AFRA). This term was derived by the US oil companies who used the AFRA system to establish tax liabilities on sea transport with the US Internal Revenue Service.
The maximum size of ship that can pass through the locks of the Suez Canal is 200,000 dwt. Ships below this size may be referred to as Suezmax.
**Panamax**
There are plans to modify the Panama Canal but at the time of writing the locks of the Panama Canal are 1,000 feet long, 110 feet wide, and 85 feet deep. This can accommodate vessels that are no larger than 965 feet long, 106 feet wide, and 39.5 feet deep.



**One of the locks on the Panama Canal**

**Very large crude carrier (VLCC)**
A crude oil tanker used to carry bulk oil of between 200,001 dwt and 350,000 dwt.
**Ultra large crude carrier (ULCC)**
A crude oil tanker used to carry crude oil on long-distance routes that are too big to use the Suez or Panama canals. They are the largest vessels in the world and exceed 350,000 dwt. They are so large they require specially constructed terminals to facilitate loading and off loading.
**Capesize**
These ships are too large to pass through either the Suez or the Panama Canal. They are therefore forced to take the long route around either the Cape of Good Hope at the southernmost tip of Africa or Cape Horn, which is at the southernmost

point of South America. Their size also requires them to service only deepwater terminals. They are used for the transport of bulk commodities such as mineral ores.

# Common ship types and their cargoes

**Cellular container vessel**

This ship is specifically designed to carry ISO shipping containers, Rail and intermodal transport). These vessels have continuously grown in size and speed over the last few years and tend to work to very strict schedules. This is possible because of the relative ease of handling containers on and off these vessels. In fact they often load and unload at the same time to speed up operations. The largest container vessel at the time of writing is the Emma Maersk with an official capacity of 11,000 TEU. It is worth noting that Maersk calculate their ship capacities based on an average weight of 14 tonnes per container. Therefore the potential carrying capacity may be significantly higher in terms of actual TEUs with a possible maximum of 15,200 TEU.


**The Emma Maersk: the largest cellular container vessel in the world, capable of transporting 11,000 TEU**

**Break bulk freighter**

These vessels carry any kind of loose cargo that is not liquid or loose bulk commodities. They used to be very common ships but these days with the increased use of shipping containers and specialized ships they have become much rarer. They are still used in parts of the world where cargo handling is less well developed. They are usually equipped with their own cranes to facilitate loading and off loading (sometimes referred to as a self-sustaining or geared ship). These vessels tend to be less efficient when it comes to time schedules due to the many problems that may occur while loading and unloading.

**Roro vessel**
These ships are designed specifically to carry wheeled vehicles. They are equipped with a ramp that can be raised and lowered to allow vehicles to be driven on and off. These ships are similar to vehicle ferries but are usually much larger and have more decks to carry thousands of vehicles. They are mainly utilized by vehicle manufacturers to transport their products to their chosen markets around the globe.
**LNG.vessel**Liquefied Natural Gas (LNG) is cooled to a temperature of minus 162 C, which causes it to reduce in size to 1/600th of its volume at ambient temperatures. LNG tankers are constructed in such a way that they have a number of large spherical tanks that are positioned longitudinally along the entire length of the cargo-carrying area of the hull. The LNG is loaded and unloaded in liquid form just like any other bulk liquid. It is important to note that due to the potential for a terrorist attack or straightforward explosion the US Government has adopted very specific safety measures regarding these vessels when they visit US LNG terminals.

A recent development has been the redesign and building of much higher capacity LNG vessels known as EQ-Max' ships. A normal vessel as described above might carry a load of 140,000 cubic metres of LNG whereas these new ships will be capable of carrying 266,000 cubic metres.
**Oil tanker**
These ships carry large volumes of crude oil in liquid form. Some of these vessels are extremely large and carry oil over very long distances from where it is produced to where it is required. Due to the environmental impact of crude oil modern tankers have a twin hull to help avoid the possibility of spillages in the event of a collision.
**Specialized heavy lift vessel**
These ships are designed to carry very heavy or large cargoes that other ships cannot accommodate. They are designed with most of the hull being covered in a flat open deck that can aid loading and off loading. They usually have their own cranes with heavy lifting capabilities.
**Dry bulk carrier.** These ships are designed to carry any type of loose dry bulk commodity such as grain, stone, ores, coal or phosphates.

# Ports and cargo handling Challenges

***Terminal handling***
Whenever cargo is sent to a port due consideration needs to be given to the nature of terminal handling facilities available. Not all ports are capable of handling all types of cargo and some ports are solely established to handle one type of cargo only, for example crude oil terminals. Others may have separate facilities for handling different types of cargo, for example ISO containers and break-bulk cargo.

Charges for terminal handling will vary from port to port and by the type of cargo handled. Many ports will offer free periods of storage prior to loading of the ship or after unloading of the vessel. If these periods of free time are exceeded for any reason then charges known as demurrage or detention will usually be charged in addition. If goods are unloaded from a ship directly on to a truck, and vice versa, then this is usually referred to as direct delivery and ports will offer a reduced charge for allowing this activity to take place. This can speed up vessel turn-around times in the port but needs careful planning to ensure sufficient trucks are continuously available to maintain the direct delivery process until the ship is fully discharged or loaded.

If stevedores are required to lash cargo, operate cranes and carry out other associated duties then ports usually have a separate tariff for these services

***Cargo surveyors***

In the event that any party to the movement by sea of a given cargo is unable or unqualified to attend the loading, unloading or handling of the cargo being shipped then a cargo surveyor may be appointed for a fee. This independent third party can document through photographs and a written report the way in which the cargo was handled during loading, stowing or unloading. The Surveyor may be able to prevent some events happening but if they cannot then at least they will be able to provide a reliable independent professional view of any incidents that occurred. This may help with insurance claims and in some cases are insisted upon by certain parties involved in the movement.

***Cargo superintendents***

A shipping line may employ a cargo superintendent whose job is to ensure that a vessel is loaded and secured in accordance with stowage plan and the ship's captain's requirements.

***Security, piracy, politics and war***

At the time of writing the issue of piracy has once again become headline news as pirates operating from the Horn of Africa have been seizing vessels in the waters approaching the entrance to the Red Sea and the coast of East Africa. Another hot spot is the Malacca Straight between Indonesia and Malaysia. The objective of the pirates is to demand ransoms from the owners, which invariably get paid to avoid either loss of life, the vessel or the cargo. Unstable political or security situations, and in extreme cases outright war, are capable of causing huge disruption to international sea transport.

This phenomenon is nothing new in the history of sea transport but the consequences are that this increases insurance premiums and encourages ship owners to take longer diversions. In turn this has the effect of increasing costs, which are passed on to the client.

***Suez and Panama canals size restrictions***

Since the building of the Suez Canal in the late nineteenth century and the final opening of the Panama Canal in 1914 many vessels have been able to save very long journeys around either the Capes of Good Hope or Horn. However, it needs to be remembered that these canals have size restrictions and that many large vessels still are forced to make these long voyages.

***Land bridges***

Another way of avoiding long sea journeys around South America and Africa is to use a technique referred to as land-bridging. Using this method one ship delivers cargo to a port on say the East Coast of the USA and then the goods are transported by road or rail to the West Coast where they are re-loaded on to another ship for the onward journey. The problem in Africa is that transcontinental routes are inefficient and the infrastructure is not currently in a good condition. Some companies have been experimenting with sending goods by road and rail from China to Europe following the ancient example of the Silk Route. Almati in Khazakstan has been proposed as a hub for these operations. The obvious advantage for shippers will be to avoid the long and slow sea route from the Far East to Europe.

***Sea—air options***

Another way of achieving a balance of cost and speed is to use an option utilizing both the sea and air transport option. For example, a less than container load (LCL) shipment can be sent by sea from the Far East consolidated with other shipments in one shipping container to, say, Dubai where the container is deconsolidated and the LCL shipment is then loaded on to an air freighter for final delivery to Europe.

Speed, weather, port congestion

Whenever sending cargo by sea transport it needs to be remembered clearly that although it can be a very cost effective option it is the slowest form of transport generally available. Vessels may be delayed due to adverse weather conditions, vessel breakdowns and port congestion. In addition the ship owner may decide to divert his ship in order that he can take advantage of revenue-generating opportunities in ports that are off the original route planned.

# *Carnet usage*

This is document used in international distribution tailored towards easy export. Carnets apply to three broad categories of merchandise: commercial samples, professional equipment and goods for use at exhibitions and fairs. With the exception of perishable or consumable items, the product range is nearly limitless. Carnets are regularly used to facilitate movement of everything from display booths to racing yachts.

Individuals or firms wishing to use a carnet to move goods in and out of foreign countries must submit an application and the necessary collateral to their home nation guaranteeing organization. The application, among other things, lists all countries of intended transit and all applicable goods with their assigned values. If the application is properly completed and submitted with the applicable fees the national guaranteeing organization will issue a carnet specifically tailored to that itinerary. The carnet document has two, green, cover pages denoting country of origin with instructions. Within the covers are counterfoils and vouchers for each country to be visited or transited. The vouchers act as receipts for entry and re-export in foreign countries and are kept by foreign customs officials. The counterfoils are stamped by the foreign customs services and act as the carnet holders receipt. Upon completion of travel or expiration of the carnet's 12—month active period, the holder must return all documents to their home national guaranteeing organization. A review is conducted. If all documents are in order and no claims are found to be forthcoming from one of the applicable foreign countries, the collateral can be returned. If a bond was used the national guaranteeing organization issues notice that the bond may be canceled. If the counterfoils, including the final one showing re-entry of all applicable goods back into the country of origin, are not in order, or if a foreign customs service notifies the national guaranteeing organization of a violation, the carnet holder is given notice to provide proper documentation or pay the applicable duties. If they do not, the collateral or bond are used to pay the claim.

