CONTENTS

SYLLABUS

M-244

PAPER – IV Materials Management

Unit – I: Material Management: An Overview

Materials Flow Systems, Strategic Role of Materials Management, Linkage with other Functional Areas of Management.

Unit – II: Sourcing of Materials

Issues and Overview, Domestic vs International Purchase, Vender Network, Buyer-Sellers Relationship.

Unit – III: Materials Planning and Control

Materials Planning and Budgeting, Pull vs Push System

Unit – IV:Inventroy Policies and Systems

Inventory Systems and Modeling, Process Inventory, Spare Parts Management, Stores Accounting.

Unit– V:Warehousing

Codification and Standardization of the Materials, Location and Structure of Warehouse, Incoming Material Receipts, Retrieval and Transaction Processing System, Security and Loss Prevention.

Unit– VI: Organising and Appraisal of Materials Management

Materials Management and its Organisation, Materials Information System, Control of Material Management and Performance Appraisal.

NOTES

UNIT 1 MATERIAL MANAGEMENT: AN OVERVIEW

★ STRUCTURE ★

1.0 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- define materials management
- know about functions of materials management
- understand materials flow process
- explain objectives and advantages of materials management.

NOTES

1.1 INTRODUCTION : MATERIALS FLOW SYSTEMS

Putting in the simplest terms materials management is about moving the materials within an organization. What do "materials" mean? Materials can basically be defined as those objects or things that are to be moved in order to produce goods. Material is one of the 5M's that a manager has at his command, the other being Men, Machine, Methods and Money. Materials could be in the form of raw materials, paperwork, messages or information etc. So materials can be both tangible and intangible. You see the newspaper boy delivering the newspaper to your doorstep everyday or the milkman delivering the milk packets to you. These are tangible materials. There is also some material moved when you watch a movie on your television or when you receive a phone call. These are the intangible materials that are moved. So materials management is an important function of every business. The better is the materials management in a company the better is the health of that company.

1.2 MATERIALS MANAGEMENT AND ITS FUNCTIONS

Materials can be put in three categories. First category is purchased materials like the raw materials, components, spare parts and items that are used and do not appear in the end product. The second category is of in-process materials or the materials in the semi-finished stages and lastly the finished goods that are ready for customers. One has to manage these materials. The aim of this management is to obtain the materials at the minimum possible price while maintaining quality also and to maintain the inventories in such a way that minimum cost is incurred while maintaining adequate materials for the production process.

Let us see what materials management actually means. It is defined as a function that integrates purchasing, storage, inventory control, materials handling and standardization etc in an organization to achieve its objective of reducing the costs. Every organization wishes to maximize its profit by maximizing its production and minimizing the cost of production. The average material cost in a manufacturing setup is around 50-70% of the total expenditure, which further goes up if one takes into account the inventory costs, storage, waste and other factors etc. It is therefore imperative for an organization to have a sound materials management with an objective to reduce material costs, control inventories, ensure uniform flow of materials and maintain good relations with suppliers. Materials Management has to do activities related to planning, accusition and utilization of materials.

Materials Management as a subject started picking up form early sixties and has gained importance thereafter. Since the amount of money incurred on materials is higher than the cumulative amount for machines, men and methods, one has to give high importance to the materials. It is the most feasible area that can offer opportunities for reduction of costs and improvement of profits. Materials add value to the product, as the product quality is directly dependent on the materials used. Materials Management thus can be seen as a system that assures the availability of products to the customers at minimum cost. In a nutshell, we can say that materials management is about making available the right materials in right quantity at a right price on the right time.

The functions of the materials management are materials planning and control, purchasing, inventory control, store keeping, material handling, warehousing, standardization & simplification and organization & appraisal of materials. This course has been designed in such a manner so that you get a feel of these functions in the subsequent blocks. Let us discuss them briefly.

1. **Materials planning and control.** Material requirement lies at the core of successful material management. This function is at the core of all the material requirements in any manufacturing process.

2. **Purchasing.** This function identifies the sources of supply, does market research, call tenders and select suppliers, negotiate with them and thus make available the raw materials.

3. **Inventory control.** This function is responsible for the location and storage of materials so that they remain available at the minimum cost and quickest time.

4. **Store keeping.** This function is responsible for the receipt and issue of the materials. The materials are stored in such a way that minimum handling is required and wastage is minimal.

5. **Material handling.** This function aims at minimizing handling and provision of equipments for handling materials. This function is crucial for minimizing space requirements, effective distribution and for providing better working space.

6. **Warehousing.** This function is responsible for the storage facilities for the materials, weighing facilities, materials handling equipments, material distribution facilities, fire fighting instruments etc.

7. **Standardization and simplification.** This function selects items of great demand and sets the standards for quality, raw material, sizes and performance of any product.

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8. **Organization & appraisal of materials.** This function helps in effective functioning by proving smooth flow. It provides coordination and avoid delays and wastages.

Management of materials embodies various costs. Since the ultimate aim of materials management is to reduce the costs of materials and hence the final product, it is worth seeing what these costs are. Let us take a glimpse of what these costs are:

Table 1.1. Costs involved in the Management of Materials

S.N.	*Costs*	*Description*
1.	Cost of materials	The basic cost of materials that has to be paid to suppliers
2.	Purchasing cost	The cost incurred in purchases e.g. cost on staff, tendering, stationary, postage, processing supplies, receiving, inspection
3.	Inventory carrying cost	The cost incurred on storage including buildings, costs on staff, interest on capital locked/ borrowed, obsolesecence
4.	Packaging cost	Costs incurred on paper, plastic, metal foils, metal and wood containers etc.
5.	Transportation cost	Costs incurred on moving the goods to different desired locations from time to time
6.	Material handling cost	Costs incurred on handling equipments like cranes and conveyors
7.	Wastage during production	Costs incurred on holding scrap, obsolete stock and their disposal

An integrated materials management system helps in taking judicious decisions that in turn leads to lower cost for materials. Similarly if an organization has low inventory carrying costs, less stock outs etc., it is bound to do well.

1.3 MATERIALS MANAGEMENT OR MANAGEMENT OF FLOW OF MATERIALS

In any organization, the responsibility for maintaining the quality of the product and incurring less cost on its production is the responsibility of the production/ operation, deciding the price of the product and finding

the customers that will buy it comes under marketing. The question arises that if it is so, what do the materials management function does? The answer is that from the time the materials enter the warehouse of the organization from the suppliers, the role of materials management starts and gets going till the final product is obtained. The interrelated activities that are carried out to achieve this are sequenced after each other in a systematic manner. Management of this flow of materials is called materials management. This flow of materials is met through a set of activities presented in Table 1.2 given below.

Table 1.2. Set of activities for flow of materials

S.N.	*Activity*	*Function*
1.	Planning	Setting the goals, indicating the sources of finance
2.	Scheduling	Requirements specification, quantum and delivery schedules
3.	Purchasing and Procurement	Vendor selection, quantum and delivery schedules
4.	Inspection and Quality control	Conforming quality
5.	Stores and Inventory control	*Determining inventories, mainternance* and upkeep
6.	Materials handling and distribution logistics	Controlling flows, distribution, shipments

The table above highlights the importance of integrated systems and dependence of function models for decision-making. The organizations have now become multidimensional in nature. Total materials management concept evolved to address this dimension and avoid conflicting objectives. Total material management helps in establishing accountability so that response to a problem is quick and appropriate.

The material functions are accomplished in more coordinated ways with the help of this integrated approach. When this happens there is increased communication for the need of materials and hence one gets lower costs, better inventory turnover, reduce stock outs and other significant benefits. Data processing systems are designed on the basis of the integrated material function.

In the subsequent units in this block you will study about the strategic role of materials management, and its relations with other functional areas.

NOTES

1.4 MATERIALS FLOW PROCESS

The aim of any organization is to manage its 5 M's as effectively as it can. These 5 M's as discussed earlier are Men, Machines, Money, Methods and Materials. The purpose of this coordination is production of superior goods at minimal costs. In this discussion, you have focused on the materials. If you have to exercise proper control over materials then you have to take care of your material flow as well as information flow. Dutta (1998) illustrated this process (fig 1.1). As can be seen from the figure that there is a definitive flow of materials from vendor/supplier to the warehousing/ customer and the organization is abounded in information flow. This is very important as materials and information both are extremely important and both should be readily available at a time when needed.

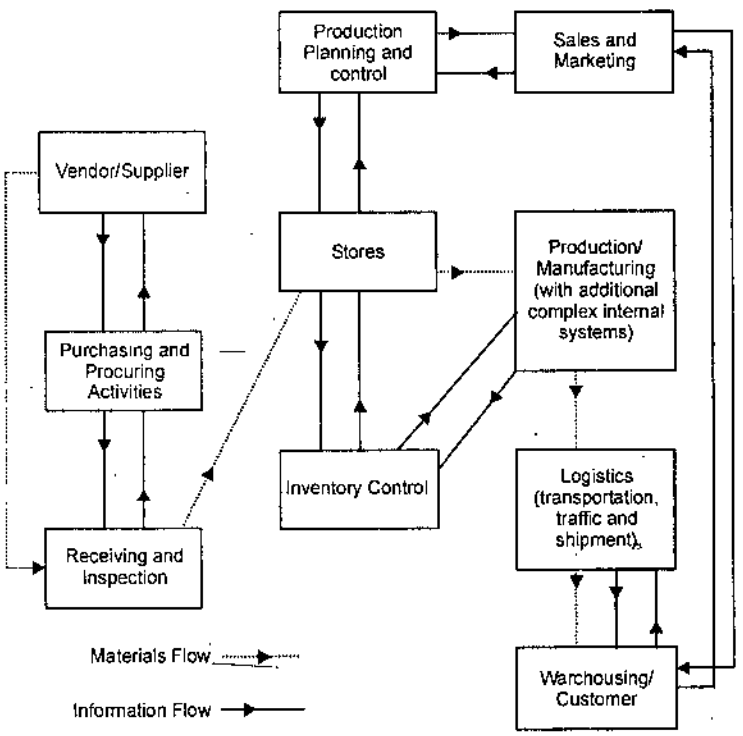

Fig.1.1

The materials flow is starting from the vendor/supplier from which material is to be purchased. Once the material is purchased it is received and inspected. After inspection stores accepts it. Production/ manufacturing and its subsystems call for the materials as and when it is required. Logistics takes control after that. Warehousing and customer comes after that.

The information flow is everywhere. As you can see, information flow embodies much more than the materials flow. Be it production planning and control or sales and marketing, inventory control or purchasing and procurement activities. The effectiveness of the materials flow is thus

dependent on decision-information. If an organization can control these two flows easily and effectively then it will definitely render goods products at a low cost and also would be able to offer good service.

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1.5 STRATEGIC ROLE OF MATERIALS MANAGEMENT

The basic objectives of material management in an organisation are:

- To obtain materials at the minimum price, however, this minimum price must not compromise on the quality of goods and the continuity of supply.
- To minimise the inventory of an organisation without sacrificing the timely availability of materials. This frees up working capital of an organisation for other useful organisation purposes.

Thus, the bottom line of any material management system is the minimisation of material procurement, storage and handling costs, without compromising quality and availability of materials.

Material management procedures are strategically placed within an organisation. They have different meanings for different people. Some of the material management procedures may give more weightage to purchasing, while others may attach a lot of importance to inventory control. A good material management process may have a strong backing of quality management and quality assurances of material purchasing and handling. This combination has a great impact on profitability and productivity as this may reduce the rejection rates of materials, thus, bringing down the overall cost of production in a well managed system. It is sometimes stated that it is the control of quality from the procurement to final distribution of the product that improves productivity and corporate image. A strong logistics system that can create a steady flow or continuum of materials flow into the production pipeline is the need of the hour. It is also claimed that such a continuum can minimise the need for material management. However, the question is how good this continuum is? And how are the quality control processes associated and linked to this continuum in an organization? Thus, the material management is an important strategic issue within an organisation. Let us discuss more about its strategic placement in the subsequent sections.

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1.6 OBJECTIVES AND ADVANTAGES OF MATERIALS MANAGEMENT IN AN ORGANIZATION

Materials Management has several core objectives and many secondary objectives. The core objectives of material management are:

- Proper, cost effective material procurement.
- Proper storage of materials so as to minimize wastages and material hold ups.
- Making available the material TIMELY.

A good material management system will keep up to data records of all the information generated in it, preferably using a computer-based system. In addition to these primary objectives a materials management system indirectly fulfills many secondary objectives also. These secondary objectives are normally related to the functions of a material management system. Some of these secondary objectives are:

- Identifying new or better sources of supply
- Development and sustenance of relationships with the vendors
- Creating a standardized quality of the products
- Performing the value analysis of inventory. This can be related to the cost of materials.
- Creating a smooth flow of materials and information among the various sections of materials management system.

The material management system works under the broad basic objectives of an organization that is "maximum profit with sustained growth and research, satisfied customers and staff of the organization". The material management supports this objective by providing support through:

- Continuity of supply by maintaining a uniform flow of materials,
- Reducing the costs of materials purchased and handling by using scientific techniques and electronic tools. The use of scientific tools and techniques for materials and information management,
- Minimizing holdups of working capital and performing effective inventory control,
- Releasing working capital by ensuring effective control over inventories,
- Providing high quality at the lowest price, and
- Development of better relationships with customers and suppliers.

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Why Integrated Materials Management? Materials Flow Systems

Some of the key functions that are undertaken during the process of material management are:

- Materials Planning
- Materials purchasing
- Receiving of Materials
- Stores
- Inventory Control
- Scrap and Surplus disposal

A material management system integrates all these functions as a single function. But what is the need of such integration? If we do not integrate the functions as above then they can operate of their own and integration can produce suboptimal results. This is analogous to a situation when you want to make a computer hardware, you buy all the sub-systems that are cost optimized in there own way, for example the mother board may support fastest CPU, RAM may have maximum capacity in the same cost etc., but when you assemble your PC you find that all these components are not compatible to each other. Similarly, one expects similar strains among the functions of the material management system, for example, although high procurement may reduce cost but is it really justifiable keeping the inventory control function requirements in considerations. Thus, various functions have conflicting optimizing requirements.

A material management system has to bring solution within these conflicting requirements. However, since the material management system is not controlled by a single subsystem, enforcing such requirements may create a problem. Therefore, in an integrated set up, a materials manager can be made responsible for inter-related function control. S/he may be allowed to control and coordinate with a view that ensures proper balance of the conflicting objectives of the individual functions.

Advantages of Materials Management

Material management has created a niche in many organizations, which have implemented the integrated materials management. These organizations usually enjoy the following advantages:

- Better accountability on part of materials as well as other departments as no one can shift blame to others.
- As materials management is handled by single authority, it can result in better coordination, as it becomes the central point for

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any material related problems.

- Materials management department makes sure that better quality material is supplied timely to the requesting departments. This can result in better performance of the organization.
- A materials management system is typically controlled through an information system, thus, can help in taking decisions related to material in the organization.
- One indirect advantage of material management is that good quality material develops the ethical and moral standard in an organization. However, please note there is no study on this issue.

Scope of Materials Management

However, after discussing so much about the role of material management it is worth mentioning the scope of the material management also. Although the scope of a material management system is vast, yet we can define the following functions as its scope functions.

Material Planning and Controlling: One of the key functions that identify the scope of the materials management is the materials planning and control. This function is based on the sales forecast and the production plans of an organization. The activities of this function are:

- *Estimation of materials requirements*
- Preparation of materials budget of the organization
- Estimating the levels of inventories required in the organization
- Scheduling the orders placed with the vendors to ensure availability of material
- Controlling by monitoring of production vis a vis sales.

Purchasing: The purchasing is another major function for the materials management. This function contains the following activities:

- Identification and selection of possible Suppliers
- Finalizing the terms and references of purchases that are to be made.
- Placing the purchase orders this activity may be staggered as per the inventory control function.
- Managing the purchase orders till delivery of materials
- Giving clearance to payment of received good; and
- Analyzing the performance of the suppliers and rating them.

Stores and Inventory Control: This function helps in physical control of materials. It has the following list of activities:

- Minimization of material losses due to obsolescence and handling. This activity controls the timely disposal and efficient handling of materials.
- Maintenance of stores records along with proper location and stocking of materials.
- Physical verification of stocks and reconciling.
- Performing inventory setting and control. Some such activities include performing ABC analysis, fixing economical ordering quantities, identification of selling safety stock levels, performing lead-time analysis etc.

1.7 ROLES OF MATERIALS MANAGEMENT IN AN ORGANIZATION

Materials Management is a system that tries to ensure the following for an organization:

- Availability of products desired by customers. These products should be prepared with best obtainable cost of manufacture.
- Quality and cost of manufacture should be most affordable for the organization. Although quality and cost of production are the responsibilities of the Production Manager, however, material management can support this process by the timely delivery of quality material.
- Advice the sales pricing. Although pricing is a sales function, but Materials Management with proper record keeping can be used for generating price data for the various destinations. For example, the cost of the materials used for a product can be determined through this system. Thus, material management can helps in determining the cost of the product.

Let us revisit the materials flow process. As shown in Figure 1.2, a simple customer demand can trigger a series of flow of material along with lot of information flow. Please notice that material management will be required across the entire life cycle of the material flow. Please also note that during the material flow a lot of information is generated, which can be used strategically for various purposes as, explained in the following paragraphs.

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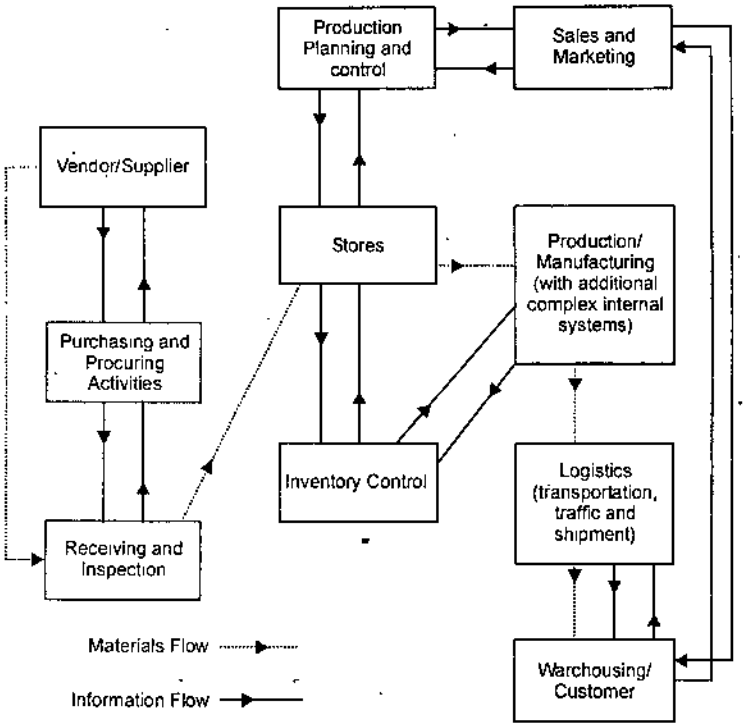

Fig. 1.2. Material flow process

In order to further define the strategic role of the material management let us relate it to the internal interfaces of material management in somewhat more detail. It is to be noted that material managements indirect benefits already have related it to the external interface.

1.8 LINKAGE WITH OTHER FUNCTIONAL AREAS OF MANAGEMENT

The Materials Management can be directly connected to the functional areas of customer satisfaction through Total Quality Management (TQM); Human Resources Management (HRM); environmental issues in material management; cost and finance issues and IT related issues.

All the above-mentioned issues contribute to the material management function directly in more than one ways and the success of each of these elements contribute to the success and the failure of the material management process. Subsequent sections shall highlight their contribution and will explain these concepts in greater detail.

1.9 TQM IN MATERIALS MANAGEMENT

In a continuing quest for competitive advantage, companies are calling upon materials managers to find innovative ways to reduce cost, enhance

service, and increase customers' satisfaction. As a result many companies have taken significant steps toward identifying and implementing materials management quality improvement processes. Some of these processes are really consistent with broader corporate wide quality initiatives. However, materials management frequently assumes the leadership role in implementation of the formal quality process.

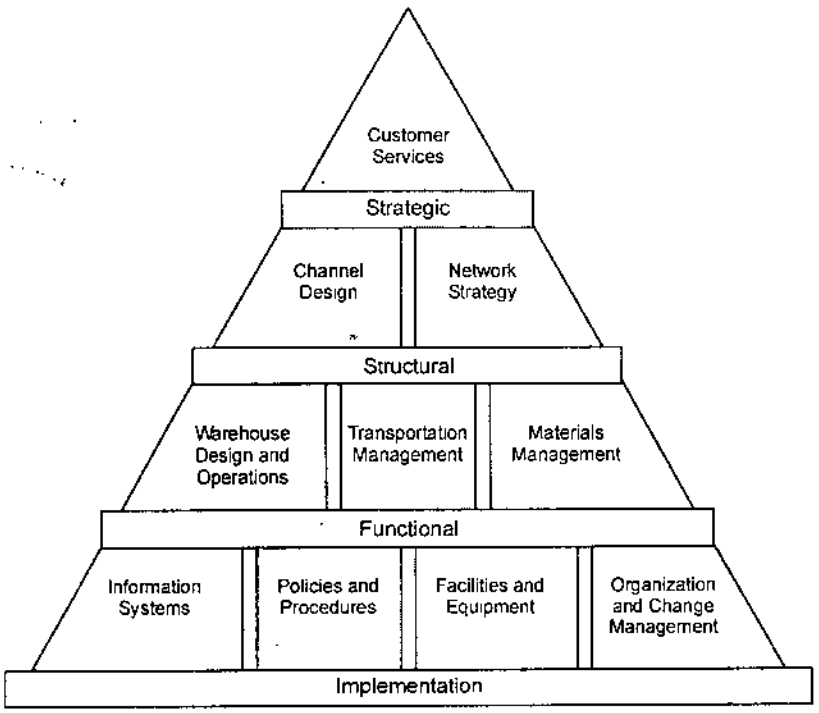

Fig. 1.3. The Materials Management Pyrramid

Because of the increasing popularity of formal quality processes, materials managers need to be well versed in how the following topics manifest themselves in logistics.

- Creating customer value
- Formalization of quality process
- Materials management quality process
- Improvement through quality analysis
- Implementation strategies.

For quality initiatives to be accepted by the employees and suppliers who must implement them, the ultimate goal of these initiatives must be clearly understood and enthusiastically supported. Proceeding added value for customer enhances a company's ability to gain and retain profitable business relationships. Quality programs lay the foundation for this customer value ensuring that customer needs are understood and satisfied. Unless materials managers have the proper orientation before embarking on a quality program, they may undertake the journey

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with no particular destination in mind and wander into failure, because customer value is the goal. It is also the final destination in mind and wander into failure, because customer values is the goal, It is also the final destination in the quality journey (described) later as the final phase in the evolution of the quality process. Thus, a discussion of the meaning of customer values must precede a discussion of quality.

Creating Customer Value

The 1980s introduced significant technological and environment changes to Materials management system yet through all these changes. The focus in logistics has remained on customers and the company's need to provide the best comparative net value through effectiveness, efficiency, and differentiation of services. The quest to create and improve customer value through logistics has required the quest of quality within logistics.

1.10 FOCUSED HUMAN RESOURCES MANAGEMENT: KEY TO MATERIALS MANAGEMENT EFFECTIVENESS

Logistics is a functional area capable of sweeping, innovative results, yet it has traditionally experienced difficulty in delivering. Logistics authorities long back have proclaimed the coordinative power of the logistics function as one that can most easily integrate the product flow-related functions of marketing, manufacturing, and supply procurement to achieve quantum gains in customer service and profitability.

However, many companies actual experiences often reflect the story of a logistics executive who developed an insightful vision and motivated his or her logistics managers into action but then ran into the police yet pervasive unwillingness of lower-level managers to change. This resistance comes both from within the company and from its suppliers and customers.

The executive understood both the great promise of logistics and the great difficulties in implementation. But some of them were able to move beyond the ever-present inertial resistance to implement sweeping, effective programs. In later conversations, they made the following, revealing statements:

- "Our sales people and account managers resist our efforts to coordinate with our customers. Their incentive compensation gets in the way. Our top managers see the big picture, but they insist on product loading to meet Wall Street's quarter-end goals."
- "The big issue is how to get people to take a strategic, rather than a tactical, view–how to make a strategic decision that tactically

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may not look right to a buyer or a salesperson. The stumbling blocks are compensation and promotion."

- "Our company is not run on a cash basis. Our officers prefer increased business to inventory savings, even if ROE drops. We need better internal controls and measures."
- "You can explain the vision, they (counterpart managers) can see the vision, but then they do what they are paid to do."
- "The big issue is taking down internal barriers to improve customer-supplier relations within the company. Planning and performance measurement must change radically for business processes to change."

Many of these managers did not turn from this task. Rather they identified the underlying behavioral drivers that were causing resistance, and developed powerful new measures to re-channel them to accomplish their programs. They understood that both the sources of resistance and the key points of management leverage are rooted in people. Thus we turn our attention to human resources management (HRM) with the discussion of the following topics:

- Fundamentals of human resources.
- Focused human resources management.
- The new strategic imperative.
- Ensuring effectiveness.
- The new logistics management.