**Export Control**

Export Control regulations are federal laws that prohibit the unlicensed export of certain commodities or information for reasons of national security or protections of trade. Export controls usually arise for one or more of the following reasons:

- The nature of the export has actual or potential military applications or economic protection issues;
- Government concerns about the destination country, organization, or individual, and
- Government concerns about the declared or suspected end use or the end user of the export

**Why Certain Exports are controlled**

- National Security
- Proliferation of chemical and biological weapons Nuclear Nonproliferation *Missile Technology
- Anti-Terrorism
- Crime Control
- High Performance Computer
- Regional Stability
- Short Supply
- U.N. Sanctions

**What is an Export?**

An export is any oral, written, electronic or visual disclosure, shipment. transfer or transmission of commodities, technology, information, technical data, assistance or software codes to

- anyone outside Nigeria including a Nigeria citizen
- a non Nigeria individual wherever they are (deemed export)
- a foreign embassy or affiliate

**Methods of Disclosure Include**

- Fax
- Telephone discussions
- E-mail communications
- Computer data disclosure
- Face-to-face discussions
- Training sessions
- Tours which involve visual inspections

**The Commerce Control List.**

1. Nuclear Materials, Facilities & Equipment (and Miscellaneous Items)
2. Materials, Chemicals, Microorganisms, and Toxins
3. Materials Processing -
4. Electronics Design, Development and Production
5. Computers
6. Telecommunications and Information Security
7. Sensors and Lasers
8. Navigation and Avionics
9. Marine
10. Propulsion Systems, Space Vehicles and Related Equipment

**Anti Dumping**

When any article is exported from any country or territory to Nigeria at less than its normal value then upon the importation of such article to Nigeria, the federal Government may be notify in the official gazette impose an anti dumping duty not exceeding the margin of dumping in relation to such article. For purpose of identification, assessment and collection of Anti Dumping Duty on dumped articles and for determination of injury, the Government has appointed agencies to implement that.

# General Agreement on Tarifts and Trade (GATT)

The General Agreement on Tariffs and Trade (GAIT) was originally created by the Bretton Woods Conference as part of a larger plan for economic recovery after World War II. The GATT's main purpose was o reduce barriers to international trade. This was achieved through the reduction of tariff barriers, quantitative restrictions and subsidies on trade through a series of different agreements. The

GATT was an agreement, not an organization. Originally, the GATT was supposed to become a full international organization like the World Bank or IMF called the International Trade Organization. However, the agreement was not ratified, so the GATT remained simply an agreement. The functions of the GATT have been replaced by the World Trade Organization.

What is the purpose of GATT? According to the Preamble of GATT, the objectives of the contracting parties include.

- raising standards of living
- ensuring full employment
- a large and steadily growing volume of real income and effective demand
- developing the full use of the resources of the world
- expanding the production and exchange of goods.

The Preamble also states the contracting parties' belief that reciprocal and mutually advantageous arrangements directed to the substantial reduction in tariffs and other barriers to trade and to the elimination of discriminatory treatment in international commerce" would contribute toward these goals. Importantly, "free trade" is not the stated objective of GATT.

The role of GATT in integrating developing countries into an open multilateral trading system is also of major consequence. The increasing participation of developing countries in the GATT trading system and the pragmatic support provided to them through the flexible application of certain rules helped developing countries to both expand and diversify their trade. It could now be said that a great number of these countries have already become full partners in the system as can be witnessed by their active participation in the Uruguay Round. The task of helping to integrate further the least-developed countries is one of the challenges that lies ahead in the WTO. Similarly, the full integration of countries with economies in transition into the trading system must be achieved in order to strengthen economic interdependence as a basis for greater prosperity and world peace.

These negotiations were critical to ensure the future health of the world economy and the trading system. The globalization of the world economy over the past decade has created a greater reliance than ever on an open multilateral trading system. Free trade has become the backbone of economic prosperity and development throughout the world. Partly as a result of this, there has been a shift in trade policy mechanisms from border measures to internal policy measures, substantially affecting the management of trade relations. The Uruguay Round sought to establish a new balance in rights and obligations among trading nations as a result of this phenomenon. We are gradually moving towards a global marketplace, and for that, we need a global system of rules for trade relations among partners in that market place.

The challenges that we face are therefore enormous. The only way back from this globalization iii the world economy would be through depression and eventual chaos. We therefore have no choice but to move forward. In doing so, however, we must be sure to preserve to the highest extent possible the spirit and tradition of the GAIT, which to a large extent was the key to its success.

**INTRA STATE AND VAT INDICATION FOR DISTRIBU11ON**

Stock transfer to a branch or consignee have been the norms of trade in other and post VAT regime, Further, Stock Transfer can be both inter-state and intra-state. Various businesses contemplate options of selling the goods to another dealer or opening up a branch in another state and sending the goodson stock transfer and then selling from that branch .

## CHAPTER TWELVE

## ENVIRONMENTAL CONSIDERATION IN LOGISTICS MANAGEMENT

### Local, UK and EU legislation

It is not the purpose of this chapter to lay out in detail current and planned logistics-related environmental legislation from around the world. The sheer variety and volume of regulation precludes such an approach. Therefore the European Union framework, including a few specific examples from the UK, will be used as an exemplar. It is inevitable that people managing logistics, either in an active operational role or in a strategic planning role, will at some stage have to consider the environmental effects of their actions.

What is meant by the environment? Broadly speaking it may be divided into the internal environment, ie inside the organization, and the external environment, which encompasses everything that is outside the organization.The internal environment will be concerned with health and safety issues such as noise levels, the handling of dangerous substances and occurrences, as well as risk assessments and safe systems of work. Naturally, some issues will be of concern to both the internal and the external environment, such as noise pollution and emissions of substances into the atmosphere or watercourses. This chapter concentrates on issues relating to the external environment.

The European Union (EU) has stated that 1.3 billion tonnes of waste are produced annually by its member states and that this figure is rising by 10 per cent every year. As a result, the EU and other national governments have produced a great deal of legislation relating to environmental issues over the last few years. Since 1972, the EU alone has enacted hundreds of pieces of legislation that have introduced, among other things, minimum standards for waste management, water, and air pollution. As a result of this experience the EU realized that it needed to set up a framework for a holistic approach to waste policy, which it has done through the 2005 Thematic Strategy on Waste Prevention and Recycling. Increasingly it is being recognized that environmental issues are everyone's responsibility and that 'the polluter must pay'. It is no longer sufficient to design, introduce and sell a product into a chosen market. Now manufacturers must consider the long-term effects of their products including the possibility of recycling all or part of the product. The management of product packaging after delivery has been effected. The processes involve in manufacture may cause unacceptable levels of pollution and need to be modified or changed altogether. The mode of transport used to deliver both inbound and outbound goods will require careful consideration of alternative modes in the light of the various environmental impacts of each mode. In 2007 the European Commission issued a communication called the 'Fright Transport Logistics Action Plan'.Those involved in logistics will increasingly have

to deal with used products being brought back through the system for recycling or disposal. Waste packaging will most likely also follow the same route or at least arrangements will have to be made for a third party to discharge the organization's legal obligations in this regard. The choice of transport system will have to be carefully considered because of the adverse effects of transport fuel, emissions, noise and congestion. Congestion and fuel emissions apply particularly in the case of road transport, but the other modes of transport are not immune from these problems. The location of manufacturing and distribution sites will have to pay due regard to environmental issues.

**The European Union and environmental legislation**

In January 2001 the European Union laid out its priorities and objectives for environmental policy up to 2010 and beyond in the Sixth Environment Action Programme of the European Community, 'Environment 2010: our future, our choice'. This communication included measures to be taken to implement the EU's sustainable development strategy and built on the previous Fifth Environmental Action Programme, 'Towards sustainability'.

The Sixth Environment Action Programme suggests five strategic approaches, which are:

1. improving the implementation of existing legislation;
2. integrating environmental concerns into other policies;
3. working closer with the market;
4. empowering people as private citizens and helping them to change behaviour;
5. taking account of the environment in land-use planning and management decisions.

Specific action is proposed in the programme for each of these approaches.

Further to this, the programme focuses on four priority areas for action, which are:

1. climate change;
2. biodiversity;
3. environment and health;
4. sustainable management of resources and wastes.

In previous communications the EU identified five areas of economic activity that may affect the environment. They are:

1. tourism;
2. energy;
3. transport;
4. agriculture;
5. industry.

These declarations by the EU, which are supported by both current and impending legislation, will affect those involved in logistics to a greater or lesser extent. For example, locating manufacturing or distribution sites may be restricted by some of

the above issues. Similarly the choice of transport mode for trunking (line-haul) and final delivery could be affected. Almost certainly the packaging used and provisions for its recycling or disposal will have to be considered.

Areas of EU environmental legislation, both current and under consideration, are concentrated in the following areas:

- Waste management. The EU has stated that it produces 1.3 billion tonnes of waste each year, which equates to 530 kgs per year per person. In addition, between 1990 and 1995 total waste generation increased by 10 per cent, which is disproportionate to the increase in GDP of only 6.5 per cent. Municipal waste increased by 19 per cent between 1995 and 2003. In addition 75 billion euros was spent on municipal waste and hazardous waste management. The problem is that these performance figures have been generated despite all the legislation enacted by the EU. In response the EU Commission proposed a 'Thematic Strategy on Waste Prevention and Recycling' in 2005. The first step in this approach has taken the form of a new EU Waste Framework Directive that covers the following areas: a) a change to a life cycle approach, which changes the focus from the waste to a review of a better use of natural resources and raw materials; b) prevention of waste production; c) recycling and the development of a market for recycled materials; d) simplification of existing legislation; e) specific targets will not be imposed on member states for recycling or prevention; and 0 improved energy recovery from municipal incinerators. EU Directive 2000/53/EC introduced provisions requiring the collection of all end-of-life vehicles. Member states are required to establish collection systems for end-of-life vehicles. This includes the transfer of these vehicles to authorized treatment facilities and a system for deregistration of the vehicles. Other EU legislation covers waste from electrical and electronic equipment (see below), packaging waste, batteries and mineral oils. Waste treatment such as incineration and the use of landfill sites has also been the subject of legislation.
- The Waste Electrical and Electronic Equipment (WEEE) Directive. The objective of this EU directive is to reduce the amount of WEEE being produced and to encourage reuse, recycling and recovery. Businesses that manufacture, supply, use, recycle and recover electrical and electronic equipment (EEE) are all covered by this legislation. EU member states are required to minimize the amount of unsorted WEEE in municipal waste. This directive will have significant implications for businesses. They will have to establish reverse logistics systems to comply with these requirements.
- Noise pollution. The EU has set maximum permissible noise levels from machines such as trucks, aircraft, lawnmowers and motorcycles.