A profound change transforming a variety of industries is requiring fundamental changes in the way that managers operate their businesses. In the future, it will be harder for a company to succeed alone. Effective managers must integrate product flow not only among the functional units within a company but also among tightly coordinated networks of companies in a channel. This presents complex new challenges to the logistics professional. Critical to the success of this new form of competition are coordinative mechanisms that we call "inter-company (or inter-organizational) operating ties" (IOTs). These mechanisms create huge savings and new competitive advantage by redefining the traditional boundaries of companies and fundamentally changing the way product flows, both within a company and from one company to another, through supply and distribution channels. The common trait of IOTs is that channel members work together to ensure smooth, efficient, and reliable product flow. In each case, tight integration is needed across the functional departments of the companies involved, and new forms of coordinative behavior must be identified and developed. IOTs introduce a further

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management complexity because one channel member, by mutual agreement, may take over activities or decision-making authority that previously had been the prerogative of the other. However, the benefits outweigh the difficulties (which subside as time passes and relationships strengthen). A few examples illustrate IOTs:

- Baxter Healthcare, Baxter pioneered a "stockless" system in which it effectively manages hospital supply ordering and replenishment – in contrast to traditional uncoordinated buying by its hospital customers – by distributing a wide variety of hospital supplies (including those purchased from its competitors) directly to hospital wards; this largely replaces the traditional internal hospital materials management function.
- Bose Corporation developed an innovative "JIT II" concept, in which supplier representatives are situated in a Bose facility; among other unusual prerogatives, these individuals have full authority for scheduling shipments from their own plants.
- PPG Companies increasingly are taking advantage of key suppliers' knowledge of products and technology by asking that the suppliers actually operate part of the buyer's production process, rather than simply purchasing parts and materials on an arm's-length basis. For example, PPG manages painting operations in certain General Motors factories.
- Polaroid, continuous product replenishment has begun to revolutionize many retail industries, including apparel, groceries, and office products. Suppliers have responded. For example, Polaroid receives daily sales figures from several large customers and effectively "pushes in" stock, without receiving orders.

There are persistent reasons why the huge benefits of coordinated product flow have remained untapped for so long, and most of these are rooted in narrow, long-standing turf-protecting behavior – often reinforced by HR policies that have outlived their usefulness. These reasons are:

- **Traditional boundary views.** Many functional managers have maintained a traditional view of their operational boundaries – especially, the decisions that are "rightfully" theirs to make – and this has both obscured and then constrained the new paradigm. This perspective has been reinforced by inward-looking compensation and performance reporting systems that act as organizational blinders.
- **Lack of resources and expertise.** Many executives lack the channel wide data, knowledge, and new methods of analysis are necessary to see the vast magnitude of the problems and opportunities. General-purpose corporate development programs fail to provide this focused expertise.

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- **Traditional functional barriers.** Traditional barriers between the functional departments of many companies hamper necessary internal coordination. For example, customer relation is often allocated to marketing and supplier relations to purchasing. Structural change can entail heated turf battles.
- **Short-term focus.** A pervasive executive focus on short-term earnings, which leads to chronic quarter-end "product loading" sales tactics and "hockey-stick" financial performance, has bred subtle concern among some managers because artificially "managing" quarterly results is not possible in the context of coordinated, responsive product flow. Similarly, the forward buying associated with trade deals is threatened, creating a perceived threat to both sales people and buyers.

Essential Top Management Role

Because the potential gains from product flow coordination are so large, and because the required changes are so sweeping, top management must be directly involved on an ongoing basis. This is the bedrock precondition for success. Top management must drive the program in several concrete ways.

The general management of a company must publicly confirm both the strategic imperative of rapid, responsive product flow and the wisdom of the proposed operational changes. Top management must communicate explicitly that cooperative behavior is necessary to gain the new benefits, that the executive responsible for logistics has the authority to focus and tailor the company's HR policies to accomplish this goal, and that uncooperative behavior will not be tolerated. The top executives of a company must take a personal stake in the program's success.

"Top-to-top" contact is crucial in developing effective inter company operating partnerships. A company's top executives must show their counterparts in the partner company that it is essential for both companies to alter and focus their HR policies to drive the cooperative arrangement at the grass roots level. In IOTs, it is not sufficient for only one partner to change. There must be an explicit agreement at the onset of the relationship. In our study, we found that the failure to specify and gain this agreement was the root cause of many problems in otherwise promising partnerships.

Top management involvement is necessary to invest the logistics executive with the authority to go beyond persuasion and to enable him or her to influence key HR policies to implement sweeping, innovative programs. Because product flow crosses through all functional departments, coordination requires broad changes in the behavioral drivers throughout

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a company. Materials Management cannot be an independent and isolated function. Rather, it must provide an integrated vision and have the ability and savvy to work through the other departments to effect changes. Logistics executives must identify new points of leverage and become expert in using them to deliver results. HR policies provide these new points of leverage.

1.11 INFORMATION AND MATERIALS MANAGEMENT

Logistic information systems combine hardware and software to manage, control and measure Materials management activities. These activities occur within specific firms as well as across the overall supply chain. Hardware includes computers, input and output devices, communication channels, ancillary technology like bar code and radio frequency devices and storage media. Software includes system and application programs used for Materials Management activities. Materials management itself includes the activities required to plan, execute and measure the movement of product from the raw material suppliers thorough the firm and ultimately to the final consumer.

Classification of Logistics Information Application

Logistics information systems include two flows that incorporate coordinating and operational activities. Coordinating activities include scheduling and requirements planning throughout the firm. Typical activities are the development of strategic, capacity, logistics, manufacturing and procurement plans. Operational activities are the information procedures that initiate and track receipts, inventory assignment, and shipment of replenishment and customer orders, replenishment orders control finished goods inventory movement between distribution facilities. Customers' orders initiate inventory movements between distribution points and customer facilities. A typical replenishment or customer order requires a series of operational activities initiated by order receipt. For a single replenishment or customer order cycle, typical activities include order receipt, modification, processing / inventory allocation, picking, and shipment. The procurement order cycle is another activity of the operational plan.

Specific coordination flow representing the backbone application are discussed to develop additional perspectives on trends in logistics system information applications.

Coordination Flow

The coordination flow represents the backbone of overall information

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architecture for firms that primarily manufacture or distribute products. Logistics applications coordinate core activities that guide firm applications and control primary valueadded activities necessary for firm stability and profitability.

The shaded components in figure 1.4 illustrate logistics coordination flow. Corresponding with the activities identifies above, coordination flow actions are as follows: (1) strategic planning, (2) capacity planning, (3) logistics planning (4) manufacturing planning, and (5) procurement planning. Materials management is an integral part of both operational and coordinating information flows. Inventory management is an integral part of both flows. Each coordinating activity is discussed below.

The primary information drives for manufacturing and distribution firms are strategic plans that seek to achieve marketing and financial goals. The marketing considerations include target markers, products, marketing mix plans, and the role of logistics value-added service straits. The primary capacity planning output is monthly or weekly requirements that specify dollar or unit volume by – product group or market region.

A comprehensive logistics plan specifies facility, equipment labor and inventory requirements using inputs from forecasts, customer orders and inventory status. The logistics plan coordinates cross – functional performance by quantifying future requirements and developing inventory requirements. Product forecasts are based on sales and marketing input and past experience. Customer orders include orders in process, future release, and contract commitments Promotional orders are particularly important when planning customer requests, because they often represent a large percentage of the total volume and have a major influence on capacity requirements and on inventory status in product available to ship.

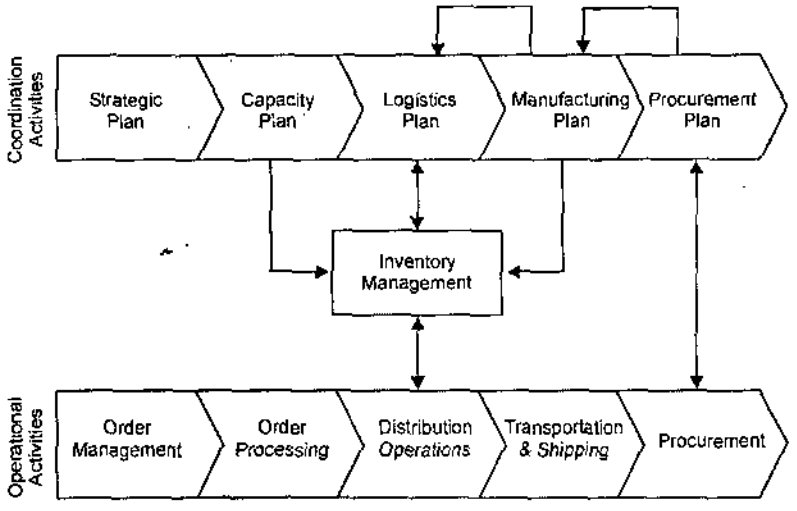

Fig. 1.4. Materials Management and Information Flow.

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The logistics plan is primary to inventory management, which, in turn, is the interface between coordination and operations. As such some inventory management characteristics are discussed within each information flow, inventory management schedules replenishment and transfers between manufacturing and distribute facilities. The logistics plan may be developed from reactive or planning logic or a combination on the two. Reactive logic uses customer requirements to initiate finished goods inventory replenishment. Reorder point logic (ROPL) is an example of the reactive mode. Planning logic on the other hand, initiates replenishment based on forecast, Distribution resources planning (DRP) is an example of logistics planning logic. Planning logic orients inventory management more closely to the coordinating plan while reactive logic shifts inventory management closer to the operational plan. The primary deliverable of the materials Management plan is a statement of time – phased inventory requirements. The logistics plan is also a key input to manufacturing planning, which includes both the master production schedule (MPS) and the manufacturing requirements plan (MRP) that defines weekly or daily production and machine schedules. Given MPS input, MRP time – phase raw material and component requirements to support the designated manufacturing plan. The manufacturing plan schedules resources and attempts to resolve day-to-day capacity bottlenecks, such as raw material or daily capacity limitations within the material management system. The manufacturing plan deliverable is the day-to-day production schedule and material requirements.

The procurement plan schedules raw material release shipments and receipt. The procurement plan uses the capacity plan to drive overall decisions concerning range of acceptable suppliers, degree of material speculation, and desirability of long – term contracts. The procurement plan uses MRP to drive short – term vendor releases. The procurement plan deliverables are important to both long and short – term purchasing requirements.

While each planning activity can, and in the past frequently has, operated independently, the potential of inconsistency can create operating inefficiencies and excessive inventories. Failure to fully appraise the impact of strategic plans can result in uncoordinated manufacturing and logistics inventories. Similarly, failures consider procurement; manufacturing or logistics capacity can create facility and processing inefficiencies. Such failure to coordinate can lead to otherwise unnecessary safety stocks to buffer independent performance.

Using Information to manage Materials Management

Integrated supply chain management is characterized as the interdependent performance of planning, execution, and monitoring activities. In the

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past, these activities were typically performed at different times, often by different individuals and sometimes in different forms. Today's competitive pressures require that coordinating and operational activities be integrated and remain timely. Increased performance requires quicker decisions covering more complex alternatives; information technology offers one way to satisfy these requirements.

Logistics information applications, problems, and directions are discussed in this section. The discussion is focused on the primary concerns related to planning, execution, and performance monitoring.

Application Characteristics

The interviews indicated four characteristics of Materials Management applications that differentiate them from other information system applications, materials management applications:

1. Are date intensive
2. Have multiple flows.
3. Place Significant Demands on the application / user interface
4. Sequential Proces

The explicit perception was that these characteristics make logistics systems mote difficult to design, implement, and manage than other applications, each characteristic is briefly discussed below.

- **Data Intensive.** Logistics applications are very data intensive because they must include information from all dimensions of customer, product, facility, and logistics activity. For each dimension, logistics application contains historical, current, and planned values. For example, for each combination of customers, products, and facilities, logistics applications must maintain past orders historical, current order (current) and forecasts (planned). In addition to the order and forecast volumes, logistics must also maintain the historical, current, and planned costs for completing each Materials management activity. The sheer number of combination resulting very data intensive application.
- **Multiple flows.** Materials management applications have substantial interaction between coordination and operating flows, while other application like accounting have coordinating and operating flows as well. Dynamic interactions are not as critical because there are defined closing times at which information is exchanged and updated. Materials Management applications, on the other hand, require dynamic interchange between coordinating and operating information flows. As future orders are entered into

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the application via the order management module, order information must be incorporated into the logistics, manufacturing, and procurement plans. This exchange of information cannot occur at a single point in time but must be continuous because the system is dynamic. Significant information exchange is necessary to achieve integrated coordination plans and operational activities.

- **Application/user interface.** some aspects of Materials management applications like order entry are structured. However there are many more that depend on user selection from range of alternatives. Examples include products substitution, promotional pricing, replenishment planning, and assignment of shipping locations. In some applications, user are guided through selection, such on line direction is not common in today's logistics applications. Further development of on–line decision aids in particularly important when one consider the experience and training of individuals who interface logistics and applications. Logistics application users frequently are young, inexperienced, and not well trained, and also change jobs often. This user profile, along with increasingly complex alternatives, places significant demands on the user interface and on–line decision aids.

- **Sequential process.** Materials management activities involve a high legal of sequential processing offer operational applications. In most logistics applications, there is a prescribed sequence for completing operational module procedures. The transactions initiating this processing are often initiated manually. For example, orders are entered and changed using a transaction. The inventory shipped, and released as the last step in the sequential process. Inventory replenishment requests are processed similarly. The transactions are usually very structured in terms of initiator, receiver, data requirements, and processing sequence. An example of the difficulty imposed by structured sequential processing is illustrated by the relationship between order entry and credit checking. If the order is changed following credit checking, it may be necessary to route the order back to credit a second time. Many logistics applications have difficulty with rerouting because it is a counter to the standard sequence. Transaction in most logistics applications still model the sequence and structure of the paper flow transaction that existed prior to computerization. The paper procedures required very sequential processing and allowed limited part routing flexibility.

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1.12 MATERIALS MANAGEMENT COST, PRODUCTIVITY, AND PERFORMANCE ANALYSIS

Logistics costs are a major component of the total cost of doing business, and distribution assets represent major potion of a firm's total assets. Clearly, managers can improve corporate profits by improving logistics productivity. Rather than attempt to minimize the costs of individual logistics components, one should select the level of expenditure for each component that leads to the greatest profit for the firm. Thus, total cost analysis is critical to the successful management of logistics. Accounting information plays a significant role in the analysis and management process, for without accurate cost data it is impossible to design or control the distribution system.

This section examines several fundamental and advanced concepts that are useful for analyzing and managing logistics processes:

- Accounting for logistics
- Distribution cost trade-off analysis
- Controlling logistics activities
- Activity-based costing
- A distribution database for decision making

Accounting for Logistics

The lack of adequate cost data has prevented the full implementation of integrated logistics management in many firms. Accountants have not kept pace with developments in logistics and, in fact, have shown relatively little interest in the area. Consequently, much of the necessary cost analysis is not performed. Costs related to separate functional areas and their interaction must be made available to logistics decision makers. With this information they can use total cost analysis to manage logistics operations, determine selling prices, and justify price differentials.

This type of decision-making is severely hampered by the lack of proper accounting data or the inability to use such data when available. The best and most sophisticated models are only as good as the accuracy of the data inputs. Several studies attest to the gross inadequacies of logistics cost data. To answer these and other questions requires knowledge of the costs and revenues that will change if the logistics system changes. That is, determining a product's contribution should be based on how corporate revenues, expenses, and hence profitability would change if the product line were dropped. Any costs or revenues unaffected by

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this decision are irrelevant to the problem. For example, a relevant cost would be public warehouse handling charges associated with a product's sales; a non relevant cost would be the overhead costs associated with the firm's private trucking fleet.

Key Accounting Concepts

The accounting concepts necessary for logistics are the same as those used in manufacturing cost analysis. Functional cost analysis is a prerequisite to the identification of costs and their behavior. Although Materials Management activities are organized along functional lines like warehousing, transportation, order processing, and inventory, many firms capture costs not on a functional basis but rather in broad, "natural" account categories like salaries, depreciation, and general and administrative expenses.

Natural accounts are used to group costs for financial reporting on the firm's income statement and balance sheet. For example, all payments for salaries might be grouped into a salaries account, whether they are for production, marketing, logistics, or finance, and the total shown on the financial statements at the end of the reporting period. Other examples of natural accounts might include rent, depreciation, selling expenses, general and administrative expenses, and interest expense. It is entirely possible that a firm with a strong financial accounting orientation may not give separate headings in the natural accounts to logistics costs such as warehousing and transportation. Instead, they are lumped into such diverse catchalls as overhead, selling, or general expense.

Further, there has been a tendency, particularly in the case of freight, to abandon the accrual accounting concept and match costs of one period with revenues of another. These conditions make it difficult to determine logistics expenditures, control costs, or perform trade-off analyses. Each firm must analyze its own Materials Management activities to determine meaningful functional account categories. The next step is to code the accounting data to make identification of the costs possible. Several key accounting concepts are applicable to the logistics function, including cost categorization, costing methods, and general cost analysis.

Cost Categorization

Within functional account categories, costs can be further characterized by their nature. This subcategorized provides managers with additional details about costs that impact decisions.

Controllable vs. Non-controllable: It is necessary to separate the more controllable costs from the less controllable or non-controllable costs so that individual managers are held responsible only for incurring those costs over which they exercise control. Generally, costs that vary with

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the volume of effort expended in an activity are controllable costs. These costs should be related to an appropriate unit of service and separately identified to assist in cost control. Costs that are fixed or budgeted for the fiscal period should be considered when logistics effort and capacity is subject to change.

Direct vs. Indirect: In manufacturing, direct costs are readily traceable to products (for example, direct material and direct labor). Direct costs also include those incurred by specific functions and are distinguished from allocated or transferred costs. In materials management, the classification of costs as direct or indirect depends on the business segment. The more general the segment (sales division or sales territory), the greater is the portion of costs directly traceable to it; the more specific the segment (products, customers), the greater is the proportion of indirect costs. Direct costs are those that can be traced to a business segment. If that segment were eliminated, the costs no longer would be incurred. Indirect costs, costs such as general administrative expenses, are often allocated to segments, but this process is arbitrary at best and should be avoided.

Fixed vs. Variable: The study of cost behavior in materials management is quite similar to that in manufacturing because most of the activities are repetitive in nature. Physical measurements like labor hours, units handled, and orders processed can be used to measure the activity. Changes in cost are usually caused by changes in activity. Understanding Materials management cost behavior requires establishing relationships between costs and appropriate activity measures. Variable costs change proportionally with changes in volume. Fixed costs remain the same despite volume. Mixed costs contain both a fixed and a variable component. An example is warehouse labor; a basic crew of three may be required to cover the normal range of activity (fixed), but if volume exceeds the crew's capacity, overtime or part-time employees are necessary (variable). Step variable costs and step fixed over a relevant range but may increase in steps. The major distinction between the two is the size of the steps. For example, in an order-processing department of 20 people, labor might safely be considered variable because a small percentage increase in the number of orders could result in the need for more employees. However, in a department of three people the cost might be considered a step fixed cost because a large percentage increase in the number of orders processed would be required to add an employee. Other examples of step fixed costs include management salaries, depreciation, and taxes associated with each company warehouse. Effective planning and control require that the total costs be separated into the fixed and variable components.

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Actual vs. Opportunity: The conservative nature of accounting requires the use of current actual costs or allocations of historic costs in cases such as depreciation. Actual costs, of course, result from transactions that actually occur. However, for management decision-making, actual costs and opportunity costs must be considered. An opportunity cost is the surface associated with the choice of a specific alternative, the value of transactions that were possible but rejected. Examples of opportunity costs include the rate of return that could be earned on money not invested in inventory and the possible income from leasing or selling a warehouse. Although opportunity costs do not appear on corporate profit-and-loss statements, these costs are real.

Relevant vs. Sunk: Relevant costs change with a decision management is about to make. Any costs unaffected by the decision should not be included in the evaluation of alternatives. The costs that will not change are sunk costs. An example of a sunk cost is the price of a forklift truck after is has been purchased. When making the decision to keep or sell the forklift truck, the relevant costs are the cash flows experience by keeping the piece of equipment, its current market value, and any income tax implications associated with the decision to sell it; the original purchase price is no longer relevant but rather it is "sunk."

Standard Costs and Flexible Budgets

Control of costs through predetermined standards and flexible budgets is the most comprehensive type of control system available. The use of standard costs represents a frontal assault on the logistics-costing problem because it attempts to determine what the costs should be, rather than basing future cost predictions on past cost behavior.

Nevertheless, the use of standards has not been widespread. In part, this is because logistics costs are believed to be, by nature, quite different from those in other areas of the business. Although there may be some merit to this argument, logistics activities are, by nature, repetitive, and such operations lend themselves to control by standards. A more compelling reason why standard costs have not achieved widespread acceptance is that few attempts have been made to install such systems. In fact, it is only recently that the importance of logistics cost control has been recognized.

The lack of standard costs for logistics is unfortunate because management accountants and industrial engineers of most firms have developed a wealth of experience in installing standard costs in the production area, which, with some effort, could be expanded into logistics. However, developing standards for logistics may be more complex because the output measures are often more diverse than they are in production. For example, in developing a standard for the picking function, the eventual control measure

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could be stated as a standard cost per order, a standard cost per unit shipped, or a standard cost per shipment. Despite these complexities, work measurement does appear to be increasing in logistics activities.

Once standards have been set, the firm must compare actual performance with the particular standard to see it is acceptable. If performance is acceptable, the system is deemed to be under control and that is the end of the control process. Inherent in this notion is that management operates under the principle of exception, exerting no changes in the system so long as it operates satisfactorily; and the measure of "satisfactory" is found in the standard. It is highly unlikely that performance will exactly equal standard. Where there is a departure, the procedure is to break the variance into its components to try to ascertain its sources. For example, the standard may be a budgeted amount for transportation in a territory. If the actual exceeds the budget, management would like to see the variance analyzed into separate measures of volume and efficiency.

It is impossible to know how to proceed unless the variance is analyzed into meaningful sources. The next question is whether the observed variance is great enough to be deemed significant. It is possible to handle such a question in strictly statistical terms, setting quality control limits about the standard. This may be done in terms of standard deviations and an acceptable limit establishment on the downside only, or the limit may be on either side of the standard. Thus, in the latter case, if performance exceeds standard, management may decide to raise the standard or reward the performer accordingly. Probably of greater concern are those departures in which performance is below standard. Much of logistics lends itself to measures of statistical significance in departures from standard. However, as with demand obtaining activities, it is probably more meaningful to judge departures from standard in terms of their practical significance. A form of sensitivity analysis here raises the question of how critical is the departure in its effects on bottom-line performance (net profit).

Regardless of how the assessment is made, the variance will be termed either significant or not significant. If it is not significant, performance is judged acceptable and the control process ends. If significant, the next question is whether action is required. The variance may be significant but, in analyzing and explaining it, we do not judge the departure from standard controllable. If so, no action may be indicated and the control process is terminated. If action is indicated, it will be one of two broad kinds. Either the standard is held to be wrong and must be changed, or the process itself is not producing the results it should and thus must be changed. The feedback goes up to the appropriate levels. If the process is changed and the standard is held, comparisons

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are again made. If the standard is changed and the process remains unchanged, the feedback is to be standard. It is possible they both would be changed. Thus, both feedbacks may result from the action phase, and the system will cycle through again.

SUMMARY

- Materials can basically be defined as those objects or things that are to be moved in order to produce goods.
- Materials management is defined as a function that integrates purchasing, storage, inventory control, materials handling and standardization etc. in an organization to achieve its objectives of reducing the costs.
- In any organization, the responsibility for maintaining the quality of the product and incurring less cost on its production is the responsibility of the production/operation.
- The aim of any organization is to manage its 5 M's as effectively as it can. These 5 M's as discussed earlier are Men, Machines, Money, Methods and Materials.
- The basic objectives of material management in an organisation is to obtain materials at the minimum price, however, this minimum price must not compromise on the quality of goods and the continuity of supply.
- The material management system works under the broad basic objectives of an organization that is "maximum profit with sustained growth and research, satisfied customers and staff of the organization".
- The Materials Management can be directly connected to the functional areas of customer satisfaction through Total Quality Management (TQM); Human Resources Management (HRM); environmental issues in material management; cost and finance issues and IT related issues.
- Logistics information systems include two flows that incorporate coordinating and operational activities.
- The coordination flow represents the backbone of overall information architecture for firms that primarily manufacture or distribute products.
- Accounting information plays a significant role in the analysis and management process, for without accurate cost data it is impossible to design or control the distribution system.

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REVIEW QUESTIONS

1. Define materials management. What are the categories in which materials can be put? Discuss the functions of the materials management in detail.
2. If the responsibility for maintaining the quality of the product and incurring less cost on its production is the responsibility of the "production/ operation" and deciding the price of the product and finding the customers that will buy it comes under "marketing". What do the "materials management function" does?
3. Materials flow and information flows are equally important in the materials flow process. Why?
4. What are the objectives of Materials management? What are its advantages?
5. What are the activities of materials and information flow in an organization?
6. What is the scope of materials management?
7. Define the various roles of materials management in the context of internal and external interfaces to materials management system.
8. Describe the role of material management in performing various functions in an organization.
9. How does TQM support in creating customer value in materials management?
10. What TQM implementation strategies would one adopt to bring about the best in materials management?
11. Identify the criticality of the role of information in logistics operation in materials management.
12. Explain the role of materials management in the conserving environment.
13. What business implication do you foresee in the area of environmental management?
14. Strategically, how do materials management and human resources management go together?
15. What are the various cost elements that contribute to the total

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cost in area of materials management? Quote examples to support your answer.

16. Explain the various cost characterizations, quoting examples as given below:
    - Controllable Vs Non-controllable
    - Direct vs Indirect
    - Fixed vs Variable
    - Actual vs Opportunity
    - Relevant vs Sunk.

FURTHER READINGS

Applied Materials Management: S Chatterjee, Response Books, 2005.

Materials Management: Preeti Oberoi, Sarup, 2001

Materials Management: K. Shridhara Bhat, Himalaya Publishing House, 2011.

Materials Management: Planning and Control: Nand Kishore Sharma, DND Publications, 2011.

Purchasing and Materials Management: Anand Kumar Sharma, Anmol Pub, 2006.