- Water pollution. Water quality standards have been imposed, which cover drinking water, bathing water and water for fish farms. During the 1980s and 1990s the EU focused on establishing emission limits, but since 1995 the focus has expanded to include a more global approach, including the promotion of sustainable use of water resources.
- Air pollution. EU legislation is primarily designed to reduce emissions from industrial activities and road vehicles. The strategy for transport is:
    - to reduce polluting emissions through the use of catalytic converters and vehicle roadworthiness testing;
    - in collaboration with car manufacturers to reduce the fuel consumption of private cars;
    - to promote the use of clean vehicles through tax incentives.
- Standards have been set on the amount of carbon monoxide, oxides of nitrogen and hydrocarbon emissions that new vehicles over 3.5 tonnes gross vehicle weight can produce. These have come to be known as Euro 1, Euro 2, Euro 3, Euro 4 and Euro 5. Standards relating to fuel quality and exhaust after treatment.
- Nature conservation. The EU has taken steps to conserve wildlife and natural habitats. The promotion of biodiversity in the fields of natural resources, agriculture, fisheries, and development aid and economic co-operation are the subject of action plans.
- Natural and technological hazards. The EU has taken action regarding civil protection from natural and technological hazards and the prevention of major industrial accidents. It has also signed the United Nations Convention on the Transboundary Impacts of Industrial Accidents.

Nuclear safety measures cover protection against radiation and the management of radioactive waste. Genetically modified organisms (GMOs) have also been covered.

The above list does not make any mention of the huge amount of health and safety legislation that mainly covers the internal environment. The main thrust of this legislation has moved in recent years from descriptive to prescriptive legislation. The principles of managing health and safety through risk assessment force management to create an agenda for corrective actions. Risk assessments are undertaken for given work activities. In the course of conducting the risk assessment, hazards are identified and an evaluation made of the likelihood of that hazard creating an accident. Having identified both the hazard and the risk, management are then obliged to undertake corrective actions.In many ways, following best environmental and health and safety practices can make good business sense. After all, is it not the objective of logisticians to optimize the performance of the whole organization? Elimination of wasteful activities can be environmentally friendly and beneficial to the company. Maintaining a safe and healthy internal environment for its workforce will ultimately benefit the

organization. Time lost to industry is breathtaking in its scale due to accidents, illness and management time in dealing with these issues.Hand in hand with lost time go the additional costs created by accidents, associated with consequential loss, and replacement assets and people. Criminal and civil legal actions will also be avoided by following best practice.

**Key UK waste legislation**

The Producer Responsibility Obligations (Packaging Waste) Regulations (1997) came into force in March 1997 and have been amended several times since then with the latest amendment being put in place in 2008. These regulations implemented the EU Directive 94/62/EC on packaging and packaging waste and required each member state to set targets for recovery and recycling of packaging waste. The responsibility for executing these regulations is shared by all the parties in the packaging chain, described as the 'producers'. These 'producers' are legally obliged to do the following:

1. Register with the relevant Environmental Regulator in the UK and submit data on packaging handled.
2. Arrange for the recovery and recycling of specified tonnages of packaging waste.
3. Certify that their obligations have been met.
4. If their main activity is that of a seller of packaging or products in packaging they are required to inform customers of their role in increasing recovery and recycling as well as the return, collection and recovery systems available to them.

'Producers' may either discharge their responsibilities themselves or register with a 'compliance scheme', which will discharge their obligations on their behalf.

The UK Environmental Protection (Duty of Care) Regulations 1991 created responsibilities for all those involved in the import, production, keeping, treatment, transport, transfer and disposal of waste. All parties involved are charged with a 'duty of care', which covers the escape of waste, the transfer of waste only to persons authorized to receive it and documentation describing the waste and parties involved in its disposal. Waste management licences are required by those involved in keeping, treating or disposing of waste. Waste transfer notes must accompany the waste on its journey from producer to final disposal.

These regulations have been amended by the Environmental Permitting (England and Wales) Regulations 2007 and at the time of writing further amendments were expected.

Freight Transport Logistics Action Plan.In 2007 the European Commission issued this communication. It clearly stresses the 'key role of logistics in ensuring sustainable and competitive mobility in Europe and contributing to... a cleaner environment, security of energy supply, transport safety and security'. It also stated that the purpose of the plan was to 'improve the efficiency and sustainability of

freight transport in Europe'. It proposes doing this by pursuing the following actions:

1. Promoting e-Freight and Intelligent Transport Systems (ITS). This includes a vision of a paperless electronic flow of information related to the actual physical flow of materials. The ability to track and trace freight movements across transport modes, the increased use of radio frequency identification (RFID), and the use of the Galileo satellite positioning system are part of this vision. This concept could lead to an 'Internet for Cargo'.
2. Sustainable Quality and Efficiency will look at continuously identifying operational, infrastructure-related and administrative bottlenecks with a view to proposing solutions to resolve them. Other areas will include improving the attractiveness of the logistics profession by looking at personnel and training. The setting of performance indicators across transport modes for freight transport logistics. Benchmarking the performance of inter- modal terminals including ports and airports with a view to establishing a set of generic European benchmarks. The promotion of best practice. Statistical data will be transformed into relevant indicators and means of measurement.
3. The Simplification of Transport Chains. The aim here is to establish a single access point and a one-stop shop for all administrative procedures, such as customs clearance, for all modes of transport. In addition a single multimodal transport document that may be used by and between all modes of transport is proposed. The plan also states that a balance needs to be struck between the free flow of trade and security procedures.
4. Vehicle Dimensions and Loading Standards. Vehicle dimensions and loading standards will be reviewed and a project on Intermodal Loading Units will be progressed with a view to improving the use of intermodal transport.
5. 'Green' Transport Corridors for freight. The plan states that 'Green transport corridors will reflect an integrated transport concept where short sea shipping, rail, inland waterways and road complement each other to enable the choice of environmentally friendly transport'. These corridors will be between major hubs and cover relatively long distances. The intention is to create freight-only rail networks and 'Motorways of the Sea'.
6. Urban Freight Transport Logistics. In urban areas freight and passenger transport demand need to be integrated into town planning. Improvements are expected from the wider use of information and communication technology (ICT) based solutions.

The communication states that all the above actions 'are designed to help the freight transport logistics industry towards long-term efficiency and growth by addressing issues such as congestion, pollution and noise, C02 emissions and dependence on fossil fuels that — if left unchecked — would put at risk its efficiency'.

# Logistics and environmental best practice

This section is designed to highlight some of the key areas that should be considered when dealing with the management of environmental issues. Given the complexity of many environmental issues and their ability to generate intense public interest, this section should be seen as only an introduction to the area. Specialist help should always be sought by management if any doubt exists as to the proper course of action in a given set of circumstances.

***Environmental management systems***

As we have seen, logistics and transport activities have been identified as having a major impact on the environment in which we all live. Consequently they have attracted significant legislation at both the national and the international level. Targets for improving environmental performance have been set by part of the international community via the Rio, the Kyoto, the Montreal and Bali climate change summit meetings. At the level of the organization it has been recognized that a formal system for the management of environmental matters would be useful. The ISO 14000 series of standards outlines such a system.

This standard provides a framework for managing environmental issues rather than establishing performance requirements. The approach is defined in the introduction of the standard's specification. It is seen as an iterative process that starts with the creation of an environmental policy by the organization. This leads on to planning how the organization will meet its legal obligations as well as any targets it wishes to set, which in turn leads to implementing and operating the plan. Implementation will pay due regard to the organizational structure and allocation of responsibilities. Training and communicating with staff, control of relevant documentation and operational controls must all be covered in the implementation.

Once the system has been set up, it is then formally monitored through an auditing process, which will identify corrective actions that will need to be taken. Top management is required 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 auditing reports or changing circumstances. This process should encourage a commitment to continuous improvement in environmental management as well as ensuring that the organization is not exposed by failing to meet its legal and moral obligations.

**Environmental checklist**

The following checklist was published in 1991 by the UK Department of Trade and Industry in a useful document entitled Environment: A challenge for business. Questions for firms' consideration are:

- What environmental risks do your firm's activities pose?
- Do your processes and materials pose any danger?
- Do you know what impact your products (including their disposal) and services have on the environment?
- Do you know what quantity and type of waste you produce?
- Do you know how it is disposed of and what the cost is?
- Is your firm operating the most cost-effective method of controlling or eliminating pollution risk?
- Are there hidden benefits (for example, greater production efficiency) — or even straight business opportunities (for example, commercial utilization of waste) — from adopting alternative methods of controlling or eliminating the pollution risk?
- Can you meet the consumer demand for environmentally improved products?
- Are you aware of existing environmental standards and legislation in the UK and overseas?
- What arrangements do you have for monitoring compliance with environmental legislation?
- Is senior management actively involved in ensuring that proper weight is given to environmental considerations throughout the firm?
- Could you improve your environmental image to the public and your employees?
- Are you highlighting your environmental performance to private investors, financial institutions and shareholders?

**Packaging**

Packaging is important to logisticians for a number of reasons. Its shape may define how effectively the products may be loaded into transport containers such as cartons or vehicles. For example, a cylindrical-shaped product is unlikely to fill a given cubic capacity as well as a rectilinear shape. This has implications for how much product can be stored or transported in a given space and, as all storage and transport resources have a finite size and weight restriction, filling these spaces effectively is extremely important. The more product stored or transported in a given cubic capacity, the more the associated unit costs, as well as the environmental impact, may be reduced.Packaging is also important in protecting the products from damage in transit and even pilferage. Packaging in the form of unitized containers, whether they are pallets or reusable containers, will often require return transportation to the point of origin to facilitate reuse.Many industries have developed forms of packaging that do all that is required of them

whilst in transit between the point of origin and the end user but that do not warrant the expense of returning them to the point of origin. Therefore the packaging is used only once and then consigned to the rubbish tip. This principle goes all the way down to the level of the single tin or carton of food. In this case the consumer transports the container from the retail outlet to the point of use and then simply discards the container.

It is this type of packaging, in all its forms, that environmental legislation aims to control. For logisticians, the problem manifests itself in the form of reverse logistics. Waste packaging needs to be returned up the supply chain, or at least the obligation to do this needs to be dealt with. It is possible under the UK regulations to join a compliance scheme that helps discharge the organization's obligations in this regard.

**Performance measures for road transport**

As with any management exercise, performance measures are useful for evaluating the progress or otherwise of a given initiative. Most business managers will be concerned with costs and benefits because businesses are concerned with making a healthy return on investment. Very often, best environmental practice will result in financial benefits in return. For example, investment in driver training may deliver savings through reduced accident figures and better fuel consumption.

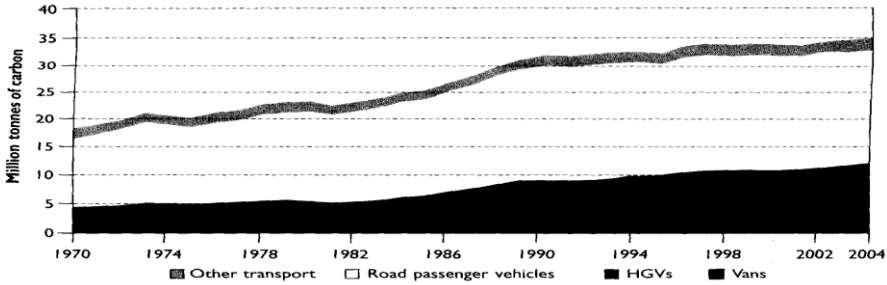
However, some environmental projects may have to be undertaken because of legal requirements and will not generate commensurate cost savings for the business. For example, a noise abatement order generated because local residents have objected to the noise emanating from a distribution centre at night may result in the installation of noise screens, landscaping or restrictions on operating hours. Clearly, any of these measures will simply add cost and no financial benefit to the business concerned, although some public relations benefits may accrue. Obviously, it would be desirable to avoid this kind of problem by selecting operating sites carefully, but some sites, through no fault of their own, have over time been slowly surrounded by residential dwellings. Unfortunately, being there first is not enough to make them immune from this kind of issue.

Organizations with environmental management systems, whether formal or informal, will attempt to monitor their performance in certain areas of their operation. Simple measures might include:

- miles per gallon or litres per kilometre of fuel used;
- percentage of fleet using less polluting fuels;
- percentage of truck fleet in the Euro 1, Euro 2, Euro 3, Euro 4 and Euro 5 emission regulation bands;
- average life of tyres expressed in miles or kilometres;
- percentage of tyres remoulded or regrooved;
- amount of waste lubrication oils generated by the operation;
- utilization of vehicle load space expressed as a percentage;
- percentage of empty miles or kilometres run by vehicles;

- targets for reducing waste packaging;
- targets for reducing noise levels.

The contribution of road vehicles to the production of harmful emissions has generated a great deal of attention from governments, the press, environmental pressure groups and many other concerned parties. For those organizations operating very large fleets of vehicles, the following formula may prove useful in measuring performance: 1 litre of diesel fuel produces 3 kilograms of $CO_2$, or 1,000 litres of diesel fuel produces 3 tonnes of $CO_2$. This formula may be used in practice by simply identifying the number of litres of diesel fuel saved through the implementation of a given initiative and multiplying the saved fuel figure by 0.003 to arrive at the number of tonnes of $CO_2$ emissions that have been avoided. Figure 36.1 illustrates the increase in $CO_2$ emissions in the UK for different modes of transport between 1970 and 2004.




**Carbon dioxide ($CO_2$) emissions by mode:**

Carbon dioxide is the most important greenhouse gas. $CO_2$ emissions from transport increased from 18 million tonnes of carbon (mtc) in 1970 to 35 mtc in 2004, although growth has been slower since 1990. Emissions of both HGVs and vans have been growing: over the period 1994 to 2004 by 19 per cent and 24 per cent respectively.

Noise levels are measured using decibels (dB (a)). The problem with measuring improvements in noise levels is that sound waves are reflected by different surfaces. Measurement of the effect of noise attenuation on, say, a piece of vehicle ancillary equipment — such as the blower used in the discharge of powder tankers — would be affected by any surrounding buildings or the position of the person in relation to the blower itself. However, providing that these limitations are recognized and accounted for then it is possible to compare different blowers in the same location and arrive at an indication of improvement.

**Possible areas of improvement for the distribution centre and road transport**

For the distribution centre, consider these areas for improvement:

- location;
- vehicle access/egress;
- noise reduction by:
  - — landscaping,
  - — erecting noise screens,
  - — moving noisy operations away from local residents,
  - — restricting noisy activities to certain hours,
  - — restricting visiting vehicles to certain hours,
  - — using noise-attenuated equipment where possible,
  - — turning vehicle engines off when not in use,
  - — insisting on drivers turning off radios when working in the distribution centre at night;
- reduction of visual intrusion through landscaping and a generally neat and tidy approach;
- reduction of water wastage by the use Of water recycling on vehicle washes;
- avoidance of pollution of the watercourse with run-off from fuel dispensing areas
- through the use of interceptor tanks;
- consideration of the use of a computerized fuel dispensing system;
- careful management and monitoring of other hazardous chemicals on-site (paying due regard to the UK Control of Substances Hazardous to Health (COSHH) Regulations);
- keeping pallet stacks tidy and out of sight if possible;
- fitting particulate traps to diesel fork-lift trucks to reduce emissions;
- consideration of the use of electric- or gas-powered fork-lift trucks;
- better management of the production, collection and disposal of waste.

For the vehicles, consider these possible areas for improvement:

- Driver training reduces accidents and improves fuel consumption. Use on-board vehicle technology to monitor driver performance. Computerized engine management can provide a wealth of information.
- Consider less polluting fuels.
- Monitor fuel consumption.
- Monitor vehicle utilization in terms of both payload and empty running.
- Use speed limiters on smaller commercial vehicles that don’t require them bylaw.
- Follow preventative maintenance programmes, because slipping clutches, blocked air filters, fuel leaks, poorly inflated tyres and binding brakes all use fuel unnecessarily.

- Consider the use of aerodynamic kits on the vehicles to improve fuel consumption.
- Specify the most appropriate driveline (engine, gearbox and drive axle) for a given vehicle duty cycle.
- Consider the use of synthetic oils, as their use may reduce the overall use of oil in the vehicles.
- Lubrication oils in the engine, gearbox and driving axles all impose drag on the drive- line. Consider using different oils to produce fuel savings.
- Use computerized routeing and scheduling packages to reduce overall vehicle distances travelled.
- Instigate better tyre management through the increased use of recutting and remoulding of tyres to extend useful life.
- Dispose of used tyre casings responsibly.
- Use low rolling resistance tyres to improve fuel economy.
- Muffle vehicle body noise where possible.
- Use self-tracking (or positively steered) steering axles on trailers to reduce tyre wear and tear.
- Specify attenuated ancillary equipment such as refrigeration units, discharge blower units and tail-lifts.
- Specify air brake silencers.
- Use quiet floor materials in vehicle bodies.
- Use asbestos-free brake linings and clutch plates.
- Use air suspension on vehicles to reduce road damage and prolong the life of vehicle components.
- Use chlorofluorocarbon-free body insulation materials.

A further important area of consideration for possible environmental performance improvement is the transfer of some freight to rail or other modes of transport.

# Reverse logistics

For the most part, logistics management is about moving materials from raw materials through production and onward to the end customer. Usually going in the opposite direction from the end customer through production planning to raw material suppliers is information about customer requirements. However, there are occasions when it is necessary to move materials in the other direction as well. These circumstances are usually:

1. product recall for quality or safety reasons;
2. the return of unwanted goods;
3. used packaging or products for recycling or disposal.

Moving materials back through the distribution channel presents organizations with many challenges because the system is primarily designed to move goods in one direction only, ie from the organization to the customer and not the other way round. However, there are businesses where reverse logistics is a part of the fabric of their organizations. For example, the mail order/catalogue companies can experience return rates on dispatched goods of up to 50 per cent, especially where fashion items are concerned. The increase in shopping via the internet or other media will clearly affect this phenomenon. The postal services and parcels carriers also specialize in systems that both collect and deliver goods.

For those companies that are not set up to deal with reverse flows through their systems, there are many obstacles to overcome. The following is a brief outline of what should be considered:

1. Is there a strategy for reversing the flow of materials in the system? Responsibilities should be allocated in advance, and any resources unavailable internally should be identified in advance. Cost elements should also be identified in advance. Cost elements involved in a product recall fall under four headings: communication costs, documentation costs, replacement costs and disposition costs. Communication costs include:
   - registered and certified mail;
   - return receipts;
   - instructions;
   - telephone, telegrams (and faxes);
   - messenger (courier) service.

Documentation costs include:

- filing of receipts of notices for recall;
- estimates for disposition and replacement;
- plans of item recalled;
- plans for replacement item;
- instructions for replacement/repair;
- authorizations for work to be performed;
- receipts for items replaced/repaired.

Replacement costs include:

- manufacture and installation;
- employee visits;
- shipping, packing and warehousing;
- testing and retesting;

— identification of product;
— identification of carton;
— identification of shipping carton;
— temporary personnel;
— invoicing;
— overtime of employees.

Disposition costs include:

— locating all items;
— inventory of items;
— removal from customer's property;
— packaging and unpacking;
— labelling;
— shipping;
— inspection;
— repair or replace;
— discard or salvage;
— instruction pamphlet;
— refunding;
— allowances for time used;
— repurchase of item;
— compensation for loss of use;
— warehousing: storage.

2. What is the urgency associated with this reverse flow? Clearly, in the case of malicious contamination of food products, which usually are life-threatening in nature, speed is of the essence. These particular situations may be further complicated by police insistence on secrecy if blackmail is involved. Even if this is not the case, very often the perishable nature of the goods has ensured that they were distributed very quickly across a large geographical area. In these circumstances, hours and minutes can be critical to success or failure. If goods are defective in some way that is not life-threatening but the consumers' enjoyment of the products may tarnish the company's reputation in the marketplace, then a rapid resolution of the matter may even enhance the standing of the company in the consumers' eyes. Naturally, the opposite is also true. Used packaging or unwanted goods need to be dealt with efficiently and professionally, but they will not attract the same level of urgency as either malicious contamination of food products or defective goods.
3. Having established the relative urgency of the reverse flow, it is then necessary to establish where the goods are in the distribution channels. It can be easily understood that the more links in the distribution channel

that exist the more complex and costly it will be to both locate and return the goods. This is where a good product traceability system will come into its own.

4. Assuming that the goods have been located, the next task is to collect them. If the goods are in the hands of the consumer then this is the most difficult situation of all, as the manufacturer's distributors may not know the identities of these consumers. This situation will require some form of publicity campaign, but even then consumers may not choose to respond. In this situation, limited success is very likely. Associated transport costs will be higher than usual because consignments are likely to be smaller and more widely dispersed.
5. When the goods are returned, care will have to be taken to isolate and quarantine them to avoid the possibility of their being inadvertently dispatched again. This is especially important where the reason for collection is not immediately obvious to the casual observer. The potential for salvage and reworking of the products will also need to be established.