UNIT 2 SOURCING OF MATERIALS

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★ STRUCTURE ★

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2.0 LEARNING OBJECTIVES

After going through this unit you will be able to:

- know about industrial enterprises and its objectives.
- understand objectives of purchasing.
- describe a comprehensive system for vendor.
- know about various policies on domestic and international purchasing.
- explain buyers and sellers selection and relationship.
- explain problems in International purchasing.

2.1 INTRODUCTION: ISSUES AND OVERVIEW

Business enterprises are established and operated by people to accomplish a specific yet common purpose—to make money. Business is a set of commercial activities, required to produce a finished product or service desirable to the ultimate consumer.

Industrial enterprises have the distinguishing characteristic that the finished product or service is not for its own consumption, rather for sale to others. The object of all these activities is to market a product or service at a price greater than its cost. To continue in operation and be successful in a competitive environment, the commercial enterprise must

show a profit. The purchasing function of an organization plays a vital role in this profit-earning endeavour. Among several activities, tasks, and assignments the purchasing function takes up, selection and development of supply sources of components, parts, and materials is a critical activity.

ECONOMICS AND PURCHASING

In a market economy, there are several factors at work: the production activity governed by numerous consumer demands, the producers' decisions as to the quantity they will produce, and the activities that are interrelated through the process of buying and selling.

Economics deals with the description and analysis of production, distribution, and consumption of goods and services that people require to satisfy their basic physiological needs, that is, food, clothing, and shelter. *To satisfy these needs—the factors of production* have to be manipulated to gain the specific end results. These factors are as follows:

- **Natural Resources.** These include all goods found in or produced by nature. These include ores and minerals that are mined and used in the production of end products. Oils and natural gas are used as fuel or may enter the finished product. Water falls are used in the generation of electricity. Agricultural commodities are used for foods.
- **Labour Resources.** These are the activities of people used for the production of goods and services.
- **Capital Goods.** These include buildings, machinery, equipment, and tools, used to house and produce goods and services. Knowledge in the basic concepts of economics helps a purchasing agent in planning his or her activities, in selection of the sources of suppliers, and in negotiating the best price. Thus, *purchasing is* an economic activity that contributes to the profitability of the company.

The purchasing agent must be concerned with the overall economic conditions, to analyze and explain why specific supplier prices are set as they are at specific times. The buyer should be able to predict the effect of various market trends on supplier output and buyer demand. Typically, business cycles with the phenomena of unemployment, overcapacity, depression, the start of recovery, and their effects on the world's demand for goods and services may be noticed and analyzed. During the uncertain times, the purchasing agent can show his value to his firm by *operating with understanding and conviction. Most prices* are determined by the law of supply and demand, whereby prices go up when the demand exceeds the supply and go down when the supply

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exceeds the demand. This is especially true with raw materials, agricultural products, petroleum products, and minerals. If the buyer feels that the current price is low, relative to the future, he will probably overbuy and build up the inventory level. The cost of carrying the resulting excess inventory must be taken into consideration. If the buyer feels that the price may drop down in near future, he may not buy at this time, but wait for further drop in price, or he may buy small quantities as a safety factor to ensure continuity of supply.

Purchasing is a very important function in the control of the flow of materials into the manufacturing process to maintain continuous operation of all departments. The flow of materials also controls the level of inventory stock maintained by the company. Good purchasing practices contribute to the success and profit of modern corporations.

2.2 OBJECTIVES OF INDUSTRIAL PURCHASING

The main objective of industrial purchasing is to contribute to the profitability of the industrial operation. In specific terms, the objectives are as follows:

- to obtain the quality of the material best suited for the function intended,
- to obtain the quantity necessary to keep going the production continuously, and to keep the inventory levels at its minimum level, consistent with economic ordering and market conditions,
- to obtain the materials or services at the best price, keeping in mind the quality and delivery requested.
- to communicate freely internally with all departments to assist in the formulation of specifications, new techniques, and new products, and externally with outside sources to gain information that the internal departments can use, such as solving some engineering or technical problem.

2.3 AUTHORITY AND RESPONSIBILITY OF PURCHASING

To achieve the objectives as mentioned, the purchasing department must have the authority to carry out a few basic responsibilities in order to satisfy the needs of the various departments within the organisation.

The head of purchasing function is referred to as the custodian of a firm's purse, and the first and foremost obligation on his or her part is integrity in spending the firm's money. He or she acts as the legally

authorized agent and represents all others in the firm in the acquisition of goods and services needed by the firm. A typical job description for this position includes duties and responsibilities:

- authority to commit the funds of the firm for the acquisition of goods and services,
- responsibility to satisfy needs of the departments when justified,
- responsibility for review of specifications, and authority to challenge the specifications, if found incomplete or incorrect,
- responsibility to interview all vendor representatives, and to arrange for the bidding or negotiation for goods or services,
- authority and responsibility for selection of the source for supplies and no body else has this authority to select a source for any item,
- responsibility to obtain the correct quality, the needed quantity, at the best price delivery at the needed time for continuous operation, and the equal responsibility that the goods, equipment, etc., are safe for the employees to handle.

The purchasing department is a decision-making department whose actions can have a major impact upon the firm's operation and its profits. For example, if the purchasing department decides to buy some material at the lowest price, and subsequently nonconforming material or late delivery occurs that disrupts smooth production resulting in higher priced emergency buying of correct material, significant loss of sales because of rejected finished products or low turnout of the finished product may result.

2.4 WHY SOURCE SELECTION?

Reputed suppliers are intangible assets to any organisation. For they are not only suppliers of materials but are also extremely important sources of information with regard to market conditions, price trends, and the general industrial climate. It is, therefore, natural that many organisations have accepted source selection as a corporate policy. This helps in bringing about a fair competition among the suppliers with supply failures at a minimum level. Source development is also important for import substitution, cost reduction, and quality improvement. Source development needs are dependent on a number of factors, such as make or buy decisions, amount of sub-contracting, break-even points at manufacturing and plant capacity. It should, however, be remembered that source selection and development are regular activities, and as such, must be a way of life in any progressive purchasing department of an organisation.

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2.5 STAGES IN SOURCE SELECTION

Regardless of the buyer's ability to provide the technical services, interpret quality requirements, determine price trends, and provide expertise in all procurement functions, the fact remains that his or her prime responsibility is to find reliable sources and to secure and maintain their cooperation in all matters. This purchasing decision directly influences both the economic success of the buyer's company and the financial stability of the supplier, thus contributing to the economic welfare of many employees and their families.

The selection of responsible suppliers is the essence of the purchasing cycle, and it is imperative that the final authority rests invariably with the purchasing department. In some companies, as a result of shared selection authority, improper supplier selection leads to receipt of inferior goods and services. This gives rise to friction and company morale suffers serious harm. Therefore, it is of utmost importance that the purchasing department is solely given the authority and responsibility for the selection of sources for supplies.

In general, the source selection process consists of four main stages:

1. **Searching.** At realisation for the need for a material or product is the starting point. The search process begins with the finalisation of specifications in consultation with technical departments. Identifying the sources of supply as exhaustively as possible is the next activity. Normally, comprehensive information may be obtained from different sources, such as the Indian Trade Journal, newspaper advertisements, telephone directories and yellow pages, trade directories, the publications of the Directorate General of Technical Development, Directorate General of Supply and Disposal, the Bureau of Indian Standards, RBI Bulletin, and Stock Exchange Directories etc. The routine salescall by suppliers' representatives is another important source of information. Salesmen should be encouraged to present the products in which the organization is presently interested, and their company's entire product line. This enables the buyer to identify potential sources for products which under normal circumstances might be overlooked. Trade-shows, technical exhibitions, and samples are other important sources that assist the search process. The buyer does not have to possess complete knowledge of the item needed. However, knowing the end use of the item can be extremely helpful in determining what information must be assembled for knowledgeable procurement. The material requirements identify the characteristics sought in a potential supplier and enable the buyer to narrow his or her selection to those capable of meeting the item requirements. These characteristics include capability,

capacity, availability, and delivery services. The buyer's goal is to determine which supplier can deliver an acceptable product most economically. The buyer may have information on the past performances of the set of suppliers already I contact. The purchasing department should keep a supplier file with updated performance history. This file should also contain the names of promising potential suppliers. When any item is requested, the buyer usually looks to his or her present or past suppliers as the most likely candidates to supply the needed item. But he should also look at new prospective suppliers. *Salespersons* are extremely valuable sources of information about suppliers. In most cases their information relates to their own company, but many professional salespersons will suggest other sources of supply. Because salespersons are valuable sources of information, the buyer should make every effort to see them and establish good rapport with them. A valuable source of supplier information is catalogues supplied by the suppliers, which describe the various items they handle. For standard production items, such catalogues are the most effective and efficient sources for potential suppliers.

2. **Selection.** The process of search thus provides a list of all possible sources. At the selection stage, specific information on the supplier's financial strength, quality, facilities, efficiency, industrial relations, technical excellence and position in industry is sought. Actually, the possible sources need to be identified and selected on the basis of their ability to meet the delivery and quality requirements in the long run at competitive price levels. The selection of suppliers starts with the floating of enquiries by the buyer to the possible sources that are made available through the search process. Certain progressive suppliers often contact buyers with a request to be included in the buyers' list of 'approved suppliers'. Both the buyers' enquiry and the vendors' request to be considered as a regular supplier, normally lead to visits by the vendors' sales representative. The buyer gets an opportunity to present his or her needs in greater details and also to assess vendors' personnel and capabilities in meeting his or her needs. The buyer follows this by meeting the technical personnel of the vendor, and inspecting the vendor's plant to assess the technical capabilities, efficiency, equipment, financial viability, quality control, raw material practices, and general management aspects. Sometimes, the buyer may write in confidence to some of the organizations which may be using the materials supplied by the vendor in order to assess vendor's rating with his or her clients. This information may form the basis for a preliminary selection

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of suppliers with whom trial orders can be placed after negotiations. It is an established norm and convention that the buyer reduces the list of suppliers to a selected number of acceptable or approved suppliers with whom to negotiate or solicit quotations by way of elimination. However, the list finally prepared should be a comprehensive one. The final list of suppliers must be prepared on the assumption that all suppliers included in the list have the ability to withstand the following three types of competition:

- Technological competition, resulting from pinpointing those suppliers who excel in good ideas, engineering planning design, material and production techniques, and are willing to work with the personnel of the buyer company.
- Price competition, resulting from pinpointing the lowest-cost producers or distributors.
- Service competition, resulting from pinpointing those suppliers who are anxious to get the contract from the buyer company and will add the "plus" values over and above the functional value and price.

3. **Negotiations and Trial Orders.** Once the preliminary screening and selection is over, the process of negotiation starts with the vendors prior to placement of trial orders. Correct and cordial relations with the vendors are essential for mutual cooperation. Various aspects, including terms of delivery, price, and quality are finalised during negotiations, and then the purchase orders are released for the initial trial. Normally, the trial orders do not exceed more than 20 to 30 days' requirements as the buyer has to be convinced, in the first place, about the vendor's capability in meeting his or her needs. The whole process of negotiation is influenced by a number of factors, such as:
   - the need for quantity and technical requirements of the order must be explicitly and concisely explained,
   - personal contact between the buyer and the vendor helps in maintaining a smooth relationship and understanding of each other's problem areas, and
   - the buyer may organise a conference of his or her suppliers on a regular basis with a view to giving them an opportunity to find out where their materials are utilised, to compare and clarify the quality and other technical requirements of the materials they supply.
4. **Experience.** After the trial orders are executed, it becomes necessary for the buyer to quantify his or her experience in the form of

rating the vendors. This activity enables him or her to determine how the total requirements can be apportioned among the vendors. Thus, the basic responsibility of the purchase manager is not only to locate the sources but also to preserve them through continuous rating. A vendor's performance in meeting the quality, delivery, and price standards set by the buyer has to be assessed in a systematic manner. Several rating systems are available. Some aspects can be objectively rated whereas some cannot, but they are nevertheless to be considered while evaluating the vendors. Computed on a periodic basis, vendor rating provides the basis for comparing one vendor against the other for the purpose of eliminating the vendors who repeatedly fail to meet the standards. The vendor's representative, in some cases, can be called for a frank discussion to point out the areas of improvement, so that he or she may continue his or her association with the buyer's organisation. Such a constructive approach, based on a rating system, definitely helps in improving the performance of the supplier in the long run.

2.6 IMPORTANT ASPECTS IN SOURCE SELECTION

In the proceeding sections you have learnt about the reasons behind source selection and its stages. Let us now see some important aspects in source selection.

- **Local Sources.** Generally local sources are preferred, provided they meet the requirements of the buyer in terms of quality, delivery, and price. A personal follow-up or a local "phone call" is enough for effecting quicker deliveries. In fact, some organisations prefer local suppliers even though they may not compare favourably with outside suppliers. This local goodwill is sure to pay in the long run. It is not uncommon to find big organisations in India encouraging ancillary suppliers in and around their plants through technical and financial assistance.
- **Subcontracting.** Selection of sources for subcontracting is another special issue. The manufacturer may decide to 'off-load' some products to suppliers so as to facilitate scheduling of production in the plant. It also enables better utilisation of human resources. This happens because subcontracting is just an extension of the plant's activities and since subcontractors are generally small, they may be in need of technical assistance. Essentially, subcontracting is purchasing, and the subcontractor is a supplier.

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In common industrial usage, the term "subcontracting" has reference to such parts or products as could be produced with the buyer's own facilities and would normally be manufactured within his or her own organisation. Successful subcontracting regards the operations of the supplier as part of a continuous process, leading up to and including the operations in the buyer's own plant. In this concept, the supplier's material control, production efficiency, scheduling, and service are definitely the concern of the buyer company, and as such, must be handled with a high level of cooperation and mutual assistance. So far as the contracts are concerned, the supplier's operations are a part of his or her customer's operation, even though they are carried out at a different shop floor and under a different management. Subcontracting, in most cases, is the fastest method of increasing output. This procedure often enables the main supplier to use the subcontractor's human resources, plant, and equipment instead of his own. This saves the main supplier from incurring capital expenditure in specialised equipment and tools he may not use for his normal production requirements. Subcontracting has come to be of particular importance when associated with primary contractual arrangements between industry and government agencies, especially with construction or defence contracts. The government usually gives extra consideration to contractors who subcontract certain portions of their business to small or minority businesses.

- **Choice between Small and Large Suppliers.** Often in selecting suppliers, the materials manager is faced with this question. If the requirements are small, the small supplier is the obvious choice. A personalised contact can be established and because he is small, he is likely to have fewer customers, be more loyal and meet even unusual requests. Big suppliers are equipped- to meet larger requirements. They usually have reserve facilities and may thus be able to meet additional requirements. They may have R & D facilities which will enable the buyer to obtain technically superior products.
- **Sole Source Versus Multiple Sources.** The buyer must decide whether to place all orders with one supplier, or to give them to two or more suppliers. Using more than one supplier has several advantages, providing there is enough business to keep all genuinely interested. Multiple sources provide a broader technical base. Competition is kept alive as suppliers seek to increase their share of the business. The buyer company is protected against failure at one supplier's plant. However, if the policy of the buyer company to have sole sourcing for its products and supplies wherever feasible,

and this policy is implemented successfully, there is guarantee of long-term and lasting buyer-seller relationship.

- **Inside Source.** There are occasions when the buyer company may have to decide if the needed part or component can be manufactured within its own plant, or procure it form outside. This is known as the make-or-buy decision. The advantages and disadvantages must be evaluated in each case in terms of the individual company's situation. Normally, industrial requirements are satisfied by purchase of the needed product or material from some outside source. However, there is usually the alternative possibility of producing a needed part or product within the buyer's own organisation, sometimes with potential advantages in cost, convenience, or control. This is not always feasible, but it should be considered. In a broad sense, the question "Make or buy?" must be answered in advance of every purchase, in the form of company policy it not by special analysis. This question may refer to a particular fabricated part for regular product use, or, on a broader scale, it may involve the decision of whether the company shall operate its own foundry department instead of purchasing castings or shall have its own printing department.
- **Special Source Conditions.** In cases of certain custom-made items, it is beneficial to both the buyer and the several suppliers to have the requirements spread among them. No individual supplier has the ability, capability, and intent to take up the entire business. Under such condition, an agreement may be reached wherein all suppliers are contacted in rotation for the manufacture, delivery, and service of the product needed by the buyer company. Should a supplier be unable to accept the order at that time, the next supplier would be called, and the rotation would be forward rotation only. This sort of special arrangement may be successful in most cases as suppliers receive a good portion of extra business.
- **Buyer-Seller Relations.** Developing, establishing, and maintaining good buyerseller relationships must be the goal of any progressive purchasing function. It is essential that the seller's representative is treated fairly and honestly in all transactions. When the seller has confidence in the buyer, the buyer's task can be accomplished more effectively. When goodwill exists, negotiations are shorter, terms and conditions are simpler to agree upon, and disputes are kept at a minimum because of good communications. As an added bonus, the buyer's company has a better image, not merely as a customer, but as a good company to do business with. The aim of source selection is to find the one most satisfactory source,

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or a group of alternative sources with adequate and reasonably comparable qualifications. Thus succeeding orders for the same item can be placed with these same suppliers with confidence in the original selection. In other words, the decision as to a source of supply contemplates a continuing and long-lasting mutually productive relationship.

- **Loyalty to Suppliers.** A continuing buyer-seller relationship, based on mutual confidence and satisfaction, implies a policy and, a responsibility of loyalty to suppliers. This is the antithesis of opportunism and constant "shopping around" in purchasing. It is true that some cost savings can be made by such methods, but it is usually at the sacrifice of uniformity and continuity of supply. Especially, it sacrifices the assurance of supply that is the first responsibility in purchasing. Without established and loyal sources of supply, every recurring requirement presents a procurement problem of the first order, and the work of the purchasing department is magnified beyond all reason and proportion.

Experienced purchasing managers are in practical agreement that the long-range considerations of reasonable cost and of satisfaction and value in respect to purchases are best attained through a consistent policy toward supply sources. And a sound purchasing program, like any sound business program, is based on long-range considerations. The buyer who relies on opportunism to gain an immediate advantage makes himself or herself and the company the vulnerable prey of opportunism in selling.

2.7 TYPES OF EVALUATION TECHNIQUES

Over the years, a number of evaluation techniques have been recommended. Some of these techniques are discussed below.

- The ***categorical plan*** is a procedure requiring little definite or specific training, minimum amounts of data collection, and simple analytical techniques; but it depends heavily on the competence and experience of the buyer. The buyer keeps a list of suppliers and their products and lists the good and bad factors concerning quality, performance, and technical service reports. The ratings use a three-point system: plus, minus, and neutral. Monthly evaluation meetings indicate trends for individual suppliers and thus permit analysis of a supplier's long-run performance. The categorical plan's simple recording, reporting, and analytical techniques allow collection and evaluation of data with relative ease and minimum cost. The buyer's experience and judgment are essential to any evaluation plan, but strong reliance on them' may result in data collection and evaluation lacking in precision and fair appraisal.

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- The ***cost-ratio plan*** is based on cost and time data that enable the purchasing department to arrive at the net cost of the goods ordered. All activities pertaining to the supplier's performance are valued in monetary terms. This includes all telephone calls, letters, and other activities required to obtain the order.
- The ***weighted-point plan*** provides a means for the evaluation of the supplier's performance by weighing the factors of measurement designated for the evaluation. The factors have actual "weights" assigned to each, which represent the measure of importance of that factor in regard to this purchase order. The suppliers are usually rated for the quality they provide, the delivered price, and the service they render.

Arbitrary values are assigned to each factor based on the importance of that factor. For example, 40 points may be assigned to the quality factor, 35 points to the price factor, and 25 points to the service factor, which totals 100 points. The supplier achieving a composite rating closest to 100 is the supplier likeliest to receive the order. This sort of factual data can permit other suppliers to take corrective action for future transactions. The technique as mentioned above involves only three factors: quality, price, and service. The number of factors to be considered depends on the product or services requested. One can assign a value to technical assistance, or cost-reduction suggestions, or other such factors, if they are considered important to be considered. The advantage of the weighed-point plan is having any number of evaluation factors included, and their ratings (value to the company) can be assigned according to the needs of the company.

2.8 THE APPROVED LIST OF SUPPLIERS

Purchasing policy in most companies traditionally call for at least two supply sources for any item purchased in volume. The objectives of such a policy are two fold: (1) to protect the company's supply lines against supplier shutdowns caused by strikes or acts of God, and (2) to encourage competition among suppliers by implying that one supplier always has a chance to increase its share of a company's orders by outperforming another supplier.

However, there may be exceptions to the multisource policy. One of the country's largest food processors, may have a single supplier for all its packaging requirements for more than 25 years. Other types of companies, notably the automakers are now sole-sourcing critical parts and plan to continue the practice.

Such relationships, however, require the highest degree of cooperation and coordination between buyer's and seller's technical staffs, comprehensive

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and airtight contracts, and greater incentives for suppliers-mainly long-term contracts that assure them of continued business and reasonable profits.

It is unlikely, however, that multiple sourcing will be abandoned as basic purchasing policy. The larger companies that use sole-sourcing restrict it to very specific items, and often for only a specific period (i.e., for critical parts for a given model of automobile). What can be expected is a continuation and wider use of the policy of narrowing the supplier base. More companies will concentrate their purchases with fewer companies which have proved that they can and will meet high standards of quality, service, and delivery-at a competitive price.

It is most likely that the buyer prefers to purchase the bulk of his or her requirement from one source previously known, provided that there is a real preference for the product and that the supplier's quality, price, and service are satisfactory. But the buyer may also make some purchases from the others from the approved list of suppliers or give them a chance to quote regularly to maintain their interest. An alternative source that is merely another name on a list represents no advantage either to the buyer or the seller. The approved list of supply sources must be used to be useful.

There are two specific criticisms against 'approved list' approach: (i) it is discriminatory in nature and serves to blacklist any supplier that is not included, whereas every qualified seller should be allowed to quote, and (ii) it limits buyers and restricts the scope of their choices. Flexibility and periodic review may overcome both objections. As to the first, it is assumed that all qualified sources have been investigated thoroughly before the list was being built. Further, it assumes that if conditions have changed or if new sources enter the field, the opportunity will be given. The purchasing manager should always be ready to maintain the list at the highest possible standard.

As to the second criticism, the limitation on buyers, if any, is a self-imposed one. In principle, the limitation is set by either of two causes. One is the absence of additional technically or commercially competent suppliers. The other is that there are practical limits to the size of a working list beyond the basic assurance of supply and reasonable competition.

2.9 A COMPREHENSIVE SYSTEM FOR VENDOR PERFORMANCE EVALUATION

A more comprehensive mathematical vendor-rating formula has been developed in the purchasing department of a large manufacturing company. It is known as the "incoming material rating" rather than as a vendor rating because the calculation is based upon experience with a single item or product. It is designed to provide a comparative evaluation of vendor performance in any case in which an item is procured from two or more sources.

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This formula is based upon the principles that: (i) the evaluation of a vendor's performance must embrace all three major purchasing factors, viz., quality, price, and service, and (ii) the relative importance of these factors varies in respect to various items. The first step, therefore, is to assign appropriate weights to each, adding up to a total weighting factor of 100 points. For example, in a given case, quality performance might be rated at 40 points, price at 35, and service at 25, and these percentages are subsequently used as multipliers for individual ratings on each of the three purchasing factors. The assignment of these weights is a matter of judgment.

In rating price, the lowest net price (gross price minus discounts plus unit transportation cost) obtained from any vendor is taken as 100 points, and net prices from other vendors are rated in inverse ratio to this figure.

The details of the vendor performance evaluation system are shown in Table 2.1.

Table 2.1. Format and Factors of a Comprehensive Vendor Performance Evaluation System

Vendon rating report					J.M. Muser Corporation				
Company			Date		Total Rating				
Company	Excellent (4)	Good (3)	Fair (2)	Poor (1)	Production	Excellent (4)	Good (3)	Fair (2)	Poor (1)
Size and/or Capacity	4				Quality	4			
Flameal Strength		3			Price		3		
Operational Profit		3			Packaging	4			
Manufacturmg Range	4				Uniformity		3		
Research Facilities			2		Waranty	4			
Technical Service		3			Total 18	12	6		
Geographical Locations	4				1.25 × Total = 22.50				
Management		3			Sales Personnel				
Labor Relations		3			1 Knowledge				
Trade Relations		3			His Company		3		
Total 32	12	18	2		His Products	4			
0.63 × Toal = 20.16					Our Industry		3		
Service					Our Company		3		
D. Time	4				2. Sales Cells				
Condition on Arrival		3			Properly Sp	4			
Follow Instructions		3			By Appointmet		3		
Number of Rajections	4				Planned and Pro		3		
Mondling of Complaints		3			Mutually Productive	4			
Technical Assistance			2		3. Sales Service				
Emergency Aid		3			Obtain Information		3		
Supply UP to Date Cotalogues, Esc				1	Furnish Q. Properly	4			
Supply Price Change Promtly	4				Fallew Orders		3		
Total 27	12	12	2	1	Expedite Delivery		3		
0.69 × Total = 18.63					H. C.		3		
					Total 42	16	27		
					0.48 × Total = 20.64				

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The service rating is a direct percentage of the lots received as promised, in relation to total lots received. These three ratings are multiplied by their respective weighting factors and the results are added to give a numerical "incoming material rating" for each vendor, for a given item.