This list has concentrated on product recalls, as they can be very complicated and costly and have disastrous results. In the case of material moving back up the distribution channel for recycling, the need for urgency is likely to be reduced unless the material is hazardous in some way. As stated earlier in this chapter, the disposal and handling of waste have attracted a great deal of legislation and media attention, which means that this process cannot be approached in a half-hearted way.

Many manufacturers are designing their products with recycling in mind. Nigeria brewery Plc, is a case in point. It produces returnable crates that are virtually completely manufactured of materials that may be recycled. In future, the challenge for manufacturers will be to retrieve and recycle their own products. Instances of reverse logistics can also be seen in the service sector. For instance, a holiday tour operator may need to repatriate its clients at short notice due to disease, civil unrest or severe weather conditions. The principles are very similar.

**Alternative fuels**

With the increasing concerns about global warming, attention has inevitably been focused on the causes of this phenomenon. One of the major culprits identified by scientists has been the emissions created by burning fossil fuels in transport vehicles, with special emphasis on road vehicles.

This area of science is extraordinarily complicated in itself. However, it is made even more incomprehensible to the layperson when the scientists themselves do not seem to agree on the extent or the degree of this problem.

It is not just the macro-environment (global warming and greenhouse gases), but the effects of road vehicle emissions on human health in the micro-environment such as a city street, that concerns many people. Fossil fuels tend to produce what is called particulate matter (PM), which is, amongst other things, unburned fuel. Diesel engines are particularly prone to producing this type of emission. Medical studies have raised concerns about what has come to be known as PM1Os and their effect on sufferers of respiratory illnesses such as asthma. PM1Os are particulate matter smaller than 10 microns in size. An effective method for reducing these emissions is exhaust after-treatment. A device called a particulate trap is fitted to the vehicle exhaust system, which effectively prevents the PMs being discharged into the atmosphere. It is not a straightforward matter to fit this equipment to existing vehicles because of the effects it may have on engine performance and the space required to accommodate the equipment.

**EMISSION CONTROL**

The internal combustion engine also produces other emissions that are a cause for concern. The main culprits and their effects are:

| Emission | Main effects |
|---|---|
| Carbon monoxide | Toxic |
| Carbon dioxide | Implicated in global warming |
| Oxides of nitrogen | Photochemical smog and ozone formation |
| Volatile organic compounds | Photochemical smog |
| Sulphur dioxide | Acid rain |
| Particulate matter | Respiratory problems |

It is little wonder, in view of the above, that attention has turned to finding an alternative fuel to power road vehicles. Before discussing alternative fuels, it is worth explaining that the quality of road fuels and engines has been dramatically improved in the last 20 years. In the main, this has been achieved by:

- reducing the sulphur content in diesel fuel;
- fitting catalytic converters to all new cars sold in the UK after 1 January 1993;
- high-pressure fuel injection systems;
- the use of computerized engine management systems.

Unfortunately, much of this good work has been nullified by the increase in road congestion and the number of private cars on the roads.

There are many alternative fuels being developed currently. This section will briefly outline some of the fuels and highlight any particular points of interest.

**Compressed natural gas (CNG)**

Natural gas is mainly methane and is to be found in most homes in Nigeria, where it is used for domestic purposes. Natural gas is used in a combustion engine in the same way as petrol, that is to say it requires a spark to ignite it rather than compression.

One obvious problem with this fuel is the lack of refueling infrastructure; therefore vehicles will either have to return to their base at the end of their journey or at least go to another point where they may be refueled. This is all the more frustrating when one understands that this gas is already widely distributed via the existing domestic gas infrastructure. Should the vehicle run out of fuel then it will have to be towed back to base, as currently there is no alternative.

CNG-powered trucks require roughly five times the volume of fuel storage that a diesel-powered truck requires. The weight of fuel tanks will obviously be increased and detract from the payload capacity of the vehicle. The actual process of refueling can be achieved in two ways-either fast-fill or slow-fill. The fast-fill method requires a compressor to compress the gas after taking it from the main supply network. The compressed gas is then stored in tanks ready for vehicles to draw the fuel. Using this method, vehicles may achieve a refueling time comparable with fuels such as diesel. The slow-fill method uses a smaller compressor and no intermediate storage tanks. This option is a low-cost alternative to fast-fill provided there is a gas supply to the vehicle's base. Its major drawback is that the vehicle will have to be coupled to the refueling system overnight.

From a financial point of view, CNG engines will cost more than standard diesel engines.

From an emissions point of view, natural gas performs very well and is increasingly seen as a viable alternative for commercial vehicles working in urban areas. This is mainly due to the range and refueling limitations of the fuel but also because of its beneficial exhaust emission performance.

**Liquefied natural gas (LNG)**

This is the same fuel as CNG, the only difference being in the way it is stored and supplied. LNG is stored at a temperature of —162 degrees Celsius but in many other respects behaves like diesel fuel. Refuelling times are very similar, although the person refuelling will have to use protective equipment for safety reasons.

The use of both CNG and LNG has been steadily growing in recent years as operators of commercial vehicles, especially in urban areas, have become convinced of their advantages.

**Bi-fuel or dual-fuel options**

Bi-fuel systems are designed so that the vehicle is running exclusively on either one fuel or the other at any one time. Dual-fuel options are designed so that the vehicle can operate on a mixture of fuels at the same time or revert to operating on only one fuel if necessary.

These types of hybrid vehicles have been developed to overcome operating range or operational difficulties. Usually the vehicle will have a choice of fuel. This could be CNG and diesel or petrol and electric power. The problem with these vehicles is that they not only are more complex in design but also do not necessarily deliver the full benefits of one option or the other.

**Liquefied petroleum gas (LPG)**

This is a mix of propane and butane gas. It is a by-product of the petroleum and natural gas production process. It requires a spark ignition engine and is popular as an alternative to petrol. It benefits from an existing refuelling infrastructure, especially in continental Europe.

**Bio-diesel**

This is a fuel that is refined from various vegetable-based oils such as rapeseed oil. It performs much like diesel fuel and is currently used in a limited way.

**Electric power**

Vehicles powered by electricity have existed for many years. The use of electricity has been confined to smaller vehicles because of the weight and volume of batteries required. Recent developments in battery and fuel cell technology have made electric power for light transport a viable alternative. These vehicles benefit from low emissions and are very quiet.

Fuel cell technology is likely to provide the motive power for light transport in the future. This technology exploits the electricity produced by hydrogen and oxygen atoms when they combine together to form water. Fuel cells require a hydrogen-rich fuel such as methane. The resultant electricity drives an electric motor, which in turn provides the motive power. Fuel cells produce low emissions.

**Dimethyl ether (DME)**

DME is a synthetic fuel that can be substituted for diesel or LPG or as a hydrogen-rich source for fuel cells. It may be made from coal, natural gas, black liquor (a by-product of paper pulp manufacturing) or biomass. DME is a gas that becomes a liquid under low pressure similar to LPG. It is suitable for use in compression ignition engines due to its high cetane factor, which is equal to or greater than conventional diesel. Compared to diesel fuel, DME produces 90 per cent less NOx emissions. It is of particular interest to countries such as Sweden, Japan and China. In fact, at the time of writing the Swedish company Volvo Truck Corporation is testing ten trucks fitted with diesel engines adapted for DME use. In China, the Shanghai city authorities are testing buses fuelled by DME.

## CHAPTER THIRTEEN

## MEASURING AND CONTROLLING PERFORMANCE

### PERFORMANCE MEASURES

Managers of LSCM support services (e.g., LSCM planning, engineering, systems design) are generally evaluated on the basis of budget performance and (sometimes vaguely defined) service criteria. These managers and their staff are viewed as resource to be used in supporting the functional managers and, as such, their service levels and productivity are not easily quantified. Typically, they are heavily involved in project type work, so that much of their evaluation occurs at project review or completion points. Evaluation of project managers is based on three considerations:

(a) Performance relative to time constraints
(b) Budget performance relative to currency limitations
(c) Actual benefits derived relative to goals, such as:
    (i) Monetary savings or profit improvement
    (ii) Service level improvements
    (iii) Productivity improvements

Every organization must manage LSCM projects but most find this a particularly difficult area, in which to perform well. Some of the problems that cause difficulties include following:

(a) Failure to start by establishing a 'base case' against which to evaluate alternatives.
(b) Failure to prepare realistic time and expense budgets, for the project.
(c) Failure to adequately specify project objectivities and scope including how to measure attainment of the objectives.
(d) Failure to cancel or redirect projects when it becomes obvious that further work on the original plan will not be cost effective.
(e) Failure to require and conduct post-project audits.

**Final Comments on Measures**

Ultimately, the true measure of LSCM management and of the LSCM process itself is the level of long-term customer satisfaction achieved for the total LSCM costs incurred. Most companies have yet to develop such a measure because:

(a) They have not yet defined long-term customer satisfaction and, thus, cannot measure it.
(b) They do not accurately and completely identify total LSCM costs because traditional accounting methods do not support activity and process costing requirements.
(c) Quotes by LSPs differ on consignment to consignment basis, based on requirements of special handling, positive security, Rustication, Push Money for a positive country etc.

**Programmes to Improve Quality and Productivity in LSCM**

While customer service improvement programmes tend to deal with external actions to improve interactions with customers, the LSCM is also concerned with internal improvement programmes to enhance the effectiveness and productivity of the total process.

Programmes that some companies are using to improve the quality and productivity of the overall LSCM process are briefly described in the following paragraphs:

(a) Formal Quality and Productivity Improvement Process: Developing and carrying out a formal process for improving quality and productivity throughout LSCM is the central theme.

(b) Integrated Operations Management: This approach was discussed at length earlier. In summary, it calls for integration of the major operational functions of the business, at the strategic, tactical, and transaction processing levels. It also includes formal coordination with customers suppliers and LSPs at these three levels.

(c) MBO Programme: Another useful technique is that of MBO (Management by Objectives) and goal setting. MBO type programmes are useful for two reasons:

  (i) They give LSCM management a target to aim for, with respect to the individual department's LSPs operations.

  (ii) Managers generally have a hand in establishing the goals which forces them to plan their operation more carefully in order to ensure attainment.It is important that the MBO goals tie hack to overall corporate goals and objectives. Thus, they should be developed as a part of an overall 'policy deployment' approach. Detailing of objectives will vary depending upon the level within the organization.

(d) MBX Programme: Once an operation is running relatively smoothly, a Management By Exception (MBX) programme is often implemented. MBX reports exceptional performance to management identifying only those areas that require attention. MBX suffers from the same problems as MBO, requiring that accurate cost and performance data be available and reported in a timely, understandable manner in order for programme to be effective.

(e) Use of Analytical Tools: Many companies in the developed nations, make use of computer based models to answer 'what if' questions regarding possible LSCM network alternatives, inventory level/service level tradeoffs, etc. Using such tools can provide a wealth of new, useful LSCM service and cost information.

(f) A major opportunity that is often over looked is to use such tools as 'checks' on actual decisions and results. For example, these tools can be used to look for a better approach or to help develop new logic for

decision making in areas such order consolidation, production scheduling, forecasting, and vehicle routing. When linked with expert system technology, such analytical capability can help improve the quality and consistency of decisions.

**MEASUREMENT OF PERFORMANCE OF HIGHER EXECUTIVES**

Strategic planning for LSCM process/functions, engineering, LSCM system design are performed by executive of LSCM support services. LSPs performance appraisal or evaluation is generally done through budget performance and service criteria. The LSCM executive often has responsibility for a sizeable array of assets — transportation equipment, facilities, computers, inventories, material handling equipments and personnel. Effective management of these LSCM assets comes in the form of eventual disposal or decission; about replacing the assets; about expanding their use, and about their return to the firm in the form of increased revenue, decreased cost or both. Evaluation of project managers including managers of LSPs is based on three considerations:

(a) Performance relative to time constraints
(b) Budget performance relative to currency limitations
(c) Actual benefits derived relative to goals such as:
    (i) Money savings or profit improvement
    (ii) Services level improvements
    (iii) Productivity improvements

1. Possible Areas of Failures.

(a) Failure to start by establishing a 'base case' against which to evaluate alternatives.
(b) Failure to prepare realistic time and expense budgets, for the project.
(c) Failure to adequately specify project objectives and scope including how to measure attainment of the objectives.
(d) Failure to cancel or redirect projects when it becomes obvious that further work on the original plan will not be cost effective.
(e) Failure to require and conduct post-project audits.

**PROGRAMMES TO IMPROVE QUALITY IN THE LSCM AT THE HIGHER EXECUTIVE LEVEL**

1. Capital Expenditure Management: Similarly, the development and use of a formal capital equipment justification system has helped ensure that funds are invested in projects that yield the highest return.
2. .Employees Motivation Approaches: In order for an operation to be effective, employees and management must be motivated to excel. Also, as a part of formal quality process, firms are currently developing their managers into improved employee motivators by conducting training

programmes to improve this aspect of their managerial skills. This type of programmes, coupled with a feeling of identity and importance on the part of the employees, is a key to effectively motivate the work force.

3. Dedicated Fleet Analysis (Transportation): In conjunction with the Divisions, analyze potential use of a dedicated fleet within the corporation for selected primary and secondary traffic lanes to improve service reliability or a dedicated transport service provided.
4. Computerized Freight Consolidation Programme: Develop a system for automating the current manual Freight Consolidation Programme. With the assistance of corporate MIS organize data that are transmitted to shipping points sorted by destination location.
5. Hazardous Material Regulations Compliance Programme: In conjunction with the Divisions, develop a formal procedure to monitor and implement changes in requirements for transportation and materials handling based on new governmental regulations. This will be carried out through the efforts of a Hazardous material Regulations Task Force.
6. Recognition Awards Programme: Develop and institute a formal awards programme that will acknowledge the service improvement and reduction efforts at the Distribution Centre.
7. Improve Warehouse Methods and Systems: Evaluate various methods and systems changes for implementation at the Corporate Distribution Centre to improve productivity.
8. New CDC Facilities Studies: Determine feasibility of establishing new Corporation Distribution Centres.
9. Unitization: Coordinate between CDCs and Divisions utilized for handling, uniform pallet pattern and packaging design programmes in an effort to reduce distribution costs. Budapest University of Technology, Department of Transport Economics, has of late done a very advanced study. The researchers have identified specific areas of measurement. The study suggests that because of the sophisticated characteristics of LSCM, it is difficult to survey the needs of the customers and to create a comprehensive quality requirement system. On the joint points of LSCM chain, there is always a seller- buyer relation. The buyer has his quality requirements to be satisfied by the seller.

   Quality measuring indicators will be suggested in the following three areas:

- Logistics facilities
- Logistics process, sub-process
- Human factors, management, organization.

If we speak of quality of LSCM beyond the above three areas, we have to involve the performance and productivity indicators, and the expenses. The facilities include:

A. delivery facilities
- warehouse facilities
- packing facilities
- Material handling facilities

B. Transport ways

**Quality indicators of LSCM facilities**

- Suitability to jobs
- Maintenance background
- Man-facilities relations (ergonomic and environment protection)
- Good-facilities relations (specialties of goods, unit loads, packaging, etc.)
- Ways-vehicles relations
- Performance-price relations
- Relation of expected life and price of facilities
- Specific energy-lubricant costs
- Specific performance costs
- Reliability
- Soundness
- Longevity (average restoring time, total break-down time)
- Storability, transportability

**Quality indicators of transport ways**

**Roadworthiness**

- Length, capacity, network, wayleading (curves, slopes)
- Easy to survey, illumination, surface, speed, sensibility to weather, comfort
- Signs, information
- Safety, help (telephone, helicopter etc.)

**Quality indicators of LSCM processes**

**Requirements**

- Optimum combination of jobs (tasks) and facilities
- Optimum packaging and load unit
- Optimum logistics chain
- Optimum route and time
- Minimum transfer of goods
- Minimum warehousing and event time
- Organizing and managing warehousing activities in environment-friendly ways (minimum noise, outside of housing estates, by-passes etc.)

Indicators

- Capacity supply/capacity demand
- Appear time/ordered time
- Damage events/total activities (packaging also)
- Missing volume/total volume (packaging also)
- Error delivery/total delivery commitments

- Physical performance/time, processing time
- Performed commitments/demand commitments
- Number of customers/year

**Quality of service**

The structure of an organization and human behavior (way of thinking, decision etc.) are very important factors. A customer needs beyond physical performance also service, such as, facility to reach company, how to get the phone number and address, after how many minutes will they pick up the receiver, is the proper person on the line to give the infonnation (price, time) and to make decision. How much time does a commitment need? It is important to advise to the customer even if the company is not able to take the job.

**Quality indicators**

- Politeness
- Quick information
- Exactness

**Costs of LSCM**

Along the LSCM chain there are seller-buyer relations in every joint point. The seller adds some profit to his costs and offers his service at a price to the buyer. For the buyer previous price means costs again. This relation is repeated in the whole LSCM process till the final buyer (customer).

There are three groups of quality costs:

- Failure costs
- Control and assessment costs
- Prevention costs

High quality of performance does not necessarily mean higher costs. The costs of wastes can be re-arranged, reduced and eliminated by quality control and prevention

How to save LSCM expenses at macroeconomic level:

- Reducing the number of LSCM activities
- Optimum selection of LSCM technologies, facilities (packaging, load unit, multi-modal transport, preferring rail - waterways etc.)
- Restructuring industrial allocations
- Contemporary, comprehensive organization (LSCM centres, just-in-time etc.)

With the specialization and globalization of production and with ensuring a wide range of choice of consumer goods, the role of LSCM is getting more and more emphasized. The rationalization of LSCM process is essential.

## BENCHMARKING

### Introduction

Benchmarking is the process of continuously measuring and comparing one's business performance against comparable processes in leading organizations to obtain information that will help the organization identify and implement improvements (Benson, 1998).

The continuous process of measuring our products, services and business practices against the toughest competitors and those companies recognized as industry leaders (Xerox definition of bench marking)Benchmarking can be crucial for a company because it enables useful and relevant performance measures to be developed based on good practice that has been achieved by best-in-class external companies. Although the process is quite straightforward to explain it can be extraordinarily difficult to conduct successfully in practice.

In this chapter the reasons for benchmarking are summarized. A general framework for conducting a benchmarking project is described and then a specific approach to distribution benchmarking is outlined. This includes a detailed discussion of some of the key practical issues that may arise when conducting such a project.As with many approaches to improving performance, benchmarking has its enthusiasts and its detractors. There is no doubt that, conducted sensibly, a benchmarking project can be of benefit to an organization, not least because it forces the participants to look closely at their own organization's processes and question them.

It is worth sounding a note of caution at this stage. Benchmarking partners need to be chosen carefully because no two organizations are exactly alike. This may sound obvious, but it is remarkable just how different organizations can be even when they are engaged in the same business, never mind a completely different industry. This tends to lead to the participants having to examine generic areas of operations, which can dilute the power of the exercise.

Another point to note is that benchmarking partners may, for their own reasons, not be strictly open and honest with others involved in the exercise. For example, competitors would fit into this category. All information derived from the process should be carefully weighed and considered in the light of corroborative evidence. Acting on incorrect information could send an organization off on a path that is not fruitful. It is worth pointing out that some detractors suggest that benchmarking only serves to make the organization aspire to be average rather than to lead the field due to the fact that some benchmarking information may be gleaned from a spread of companies. This results in the available figures containing a spread from the very best to the worst performers who have submitted data. Therefore the performance figure provided as a benchmark is an average of the best and worst performers. The stated aim of benchmarking is to aspire to match the best not the average. This maybe true in certain areas of the business, but it is also the case that

organizations can learn from one another, and benchmarking is one way of facilitating this learning process.

Benchmarking by definition forces an organization to change its focus from the internal to the external environment by attempting to compare its performance with that of the best-in-class companies.

**Why should an organization engage in benchmarking?**

The simple answer is to remain competitive. The process of institutionalizing benchmarking leads to the organization having a better understanding of its competitive environment and its customers' needs. Table 30.1 neatly sums up the main reasons for benchmarking.

**Reasons for benchmarking**

| **Objectives** | **Without Benchmarking** | **With Benchmarking** |
|---|---|---|
| Becoming competitive | Internally focused | Understanding of competition |
| | Evolutionary change | Ideas from proven practices |
| Industry best practices | Few solutions | Many options |
| | Frantic catch-up activity | Superior performance |
| Defining customer requirements | Based on history or gut feeling | Market reality |
| | Perception | Objective evaluation |
| Establishing effective goals and objectives | Lacking external focus | Credible, unarguable |
| | Reactive | Proactive |
| Developing true measures of productivity | Pursuing pet projects | Solving real problems |
| | Strengths and weaknesses not understood | Understanding outputs |
| | Route of least resistance | Based on industry best practices |

**How to conduct a benchmarking exercise**

This section will describe a general framework for conducting a benchmarking project. Given the diversity of organizations and processes, it will not be possible to go into great detail. The Japanese are credited with starting the benchmarking approach to continuous improvement. At a very simple level, employees are seconded to other companies in order that they may learn new ways of working..