2.10 INTRODUCTION: DOMESTIC VS INTERNATIONAL PURCHASE

Once the role and organization of a purchasing department are known, the most basic and important job is to find suppliers that are capable and willing to provide quality, service, and competitive price for the items to be purchased. To get the best sources of supply to meet various kinds of organizational buyers may make choices from among a number of equally eligible sources. Also there can be cases when an *extensive* search may be required to find a supplier, or to even develop a new source of supply in case of complete unavailability of a supplier. A number of principles and methods are required to be applied more intensely today than ever before by any organization. As companies are forced by competition to improve the performance of their products, they, in turn, press the suppliers to upgrade their performance on quality, service, and price. The purchasing managers must apply basic methods of selection analytically and aggressively.

2.11 DECISION ON MANUFACTURE OR PURCHASE

Normally, industrial requirements are satisfied by purchase of the needed product or materials from some outside source. However, there is usually the alternative possibility of producing a needed part or product within the buyer's own organization, sometimes with potential advantages in cost, convenience, or control. This is not always feasible, but it should be considered. In a broad sense, the question "Make or Buy?" must be answered in advance of every purchase, in the form of company policy it not by special analysis. This question may refer to a particular fabricated part for regular product use, or, on a broader scale, it may involve the decision of whether the company shall operate its own foundry department instead of purchasing castings, or shall have its own printing department or undertake similar operations. It may likewise concern the making of special equipment, such as warehouse shelving, or major construction projects.

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2.12 MAKE OR BUY: A POLICY DECISION

Whether to make an item within the user's plant or to buy it from outside sources is a major policy decision. Normally decisions in this aspect are taken at the top level. The role of materials management depends upon the position of the head of the materials management division in the organization. If he is a member of the top management team, a key role is played by him as he is best equipped to deal with the problem.

Otherwise he has to play a supporting role by providing relevant data so that the top management can take a scientific decision. A great deal of coordination is required between materials management and production departments in collection, collation and analysis of data, *such as quality requirements, quantity requirements, existing production* facilities, balance equipment requirements, and so on. An organization may form a committee to analyze and recommend proposals. Make or buy decisions arise due to either of the following two reasons: (i) consistent failures on the part of suppliers in the supply of items, and (ii) availability of items from outside suppliers may not be adequate owing to stiff competition from many end-users.

2.13 "MAKE OR BUY" DECISION MAKING PROCEDURE

The decision to make or buy an item is presumably made before the requirement ever gets to the stage of a purchase requisition, and it is frequently outside the scope of purchasing department responsibility to find the answer. On the other hand, it is an ever-present consideration in determining the best method of procurement, even after a requisition has been received and regardless of previous practice. Therefore, a purchasing department is responsible for analyzing the relative merits and advantages of both procurement methods and of making policy recommendations if a change is indicated. Costs and conditions in the supplier industry may be such as to suggest very strongly the advisability of self-manufacture products, formerly purchased. It may also work in the other direction, when the possibility of advantageous purchase arrangements suggest the adoption of this method, even though such action may mean retirement of equipment and facilities formerly used *in production. The whole program of subcontracting, is an example of* procuring by purchase a wide variety of components, many of which would normally be produced in the purchaser's own plant.

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The significance of the question "Make or Buy?" and the amount of study justified in arriving at a decision depend largely on the volume of business involved in monetary terms. If it concerns a product representing only a few thousands rupees of annual expenditure, it will not make much difference either way. If the amount reaches hundreds of thousands of rupees, it is frequently a matter of utilizing existing equipment balanced against the convenience and cost of procurement from outside sources. If the amount of money involved is really substantial, involving investment in new equipment, a full-scale analysis is essential, going beyond direct cost considerations into matters of company policy, personnel, labor relations, plant layout, scheduling, and the numerous other details incident to any kind of new project or manufacturing programme.

The procedure of arriving at either of the two decisions must be comprehensive one, considering a number of important factors and aspects related to manufacture and purchase. These factors are briefly explained below.

Cost Comparison

The decision of "make or buy" must be approached analytically and objectively. The company's own facilities must be considered as an alternative source of supply in competition with outside suppliers. A change in policy is not so simple as merely changing from one supply to another. When it is concerned only with manufacture of a particular part, utilizing surplus capacity or facilities already on hand, it may not be too serious a matter, and the policy could easily be revoked in case the results proved less advantageous than expected. But in respect to larger and more significant items of supply, and particularly when new facilities are to be added or a new line of operation undertaken, it is likely to involve significant tooling costs, investment in space and equipment and enlargement of the organization, all of which represent a continuing problem of cost and efficient operation. There may be different kinds of analysis worksheets discussed under different situations. A typical, analysis worksheet for cost comparison is presented in Figure 2.1.

In this analysis, first the total cost of purchase is determined for the given item. Cost of purchased goods is accurately determinable. Complete cost up to the time of use is the significant figure: price, plus transportation charges, plus costs of handling and storage. This cost should be calculated on an annual basis.

	Purchased Cost (Rs.)	Manufactured Cost (Rs.)
A. Direct Variable Costs – Note A:		
1. Material–Include Variations for Major Products	Rs.	Rs.
2. Labour–Include Variations for Major Pruducts		
Reroute		
Shift Premium		
Incentive Pay		
Etc.		
3. Subcontract		
B. Overhead:		
1. Materials Handling		
2. Indirect Labor		
3. Hourly Supervision		
4. Training–Include Special Skills		
5. Set up		
6. *Overtime Premium*		
7. Vacation an Holiday Pay		
8. Fringe Costs		
9. *Other Variablek Costs:*		
C. Semi-Variable and Fixed Costs:		
D. Other Costs and Expenses – Note C:		
1. Purchasing, Shapping Storage, Testing, etc.		
2. Administration Cost		
3. *Tooling charges, if any*		
4. Excess Capacity charge, if any		
Total		

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A. Separate departmental labour hour and overhead rates may be preferable to the use of composite rates.
The divisional rate for overhead applied should be predetermined as substantial amounts of direct labour hours are absorbed in the make or buy product.

B. Semi-variable and fixed costs may be included for opecific items.

C. These incremental and out-of-pocket costs are included only when quantities being considered and substantial in amount.

D. Includes vendor's invoice price and adjustmentsd for out-of-pocket non-compensating costs inchuded in the manufactured cost column.

Fig. 2.1. A Typical Analysis Worksheet for Cost Comparison.

Against the estimated total cost of purchase as determined, the total estimated cost of production should be compared. The production cost should include the cost of materials and direct labour, the investment and carrying charges, including depreciation on equipment, and overhead expenses, with due allowance for the possibility of idle time and production at less than capacity, normal waste and spoilage, and the other usual risks of management that are assumed by the supplier when goods are purchased. These costs should be calculated on the standard basis used throughout the company, because the new manufacturing operation may become a part of the company's general activities and must assume its share of the burden. The factor of profit, which is necessarily a part of the supplier's price, is not a proper consideration for the buyer, because the buyer is concerned with costs, and the profit to his or her company accrues only in the sale of the finished product; however, efficient self-manufacture, elimination of sales expense, and consequent lower cost of components do enhance the profit potential in the eventual sales.

The results of a full-scale cost comparison may seriously modify estimates of cost and other advantages based on casual judgment. Almost certainly, it will indicate the prudence of a highly selective approach to the question of "make or buy" based on detailed analysis of the individual case.

Quantity Factor

Unit cost is not the only factor to be considered. The quantity of a requirement is important for several reasons. In the first place, it will help to determine whether or not the potential cost saving is sufficient to warrant the undertaking of a special manufacturing project or process. Second, it has an important bearing on actual costs through the economies of mass manufacture and the possibilities of absorbing initial costs. Third, it should be sufficiently large to ensure that any facilities that may be

established or installed for the purpose are kept reasonably fully occupied so that overhead costs for idle time do not offset the unit-cost advantage.

The solution lies in setting a basic production capacity that is large enough for economical production yet within the limit of minimum expected requirements. This is calculated to keep the facility running at capacity, any deficiencies being supplied by purchases from the outside. The advantages include the convenience of having such facilities conveniently available, the possibility of producing rush jobs without waiting for an outside supplier to fit them into his or her schedule or paying premium prices for extra service, and the possibility of handling short runs and other special and commercially uneconomical requirements on a cost basis.

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Quality Control

In many cases, cost comparison and quantity factor may not necessarily be the determining factor in reaching a decision. It may be desirable to undertake, or to retain the manufacture of an item in the buyer's own plant when costs under this method are demonstrably and substantially higher than prices obtainable from outside sources.

Such high-cost procurement by manufacture is justified on the basis of quantity of the item obtainable through self-manufacture. It is possible to have the assurance of strict quality control when the processing and fabrication of components are performed and supervised by the organization. Close coordination and a single responsibility are frequently better than divided responsibility, and the manufacturer's assurance of guaranty of the item may become the sole determining factor in making the decision.

Furthermore, greater interest and effectiveness in quality development and improvement can be expected on the part of a producer who is following through from raw material to end product than from a supplier who is producing to strict specifications furnished by a customer.

Make-or-Buy Checklist

It is better if the company is able to prepare a checklist for each of the factors to be considered. Answers to the select questions in each factor will help an analyst make decision on the basis of scientific and logical reasoning. A typical checklist may consists of the following questions:

- **Quantity Factors.** Adherence to specifications? Quality control setup? Is proper equipment available? Experience in this type of work? Who pays for bad parts?
- **Capacity Factors.** Is space available? Is available space obtainable? Is machine time available? Must machinery be bought? Are outside

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finishing operations required? Is sales relationship a factor? Is stability or supplier relationships a factor? How much working capital is needed for inventory? Is new capital investment needed? How much use have we for the new equipment? What return can we expect?

- **Labour Factors.** Would layoffs be created? Would it help us hold the organization together? Must staff be increased? Is special training necessary? Are there union pressures? Is the labour rate competitive?
- **Scheduling Factors.** Can we get all necessary components on time? Have we the capacity to adjust to peaks or slowdowns? Would timing be surer with added sources? Are engineering changes frequent?
- **Skill Factors.** Is the best design experience available? Is the part natural to us? Is this the most profitable use of our executive' time? Is design-assistance relationship a factor? Do we have adequate measures of inside efficiency?
- **Cost Comparison** (on the basis of 100 pieces). Material cost, operations cost (direct labour, overhead, and profit), setup cost, tools repair allowance and spoilage, packing and shipping costs from outside supplier, tool charge (cost of tools per 100 pieces).

This is a very complete and scientific evaluation of the problem, dealing principally with the internal company factors involved. However, it should be pointed out that make-or-buy decisions also have external effects and that there are some long-range considerations of this nature that should also have serious attention. The checklist section on capacity factors recognizes this by querying the effect on sales relationships and the stability of supply relationships.

It is not uncommon, in times of business decline, for manufacturers to switch from buying to making certain parts when excess capacity shows up in their own plants. Even if this is done as a temporary measure, rather than as a considered policy based on economy of manufacture, the immediate effect is to leave the suppliers of these parts stranded and to intensify for them the hardships of the business decline, The purchasing manager may well question the wisdom of such use of the make-or-buy alternative, especially if the decision is of a temporary nature. For, when business picks up and the buyer once again seeks parts and service from that vendor, the buyer will almost certainly find that the supplier relationship has deteriorated. In extreme cases, he or she may actually have lost that source of supply. It is apparent, from the many internal elements affected by the make-or-buy policy, that the decision is not one to be made by the purchasing executive alone, even though it is primarily a question of procurement method. It is within his or her province to make are

commendation for or against the method in respect to certain requirements of the materials program, and his or her recommendation should be supported with a detailed analysis of available outside sources, comparative costs, and other factors.

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His or her company, as is true for any other supplier, has the privilege of judging the profit potential and other advantages and disadvantages of the proposal that will determine whether it is advisable to undertake the production or to relinquish it in favor of outside purchase.

Production executives will naturally be in the best position to pass judgment on the equipment and facilities available or needed and on the practicability of the plan. Production and cost departments will check the purchasing manager's cost estimates. Financial officers will check the advisability of the capital investment involved. Technical and engineering advice will be sought on the advantages of quality control within the organization. Marketing executives are concerned with anything that will enhance the salability of the product and possibly with finding an outlet for surplus production from the new department. The final decision, after all these viewpoints have been presented, is a matter for top management.

Conditions for Make-or-Buy

- During the period of business decline or recession, the equipment may be idle, and the manufacturer may undertake to make rather than buy some parts or components to spread the overhead costs and keep employees working, happy, and loyal for the future.
- When an item is purchased, the purchasing agent can negotiate with several suppliers, and the keener the competition, the more favourable the terms that can be gained. When a firm makes an item, flexibility is lost, for there is no competition.
- When there is a monopoly or suspicion of collusion among the suppliers to maintain high prices, the manufacturer may lean toward making the item.
- When top management decides to buy something it formerly made, it obviously incurs all risks associated with the selection of an outside supplier. Less obviously, risk is also taken when management decides to make an item it formerly bought.
- Subcontracting is the result of a make-or-buy decision to purchase the item or component instead of making it.

When a manufacturer is operating at full capacity and still cannot meet his customer's delivery dates, he will subcontract some part or component to enable him to increase his output of the finished product

and thus remain competitive. In this case, the subcontractor can be viewed as an extension of the manufacturer's production process.

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2.14 NEED FOR INTERNATIONAL PURCHASE

For a growing economy like India's, achieving self-sufficiency should be the goal but not at the cost of imports. Importing is an essential economic function which cannot be completely eliminated. Ricardo's principle of comparative advantage states that it would be beneficial for an economy to concentrate on the production of items in which it specialises, to export these items, and to import its requirements of other items. The principle, though not totally practical, cannot be dismissed. International trade is undoubtedly governed by political motives and, as such, a country cannot totally rely on another country for its requirements of specific items. It would be equally fruitless to undertake import substitution at any cost. The Government of India from time to time reviews the import policies considering various aspects such as trade balance, and raw materials stock. Import policies of any state as such are not static and changes in policies and procedures are very important to industries which depend on imports for their production.

The relatively sudden development of a one-world market has important implications for purchasing managers. They now have greater availability of supply, but also a great need for careful selection of sources, some of which may be located thousands of kilometers away. This situation calls for involvement of purchasing department of a company in international purchase.

There are several reasons for international purchase. Some of these reasons are described below.

- **Cost Benefits.** Generally, offshore sources have been able to offer buyers lower prices, particularly on manufactured goods, because of lower labour, material, and overhead costs. Total landed costs, including the cost of transportation for thousands of kilometers in some cases, are often lower than are those of domestic suppliers of a wide range of industrial suppliers and equipment.
- **Continuity of Supply.** Increased worldwide demand of goods made it imperative that new sources of supply be developed. Most industries have become aware since they experienced the kind of shortages during Yom Kippar Arab-Isreal war of 1973.
- **High-quality Technological Know-how.** Foreign suppliers have displayed great flexibility in adapting their manufacturing methods to special requirements. Their products, particularly the process equipment and machineries, are often far advanced over Indian

counterparts and the quality of many products (e.g., stainless steel, high-tolerance forgings, precision ball bearings) is often superior to that of higher-priced domestic items.

- **Greater Competition.** The growth of commerce and industry in economically underdeveloped nations has opened up new sources and new productive capacity. Increased competition and availability in international market have a powerful attraction for professional buyers.
- **Relative Ease of Communication.** The development of almost instantaneous communication and rapid transportation between any points in the world has helped promote international trade. A telephone call from New Delhi to New York, for example, may take almost same time that a call between far cities in India takes. Air shipments from Europe and North America have become very fast.
- **Suppliers may be Customers.** Virtually the whole world may be a potential market for goods produced by a company, so it makes a good economic and political sense to buy in that market when it offers the competitive advantages.

It may be the policy of most multinational corporations to accept some responsibility for the economic development of the nations in which they operate. Moreover, a country may resort to countertrade to generate hard currency to finance new industrial projects. Countertrade is generally a transaction in which a seller agrees to purchase goods from buyers, equal to an agreed-upon percentage of the original sales contract value. It can take a number of forms. In *counter-purchase* transactions, suppliers receive certain goods as partial payment from the buyers. One western tool manufacturer, for example, received products in good supply in the buying country¾salt, silverware, and shoes.

In any case, the recipient of those goods has to dispose of them. In a *compensation* transaction, the supplier agrees to buy a certain amount of "resultant products" (i.e., those derived from the equipment or technology sold to the buyer). The builder of a chemical plant, for example, would agree to buy a certain amount of the product produced by that plant. In both cases, the counter-deliveries do not represent 100 per cent of the value of the sales contract. Each side pays some cash for the products it receives.

Barter is the direct exchange of goods having offsetting values, an even swap, without any flow of money taking place. Generally, purchasing and marketing share responsibility for counter-trade programmes.

NOTES

2.15 PROCEDURE FOR INTERNATIONAL PURCHASE

If a company is importing for the first time, the first and foremost step for it is to check whether the item is allowed to be imported. If the item is banned for imports (on the ground that it is indigenously available), the starting point is to get a list of all local manufacturers and ask for quotations. If the manufacturers are not in a position to supply, a written statement to that effect should be obtained from them. These statements should be presented to the government to get the clearance for imports.

The government, on its part, might give names of some more possible suppliers, or may write to the suppliers themselves and then possibly clear the import of the items. Companies can get import entitlements on the exports even if they are indirect. In case the import clearance is obtained or the item is not banned for import, a company has to go through the following stages to accomplish the purchase:

- **Locating the Foreign Source of Supply:** This has to be done by contacting the Ministry of Trade, Foreign Consulates and Embassies, Indian Consulates in foreign countries and other sources. A foreign consulate or embassy has a commercial attaché who is well versed with the list of suppliers in his or her country.
- **Procurement of the Item:** At this stage the importer will be involved with foreign source of supply, manufacturing unit of his company, engineering department and governmental institutions, such as DGTD, MMTC and STC.
- **Documentation:** Special documents, not used for indigenous purchases, are required in foreign purchase: The Bill of lading, Invoices, Certificate of origin, Weight certificate, Insurance policy, and Markings of Packages are the commonly used documents.

2.16 PROBLEMS IN INTERNATIONAL PURCHASE

Issuing a purchase order to a foreign supplier does not, however, automatically guarantee acceptable prices, better service, high quality for the product to be purchased. Suppliers must be as carefully researched as domestic vendors are. Dealing with unknown companies in foreign markets may present a number of difficulties and obstacles. In order to overcome them, the purchasing people get many opportunities for improving their skills in negotiation, research, and finance. A number of large companies with overseas purchasing operations have, as a matter of policy, used such operations as training grounds for younger personnel marked for advancement to high managerial positions.

There are some problems in overseas buying that require close attention and control. Unless total costs are carefully considered and monitored, the economic advantage that seems to exist in a low initial price may quickly evaporate. Rising freight costs, a high rate of reject in items purchased, labour troubles at supplier plants, delayed deliveries, the need for carrying heavier inventories to protect against such delays, and the possibility of having capital tied up in letters of credit are just some of the elements that may affect the final cost of a product purchased from a foreign supplier.

2.17 SELECTION OF FOREIGN SUPPLIERS

Locating a supplier may involve something as simple as a telephone call or as extensive as a small research project. The buyers may get relevant information on foreign products and producers from a number of sources. However, evaluation of the supplier is somewhat more difficult and time consuming as it may require consultation with other customers of a distant supplier, obtaining and testing samples, or preferably, visiting overseas plants if the producer's reputation is unknown. Information sources include a variety of publications, from trade journals and newspapers to directories of manufacturers and distributors, to trade lists, directory reports, and surveys from the Department of Commerce. One guide to international purchasing procedures lists twenty major directories on international trade. They include such volumes as *The American Register of Exporters and Importers*, published in New York; *Jane's Major Companies of Europe,* published in London; *Dun & Bradstreet's World Marketing directory*, published in New York; *Directory of Swiss Manufactueres and Products*, published in Zurich; and the *Bottin International Business Register*, published in France, which contains information on companies throughout the world.

The Department of Commerce maintains up-to-date lists of names and addresses of foreign companies dealing in specific products in more than a hundred countries. The lists also identify importers and dealers, along with other pertinent information. The department also maintains trade centers in leading foreign cities such as Warsaw, Seoul, Milan, Paris, and Sydney. There are also American Chambers of Commerce in fifty leading cities throughout the world, all prepared to help U.S. buyers and sellers. Embassies and consulates, both of foreign countries and the United States, are similarly equipped to aid businessmen seeking to trade in their respective countries.

Banks, airlines, and shipping companies have significant collections of data on businesses in the countries that they serve, as well information on local customs and procedures. The International Federation of Purchasing

NOTES

and Materials Management (IFPMM) has drawn up a list of member correspondents in twenty or more nations who have agreed to provide overseas buyers with data on suppliers in their respective countries.

When there is no competitive advantage involved, purchasing managers of other companies experienced in overseas buying are usually willing to help newcomers to the field.

2.18 DIRECT AND INDIRECT BUYING

Whether to buy directly from overseas suppliers or indirectly through intermediaries depends to a large extent on the volume and frequency of purchases, the anticipated length of a relationship with a supplier, and the availability of qualified buying personnel.

Small volume or occasional purchasers most often use a variety of middlemen (wholesalers, brokers, selling agents) for overseas transactions. For a fee (which in the case of selling agents or representatives is paid by the supplier), they will handle the basic details of a purchase, including choice of a supplier when necessary. The breadth of services varies widely among these intermediaries, so it is important to know in advance whether or not their fees (which can run up to 25 per cent of the value of the purchase) cover such important elements as research on vendors, shipping costs, insurance, customs, administrative expenses, and degree of financial responsibility, among others. Prudent buyers will also make an effort to determine, preferably from their other customers, the broker's or agent's performance record.

Among the advantages cited for buying through trading companies are greater efficiency and convenience, lower costs, shorter lead times, and assurance of quality inasmuch as inspection is made before shipment and the trading company remains responsible for unacceptable shipments. One criticism is that the prices the companies obtain are seldom established on the basis of costs. Instead, they are based on market levels at the time of purchase and hence the buyer may be deprived of the benefits of direct negotiation.

As transportation and communication improvements make the world market even more compact and accessible, middlemen will undoubtedly be relegated to a minor or highly specialized role in international trade. A separate foreign purchasing office or cell in an organization may be set up because of the following reasons:

- **Lower Operating Costs.** Foreign purchasing overhead is generally lower than the brokers' fees. Communication is more effective and less costly.

- **Better Control.** On-site administration provides better control over price, quality, and delivery schedules. The foreign office is also better equipped to handle the intricacies of foreign exchange.
- **Up-to-date Information.** The rules and regulations that govern foreign transactions in overseas countries often change, and an on-site office has access to the most current legal and economic information.
- **Better Understanding.** Foreign nationals in such offices can *often negotiate better agreements because of their familiarity* with the territory, local business conditions, local customs, and, of course, language.

2.19 MAIN DOCUMENTS IN INTERNATIONAL PURCHASE

There are many types of documents prepared and used for international purchase. The main documents are discussed below:

1. **Bill of Lading.** The bill of lading is the most important document which accompanies bills of exchange drawn under letters of credit. It is an evidence of the fact that goods have been despatched by the exporter and gives the importer title to the goods and enables him to claim them on arrival at the destination. *A bill of lading* is a document signed by the master of a ship or by the ship owners or their agents acknowledging the receipt or certain specified goods for carriage and embodying an undertaking that the goods will be delivered to the consignee, or to his order or assignee, or merely to order. The bill specifies the port of shipment, the destination and the condition under which the goods are received for carriage.
2. **Invoices and Certificates.** Among the documents that accompany bills of exchange drawn under letters of credit in foreign trade transactions are the commercial invoice, the consular invoice, the certificate of origin, and the packing list. There are in effect detailed descriptions of the goods shipped, their prices and other charges, the country of origin of the goods, and other particulars of the transaction. Which of these documents are included and in what form is a matter of contract between the buyer and the seller.
    - **Commercial Invoice.** This document describes the merchandise, and indicates the price and other details of the transaction. The name and address of the buyer and the seller, the vessel

NOTES

of shipment, the port of discharge, the shipment, export and import permit numbers, the number of contract and invoice, and the other essential details of the transaction are recorded on the invoice. The financial terms of the sale, such as whether under letter of credit, and sight drafts are given. The number of packages and the identifying marks and numbers on them are clearly indicated. The goods contained in the packages are detailed and prices are given item by item, the trade discount is deducted from the gross aggregate price of the goods, and a total net value is shown. Any other charges to be included under the contract such as for packing, freight, insurance, and the cost of preparing a consular invoice are added to the total. The commercial invoice is neither a document of title, nor is it negotiable.

- **Certificate of Origin.** The laws of some countries require a certificate of origin of imported goods to be produced before clearance of goods by customs and assessment of duty. An importer, therefore, may request the exporter to send a certificate of this kind along with other documents. The certificate is usually required where goods from certain countries receive preferential treatment or the import of goods from some countries is partially or wholly prohibited. The country where the goods are produced should, therefore, be known to the customs authorities. Sometimes, the certificate of origin is endorsed on the back of the relative invoice, in which case the whole document is known as a "Certified Invoice".
- **Packing List.** A packing list serves to indicate the exact nature, quantity, and quality of the contents of each package in a shipment. The list helps the importer to identify the goods and check them against his own order. Banks may require such a list when they have financial interest in the merchandise. Clearance of goods through customs is also facilitated by packing lists.

3. **Nature of Insurance Policy.** Marine Insurance Policy is a contract between the insurer and the insured whereby the former, in consideration of the payment of a premium by the latter, agrees to indemnify the latter against loss incurred by him in respect of goods exposed to "perils of the sea" or to the particular perils insured against. For a policy to be valid, the insured must have an insurable interest in the goods subject to insurance, i.e., he benefits from the existence of the goods and suffers a loss if the goods are damaged or lost. The insured need not have this interest at the time of insuring, but must have acquired it at the time of putting

a claim under the policy for damage or loss of the goods. The insurer, known in marine insurance parlance as the underwriter, is the party providing insurance cover, and it may be an insurance company transacting marine business or some firm of underwriters. A proposal for marine insurance is made through a marine insurance broker, who writes the particulars of the proposed insurance on a ship, which he submits to some underwriter. If the latter accepts the risk he signs the slip, and the insurance is in force from that time though the actual policy is delivered later.

4. **Markings of Packages.** A packing list serves to indicate the exact nature, quantity, and quality of the contents of each package in a shipment. The list helps the importer to identify the goods and check them against his own order. The banks may require such a list when they have a financial interest in the merchandise. Clearance of goods through customs is also facilitated by packing lists. The packages should be suitably marked with address, dimensions, weight, and other particulars.

5. **Payments.** The importer is involved with banks, the Ministry of Finance, and the Reserve Bank. The documents involved are: (i) letter of credit/drafts, (ii) terms of payment, (iii) rate of exchange, (iv) payments under various credits and trade agreements.

6. **Letter of Credit.** A letter of credit is an arrangement whereby the obligation to pay an exporter is undertaken by a bank. The bank's credit is available to an importer who is not known outside and who otherwise would not be trusted with goods by a trader in another country. If a letter of credit is received from a bank, the credit standing of the importer is of little consequence. What becomes important to the exporter is the credit standing of the bank issuing the letter of credit. The importer requests a bank in his country to issue a letter of credit in favour of the exporter. The bank writes to a correspondent or some other bank in the exporter's country that a credit has been opened in favour of the exporter, and the latter bank informs the exporter about it. The advising bank informs the exporter that it will honour drafts drawn by the latter under terms and conditions laid down in the letter of credit. The liability for payment is really that of the bank issuing the letter of credit and the bank that honours the drafts drawn by the exporter, gets reimbursed by the issuing bank. The essential elements of a letter of credit are as follows:

   - The name of the bank issuing the letter of credit is stated on the top of the instrument. The exporter receiving the letter should see whether the bank is acceptable to him or not.

NOTES

- The instrument mentions the name and full address of the beneficiary, i.e., the seller in whose favour it is issued.
- The amount for which the credit is issued is clearly stated. This amount is sometimes calculated exactly on the basis of the quantity of merchandise to be shipped. Banks are then not willing to accept and honour drafts for a smaller or larger amount. To avoid this difficulty some flexibility mentioned in the amount is introduced by using the word "about" with the sum.
- The name of the importer for whose account the credit is opened is mentioned in the letter of credit. The credit standing of the importer is of little consequence to the seller if he is satisfied with the issuing bank. In fact, the importer may not be known to the exporter at all.
- The letter of credit lists the documents to be attached to the draft drawn under it. The list is made out by the importer and given to the bank of issue. The documents are such as clearly indicate the discharge of contractual obligation by the exporter. Any discrepancy between the documents that accompany the draft and as those specified in the letters may result in a refusal by the advising bank to honour the draft.
- The letter of credit has an expiry date, *i.e.*, a date up to which the instrument is valid. A time or an exact date is mentioned by which the whole operation should be completed. The date given is normally one which will allow the exporter to conveniently ship the merchandise under the contract and to get all the required documents within the period. Again, if the time given is not enough for the exporter he may communicate with the issuing bank or the importer and get the date changed.
- The type of credit opened, whether revocable or irrevocable, confirmed or unconfirmed, is stated on the instrument.

2.20 INTRODUCTION: VENDOR NETWORK

The search for competitive differentiation has led firms to move from their predominantly cost-based focus of the 1950-1970s to the one based on both quality and cost during the 1990s. This change has created a paradigm shift in business practice from the "producer-driven orientation" of the past to today's "customer driven orientation". The competitive environment of the present is characterized by continual and unpredictable

changes in market demand, in terms of both product specifications and quantity. This has also led to the need for manufacturers to have enough capacity to produce a broad range of high-quality products at low cost with short lead times, and to build these products in an efficient way to suit the specifications of individual customer.

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It may often be the case that no single organization can respond quickly enough to the changing markets in a competitive environment of this type. Furthermore, large organizations are often very complex and slow to move, while smaller organizations suffer from a scarcity of resources. These conditions favour the emergence of new forms of dynamic network to connect manufacturers. Such a network develops on the basis of temporary alliances with other parties. These alliances are based on the core competencies of the various suppliers to create a supply chain that is highly responsive and flexible at responding to customer orders. To ensure such flexibility, the supply chain is considered to be temporary and its precise form is dependent on the demands of the market. By developing collaborations of this kind, manufacturers can increase their level of expertise and minimize the risk of investment.

2.21 SELECTION OF SUPPLIERS: A KEY ISSUE

One of the key issues in developing such a supply chain network is the selection of the suppliers. Sound selection is crucial since the performance of the chain depends on every single organization involved. Many factors are usually taken into account in the supplier selection process. Samadhi and Hoang (1998) have suggested a three-stage procedure for evaluating supplier compatibility, starting with abstract and strategic factors, moving through their attributes in terms of manufacturing, and ending with logistical factors. Talluri et al. (1999) have given a framework for the design of a design value chain network with a two-stage procedure that combines data envelopment analysis (DEA) and goal-programming techniques. In other work, De Boer et al.(1998) have proposed the outranking methods to support the selection of suppliers. These methods are based on multi-criteria factors. In all of this research, by De Boer et al. (1998), Samadhi and Hoang (1998), and Talluri et al. (1999), the strongest emphasis is placed on the strategic factors that need to be considered in selecting suppliers.

On the other hand, some efforts have been made to address operational factors. D'Amours et al. (1996) have developed a model for the price-based planning and scheduling of actions to do with multiple products to create a symbiotic manufacturing network. In that research, they have assumed a set of bids from potential suppliers as given. The impact of information sharing on the development of networked

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manufacturing has been considered in subsequent work by D'Amours et al. (1999). Li and O'Brien (1999) have developed a two-stage model for the design of an efficient supply chain. It focuses on analyzing the impact of three possible manufacturing strategies, the make-to-order (MTO), make-from-stock (MFS), and make-to-stock (MTS) strategies.

2.22 OVERVIEW OF DECISIONS AND PROBLEM DEFINITION IN SUPPLY CHAIN NETWORK

The objective of the supply chain network is to minimize the end customer's total level of dissatisfaction, composed of price and delivery lead time. As Samadhi and Hoang (1998) have explained, there w be no collaboration if there is no one to initiate it. The suppliers to be selected to participate in the collaboration must also be compatible with the initiator(s). In this research, a set of manufacturers is given. The manufacturing company that receives the prospective order directly from the ends customer acts as the initiator. This manufacturer is then at the chain level decision of this supply chain network. The other manufacturers respond to the initiator's lower-level product-procurement requests. In this research we use the term "supplier" to describe any manufacturer playing a lower-level supporting role. After receiving a prospective order, the initiating manufacturing company sets the goals for the potential suppliers at each stage of the supply chain. These goals are: due date for delivery (d), quantity required (q), and required unit price (r). The potential suppliers then play their part in achieving these goals by applying the operational-level model to optimize their manufacturing and logistical activities to determine the order quantity(Qo^{min}). After receiving responses from all potential suppliers at each lower stage of the chain, the initiating manufacturing company uses the chain-level model in the final stage to determine the order quantity for each selected supplier (partner), and estimates the performance of the supply chain.

Decisions at the operational level are thus concerned with the optimizing the manufacturing and logistical activities of each potential supplier to meet the customer's requirements. Chain-level decisions then deal with evaluating each bid from the potential suppliers and determining the final configuration of the supply chain.

2.23 PURCHASING PERFORMANCE AND SUPPLIER DEVELOPMENT

Facing increasingly competitive challenges, many organizations view supplier performance as an important contributor to their competitive advantage.

They work closely with suppliers and expect to improve performance and capabilities by engaging supplier development programs.

It has been reported that such programs have been extensively implemented in western countries. However, developing the supplier has also provided quite challenging. A conceptual model for guiding the implementation of supplier development program was proposed by Hahn et al. However, it was not empirically tested. Some perceived critical elements of supplier development were explored by Krause and Ellram, and some "antecedents" of involvement in supplier development program were also identified by Krause. But these factors were not linked with purchasing performance. In this body of literature, few empirical research studies have been conducted to examine the factors which are critical to the success of the approach.

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2.24 SUPPLIER DEVELOPMENT MODELS: A REVIEW OF LITERATURE

Hahn et al. developed a conceptual model that described the organizational decision process associated with a supplier development program. This model was established just on the basis of experience of several companies actively engaged in such a program. Krause and Ellram conducted a survey of 96 US purchasing firms and found that the majority of buying firms involved in supplier development perceived their suppliers as partners and placed a greater emphasis on some critical elements than those not involved in such programs. These critical factors included two-way communication, top management involvement, cross-functional teams and larger purchasing power.

Krause developed reliable and valid measures of the factors influencing supplier development and tested a structural model that postulated the interrelationship among these factors. The buying firm's propensity to engage in supplier development may be affected by its perception of supplier commitment, its expectation of relationship continuity, and effective buyer-supplier communication.

The studies in this field provide some useful insights for managers who wish to invest their time and resources to improve supplier's performance. Supplier development stresses that direct supplier development plays a critical role in driving performance improvement in purchasing and contributes strategically to overall organizational effectiveness.

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2.25 INFLUENCING FACTORS OF SUPPLIER DEVELOPMENT

The important elements of supplier development may be identified from the buying firm's perspective. The following factors are worth mentioning:

- **Long-term Strategic Gal.** Supplier development efforts should focus on developing supplier future capabilities in technology and product development rather than focusing only on current quality and cost. The clarity of long-term strategic goals is the key to the success of supplier development programme.
- **Effective Communication.** Open and frequent communication between buying firm personnel and their suppliers is identified as a key approach in motivating suppliers. Early involvement and open channels of communication increase both parties' understanding and encourage problem solving between both parties.
- **Partnership Strategy.** The majority of buying firms involved in supplier development may perceive their suppliers as partners. Adopting a partnership strategy means that a buying firm pursues a long-term relationship with suppliers and they would like to show their commitment. Without buyer's commitment, the suppliers may be unwilling to make changes in their operation to accommodate and desires of that.
- **Top Management Support.** It is top management who recognizes the need to initiate a supplier development programme based on the firm's competitive strategy. Purchasing management needs the encouragement and support from top management to expend their resources within a supplier's operation.
- **Supplier Evaluation.** Not all selected suppliers qualify for development assistance and a buying firm must carefully identify where to focus its supplier development efforts. Supplier evaluation results can provide valuable information about general areas of weakness where performance improvements are required.
- **Direct Supplier Development.** In order to pursue excellence and develop best practices, the suppliers need the encouragement or expertise of their buyers. Direct supplier development activities include providing support personnel, capital, equipment, technology, or direct involvement with suppliers in identifying and eliminating non-value or duplicate costs, processes and time. These assistances from the buyers can accelerate supplier capability improvement greatly.
- **Perception on Supplier's Strategic Objective.** Supplier

development requires a mutual recognition by the buyer and supplier of the need for continuous performance improvement. Supplier development would not work if the supplier does not have a compatible strategic objective with that of customer.

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2.26 INTRODUCTION: BUYERS-SELLERS RELATIONSHIP

Purchasing decisions remain largely a matter of personal judgment and it is necessarily carried on, to a great extent, through personal contacts and relationships. The purchasing manager is the custodian of company funds, responsible for their conservation and wise expenditure. He or she also is a custodian of the company's reputation for courtesy and fair dealing. The ultimate act of selecting a vendor and awarding the order is essentially a matter of patronage. For all these reasons, a high ethical standard of conduct is essential. The purchasing manager not only must act ethically but should be above the suspicion of unethical behavior. A code of conduct in this context may be a prerequisite and should be formulated. A few principles that are required to be followed by the purchasing function are as follows:

- To consider, first, the interests of his company in all transactions and to carry out and believe in its established policies.
- To be receptive to competent counsel from his colleagues and to be guided by such counsel without impairing the dignity and responsibility to his office.
- To buy without prejudice, seeking to obtain the maximum ultimate value against each rupee of expenditure.
- To subscribe to and work for honesty and truth in buying and selling and to denounce all forms and manifestations of commercial bribery.
- To accord a prompt and courteous reception, so far as conditions will permit, to all who call on a legitimate business mission.
- To respect his obligations and to require that obligations to him and to his concern be respected, consistent with good business practice.
- To cooperate with all organizations and individuals engaged in activities designed to enhance the development and standing of purchasing.

In fact, establishing a long-standing relationship with the supplier base becomes the ultimate objective of any purchasing function.

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2.27 OBLIGATIONS TO THE COMPANY

The purchasing manager's obligations to his or her own company essentially consist of the responsibility for doing a complete and conscientious job in the function to which he or she has been assigned. The code wisely goes beyond this, however, in emphasizing the obligation to buy without prejudice. That implies the obligation to maintain an open mind on purchasing matters. Prejudice is usually interpreted as discrimination against particular suppliers, their representatives, or their product, usually on personal or irrelevant grounds. Basically, however, prejudice concerns an attitude of mind on the purchasing manager's part that has implications far beyond this relatively simple and elementary example. Prejudice is not altogether a negative concept. A good part of all sales effort consists of the attempt to prejudice a buyer in favor of a product or supplier. There is nothing remotely unethical about this. Often it succeeds only too well. There are probably more orders placed because of the inertia that comes from habit, reinforced by relatively trouble-free experience with an established source of supply, than are withheld because of annoyance with a salesperson's mannerisms or dislike for his or her taste in shoes. The purchasing manager has an ethical responsibility to the company not to be put under special obligation to any supplier by the acceptance of excessive entertainment or by permitting sales representatives consistently to buy his or her lunches, even though this may be done in the spirit of ordinary business courtesy. Such relationships should be kept on a thoroughly equitable basis. For this reason, progressive companies provide their purchasing executives and buyers with expense accounts. A few important aspects in this regard are as follows:

Ethical Obligations

The code of conduct as mentioned is necessarily of a general and practical nature. It is certainly true in purchasing that courtesy and fair dealing beget confidence and cooperation on the part of the supplier, assets that frequently spell the difference between a merely adequate purchasing performance and a major contribution to operating efficiency and sound profits. Without these, ordinary purchasing problems can readily become serious supply emergencies, particularly in times of economic change or stress. There are opportunists and "sharpshooters" in purchasing as in every other field, but they are rarely successful over any extended period of time. A growing company that expects to be in business a year or ten years hence will do well to insist upon and to support high ethical standards in its procurement policies and practices.

NOTES

The Problem of Gifts

It is a fairly common practice for a company to distribute some sort of gift to its customers during festival seasons. It is natural for sales representatives to direct some of these gifts to the purchasing department. In the great majority of cases, such gifts are relatively inexpensive and represent a genuine expression of appreciation and goodwill. Many purchasing departments, however, have established a definite policy against the acceptance of such favours: First, because of the possible suggestion of commercial bribery; and second, because the cost of such gifts is a "sales expense" that eventually must be reflected in the price of the goods sold and purchased. Some weeks before the holiday season, suppliers are notified of this policy by letter. Any gifts received contrary to the policy are returned with an explanation or donated to a charity. Items of small value, usually of an advertising nature, may be exceptions to such a rule. But there is danger in the haphazard interpretation that "two cigars are acceptable, but a box of cigars must be returned."

The Effects of Example

The head of the purchasing function is usually concerned with prestige and efficiency in the buying operation, and will avoids placing him or her under any obligation to a supplier, as a matter of ordinary business sense. Buyers can be similarly motivated if they are convinced that the company policy is firm and is enforced and observed at every level of the company, starting at the top. Various forms of commercial bribery have taken place in many company departments, even in top management-more than most people realize. That is why the head of the department must not only establish a strong policy but set a good example.

2.28 SUPPLIER RELATIONS

All department heads, but particularly purchasing managers, have an ethical responsibility to see that their companies enjoy a reputation for scrupulously fair dealing. As the point of contact in dealing with suppliers, they have a special responsibility in this respect. Their actions and conduct are critically judged, and this judgment is quickly and widely disseminated among salespeople at large. Whether or not the criticism is justified, purchasing managers cannot afford to ignore it.

It should be clear that purchasing managers are under no moral obligation to see every salesperson. Sales interviews are but one of the many activities that occupy them. This does not contradict the policy of receptiveness and openness. Some matters are not appropriate to the company's needs; others are not timely at the moment the salesperson

NOTES

chooses to call. Some salespersons are inconsiderate in making frequent calls when they have nothing new to contribute. Purchasing managers and not sales representatives are the proper judges of when calls become too frequent. But this does not relieve buyers of the obligation of courtesy, a prompt acknowledgment of the call and a reason for not granting an interview. Every salesperson should be seen on the first call and be given an opportunity to tell his or her story; subsequent policy will depend on the particular circumstances. There is no justification for keeping any caller waiting for a protracted period if the interview is to be denied. And in any event, waiting time should be kept at a minimum.

Accomplishing this may be primarily a matter of organizing the reception procedure. Callers should be announced to the buyer on arrival. If there is an immediate answer, it can be given at that time. If there is to be any appreciable delay before the interview can be granted, for any reason, the sales representative should be apprised of the approximate waiting time that will be necessary.

Similar courtesy should prompt the purchasing manager to inform unsuccessful bidders when a proposition has been closed, as well as to inform the one who receives the order. Small companies, particularly, cannot afford to have a large number of proposals outstanding. This would overtax their capacity should all bids be successful.

They should therefore be relieved of these tentative commitments of capacity promptly. Furthermore, if the notification indicates in what respect the proposal fell short of the buyer's requirements, it will help the vendor in future negotiations and may lead to the development of a useful source of supply for the buyer. At the same time, it will temper the disappointment of an unsuccessful bidder to know that there was a real reason for the adverse decision.

When a sample is accepted for test, it entails an obligation on the buyer's part to make a fair trial, and it is a courteous gesture to inform the vendor of the outcome of that test, at least in general terms. Some buyers find it easy to terminate an interview by accepting a sample, even if they have no serious intention of giving it a trial. Such practice verges on misrepresentation and in the long run undermine the confidence that is essential to sound business relationships. It is avoided in many companies by a policy requiring that all sample lots for trial be bought and paid for by the buyer's company. This procedure works both ways: it incurs no obligation to the vendor, express or implied, beyond the transaction itself, and it gives the company a definite interest in completing the trial and making a fair evaluation of the product or material thus acquired.

Well-considered policies of this nature build confidence and respect and

strengthen the personal relationships between the buyer and the vendor. Relations with supplier are affected by a number of factors, which are briefly discussed below.

NOTES

Obligations to Suppliers

If business is to be awarded on the basis of bids, the buyer should insist on receiving firm bids within a stated time. If the buyer permits or encourages revisions, particularly at the last moment, the way is opened for sharp dealing on the part of vendors, and the buyer is not free from suspicion of the same fault on his or her own side. *If revisions are to be permitted*, the same opportunity should be frankly offered to all bidders, and, if the specifications are changed because of an alternative product offered by one of the bidders, all should be invited to bid on the new specification. The purchasing manager is *not responsible for a vendor's error in calculating a bid.* But, if one of the proposals seems excessively low, indicating that an error may be responsible for the discrepancy, it is good practice to ask for a recalculation. If it happens that some item has been omitted from the estimate or that a mathematical error has been made, the purchasing manager is not in the position of taking advantage of such an inadvertent slip to the detriment of the seller. On the other hand, it frequently happens that such a recalculation results in an even lower bid, although this possibility may have been far from the buyer's mind. Naturally, if the bid is accompanied by a detailed breakdown of costs and the error is patent, it would be unethical to hold the vendor to such a proposal, which obviously does not represent the vendor's real intention.

Once an order or contract has been placed on the basis of a legitimate bid, the buyer is not responsible for assuring the bidder a profit on the transaction. Sellers occasionally appeal for relief from a contract that turns out contrary to their expectations, but the buyer is under no obligation to surrender or modify his or her own contractual rights if the agreement has been made in good faith. The buyer has an ethical responsibility to his or her own company and to competitive bidders in cases of this sort. If an adjustment can be made, or an alternative source found, without sacrifice of the buyer's position, it may be wise to take such action on the grounds that service and satisfaction will be greater under the new arrangement. But the whole purpose of the contractual agreement is to provide for carrying out the transaction as planned, with a definite allocation of responsibility to both parties, including the risk of unforeseen developments. As a general rule, sellers respect the buyer who stands firmly on his or her rights and prefer to do business on this basis, having the corresponding assurance that the buyer will observe his or her responsibilities under the contract just as conscientiously.

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Confidential Information

The buyer is under no ethical compulsion to answer questions other than those that relate directly to the proposal. Competitive price information is regarded as confidential and should not be disclosed under any circumstances. And, although it is generally true that full and frank discussion leads to a better mutual understanding and perhaps to a better purchase, there are circumstances in which factors other than price are also of a confidential nature. Although trade secrets are much less a factor in industry today than they were a generation ago, there are still a number of things that a company may wish to keep strictly within themselves. All buyers are well aware that suppliers rarely know the full extent of the uses that their product serves, the buyer may need to waive the benefits of any implied warranty on the seller's part and has no basis for later expressing dissatisfaction or pressing a claim for unsuitability in his or her purchase. The seller who is not informed as to the intended use is bound only to the extent of conformance with any specifications that may be set forth in the order.

Sharp Practice

The term "sharp practice" is best defined by some typical illustrations of evasion and indirect misrepresentation just short of actual fraud. They belong to the old school of unscrupulous shrewdness, when buying was concerned with the immediate transaction rather than the long-range programme. These examples would have been commonplace among an older generation of buyers, and sellers in that period were habitually on their guard against such possibilities. In modern procurement and marketing, which are based on mutual confidence and integrity, such practices are frowned upon just as severely by the buyers themselves as by the sales organizations with which they deal.

It is sharp practice for a buyer to talk in terms of large quantities, encouraging the seller to expect a large volume of business and to quote on a quantity basis, when in fact the actual requirement and order are to be in relatively small volume that would not legitimately earn the quantity consideration.

It is sharp practice to call for a large number of bids merely in the hope that some supplier will make an error in his or her estimate, of which the buyer can take advantage. It is sharp practice to invite bids from suppliers whom the buyer will not patronize in any case, using these quotations only for the purpose of playing them against the proposals of those who are really acceptable sources of supply. It costs money, time, and effort to prepare estimates and bids. Sellers are glad to undertake the expense in the hope of securing a contract, but the buyer has no

right to impose these costs on a seller when the buyer has no intention of giving the seller an opportunity to get the business.

It is sharp practice to leave copies of competitors' bids or other confidential correspondence in open view on the desk while negotiating with a seller, in the knowledge that the latter can scarcely fail to notice them.

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It is sharp practice to deal only with "hungry" suppliers and to try and keep them hungry so as to force concessions. More generally stated, this applies to any abuse of purchasing power to the detriment of the seller. Although it is legitimately expected of a purchasing manager to make full use of his or her company's purchasing power, this factor should normally operate to mutual benefit, with the buyer's position strengthened by virtue of being a more desirable customer, offering greater volume, steadier flow of orders, more prompt payment, or similar considerations of value to the seller.

Combating Unethical Practices

The subject of business ethics is not one-sided. Purchasing managers and buyers are faced from time to time with unethical sales practices. There is sharp practice in selling, collusive bidding, restrictive conditions in specifications, artificial stimulation of demand and prejudice among shop operatives, sabotage of competitive products, padding of orders and shipments, use of unfamiliar trade terms and measurements, supposedly sample orders that are magnified into excessive quantities, obscure contract clauses buried in small type, and many others. In most cases these can be avoided by proper selection of vendors, but perhaps only after unfortunate experience has indicated the disreputable sources of supply. In dealing with some of the practices, such as collusive bidding, more direct and aggressive action is called for as a corrective measure.

What is needed to restrict such unethical practices is competent, objective buying, supported by the necessary follow-through with insistence on contract performance, acceptance testing, and the like. The purchase order or contract in itself constitutes a legally enforceable document. All supplementary agreements, specifications, and special terms should likewise be reduced to writing, using care to see that no ambiguity exists in respect to what is expected of the seller.

Confidence in a supplier is an essential of any sound purchasing department, but confidence need not be blind. It must be earned and the reputable supplier welcomes the opportunity to show that he or she is worthy of confidence.

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2.29 POLICIES FOR RELATIONSHIPS

Every purchasing department has policies, whether or not they are put into writing. They are one of the administrative tools of departmental management. There are three specific advantages of establishing these policies:

1. an established policy eliminates the necessity for making a new decision every time a comparable situation arises,
2. a written policy assures understanding and ensures that decisions and actions are consistent and in accordance with the judgment of the responsible department head, and
3. an approved policy gives authority to the indicated course of action. The policies may be described under the following categories.

Internal Relationships

The establishment of a purchasing department is in itself a policy or company management. It immediately entails a whole series of internal and interdepartmental policies relating to lines of authority, channels of procedure, and departmental relationships in general. These policies should be promptly clarified and made a matter of record, for they define the scope and responsibilities of the purchasing function in any particular organization and determine to a considerable extent the effectiveness of the purchasing operation. Neither can they be set by the purchasing manager alone, because they affect the responsibilities and actions of other departments as well. Policies in this category include such matters as the authorizations required on requisitions to purchase, permissions for vendors' sales representatives to contact plant personnel, the final responsibility for specifications, the procedures to be followed in standardization and value analysis recommendations involving engineering changes.

To be effective, a policy must be clear and definitive, but it need not be arbitrary. Consequently, many policies set up criteria for decisions, or methods of handling situations, or conditions of action. For example, it is obviously undesirable to grant free access to plant personnel for all vendors' sales personnel, either at their own initiative or at the request of plant managers, for such a policy would negate the principles of centralized purchasing. Yet there are many situations in which such a contact is mutually desirable and is, in fact, an aid to intelligent procurement. A sensible and commonly accepted policy on this point is to require that such contacts be made through the purchasing department and that in such interviews no commitments are to be made by plant personnel as to preference for products or sources, which might weaken the position of the purchasing department in subsequent negotiations.