The following examples illustrate benchmarking approaches developed by two companies

The approach to benchmarking is as follows:

Planning

1.dentify what is to be benchmarked.
2. Identify comparative companies.
3. Determine the data collection method and collect data.

Analysis

4. Determine current performance 'gap'.
5. Project future performance levels.

Integration

6. Communicate benchmark findings and gain acceptance.
7. Establish functional goals.

Action

8. Develop action plans.
9. Implement specific actions and monitor progress.
10. Recalculate benchmarks.

Maturity

11. Leadership position attained.
12. Practices fully integrated into processes.

The other approach to benchmarking is as follows:

1. Decide what to benchmark — what is important to the customer, mission statement, business needs, etc.
2. Plan the benchmarking project (choose a team leader and team members, submit the project proposal).
3. Understand own performance (self-study in order to examine factors that influence performance positively or negatively).
4. Study others (identify candidates for benchmarking, short-list, prepare questions of interest, conduct the study).
5. Learn from the data (identify performance gaps and which practices should be adopted).
6. Use the findings (for the benefit of the organization and its employees).

The following is a step-by-step guide to conducting a benchmarking exercise. Naturally, each organization will have its own special needs and circumstances that will dictate how it will conduct its own projects; therefore this is only an example of how the exercise may be undertaken.

**Step I Senior management commitment**

As with any major project, senior management commitment to the exercise must be secured at the outset. This is necessary not only to ensure that resources are made available for the project but also because any potential improvements identified by the benchmarking team will need senior management support to

progress them satisfactorily. Ideally a senior management champion should be chosen who can take ownership of the project. This will ensure that any useful outcomes are presented at the highest level in the organization. If senior management commitment is not secured then progress to a satisfactory conclusion is unlikely. Middle managers may feel threatened by change and quietly bury the results.

**Step 2 — Set objectives**

Objectives need to be set for the project. It is a mistake to attempt to do too much immediately. These types of project can generate huge amounts of data. The trick is to be able to identify the useful information buried in all the data. It is much easier to identify a specific process or activity and concentrate on this one area before moving to the next one. Therefore a list should be prepared of specific processes and performance criteria that the company wishes to benchmark first.

**Step 3 — Choose benchmarking partners**

The next stage involves deciding whom to benchmark against. There are several options.

**Internal colleagues**

This is the easiest form of benchmarking to conduct, as the information should be readily available and accurate. Different divisions in the same organization may be compared easily. The problem with this approach is that if performance is generally poor in the company then any benchmarking project will not improve competitive performance.

**Industry benchmarking**

Benchmarking against competitors can be fraught with problems. Firstly, it seems unlikely that a competitor would wish to engage in an exercise that might lead to a loss of competitive advantage, but some organizations are very open with their information so it is not impossible. Secondly, information provided by a direct competitor without corroborative evidence should be treated with scepticism. Finally, trade associations do produce industry statistics, but these are likely to be non-specific and based on averages. This information will be of little use if the benchmarking organization is already exceeding these standards. The statistics may provide some comfort through the knowledge that the company is not below average, but it will not be helpful if offshore competitors are exceeding these standards significantly. The desire of many companies is to be the best in class or world-class for their industry.

**Non-competitive benchmarking**

This type of benchmarking involves benchmarking against other companies in different industries. This has the advantage of excluding market competition from the process of comparison. By the same token, it does make it more difficult to identify specific areas of comparison between non-competitive benchmarking partners. For example, a retailer is unlikely to have areas of operations that are similar to a manufacturing company. However, what they will have in common is

processes such as purchasing or supplier appraisal. It is through examining in detail the processes used by the different partners that areas of improvement will be identified.

Many companies see the advantages of continuing benchmarking activities on a regular basis and so they have set up benchmarking clubs as a forum to continue the activity.

**Other benchmarking activities**

Obtaining competitors' products or services and dismantling them (reverse engineering) is one way of comparing the organization with its direct competitors. Published accounts, trade conferences, articles in the trade press and employees recruited from competitors are all sources of useful information about competitors. It must not be forgotten that the organization's customers are a good source of competitive information. Through asking the customer questions about the organization's performance it is possible to glean information about competitors' performance in key areas also. This should help to forge stronger links with major customers.

**Step 4 — Choose a mixed-discipline team**

Having decided on objectives and benchmarking partners, it is necessary to identify what disciplines are required in the team. Clearly, one member of the team should be intimately acquainted with the process to be benchmarked. Other useful disciplines might include an accountant for financial information or an information systems expert, if that is appropriate. Apart from relevant related disciplines, it may be worth including one member of the team who is simply there because he or she knows the business and where it is going but is not aligned to the process under review. This approach can often prompt the naive question: 'So why do we do it this way?' It is a well-used idiom, which says that sometimes individuals are so intimately involved in a process that they find it hard to question fundamental principles. Managers being unable to 'see the wood for the trees' is as common as it ever was.

Next it is essential that any available information is identified and located. Information is unlikely to be forthcoming from the benchmarking partner in a format that matches the company format. Time will have to be spent configuring and sifting the information from both sides to allow meaningful comparisons to take place. Mapping out the steps in a process by producing a process flow diagram is also very useful by way of preparation. Information may flow between the partners even at this stage by means of questionnaires, company literature or informal meetings.

In some cases, confidentiality agreements are exchanged between the participating companies. If required, these need to be in place at an early stage and are useful if a long-term relationship is envisaged.

**Step 5 — Getting acquainted with your partner**

It is highly likely that a number of visits and meetings will be required as requests for information from both sides are processed after each round of meetings.

Early meetings are likely to include tours of facilities. This helps set the scene for the visiting team. Establishing agreed terms of reference at this stage will also be useful.

If the planning and preparation have been carried out thoroughly then the process will move swiftly to exchanging information. The process will be iterative as partners return to their companies to digest the information they have received. As the analysis progresses, many questions will emerge on both sides that will require answers. These must be logged for future meetings. Eventually, useful information will begin to be extracted.

**Step 6 — Analysis**

Obviously not all the information gleaned from an exercise will be useful, but it would be unusual if absolutely nothing of benefit emerged.

If conducted with appropriate energy then the very minimum to be gained will be a better understanding of how the company functions in a given area. Some may throw their hands up in horror and say that a company should already know what is going on inside itself without going through such an elaborate process. The truth is that many companies do not really know what is going on inside their organization. Where there are written operating procedures, senior management (understandably) tend to assume that this is how things get done. At the point where the operating procedures are supposed to apply, things may be very different. In the course of collecting information and possibly mapping the process in preparation for a benchmarking exercise, these anomalies should be exposed. When and if this situation arises then an open-minded approach will be useful. It may well be that the way the job is really done, as compared to the way the procedure says it should be done, might be the most effective way of working.

When better ways of working or tighter targets are identified through benchmarking as achievable then systematic plans should be made to implement the necessary changes. Assuming that senior management support for the process is in place then resources and responsibilities need to be allocated. Once this has been decided, the staff involved in the planned change need to be involved fully. They should already be involved to some extent, as they will probably have participated in the preparation stage of the project.

As with any change in the management situation, there will be a measure of concern amongst the staff involved, because change usually augurs (for them) a step into the unknown. If these fears are recognized and dealt with sympathetically by management then communication and involvement will generate commitment to the process of change.

The success of any improvements instigated as the result of benchmarking should show up in the relevant performance measures for that functional area. It could be

in the business ratios such as return on capital employed or in something as straightforward as reduced picking errors in the warehouse..

**Formal benchmarking systems**

The following are some of the formal benchmarking systems that have been developed over the years:

- Quality function deployment (QFD). This benchmarking approach has been developed by Japanese managers. It takes the customer's requirements as the starting point and aims to improve performance by converting customers' perceptions of suppliers' performance into an improvement agenda.
- ISO 9004. As part of the ISO 9000 series of quality management frameworks, ISO 9004 provides a framework of constant comparison for any type of business.

**Benchmarking distribution operations**

This section outlines the major features of a benchmarking or auditing exercise for a group of companies involved in grocery distribution. The aim is to describe an approach to distribution benchmarking. In addition, some of the potential problems and pitfalls are identified, and some key issues are highlighted. The major emphasis is on distribution centre operations, but a similar approach can also be used for benchmarking transport operations.

The key elements described are:

- the main principles behind studies such as these;
- a typical format and approach;
- data collection and analysis;
- interpreting the results.

For this type of benchmarking, there is a recognized benchmarking hierarchy that can be summarized at four different levels:

1. Single task benchmarking — covering single distribution activities such as goods inwards, order assembly, etc.
2. Function-wide benchmarking — where all the tasks in a distribution function are reviewed with an aim to improving overall performance. For example, this might include all the processes from goods receipt to vehicle loading in a given distribution centre.
3. Management process benchmarking — covering broader cross-functional issues such as quality, information systems, payment systems, etc.
4. Total operation (logistics) benchmarking — where the complete logistics chain is reassessed, from procurement and supply through to end-user delivery.

The approach described here is for the quite specific function-wide benchmarking that applies to a distribution centre. The example used is based on an inter-firm comparison in the grocery industry. The major factor is that it is a single industry

study. This helps to ensure that any comparisons between the different operations are drawn on a reasonably similar base.

The study broadly consists of a series of snapshot evaluations of the actual cost and performance derived for the different distribution centres. This is undertaken through detailed data collection and analysis of the key functions within the sites. Data are broken down according to various activities (goods receipt, reserve storage, etc) and various product groups (chilled, ambient, wines and spirits, etc). Other categorizations may be relevant in different circumstances — for manufacturers, customer classification may be important (national account, wholesale, independent, etc). Comparisons are made across different distribution centres and! or companies according to a series of 'league tables' drawn up for all the key statistics. The cost and performance of an individual site can then be assessed according to the position in the league table.

Such an audit procedure is likely to be a two-stage process: 1) an initial function-wide study to identify the key cost and performance drivers; and 2) subsequent smaller and more directed studies to monitor the key drivers and identify any activity shifts and new drivers that might evolve. These might suggest a revision of certain operations or activities.