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Vendor Relationships

Relationships with vendors and their representatives, too, are subjected to policy control. It is for the buyer to decide whether a particular proposal from a supplier is per tinned and timely from the viewpoint of the company's needs and whether the interview time is warranted. The purchasing department may suggest fixed calling hours, and, make provision for exceptions in the case of the out-of-town caller and special appointments. The policy guidelines may dictate that

- price information is kept confidential for industrial purchasing,
- vendors are permitted to revise their bids only in case of obvious error, or in a subsequent negotiating stage if terms, quantities, or specifications are modified so as to warrant a price adjustment,
- if it becomes a new proposal on the buyer's part, a new request for bids may be in order,
- if the vendor is selected on merit, on the basis of the original proposal, and the terms are altered in negotiation, he or she will probably stand on the original choice,
- unsuccessful bidders are required to be with the reasons for the adverse decision, if feasible.

Ordinarily, purchasing policy favours the use of the buyer's standard order form and terms in all cases. But sometimes, when Installations and special warranties are involved, the vendor's form that is specifically designed for these situations is more appropriate and obviates the need for writing in a lot of special clauses and conditions on the buyer's form. For such cases, purchasing policy can set up certain criteria for the acceptability of a seller's form. These criteria safeguard the rights of the buyer and avoid conflict with other basic company and purchasing policies. The policy may include getting approval of the contract by the company's legal department. It may be good policy to use personal contacts on a systematic basis and to extend it with a policy of inviting vendors periodically, individually or as a group, to acquire a personal knowledge of the buyer's plant operations.

Policies On Supply Source

Another group of purchasing decisions that lend themselves to the guidance of a consistent and considered policy concerns the selection of supply sources. The policy of maintaining multiple or alternative sources is almost universal. But this does not answer the question of what kind of sources should be chosen. The local supplier usually offers natural advantages of convenience, faster deliveries, and lower transportation cost. There are factors that weigh in his or her favour

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in any source consideration. However, the objective appraisal of supply sources may show others to be equally or more desirable, and a more distant competitor may underbid the local bidder sufficiently to offset his or her initial advantage. To foster good community relations local sources sometimes, are given business thereby helping maintain local prosperity by keeping business in the local area. These factors have enough validity and importance to make some companies go so far as to establish a small percentage cost differential that is considered acceptable in dealing with local sources, all other things being equal. Such a policy is usually permissive, rather than mandatory.

Assuming that facilities are adequate and that prices are competitive, the policy should be made known regarding preference of small or large companies as suppliers. The case for the small company as a supplier usually hinges upon the fact that an order or account of given size looms proportionately larger in the operations of a small supplier, and it is logical to expect that he or she will give it closer individual attention and service than it might receive in the larger organization, where it is of relatively minor importance. Another argument cited in favor of the small company is the rather paradoxical one that the buyer's patronage helps the small company to grow larger and hence the buyer will get greater loyalty and cooperation from the small supplier.

Both arguments are probably unfair to the many efficient and conscientious large supplier companies that have attained their present stature through high standards of service. Should an effort be made, as a matter of policy, to deal, so far as possible, directly with primary manufacturing sources rather than through distributors and other middlemen? If quantity warrants, there may be some price advantage on direct shipments. If the distribution system and price structure are such that there is no saving on direct purchases, as is often the case, there may be advantages in the distributor's services. A reputable manufacturer supports his or her products and warranties, and usually provides essential technical services in either case.

Reciprocal Purchasing Policy

One of the most troublesome and controversial policy questions that purchasing executives have faced is that of reciprocity. The urge to select suppliers on the basis of how much they may buy from one's company is both common and understandable. But it generally does not come from those purchasing managers who take scientific purchasing seriously. Most of the effort to promote reciprocal buying comes either from suppliers or from within the buyer's own organization, usually from top management or the sales department. Under any form of reciprocal buying policy, purchasing becomes less selective because freedom of choice from among

several suppliers is limited. It negates the critical criteria that scientific purchasing calls for in the selection of sources, and it discourages competition among other suppliers, who quickly become aware of its existence. In short, the purchasing manager may lose of negotiating and buying power.

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2.30 NEGOTIATION IN PURCHASING

Negotiation is one of the more important and interesting aspects of the purchasing cycle. It can also be one of the most stressful parts of arriving at a purchasing agreement. Negotiation is complex and costly, and is used primarily for high volume purchases and for new items where costs are unknown. High value purchases do not automatically dictate the use of negotiation. The competitive bidding process is the preferred method of purchasing, because competition is more likely to determine the right price than are most skilled negotiators. When competitive bidding is not feasible, negotiation becomes the appropriate method of purchasing.

2.31 DETAILS OF NEGOTIATION

Webster's defines negotiation as "conferring, discussing, or bargaining to reach agreement in business transactions." For the purchasing agent, negotiation must be used in its broadest sense, as a decision-making process regarding a purchase order. In this context, negotiation is a process of planning, reviewing, and analyzing all data used by the seller and the buyer to reach an acceptable agreement for the purchase order, which includes all aspects of the business transaction, not just price. Thus, *Negotiation* may be defined as "the process of working out a procurement and sales program together, to the point of reaching a mutually satisfactory agreement."

In practice, the term is generally applied in industrial purchasing to the more complex situations involving buyers and sellers, in which both make a number of proposals and counterproposals before an agreement is reached.

Elements of Negotiation

Negotiation depends on the use of communication skills and involves the psychology of persuasion. The purchasing agent must know that negotiation in itself is a useful tool of human behavior, for negotiation is conducted between two individuals, and as such, can be mastered by study and practice.

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The purchasing agent should enter negotiation with a positive attitude toward achieving the objective, as well as having decided upon the maximum extent of his potential concessions. Nothing contributes more toward successful negotiation than advanced planning of strategy and setting the objective.

Objectives of Negotiation

The main objectives of negotiation are as follows:

1. to obtain a fair and reasonable price for the quantity requested,
2. to receive assurances that the supplier will perform on time,
3. to exert some control over the manner in which the contract is performed,
4. to persuade the supplier to give the buyer's firm maximum cooperation, and
5. to develop a sound and continuous mutually beneficial relationship with competent suppliers. Contracts often contain clauses pertaining to changes in the original agreement, which are usually made by negotiation. A typical contract contains the following information:
   - Price (escalation clauses, redetermination clauses, allowable costs in cost-plus contracts, etc.).
   - Quantity, quality, delivery schedule, and mode of transportation.
   - Terms or other conditions that may alter the performance of the original contract.

The Negotiation Process

Prior to any negotiation session, the purchasing agent negotiator must evaluate all relevant information and assess his or her own strengths and weaknesses as well as those of the supplier. From this assessment, the purchasing negotiator develops the tactics and strategy for negotiation. This plus the negotiating skills are the controlling factors that can be influenced by the level of preparedness for any and all contingencies.

The first step in planning for negotiation is to establish the objectives. In developing these objectives, actual numerical ranges are established for quality acceptance, actual dates of delivery, and actual monetary value for applicable elements of cost. The major elements of cost traditionally negotiated include quality of material, quantity of material, quantity of labour, labour wages, price of material, factory overhead, and other costs entering the price factor. It must also be noted that the purchasing agent should never enter into negotiations unless the supplier's negotiator has the authority to agree to any or all of the points in the negotiation.The following issues become highly relevant in the negotiation process:

NOTES

1. **Supplier's Bargaining Strengths.** The seller's bargaining strength usually depends on the following three factors:
   - the seller's desire for the contract,
   - the seller's certainty of getting the contract, and
   - the time available for negotiation

The seller's desire for the contract: The purchasing agent should encounter no difficulty in determining the eagerness of the seller for the contract by noting the frequency of the sales representative's calls about the goods in question and by knowing general market conditions. These are positive indicators of the seller's interest in the contract. The seller's annual financial report, as well as the backlog of orders, volume of operation, and the trends of the industry are valuable information. The less a seller needs or wants a contract, the stronger is his bargaining position. The presence of an industry boom places the seller in a strong bargaining position. The reverse is true in a general recession or when the seller has excess unused production capacity.

The seller's certainty of getting the contract. If a seller learns that his prices are lower than his competitors' or that he is the preferred source or the sole source, the seller will conclude that the chance of obtaining the contract is almost 100 percent. Under these circumstances the seller can become most difficult to deal with during any negotiation. In extreme situations, the seller may be unwilling to make any concessions.

When trapped by such circumstances, the purchasing agent may threaten delay and search for an alternate source. Such approach is likely to be ineffective unless the supplier knows that other sources are available and interested in the contract. Another option, when no payments are involved, is for the purchasing agent to threaten to have the item manufactured in the plant. When made realistically and the seller believes that the buyer's plant has the technical know-how and capacity to make the item, this threat gets consideration.

A firm's negotiating position is always strengthened when the firm has a policy that states that only the purchasing agent has the authority to discuss pricing, timing, and other contractual conditions with the seller. Most pre-negotiation leaks give the seller a feeling of self-confidence about getting the contract. Such leaks are often from the technical or production staff, and because they are often undetected by general management, they can be a continuing source of profit loss.

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The time available for negotiation. Short lead time drastically reduces the purchasing agent's bargaining strength. Once the seller learns of the short lead time, he merely "drags his feet" and negotiation terms become favourable to him.

2. **Purchasing Agent's Bargaining Strengths.** The purchasing agent's bargaining strength also depends on the following three factors:
   - the extent of competition among the potential sellers,
   - the adequacy of cost and price analysis, and
   - the thoroughness of preparation by the purchasing agent.

The extent of competition among competitors. The greater the number of potential suppliers, the greater is the purchasing agent's bargaining strength. The general economic climate, among other factors, has a substantial bearing as to the extent to which supplier wants to compete. The backlog of orders, shop load, and inventory position, are the other factors that have a stray bearing on the ever-changing competitive climate. If necessary, the purchasing agent may increase competition by developing new sources of supply, buying supplier companies, providing tools, money, and management to competent but temporarily weak suppliers, or by making the items in-house rather than buying.

The adequacy of cost and price analysis. A comprehensive knowledge of the principles of cost and price analysis is one of the basic responsibilities of an effective .urchasing agent, and more so for the- purchasing negotiator. The greater the amount of information available to the purchasing agent concerning the various costs of the supplier, the greater is his bargaining strength.

The thoroughness of the purchasing agent's preparation. The more knowledge the negotiator acquires about the theory and practice of negotiation, the supplier's bargaiiling position, and the items being purchased, the stronger his bargaining position becomes. A purchasing negotiator without a thorough knowledge of the item *being negotiated (how it is used, what items can be substituted* for it, its alternate method of production, and his company's future requirements for the product, etc.) is greatly handicapped in negotiation. The purchasing agent is similarly handicapped if he has not studied, analyzed, and evaluated every detail of the supplier's proposal. Whenever feasible, before requesting quotations or entering negotiations, the purchasing agent should estimate the price and value levels of the product to be contracted for. Knowledge of current economic conditions as well as trends in the market for the product in question are also essential to preparation.

NOTES

3. **Negotiation Techniques.** A competent negotiator determines before, or very early in, the session which o f the *concessions* he is prepared to make are of the greatest importance to the supplier. By holding off in these areas while making minor concessions in other areas, the purchasing agent retains assurance of making substantial gains later in the session. Once the purchasing agent makes the concessions important to his adversary, he loses his bargaining strength. The buyer should strive *never to lose the initiative* that he automatically obtains when he receives the supplier's proposal. The competent buyer always "carries the game" to the supplier. He should keep the supplier on the defensive by making him justify his position. The *wise use of questions* is a very important technique in negotiation. By properly timing and phrasing the question, the negotiator can control the progress and trend of the negotiation. The *technique of answering* questions is just as important as the technique of asking them. The competent negotiator knows when to answer, when not to answer, when to answer clearly, and when to answer vaguely. Not all questions require an answer. The *correct answer* in negotiation is not governed by the same rules governing answers in the classroom. In case of negotiation questions, the correct answer is the answer that helps promote short-term tactics and long-term strategy. Another important characteristic of a competent negotiator is being a *good listener*. By listening the buyer can learn the basic need of the supplier. Suppliers may talk themselves into concessions the buyer could not otherwise gain. Listen carefully to the choice of words, phrases, and tone of voice; at the same time observe any gestures or "body language" used. They can be revealing. There is also the *human side* to negotiations. The buyer may know the supplier's representative; if not he should strive to learn as much as possible about the personal habits of that representative. When tempers start to get out of hand, as they occasionally do, the experienced negotiator quickly diverts attention from the "stressful" situation at hand. A joke or a tea break can be an effective method for easing the tension. This type of diversion is usually more easily accomplished when each participant knows what situations are most irritating to the other. In most purchasing negotiations, interdependence is the backbone of bargaining relationships. Neither the buyer nor the seller can achieve any goal without taking the goal of the other into consideration. The end product of negotiation is an exchange of concessions that result in a contract advantageous to both parties. While both buyer and seller benefit from a well-negotiated contract results are seldom divided 50:50. In most cases a 60:40 contract results because one negotiator is more skillful. The process and techniques of negotiated purchasing deserve special attention for two basic reasons. First,

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the whole concept of negotiation is widely misunderstood, and in many cases suspect, even by persons engaged in purchasing. Second, technological change has made industrial procurement increasingly complex, particularly in defense related industries. Simple rule-of-thumb approaches to buying one-of-a-kind machines or systems, for example, are no longer adequate. Nor are they any longer satisfactory in the purchase of less complicated items like raw materials and maintenance supplies. The trend toward long-term purchase agreements on these commodities has placed special emphasis on many aspects of the transaction that are open to negotiation. Responsibility for holding inventory, timing of deliveries, methods of transportation, inspection, and prices are only a few of the factors that must be agreed upon before a purchase is complete.

2.32 COMPETITIVE BIDDING AND NEGOTIATION

When competitive bidding is used in industrial purchasing it usually indicates that there is a market for the item and that some prices level has been established. The product to be bought is an accepted standard and its specifications are relatively simple and clearly spelled out.

Negotiation, on the other hand, calls for face-to-face discussion by buyers and sellers to hammer out details of a contract too critical to be covered by an exchange of paperwork. The product under consideration may be one-of-a-kind of special design or competition. There are rarely competitive markets for such items, and certainly no established prices. Negotiation is definitely called for when buyer and seller have different estimates of what it costs to make, deliver, and service a product.

Negotiation invariably involves discussions on a range of elements that go beyond price, such as warranties, technical assistance and service, methods of shipment and packaging, and payment terms. Even contracts for standard items requiring large expenditures over a year or more should be negotiated on the same basis.

Negotiation is generally used in the following situations:

- When the purchase involves equipment of a unique or complicated nature that has not been purchased before and for which there is little cost information. A conveyor line for a new, automated food-processing plant is an example. Details of the construction, performance, and cost of such an installation require involved technical discussions before a purchase was actually made.
- When prices of an item are fixed, by custom, "fair-trade" laws, or actual collusion among suppliers. If there are many suppliers in

the field, good negotiating tactics are generally successful in winning concessions from one producer who is anxious to get the business.

- When there are few suppliers or only one in the field, but the product in question can be made in the buyer's own plant or bought from abroad or a substitute for it is readily available.
- When a number of suppliers have bid on an item, but none of the quotations is completely satisfactory. None may meet the buyer's requirements as to price, terms, delivery, or specifications. In this situation, the buyer must be sure, before he or she attempts to negotiate, that all bids are unsatisfactory in terms of the requirements that he or she first placed before the suppliers. It is highly unethical to lead a supplier into committing himself or herself in a quotation merely to put him or her into a disadvantageous bargaining position. Responsible buyers will notify suppliers in advance that bids may be subject to negotiation.
- When an existing contract is being changed and the amount of money involved is substantial enough to warrant discussion. Major price changes on high-volume items, for example, are subject to negotiation.

2.33 NEGOTIATING GUIDELINES AND RULES

Negotiation is often a highly technical matter, but it is always a very human matter as well. Because the essential element in a negotiation is bargaining between individuals, the process involves personalities, human motives, people's strength and weakness, and a great deal of psychology. The following general rules are worth mentioning in this context:

- **Try to have the negotiation carried on your home ground, according to your own arrangements.** There is a psychological advantage to having the other party come to the discussion. It implies that you are in control and have already won one concession. Provide a dignified, comfortable, well-lighted meeting place, free of distractions. Put the leader of your own negotiating team at the head of the table, and try to keep the members of the other team separated.
- **Let the supplier do most of the talking.** At least, in the beginning. Let the supplier give the reasons for his or her demand first. If you use the proper restraint, he or she may talk himself or herself into making concessions that were never intended.

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- **When your time comes to talk, don't fumble over facts and figures.** Never send out for vital information in the middle of a discussion. Lack of information or lack of confidence puts you at a strong psychological disadvantage.
- **Try to avoid emotional reactions to the supplier's arguments or an emotional approach in presenting your own.** Otherwise, you'll obscure the real purposes of the negotiation and possibly endanger your own position. A person who lets pride or anger govern his or her relations with others usually ends up by giving away more than he or she intended.
- **If the supplier has to retreat on a point, let it be done gracefully.** If you spot something wrong in a cost estimate, for example, don't accuse the other side of trickery or ineptitude. Suggest that a revision is in order.
- **Avoid premature showdowns.** You have to come to some sort of a showdown ultimately—that's the reason for the negotiation. But, if you force a supplier into a position in which he or she feels compelled to say, "Here are my terms, take them or leave them," that may end the discussion there. After that kind of an ultimatum it would be difficult for the supplier to give further concessions. So, before you make your final concession, be absolutely sure that it is absolutely final.
- **Satisfy the emotional needs of the people with whom you are negotiating.** Most suppliers enjoy selling and persuading, but they are somewhat insecure. Give suppliers a chance to persuade rather than trying to head them off brusquely, and they will be better disposed to make concessions to get your business. And give them the impression that, despite your bargaining with them, you respect their position and regard them as members of your corporate team. Attributes of the person negotiating a contract play a crucial role for successful negotiation. In this context, one must be familiar with the attributes of good negotiation. The attributes of good negotiators may be as follows:
  - They must be clear, rapid thinkers. The give and take of a complex negotiation requires a person bale to think quickly.
  - They must express themselves well and easily. In negotiation what you know may not be as important as what you convey to others. The ability to communicate effectively is an absolute must. Ease of expression does not mean glibness. It comes from a knowledge of the business at hand.
  - They must possess the ability to analyze. They must be able to

analyze the statements of others and identify those who favor their position, those who oppose it, and those who favor another solution.

- They must be impersonal. In the heat of a hard-fought negotiation, it is sometimes difficult to remain calm. But a negotiator must always approach a problem from the basis of the company objective rather than from personal inclinations.
- They must be patient. Sometimes letting the other persons talk themselves out or explain their positions helps resolve issues without argument.

SUMMARY

- Business is a set of commercial activities, required to produce a finished product or service desirable to the ultimate consumer.
- Economics deals with the description and analysis of production, distribution, and consumption of goods and services that people require to satisfy their basic physiological needs, that is, food, clothing, and shelter.
- Purchasing is an economic activity that contributes to the profitability of the company.
- The main objective of industrial purchasing is to contribute to the profitability of the industrial operation.
- The ***categorical plan*** is a procedure requiring little definite or specific training, minimum amounts of data collection, and simple analytical techniques.
- It would be beneficial for an economy to concentrate on the production of items in which it specialises, to export these items, and to import its requirements of other items.
- If a company is importing for the first time, the first and foremost step for it is to check whether the item is allowed to be imported.
- The bill of lading is the most important document which accompanies bills of exchange drawn under letters of credit.
- A letter of credit is an arrangement whereby the obligation to pay an exporter is undertaken by a bank.
- The objective of the supply chain network is to minimize the end customer's total level of dissatisfaction, composed of price and delivery lead time.

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- The purchasing manager is the custodian of company funds, responsible for their conservation and wise expenditure.
- Webster's defines negotiation as "conferring, discussing, or bargaining to reach agreement in business transactions."

REVIEW QUESTIONS

1. List and discuss the important criteria that you may use to determine: (i) possible sources of supply, and (ii) acceptable sources of supply.
2. Identify the elements that determine a stronger and longer buyer-seller relationship. Does multiple sourcing lead to a bad relations with suppliers? Why or Why not?
3. Discuss some of the socioeconomic developments of recent years that have had an impact on purchasing in India.
4. Discuss, in detail, the components and structure of a comprehensive vendor rating system. Is it necessary in all situations? Justify.
5. Differentiate between purchasing and subcontracting.
6. Why is "approved list of vendors" approach not suitable in certain cases?
7. List the advantages of purchasing requirements from foreign suppliers.
8. Mention and briefly discuss the problems that a buyer may encounter while entering the international market in the first time.
9. Discuss, with suitable examples, how socioeconomic and cultural aspects may become the determining factor in the success of international purchasing.
10. List the important documents that are required for purchasing products from foreign suppliers. What are the essential elements of each of these documents?
11. How are the foreign suppliers selected? What precautions must be taken while negotiating a contract with a foreign supplier?
12. Why has management of supplier network become a contemporary and critical issue? Explain with reference to the present industrial situations.
13. Draw the supply chain network indicating different kinds of flows and decision variables. What is the basic objective of such a network?
14. What are the issues critical for supplier development? Discuss each.

15. How is the performance of purchasing function dependent on supplier development? Illustrate with suitable cases and examples.
16. List the problems and risks in supplier networking. What are the preventive measures that may be suggested in this context?
17. Describe a few situations in which negotiation is considered the appropriate method of purchasing.
18. Explain the difference between purchase by competitive bidding and purchase by negotiation.
19. Mention the basic principles and techniques to be followed in purchase by negotiation.
20. What are the factors that influence the buyer-seller relationship? Discuss them in brief.
21. Discuss the important policies that a company is required to use to foster good buyer-seller relationships.
22. 'Sound ethical principles contribute toward better buyer-seller relationships'. Comment.
23. What precautions a company should take to maintain sound ethical purchasing norms and practices?

FURTHER READINGS

Applied Materials Management: S Chatterjee, Response Books, 2005.

Materials Management: Preeti Oberoi, Sarup, 2001

Materials Management: K. Shridhara Bhat, Himalaya Publishing House, 2011.

Materials Management: Planning and Control: Nand Kishore Sharma, DND Publications, 2011.

Purchasing and Materials Management: Anand Kumar Sharma, Anmol Pub, 2006.

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UNIT 3 MATERIALS PLANNING AND CONTROL

★ STRUCTURE ★

3.0 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- know what is materials planning and budgeting.
- understand about manufacturing of products.
- know about various types of industries.
- explain about MRP and its uses.
- define pull and push system.
- understand various concepts like RRP, CRP, PAC etc.
- define just-in-time (JIT) function.

3.1 INTRODUCTION: MATERIALS PLANNING AND BUDGETING

Production and manufacturing are terms used to describe a set of processes used for converting raw materials into finished products. These raw materials, or inputs, undergo a number of stages of conversion, with each stage using a particular production, or manufacturing, process, and at each stage, the material(s) undergoes conversion and assumes a different form. The effective management of production and manufacturing must provide finished or end–products of the required quality, and in appropriate quantities, to satisfy the demand for the products at the desired times and at a reasonable cost. Thus, production and manufacturing planning and control functions are concerned primarily with the aspects of quantity or volume, delivery or timing, quality and cost. Before going any further, we must note the fine distinction between production and manufacturing. Technically, manufacturing and production are the same, but whereas the term manufacturing can be used for any kind of production, it is generally used in cases where discrete products are produced. Such products are usually engineered products like automobiles, aircraft's, refrigerators, machine tools, heavy, medium and light machines, televisions, radios and appliances, and manufacturing is the process of transformation of raw materials into these discrete engineered products. These products are distinctly different from bulk materials and products such as steel, fertilizer, chemicals, cement and pharmaceuticals.

The important point here is that material in various forms, such as ores, raw stock, raw materials in the form of bars, plates, sheets, angles etc., purchased components and subassemblies, and in-house manufactured component and subassembly, is the essential input, and production of bulk materials and manufacturing of discrete products can only be carried out effectively if, and only if, the requirements of various materials are adequately planned, budgeted and controlled.

Material planning and budgeting is the starting point and the most important activity of materials management. If the planning of the requirements of various material inputs is either wrong or untimely, then the functions of manufacturing planning and control are most adversely affected. Materials planning deals with a number of critical questions, which include the following:

(*i*) whether to make a component/subassembly or an intermediate product, in house, or buy from an external vendor/supplier?

(*ii*) How much to order? Or how much to order every time an order is placed?

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(*iii*) When to order? Or how frequently to place orders for that material? Moreover, the amount of order will depend on the stock, or inventory, in hand and on order. The elements of the task of materials planning and budgeting for production of bulk materials and products differ (and at times quite significantly) from that for the manufacture of discrete products. The procedures and algorithms used for planning, budgeting and control are also somewhat different.

In this unit, we will discuss the various aspects of materials planing and budgeting in manufacturing and production. However, before we can take up the details of materials planning and budgeting in manufacturing industries, and in continuous process industries engaged in the production of bulk materials and products, we must briefly discuss the management of production and manufacturing. We must also identify the links and interfaces of materials planning and budgeting with purchasing and stores on one hand, and materials control, on the other. The material requirements planning algorithm will be discussed in detail in this unit.

3.2 MANAGEMENT OF PRODUCTION AND MANUFACTURING

When we think of materials management, we basically have in mind the management of materials required for production and manufacturing of end products. Materials management is very closely tied with production and manufacturing and, as a mater of fact, the requirement of materials originates from production, or manufacturing. For this reason, we must first briefly discuss the relevant details of production and manufacturing management. Production is the term used for the set of processes needed to transform raw materials into finished products. These raw materials can be different forms, such as, ores for production of steel, copper, aluminium etc., raw stock for production of chemicals and pharmaceutical formulations and crude oil for production of petrol, diesel, kerosene/ aviation fuel etc., pig iron and steel scrap for iron foundries, and bars, plates/sheets, pipes/tubes etc. for being converted into components for discrete products like automobiles, machine tools, refrigeration's etc. The production processes transform these raw materials through various stages of conversion to the desired end products(s), with each stage of conversion transforming the input material to another form. The cut length of steel bar, a raw material, becomes a spindle (a component), and then the component becomes an input to the next stage, undergoes an assembly process to become the part of a subassembly, and so on. The point to remember is that all these – the bar, spindle and subassembly – are materials, and the timely availability of these materials is crucial

for the production of the end product. The transformation of raw materials into a discrete engineered production is shown in Figure 3.1.

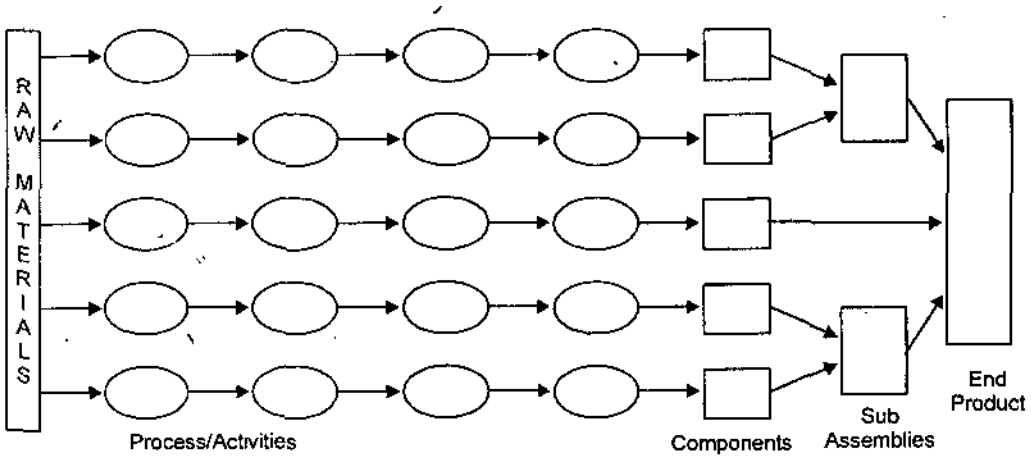

Fig. 3.1. Manufacturing—Transformation of Raw Materials into a Discrete Engineered Product

The management of production and manufacturing thus deals with the management of industries engaged in the production of bulk materials and products and the manufacture of discrete products. We should first examine the different types of such industries, and this should be followed by a discussion of the function of planning and control of production and manufacturing systems in these industries.

Types of Industries

We have already made a distinction between production and manufacturing. Based on this distinction, we may classify all these industries under two broad heads, namely:

1. Continuous process industries engaged in the production of bulk materials and products, and
2. Manufacturing industries engaged in the manufacture of discrete products.

The manufacturing industry is very diverse, ranging from aircraft and ship building industries, right through machine building (heavy, medium and light), machine tools, equipment manufacturing, manufacturing of consumer durables and appliances, up to automobiles, and manufacturers of electronic devices, computers, radios and television. This diversity of products gives rise to differences in the mode of management of the manufacturing system. There are companies which take up the manufacture of the product only after the receipt of an order from the customer. These are the make-to-order companies. In these companies there is no finished goods, or end product, inventory. Then there are the make-to-stock companies which manufacture products for inventory and then

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this finished goods inventory is sold to the consumers through the channels of distribution. The third kind of manufacturing company is the assemble-to-order company. These companies assemble a wide variety of end products from a smaller set of standardized options. The difference here (with the make-to-stock companies) is that the finished goods inventory is essentially of standardized subassemblies/ assemblies and devices, and when an order is received from the customer, these standardized options are assembled, in accordance to the specific requirement, to make the desired end product. In the make-to-stock companies, the finished goods inventory acts as a buffer and separates the assembly process from the customer orders. The forecast of demand for different products, in its portfolio, is thus crucial in such companies. The reader should also realize that the demand of some of the products may be seasonal in nature. As opposed to this, the assemble-to-order firms need to carefully integrate actual customer orders with planning of manufacture of the standardized options and final assembly.

Another distinction between manufacturing companies has to do with the complexity and volume of component manufacture and assembly undertaken. Some companies do little in-house manufacturing, and purchase most of the components prior to assembly, whereas, others with extensive machining and other processes of conversion, have significantly more complex and larger component manufacturing activities.

Manufacturing Planning and Control*

The three primary objectives in most manufacturing organisations are as follows:

1. Maximizing customer service.
2. Minimizing inventory investment.
3. Achieving efficient plant operation.

The inherent problem in meeting these objectives comes from the fact that these three objectives are basically in conflict with one another. Maximum customer service can be provided if finished goods and in-process inventories are raised to very high levels and the plant is kept flexible by altering production levels and varying production schedules to meet the changing demands of customers/market. The second and third objectives are thus in conflict with the first. Efficient, that is low cost, plant operation can be achieved if production levels are seldom changed, machines are run for long periods once they are set up for a particular product and no overtime is incurred. However, this results in large inventories and poor customer service.

Inventories – raw materials, work-in-process, and finished goods – can be minimized if customers are made to wait, and/or if the plant is forced

to react rapidly to changes in customer requirements and interruptions in production resulting from changes in priorities. The fact is that few companies, if any at all, can afford to work towards one of these objectives to the exclusion of the others, since all three are equally important for earning an adequate profit on investments made and for the sustained success of the organisation. Manufacturing planning and control is concerned basically with providing the information needed for day-to-day decisions required to reconcile these objectives in plant operations. Thus an effective manufacturing planning and control system is essential for the successful operation of a manufacturing organisation. Before we take up the discussion of the manufacturing planning and control system, a basic misconception must first be removed. This is that production and inventory control are two separate functions, because in most organizations, production and materials management are separate departments. However, the basic truth is that raw material and purchased/bought-out components are procured in a manufacturing plant and their inventories maintained to support production, and thus materials and inventories are themselves the result of production. Only in a trading organisation, where materials are bought and then resold without any processing at all, can material/inventory planning and control have a meaning apart from manufacturing planning and control (however, in such organisation, the production function does not exist and therefore, there is no need for manufacturing planning and control). Thus, material/inventory planning and control is an essential part of the manufacturing planning and control system.

A block – diagrammatic representation of the manufacturing planning and control system is shown in Fig. 3.2. The figure shows the principal activities (shown in blocks) and the way they are connected to each other (shown with the help of arrows). Since planning and control are evidently an ongoing iterative series of activities (control based on plans and feedback from control, in turn, affecting the plans), material control and capacity control are connected to material planning and detailed capacity planning respectively with the help of two-headed arrows. The process of planning begins with forecasting. Long-range forecasts are used to develop resource requirements for production, such as technology, equipment, machinery, capital, and skills required. These resources do not change in the intermediate range, that is, over the period for which production has to be planned. Thus the resource requirement plan, derived from the long-range forecast, is then used as an input to production planning (Note: resource requirements planning is a part of strategic planning and this has been so noted in the figure). Production planning is also known as aggregate production planning,

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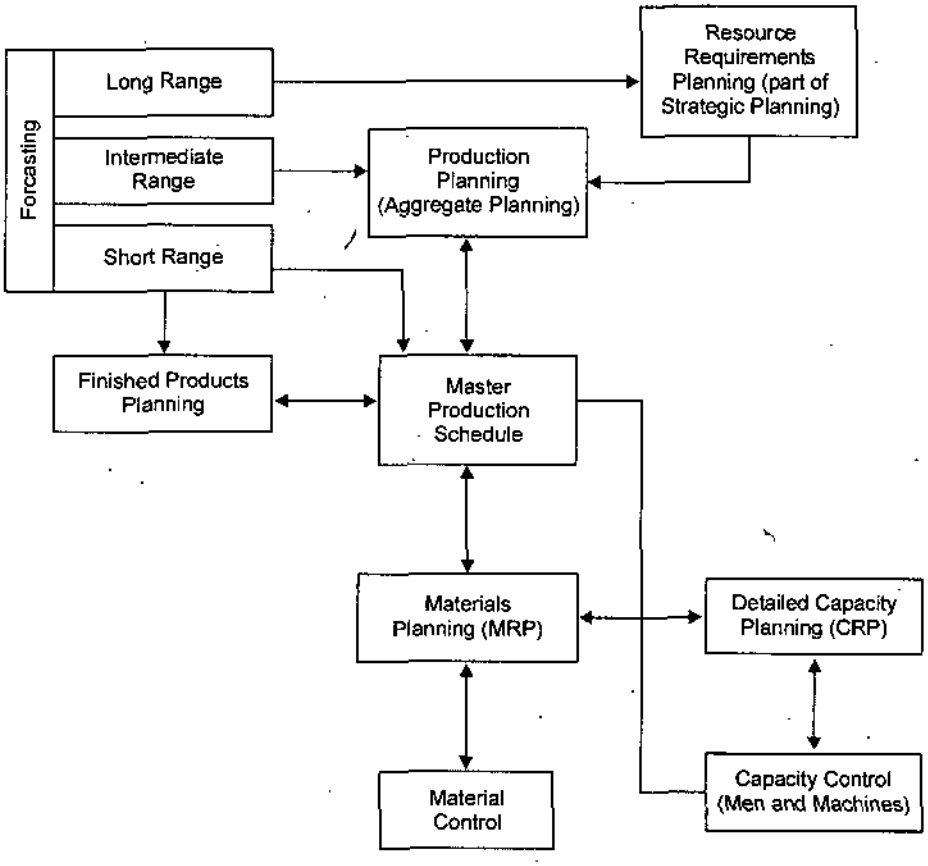

Fig. 3.2. Block Diagrammatic Representation of Manufacturing Planning and Control System Framework.

or aggregate planning in short, and its objective is to establish general production levels (or volumes) for the different products and product groups in the intermediate range (over the next 12 to 18 months). It is used to check the availability of different types of production capacities (as for example, turning hours, welding and fabrication man-hours and machine-hours, assembly man-hours etc.) for the end products demanded/ forecast in the intermediate range.

The master production schedule (MPS) is derived from production planning. MPS breaks up the production plan into time periods and gives a detailed statement of quantities of each product, or product group, which is planned to be produced in each time period of the planning horizon (that is, in each week, or each month, of the next financial year). Short-range forecasts are the principal ingredients to finished goods planning of products made to stock, and also provide information directly to the master schedule for products made to order. Let us, as an illustration, consider the circuit breaker manufacturing division of an electrical equipment manufacturing company (also assume that this division makes only airblast circuit breakers). The MPS for this division is given in Table 3.1.

The MPS is the driver of the manufacturing planning and control system.

Once the MPS is deemed to be realistic (or achievable), it is taken as the basic planning document, and plans for material and capacity requirements are generated in detail. Feedback during execution (the control function) detects significant deviations from plans and then the material and capacity plans are updated and simultaneously necessary corrective actions are also initiated. A careful study for Figure 3.2 reveals the following interesting aspects of the manufacturing planning and control system:

1. Most interactions between elements of the system are represented by two headed arrows indicating that direct linkage between the two elements so connected is essential for proper operation of the system.
2. Forecasting is an exception; forecast of demand for products are made unilaterally, and they should not be influenced by constraints since demands for products must be met by the system. MPS is derived from the production planning exercise which gets its input from forecasting.
3. Effective control of capacity is essential for the execution of the plan expressed in the MPS. This implies that the MPS must be revised if the capacity requirements of the formal plan cannot be met (feedback from capacity control). Once material and capacity plans are made (since materials, men and machines are the basic requirements of production), control is required to ensure that the plans are met during execution. This involves feedback during execution to report the actual status in relation to the plan and determination of significant deviations, which, in turn, must point out where corrective action is required to get back to the original plan. This intimate relationship between planning and control must be recognized.

Table 3.1. Master Production Schedule for the Circuit Breaker

Financial Year: 1976-77												
Month	A	M	J	J	A	S	O	N	D	J	F	M
Total Number of Circuit breakers	40	25	50	30	30	50	30	40	50	40	50	30

Master Production Schedule

Month	A	M	J	J	A	S	O	N	D	J	F	M
Railway Breakers	15	–	30	–	–	30	–	–	10	10	10	10

Metal-clad 11 kv Breakers	20	–	20	15	15	15	20	20	20	20	20	–
Air-blas Breakers 220 kv	–	25	–	15	15	–	10	10	10	10	10	20
Air-blast Breakers	5	–	–	–	–	5	–	10	10	–	10	–

3.3 MATERIALS MANAGEMENT IN MANUFACTURING AND PROCESS INDUSTRIES

The manufacturing or production function, in the overall sense, can be viewed as a combination of the following two points:

1. Materials management to provide the planning for material requirements, purchasing of these materials, their storage and flow through the processes of conversion to finished product inventories.
2. Production management for the actual conversion activities, such as machining, fabrication, assembly and packaging.

A flow of materials occurs in any production, or logistics, process that procures raw materials, produces components, creates products for sale from in-house manufactured and purchased components and subassemblies, and moves them to consumers. This flow is shown in Fig. 3.3, where inputs received from vendors and suppliers are converted by conversion activities, and processes, to finished good inventories, which, in turn, are then shipped to customers and markets using different channels of distribution. From the figure it is also evident that manufacturing, or production, management is tied to the flow of materials and the set of process activities that transform these materials to the end products.

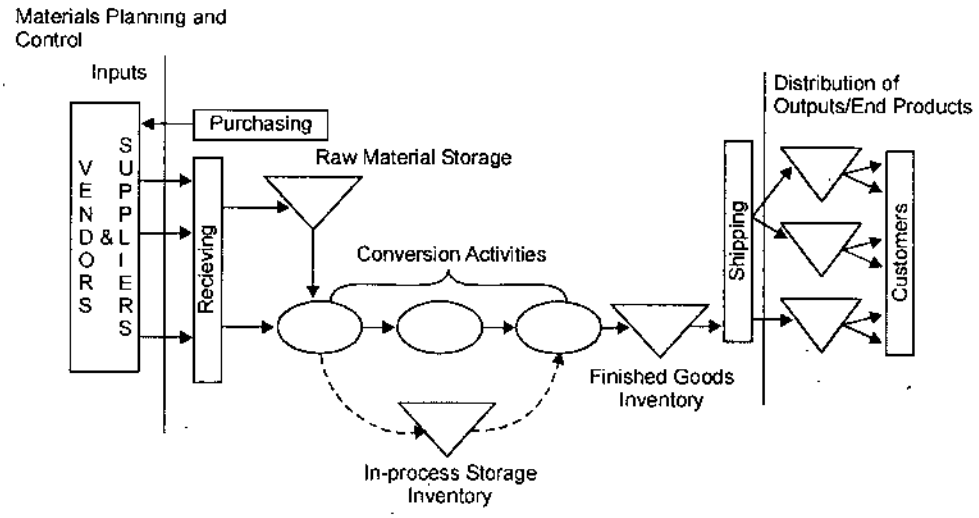

Fig. 3.3. Flow of Materials in Production/Manufacturing.

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The materials management concept stems from the need to integrate the planning for purchasing of the needed materials, their conversion and flow, and the inventories of finished products. Also recollect that these materials include not only raw materials in different forms, but also, in the manufacturing industry, purchased, or bought–out, components and subassemblies. Raw materials and the purchased components must be purchased and stored, if necessary, and this can only be done if the type (what?), quantity, or amount (how much?), and timing (when should it be available?) of the requirement of these materials is determined first. Thus purchasing and storage and inventory control have to be preceded by planning and budgeting of material requirements. This activity is the first activity of materials management; and the three activities of materials management are: (i) materials planning, (ii) purchasing, and (iii) storing, inventory control and material handling. The materials manager takes the responsibility for designing, installing and operating an inventory and materials control system. The basic purpose of the system is to develop manufacturing plans and a flow of materials that will conform to the stated plans and policies, using inventories properly to minimize operating costs. The complexity of this system depends on the product diversity/product mix, the conversion processes and cycles, and the manufacturing environment (make-to-order, make-to-stock or assemble-to-order) and method of distribution. The simplest combination is a few products made in a single plant by a continuous process, as in a chemical or a fertilizer plant, and distributed directly from the factory, and the most complicated combination is a variety of complex assembled products produced from components purchased and manufactured through multi-operation processes, involving several plants and distributed both from the factories and from warehouses or branches. As per the American Production and Inventory Control Society (APICS), the term materials management stands for "the grouping of management functions supporting the complete cycle of material flow, from the purchase and internal control of production materials to the planning and control of work in process to the warehousing, shipping and distribution of the finished product". However, there is no universal agreement about the activities that come under materials management. Sometimes, materials management includes only the activities related to input materials, namely, materials planning, purchasing and inventory control, as noted earlier, and the terms logistics and physical distribution management are used to refer to shipping, transportation and warehousing of finished goods/end products. Logistics management may also be used for the management of all the activities given in the APICS definition (the full scope of material flow activities).

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3.4 MATERIALS PLANNING AND BUDGETING

The objective of materials management is to have the right material required for manufacturing, or production, in the right amount, at the right place, and at the right time, and, as we have already noted, this implies that the what, how much, and when of material requirements must be determined first. This is the basic objective of the materials planning and budgeting function. The questions that must be answered are the following:

1. Which material inputs must we get? Note: The inputs required are dependent on the outputs/end products planned to be manufactured.
2. How much of each of these inputs do we need, and based on how much is available in stores and/or has already been ordered (inventory on hand and or order), how much of each of these should be ordered? The gross requirements of each of the required material inputs is calculated first and the net requirements are derived by subtracting from it the on hand and on order inventory.
3. When should the orders for each of these material be placed?

These decisions are dependent on: (i) where in the manufacturing process for the end product is the particular material required, namely, the crankshaft forging for the machining of the crankshaft prior to its assembly with the piston, cylinder etc. for the engine subassembly of the automobile, and (ii) the lead times for procurement and manufacturing, namely procurement lead times for raw materials (including forgings and castings) and purchased, or bought-out, components and subassemblies, and manufacturing lead times for the in-house manufactured components and assembly operations, both subassemblies and final assembly. Materials requirement planning (MRP) is a computational technique that converts the master schedule for the end products (MPS) into a detailed schedule for the raw materials and components used in the end products. The detailed schedule identifies each raw material and component item required for a particular end product.

It also determines when each of these items must be ordered by the factory and delivered by the vendor/supplier to the factory so as to meet the planned completion date for the end product as per the MPS. The underlying concepts for the techniques collected and unified by Orlicky under MRP in the early 1960's had been known for many years, but they could not be fully exploited without the data processing power of the modern computers. Its early application, in the 1960's, was a bill of material explosion technique (desegregation of the end product) for determining the time-phased requirement of the components and subassemblies (for the quantity of end product given in the MPS) and a

method of releasing manufacturing and purchase order to the shop and vendors/suppliers. Orlicky called the technique 'time-phased material requirements planning'. Before we take up the discussion the MRP technique, or algorithm, we must note the distinction between independent and dependent demand inventory item. This is necessary since this distinction is basic to the MRP technique.

Dependent Versus Independent Demand

Items stocked by a manufacturing company (inventory items) can be broadly classified under following four heads:

1. Raw materials and purchased, or bought-out, components.
2. Work-in-process
3. End products, or finished goods.
4. Maintenance items, or spare parts, and tooling inventory, namely, cutting tools, jigs, fixtures, dies and moulds.

The first three kinds of inventory items are directly related to the end products manufactured by the company. The fourth class of inventory item, however, is not directly related to the end products and is maintained to support the activity of inhouse manufacture of components.

Demand for a given inventory item is termed *independent* when such demand is unrelated to the demand for other items, or when it is not a function of the demand of some other inventory items. The demand for spare parts and cutting tools is independent of the demand for raw materials, purchased components, or finished goods. Conversely, demand is defined as *dependent* when it is directly related to, or derives from, the demand for another inventory item or end product.

This dependency may be 'vertical', such as when a component is needed to build a subassembly or end product, or 'horizontal', as in the case of an attachment or the owners manual which has to be shipped with the end product. The first three classes of inventory items are needed for the end products and we may call them as items of production inventory to distinguish them from maintenance and tooling inventory items. Moreover, the bulk of the total production inventory is in raw material, components and subassemblies, and all of these are largely subject to dependent demand. Their demand is derived from the demand of the end products for which they are needed. Dependent demand should not (and need not) be forecast, as it can be precisely determined from the demand for those items which are its sole cause. On the other hand, the demands for the independent demand inventory items have to be forecast. Coming to the items of production inventory, the demand for the end products, therefore, may have to be forecast. For

example, Maruti will need to forecast how many Swift model cars it will be able to sell in the next financial year.

Material Requirements Planning (MRP)

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The flow chart, or structure, of the MRP technique is shown in Fig. 3.4. The most important input to the technique, or algorithm, is the MPS, which specifies the quantities of the end products to be produced in each time period of the planning horizon. As we have already noted, the MPS translates the aggregate production plan, which, in turn, is developed based on forecasts and firm orders, and expresses the overall plan in terms of the specific products and/or models to be produced (please see Table 3.1) in each time bucket/period of the planning horizon. After the end-product production schedules have been developed and enumerated in the MPS, they must be broken down into detailed requirements of purchased and manufactured components and subassemblies, and also the raw materials for the manufactured components.

This is done by the MRP processor; the MPS triggers the MRP processor, which then converts the requirements of the end products given in the MPS into initially the gross requirements and subsequently the net requirements of purchased and in-house manufactured components which go into subassemblies and the final assemblies of the end products and also the raw materials required for the manufactured components. The calculation of gross requirements is done with the help of the bill of materials (BOM) file. The dependent nature of material requirements is given in the bill of materials, also known as product structure, or assembly parts list. The bill describes how an end product is made, or built up, from its constituent components and subassemblies. This the 'explosion' or desegregation of the end products into requirements of purchased, or bought-out, components and subassemblies and raw materials required for the in-house manufactured components is done by the BOM file. The net requirements must then be derived from the gross requirements and this is done with the help of the inventory status file. The inventory status file provides for each purchased component and the raw materials required for the manufactured components for all the end products an up-to-date (updated) information on on-hand inventories, scheduled receipts (inventories on-order and scheduled to be received), and planned order releases. The net requirements are obtained by subtracting the on-hand and on-order quantities from the projected gross requirements.

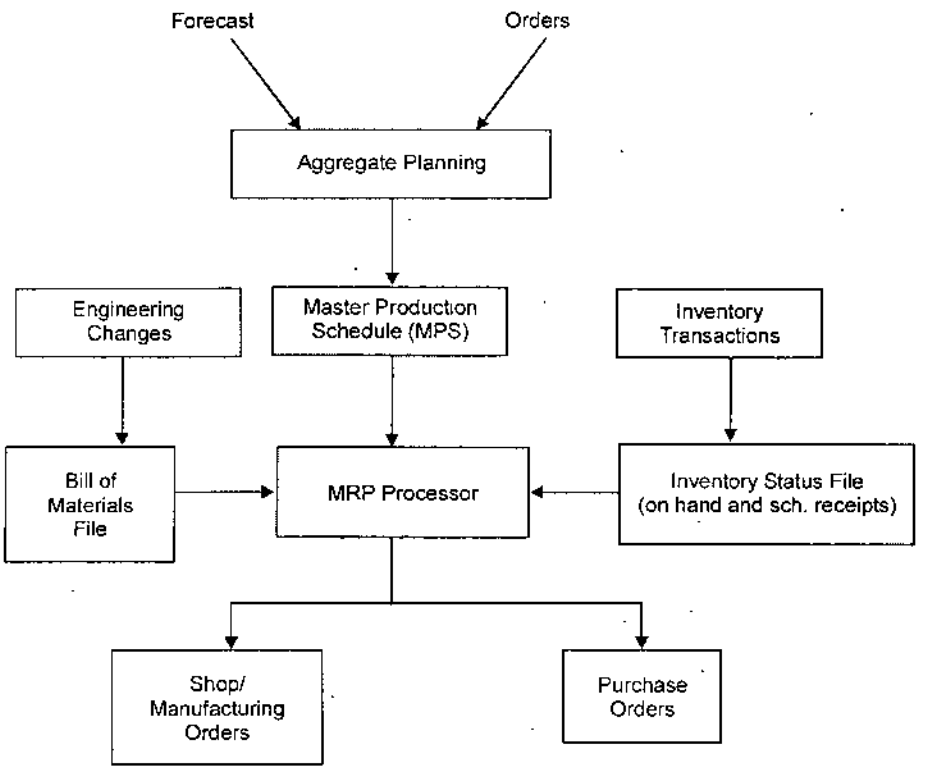

Fig. 3.4. Structure of a Material Requirements Planning (MRP) Technique

Moreover, the inventory status file also provides essential material planning information, such as, lead times, stock levels, and scrap allowances for raw materials. Thus the time phasing of the purchase order releases and shop order releases can also be determined since information on lead times, both procurement and manufacturing lead times, is also available in the inventory status file.

The time phasing, or back scheduling, by the amount of the relevant lead time (procurement lead time for the purchased component, or procurement lead time for the required raw material (*e.g.*, crankshaft forging) and manufacturing lead time for the in-house manufactured component (machining of the crankshaft), or the assembly time (manufacturing lead time) for the subassembly and final assembly operations) from the time the specific material is required to be delivered for the manufacturing of the end product gives us the date by which the purchase, or shop, order must be released. With the determination of planned order releases, the material planning exercise is complete, since the what, how much, and when have been determined for all the materials of all the end products required to be manufactured and as given in the MPS. In Fig. 3.4, engineering changes and inventory transactions have been shown as inputs to the BOM and inventory status files respectively. In the manufacturing industry, changes to engineering drawings and material specifications are quite common and such changes come under engineering changes. Information on engineering changes

and inventory transactions (receipts and issues) are used for updation of the two files.