**Format and approach**

There are two main areas for data collection and analysis. The first includes all the major functional distribution centre activities, costs and performance factors. These are likely to be fairly standard (cases picked per hour, etc). The second includes those other elements that may be essential to help explain the cost and performance indices derived. Why is site X performing so badly in its order picking operation? Why does site Y have such a high-cost goods reception facility? These are often classified as a part of the logistics 'environment' in which the distribution function operates. Typical examples of the essential elements within the logistics environment are:

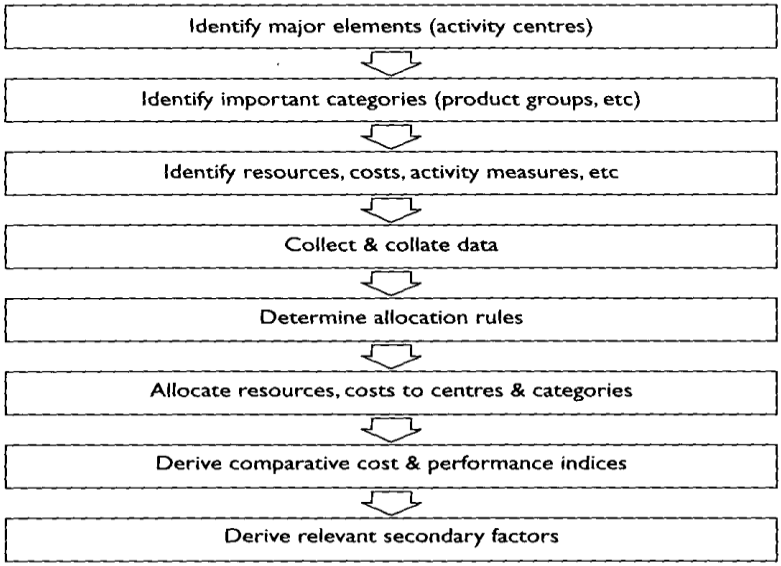
- source of goods coming into the depot;
- product characteristics;
- sales characteristics;
- customer profile;
- inventory profile;
- returns, etc.

One additionally important element is the information system that supports the physical distribution operation. A clear understanding and measurement of this may help explain some of the audit results. Thus, information flows, hard-copy versus paperless operations, software and associated systems, electronic point of sale (EPOS) and other external systems may all need to be included within the audit structure.

Finally, distribution centre performance will be very dependent on the impact of service levels. The importance of these may vary from company to company, but they may include:

- levels required (and achieved!);
- lead time;
- stock availability;
- minimum delivery/order size policy;
- order and delivery frequency;
- quality checks;
- full loads delivered on time.

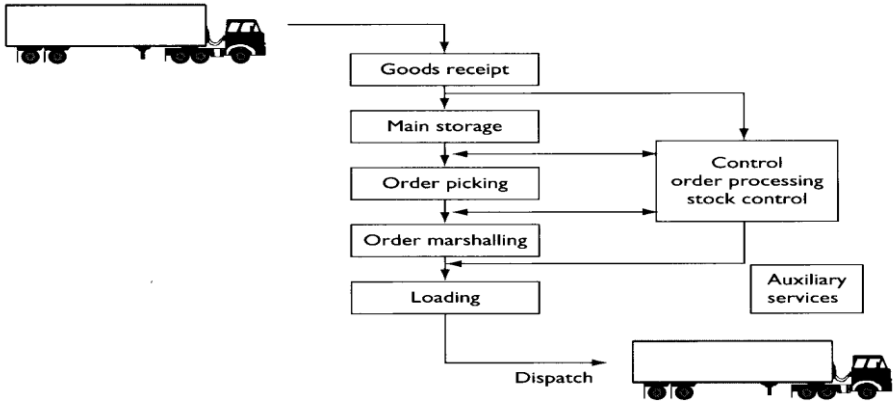
The general approach to the distribution audit is outlined in the Figure below. It follows a logical sequence of data collection, collation, analysis and interpretation.




**The Figure Showing The General approach**

The steps are:

1. Identify major elements. These are the major activity centres that best represent the flow of product through a distribution centre.




**Typical activity centres**

2. Identify important categorizations. These should consist of any major categories that are fundamental to the operations under review. Careful selection will enable some useful comparisons to be made of key elements within the business. For grocery distribution, this typically means different product categorizations — chilled, ambient, fresh, etc.
3. Identify resources, costs and activity measures. All resources and their associated costs need to be included. A classic breakdown covers buildings, building services, equipment and labour. In addition, some key activity measures need to be made. These are likely to include throughput in an appropriate unit of measurement. Examples may include: receipts in outers; storage in pallets; picking in line items; the number of orders; the number of picking lists; the number of lines per picking list; etc.
4. Collect and collate data. This is ideally undertaken using a spreadsheet format. This shows the main activities across the top of the spreadsheet and the main cost elements along the side of the spreadsheet.
5. Determine allocation rules. This is an important aspect of the process. A typical example might be how to allocate main storage costs across a number of different product groups where products are randomly located. Most rules will follow a logical, common-sense approach — in this example, allocate main storage on the basis of the number of pallets stored per different product group.

6. Allocate resources and their costs to centres and categories. Use the allocation rules. Ensure that all the inputs (resources, costs, throughputs, etc) are double-checked for accuracy.
7. Derive comparative cost and performance indices. Many of these will be common to most distribution centre operations (cases picked per hour, etc); others may be particular to one type of operation (units returned and reprocessed in a mail order depot, etc).
8. Derive relevant secondary factors. These are the elements of the logistics 'environment' that might help to explain the main results.

The key points to the approach can be summarized as:

- A formalized approach such as this should be used to ensure that all the appropriate costs are included in the analysis.
- There is a need for relevant support information. This concerns the 'logistics environment', and the information is essential to help explain the results.
- It is important to select the appropriate functional elements. These are the activity centres, and they should represent relevant elements of the distribution operation.
- Valid activity measures should be used to ensure that the costs are allocated correctly.
- The matrix structure provides a very suitable format for data analysis.

Company-level ('top-down') costs should be collected as well as detailed operational ('bottom-up') costs. This allows for consistency checks to be made using costs derived from different sources.

**Data collection and analysis**

The collection of accurate and useful data is by far the most problematic aspect of a distribution audit. It is also, of course, essential to a successful auditing or benchmarking exercise.

Some of the major problems and potential pitfalls are:

- Data availability. It will always be necessary to compromise. The data required will never be available in their entirety. This is especially so where several companies are involved.
- Sampling. It is likely that some sampling will be required. Care must be taken to ensure that sample sizes are sufficient and that samples are adequately representative.
- Data consistency. Again, especially where cross-company analysis is to be undertaken, care must be taken that allocation rules and procedures are common. Most companies have different accounting practices, so there is ample opportunity for error due to inconsistent classification. It is likely

that a uniform or generalized allocation procedure will need to be designed and used.

- Appropriate categories and groups. Any categorization needs to be relevant for all participating companies. An example might be where different companies have different product groups.
- Time periods. Clearly, these need to be common for all distribution centres. Any sales cycles, seasonality, etc need to be taken into account. Data availability is likely to be a prime driver. Beware of the problem of 12 calendar months as compared to the 13 four-week periods used by some organizations.
- Units of measure. These may differ from one company to another, and will be especially important when drawing comparisons across industry sectors.

**Interpreting results**

The grocery distribution audits produced a series of results that could be interpreted in a general context, as well as some that were specific to a particular distribution centre as it was compared to the others in the study. In general terms, there were two key drivers identified as being crucial to the understanding of each site's efficiency in the context of grocery distribution. These are consistent with earlier studies.

Firstly, the results indicated that building costs could vary considerably from one location to another. The extent of this variation, and the impact of these costs, meant that some distribution centres that appeared to be operationally expensive were not in fact so, because the major cost element was a very high building cost. Thus, it was clear that building costs needed to be treated carefully when assessing operating efficiencies. It was possible, however, to identify economies of scale to the benefit of the larger distribution centres. Also, a clear lesson to be learned was the need to maximize space utilization within each centre. In particular, this applied to the full use of height in a building.

Secondly, the highest-cost operational area in all the sites was that of order picking. Clearly, good picking performance was one of the keys to a cost-effective operation. There were obvious benefits to accrue through reviewing layout and reducing travelling time, and through reviewing the information processing time spent by order pickers.

It is possible to produce a myriad of detailed results from a study of this nature. These can be represented in chart or histogram format. For ease of comparison, 'league tables' that rank the performance of different sites may be produced. Some useful results from this study showed:

- the overall warehouse unit cost analysis broken down by main costs;
- the relative weekly throughputs for the different sites involved — these can help to explain some of the differences in cost and performance results;

- the breakdown of direct labour costs for the different sites;
- the range of picking performance for the different sites in cases picked per person- hour. Different handling and information systems as well as lines per order and picks per line will influence these results.

A number of general issues are relevant to the interpretation of results from such a study. These can be summarized as:

- It is useful to draw up a number of 'league tables' to compare individual site performances.
- Even in a single industry study, major differences can be apparent. It is necessary to take special care in a cross-sector study when comparing operations that are very dissimilar.
- It is a good idea to group common operations and concentrate comparisons on these.
- It is possible to identify key drivers from this type of study.
- It can be useful to compare the cost and performance implications for different product groups, etc.
- High-cost and low-performance areas can be readily identified, allowing significant improvements to be made.
- It is very important to identify and select suitable measures that help to explain any major differences in the results (the logistics environment). Typical variables that might influence operations are:
  - volume forecast accuracy;
  - throughput variability (by day);
  - product profile;
  - retail store profile;
  - retail store returns;
  - special projects (promotions, alternative unitization);
  - equipment specification;
  - distribution centre design (building shape, mezzanines);
  - employee bonus schemes;
  - warehouse methods used (secondary sorts, etc);
  - local labour market (quality, need for training, etc);
  - regional cost variations;
  - staff agreements (guaranteed hours, etc);
  - unit definitions.

It is useful to differentiate between controllable and non-controllable elements and costs. An expensive building may lead to a relatively high-cost operation overall. The actual operation itself (that is without consideration of the cost of the building) may be very cost-effective. There is little a manager can do to affect the cost of a building.

Regional differences may impact on results, especially considering relative labour costs. Scale effects may be relevant — that is, economies that result from large-scale operations.