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3.5 PULL VS PUSH SYSTEM

This block of the course material on materials management is devoted to the discussion of the materials planning and control function. We had discussed the activity of materials planning and budgeting as it applies to manufacturing and production of end products/ finished goods. Also therein we had noted that material requirements planning (MRP), which is the most widely used technique for materials planning and budgeting, is incomplete, since it does not carry out the activities which it facilitates. These are the activities of material control, planning of capacity requirements (determination of manhours and machine-hours required), and capacity or shop floor control, which is referred to as production activity control in some text books. In this unit, we will discuss the activity of material control, together with materials planning and budgeting, and thus fulfill the requirement of the title of this block. But this, by itself, will be incomplete and inadequate, since we are discussing the function in the context of manufacturing and production of end products. We have to include herein the discussion of capacity requirements planning, capacity control, and the necessary feedback of information from materials and capacity checks and production activity control (includes both vendor and shop floor activity control) to ensure the viability of the master schedule (MPS). Materials planning and control is done in the final analysis, to ensure that the end products of the company are produced as per the MPS. Also, since materials and production capacity (in the form of man-hours and machine-hours) are the two basic resources for manufacturing and production of end products, we will, in essence, discuss the manufacturing planning and control (MPC) system in this unit. The function of materials planning and control is a part of this system, and we must look at the whole picture (MPC) to truly appreciate this important function of materials management.

The student must have noticed the title of this unit. Push and pull systems are the two possible systems of linking the production of work centres in a manufacturing setup/ organization. Essentially they are the two systems of operating the manufacturing/ production organization, or the two basic approaches used for manufacturing planning and control (MPC). MPC brings to mind manufacturing resources planning, which has the same acronym as material requirements planning and because of this is commonly referred to as MRPII. MRPII is an example of the push system of production. As opposed to this, the just-in-time (JIT) production system, sometimes also known as the Toyota production system, is an

application of the pull system. Instead of discussing the differences between push and pull systems here, we will take up the discussion of MRPII straight away and then bring out the difference between the two systems through the discussion of the JIT production. This way, it is felt that, the difference between the two systems will become much clearer to the student. We will also discuss repetitive manufacturing, the operation of the 'kanban' system, and then the core and enablers of the pull system Thereafter, we will discuss the mixed strategies. Thus in this unit, there are three main sections, namely, MRP II, JIT, and mixed strategies of manufacturing planning and control, in that order.

3.6 MANUFACTURING RESOURCES PLANNING

We have discussed the technique of material requirements planning (MRP). We have noted the difference between independent and dependent demand inventory items, and thereafter having realized that the bulk of the total production inventory (excluding items of maintenance and tooling inventory) is in the form of raw materials, components and subassemblies, we have noted that MRP is the most appropriate technique for planning and budgeting of production inventory items. MRP is used for the planning of production inventories, since production inventory items like raw materials and purchased components are procured and kept in stock to support planned production of end products, and are items of dependent demand since the quantity required depends on the number of end products scheduled for production. But manufacturing operations also require manpower and machines (and other production equipment). Hence one has to take into account the capacity constraints, which must include man-hours in the required skills, such as welding hours *etc.*, and also machine-hours on the required types of machines, namely, turning hours, milling hours, horizontal boring hours, shot-blasting hours etc. required and available in any given time period of the planning horizon. In some cases, it may be necessary to consider other constraints, such as funds required for procurement of materials and even storage space required for in-process and finished goods inventories. Thus, for the effective planning of manufacturing and production operations, as an obvious and logical development, capacity requirements planning was also incorporated and integrated with the detailed planning of material requirements. Moreover, a closedloop system was also conceived so that the control function and feed-back of essential information were also incorporated to make it a complete manufacturing planning and control system. This refinement and extension of MRP was named manufacturing resources planning, and to differentiate it from materials

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requirements planning, it is called MRP-II. This section of the unit will be devoted to the discussion of manufacturing resources planning. But before we can take up the evolution of MRP II from MRP and the detailed discussion of the manufacturing planing and control system enabled by MRP II, we must necessarily revisit MRP. The MRP subsection will not just be a recapitulation. Instead of repeating what has already been stated, we will concentrate on (i) the things which led to the development of MRP – the basic MRP concepts, (ii) the outputs of MRP and the basic MRP record, and (iii) the deficiencies (or shortcomings) of MRP.

MRP Revisited

As we have noted earlier, MRP is essentially a computational technique for bill of materials 'explosion' (or, disaggregation) and then deriving the net requirements from the gross requirements (obtained through explosion) through the use of the inventory status file. Once the net requirements of all sub-assemblies, components and raw materials are known, lead time offsetting is done for determining the time-phased requirements of the individual subassemblies, components, and raw materials. This is also done by the MRP processor. Thereafter, the manufacturing of shop orders and purchase orders are released. Thus, the three inputs to the MRP processor are the MPS, BOM file, and inventory status file. The MPS triggers the processor, and thereafter, the BOM file and inventory status file data are accessed and used by the processor for each and every end product listed in the MPS, one after another. The time phasing is done by lead time offsetting, or back scheduling, by the amount of the relevant lead time.

The MRP technique is based on four basic concepts. We have already discussed the first, namely, the difference between independent and dependent demand inventory items, and we have duly noted that this distinction is fundamental to MRP. The remaining three concepts are the following:

- Existence of lumpy demand.
- Existence of two kinds of lead times.
- Need to take due account of common-use items.

In a reorder point system (used nowadays for independent demand inventory items), it is generally assumed that the demand for an item in inventory occurs at a gradual and continuous rate. This assumption is fundamental for the derivation of the economic order quantity (EOQ) formula. However, in a manufacturing organization, the demand for raw materials and components of an end product occur intermittently in large increments (in lumps), rather than in small and almost continuous amounts. These

lumps correspond to the quantities needed to make a given batch of the end product.

An example of the basic MRP record is shown in Table 3.2. This record, or statement, is produced by the MRP processor for each individual item (of raw material, component, and subassembly) for all the end products listed in the MPS. For each time period of the planning horizon, the record shows the gross requirement, scheduled receipt, projected available balance, and the planned order release for the item. At the heart of the manufacturing planning and control (MPC) system enabled by MRP (and MRP II) is a universal representation of the status and plans for every single item (part number), whether it is a raw material, component, subassembly, or finished product. The explanation of the terms used in the record is given below:

Table 3.2. An Example of the Basic MRP Record

			Part Name		Drive Shaft		
			Part Number		FAG 159342 MXP		
Time Period	1	2	3	4	5	...	12
Gross Requirements		10		40	10	...	...
Scheduled Receipts	50					...	...
Projected available	54	44	44	4	44	...	...
Balance							
Planned Order Releases		50					
Lead Time = 1 period							
Lot Size = 50							

Gross requirement is the anticipated future usage of (or demand for) the item. These are time phased, or in other words, gross requirements are stated on a period-by-period basis. The item must be available at the beginning of the time period.

Scheduled receipts are the existing replenishment orders for the item due at the beginning of each time period.

Projected available balance is the current and projected inventory status for the item *at the end of each period.*

Planned order releases are the planned replenishment orders (purchase orders/shop orders) for the item *released at the beginning of each time period.*

The important point to note here is that the gross requirement in a particular period will not be satisfied unless the item is available

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during the period and the timing convention used comes from the question of availability. The item must be available at the beginning of the time period in which it is required, and the availability is achieved by having the item in inventory, or by receiving either a scheduled receipt or a planned replenishment order in time to satisfy the gross requirement. This means that plans must be made so that any replenishment order will be in inventory at the beginning of the period in which the gross requirement for that item occurs.

Purchase orders and shop orders are released based on the MRP record. The order release notices, thus, constitute the first of the five primary outputs of MRP. The other outputs are the following:

1. Reports on inventory status.
2. Reports showing planned orders to be released in future periods.
3. Rescheduling notices indicating changes in due dates for open orders-shop orders as well as purchase orders.
4. Cancellation notices indicating cancellation of open orders because of changes in the MPS.

The secondary outputs of MRP include the following:

1. Performance reports on product/component costs, item usage, actual versus planned lead times etc.
2. Exception reports showing deviations from schedule, namely,/orders that are overdue, scrap etc.
3. Inventory forecasts indicating projected inventory levels (aggregate inventory as well as item inventory) in future periods.

Whereas the first four reports are primarily directed at the materials management function, the three secondary reports are meant for the senior management personnel.

MRP to MRP II

MRP provides disaggregation of the MPS into the resultant detailed plans for each manufactured and purchased part number. This, by itself, was a major breakthrough made feasible by random access computers and database management systems. But the problem that was first encountered was one of the need for frequent rescheduling of orders. MRP does not take into account the capacity available in a given time period/periods (and does not even determine the capacity requirements) before releasing shop orders. The result is that the capacity may be exceeded during some periods (that is, the required capacity for a given production lot > available capacity).

Moreover, the manufacturing lead time will be longer than what was used for time phasing. Because of this, the actual manufacturing schedule will be different from the planned schedule, necessitating the rescheduling of orders. Thus, the viability of the MPS is essential for the integrity of the MRP technique. This, in the first instance, not only requires the determination of capacity requirements for the output from the material planning module and incorporation of a capacity requirement module, but also calls for feedback from the capacity planning module before the release of shop orders. If the capacity is not adequate, then this information must be fed back to the MPS for necessary correction/ amendment. The data from the amended MPS can then be fed into the MRP processor for detailed material planning and thence the material planning module data fed to the CRP processor for detailed capacity planning. This ensures that the MPS is feasible, or viable.

MRP II evolved from MRP through a series of extensions to the functionality of the MRP technique. We have, in the preceding paragraph, discussed the first series of extensions, through which MRP was extended to support the following functions:

1. **Resource requirements planning (RRP) (also called 'master planning').** Derived from long range forecasts of product demands (recall that the long range forecasts look ahead 3-5 years or more).

2. **Aggregate Planning.** Based on the resource requirement plan details (recall that these resources do not change in the intermediate range), intermediate range forecasts of product demands, and firm orders for products.

3. **Capacity requirements planning (CRP).** Derived from the material requirement planning output, which in turn, is based on the MPS (and MPS is derived from the aggregate planning output and changes in forecasted demands as obtained from short term forecasts). Capacity requirements planning (CRP) is carried out through the use of a CRP processor (like the MRP processor).

4. **Production activity control (PAC).** Consisting of material, or vendor, control, and manpower and machine capacity, or shop floor, control. The closed – loop MRP denotes the stage in MRP II system wherein the planning function of MPS (master scheduling), MRP and CRP are linked to the execution function of purchasing and shop floor activity control. Thereafter MRP II was extended to support business and financial planning. The MRP II software package also includes an extensive 'what if?' capability. Alternative

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business and manufacturing scenarios can be assessed through the use of the package. The further extension of MRP II involves the integration of financial, accounting, and personnel data and information with the manufacturing planning and control activities of the basic MRP II system.

Is MRP II the Ultimate Manufacturing Planning and Control System?

Whereas MRP, by itself, is only a technique, or an algorithm, MRP II is a system. It is a manufacturing planning and control system and it carries out all the necessary planning and control activities needed to support the manufacture of end products demanded by customers. The flowchart of MRP II is given in Fig. 3.5. The top part of the figure upto the MRP processor is the same as that for the MRP technique herein we have included the forecasting block and resource requirements planning, and this has been done since we want to stress that MRP II represents a manufacturing planning and control system). Thereafter, the material requirements planning output is fed to the capacity requirements planning (CRP) processor to calculate the specific types (skills and machines) of labour and machine capacity requirements, in man-hours and machine hours, for each time period of the planning horizon. This is done with the help of two important input files, namely, the production, or shop, routing files, and work centre status file. After this is done, the net requirements of the purchased components (and subassemblies) and raw materials, and also the capacity requirements, in terms of man-hours and machine-hours, are known. Accordingly, the material and capacity plans are prepared. However, based on these plans, the purchase orders and production, or shop, orders are only released after a due check to see whether funds (for purchase of material) and man-hours and machine capacities required are available. If any one or both are not available fully, then such information is fed back to the MPS for necessary amendment(s) and rescheduling. The control process and the feed back from the control process finally closes the loop, updating both the inventory and work centre status file.

From this point on, in this unit, the term MRP will be used for MRP II (whenever MRP is used, we will actually mean MRP II). MRP is a complete manufacturing planning and control system. Benefits of MRP include the following:

1. Reduction in inventory – raw material, purchased component and WIP inventory.
2. Quicker response to changes in demand and the master schedule (MPS).
3. Productivity increases and labour requirements are also

correspondingly reduced – this is obtained through a reduction of lead time.

4. Improved machine utilization.
5. Improved customer service – better delivery performance and reduction in the number of late orders.
6. Increased sales.

MRP highlighted the fallacy of applying reorder point inventory control techniques for dependent demand inventory items. MRP also showed that hierarchical planning with multiple levels of representational detail of the manufacturing process (RRP ® aggregate planning ® MPS ® MRP ® CRP ® PAC) is a highly effective way of coping with the complexity and variety of manufacturing systems. Another important lesson from the MRP approach is that through the use of a computer and a manufacturing database, the work of people in many different manufacturing functions can be better coordinated and also volumes of common information can be shared by these functions.

However, MRP is, by no means, the ultimate manufacturing planning and control system. The key failing of MRP is that it does not address (and does not even attempt to address) the design of the manufacturing process for the product(s). It accepts the actual manufacturing process, or the production methods used, and the product structure (design of the product) as they are, and uses what is primarily a paperwork system of planning and control. No attempt is made to either redesign the production methods or the product structure. In this context, consider what is generally referred to as the "push system" of linking work centres. MRP is based on the push system, and in the push system, when the work on s lot/batch of items (say, components in process) is completed at a work centre, the lot is pushed to the next work centre where it waits in a queue until the work centre is free and the lot is selected to be worked on at that centre. In this context, the break-up of the time a typical job spends in a plant is given in Table II. From the table, it is clear that a great portion of the time is spent waiting in queues. In some cases, it may even be more than what is given in the Table 3.3. Thus the manufacturing lead time of the component is also very significantly affected by the queue, that is, the amount of work that builds up in front of a work centre. With a given capacity, a work centre can only perform a fixed amount of work per hour, or per shift. If work flows to this work centre faster than this rate, without a change in the capacity, then the queue will become longer. This points out the need to design (redesign, in many cases) the production methods to facilitate unhindered flow of material through the manufacturing processes. The flow is most affected by the amount of imbalance between production operations. If stress is given on process balance, and the operations are designed such that the operation times are approximately

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equal and all the operations finish within a given cycle time, then the amount of work build up can be effectively kept under control. The next important element is the layout of the shop. It affects the move time, which, the student will notice, is also fairly significant.

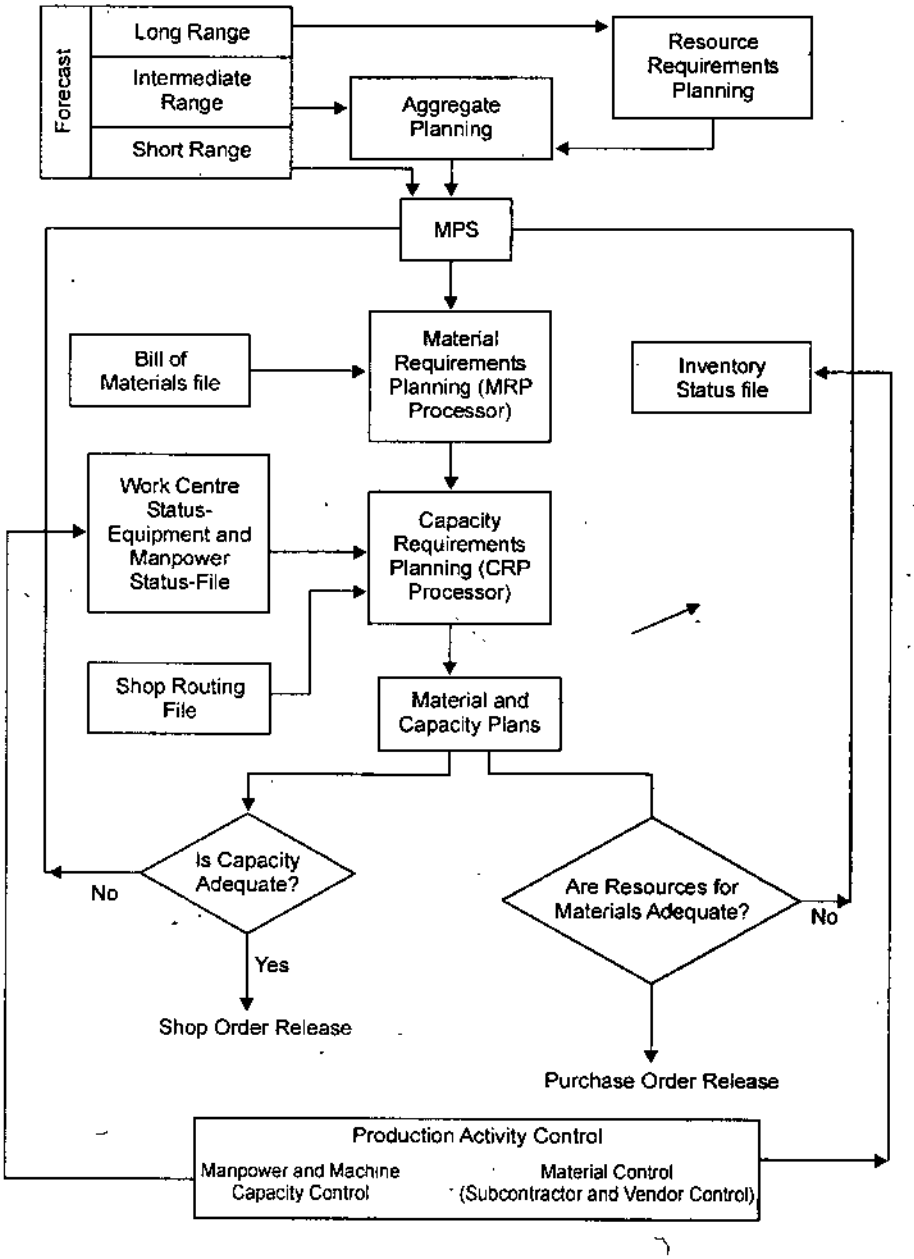

Fig. 3.5. Flowchart of MRP II—Integrating MRP, CRP and Feedback from Control

Table 3.3. Break-up of Time a Job Spends in a Factory

Sl. No.	*Work Elementk Description*	*Percent of the total time*
1.	Move to work centre	16.7
2.	Wait in queue	51.6
3.	Being Set-up at work centre	6.3

4.	Being processed at work centre* (run time)	15.1
5.	Wait to be moved to next work centre	10.3
	Total	100

The product structure also affects the manufacturing lead time of the product. The concept of BOM has tended to encourage the development of numerous stages in the build up of the product. The greater the number of stages, the greater will be the move time, in-process waiting time, and the time spent by components in storage waiting for other components. These and other issues stress the importance of the design of the manufacturing process and the end product, and in recent times, the emergence of JIT has focussed attention on the need to look at the basics of manufacturing engineering.

3.7 JUST-IN-TIME PRODUCTION SYSTEM

Just-in-time production system (or JIT) is also known as the Toyota Production System, since it was developed in Japan at the Toyota automobile plant in the 1960's. It is currently being used by a variety of industries, including automobile, aerospace, machine tools, and computers and communication system manufacturing industries. The philosophy and full intent of JIT is expounded by the following definition of JIT:

JIT is a disciplined programme for improving overall productivity and reducing waste. It provides for the cost-effective production and delivery of only the necessary quality parts, in the right quantity, at the right time and place, while using a minimum amount of facilities, equipment, materials, and human resources. JIT is dependent upon the balance between the supplier's flexibility and user's stability. It is accomplished through the application of specific techniques, which require total employee involvement and team-work.

Many people consider JIT as a narrow shop-floor based technique concerned with making very small batches just in time for the next production process using a 'pull system' of production scheduling called 'kanban'. To them JIT is just the use of the kanban technique. However, it should be clear to the discerning student (in the light of what we have discussed) that making of very small batches just in time cannot be done unless accumulation of inventory between successive operations is removed and unhindered flow of material is achieved. This calls for a highly integrated production, sales and distribution system leading to continuous flow through the whole supply chain. This broad view of JIT is held

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not only by the Japanese but also by some Western companies like IBM, who have successfully implemented the JIT production system.

These companies use the term 'continuous flow manufacturing' for JIT. Kanban technique is the most visible part of JIT, and thus this misconception. However, before we can discuss the kanban technique, we must identify the basic differences between the push and pull systems of linking work centres. We will also discuss repetitive manufacturing, as opposed to batch production used in the push system (recall lumpy demand), to realize its implication for the JIT production system.

Push vs Pull System of Linking Work Culture

The basic objective of the pull system is to produce the right components/ subassemblies needed, at the time needed, and in the quantities needed, or that the right component/subassembly should be at the right place at the right time. The primary goal is the elimination of all kinds of waste in the production system. Inventory is also a source of waste, since there is no value added by allowing the accumulation of inventory between work centres. Thus if one gets the component/ subassembly to the next work centre just in time for the next step of production, then the inventory between the production stages is reduced. The attainment of this objective of minimizing the stock accumulation between successive manufacturing is enabled fundamentally by action on two fronts, namely, redesign of production methods, and use of an information system for production scheduling supported by the kanban technique. This is shown in Figure 3.6.

Instead of pushing a lot/batch of completed (processed components/ subassemblies to the next work centre, the pull system adopts a reverse method in which the following work centre, or operation, withdraws the components/subassemblies from the preceding work centre, or operation. To understand the reason for this, let us consider our example of manufacture of an automobile. In this case where the end product of the company is an assembled car, only the final assembly line is the work centre which knows the exact timing (of receipt) and quantity of the required parts (in this case, major assemblies like engine, transmission, suspension etc.). Therefore, the final assembly line instructs the preceding work centre to supply the necessary parts, or in other words, it goes to the preceding work centre to obtain the necessary parts. The preceding work centre then produces the parts withdrawn by the following work centre (the final assembly line, in this case). Similarly, for the production of these parts, the preceding work centre obtains the necessary parts from the work centre preceding it, and so on.

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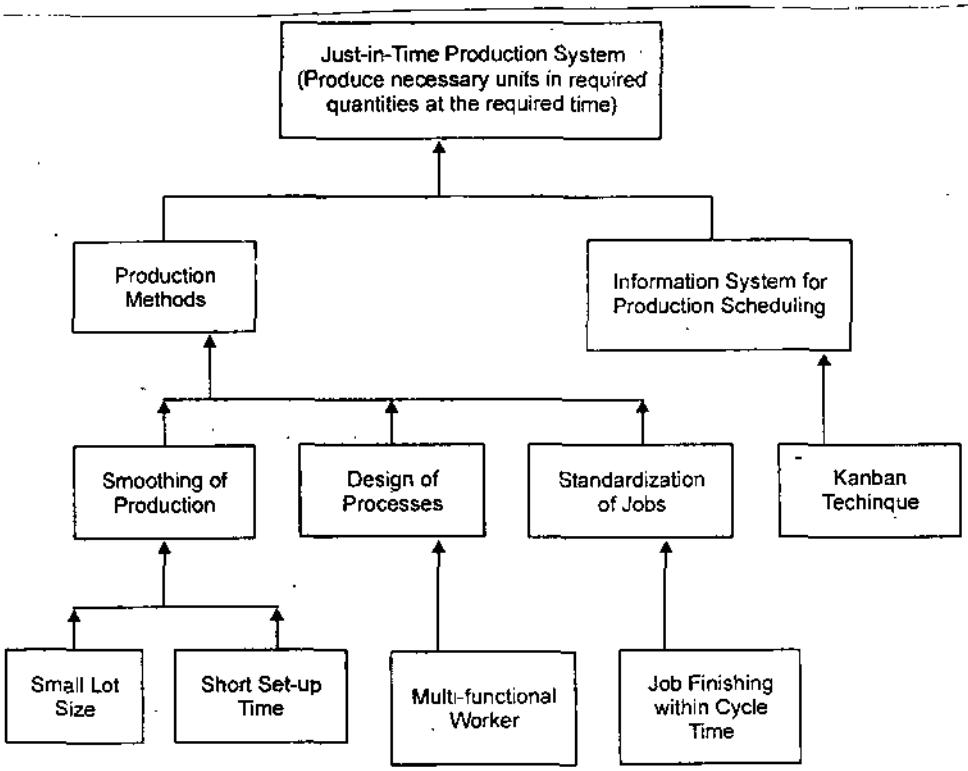

Fig. 3.6. Enabling of Objective of Just-in-Time Production System

The student will realize that this simple method of production scheduling can only be achieved if the production methods are redesigned to ensure smoothened unhindered production in which the parts (or components and subassemblies) are manufactured quickly and with the minimum amount of non-productive time on account of in-process waiting and set-up, a balanced production system in which all jobs (operations) finish within the cycle time, and multi-skilled workers and flexible facilities. Such a production system can achieve a smooth, synchronized flow of small lots of parts at a uniform rate.

Repetitive Manufacturing

In addition to the pull method of linking work centres, quick and inexpensive set-ups, multi-skilled workers and flexible facilities, one of the identifying characteristics of JIT production system is a pre-set uniform production rate. The JIT system works best when the production rate is kept leveled, and inside the plant, the objective is to achieve a smooth, synchronized flow of small lots of material at an uniform rate. Thus the implementation of JIT requires that the lumpy demand of batch production be transformed to a leveled demand to enable the uniform rate of production of repetitive manufacturing. Please recall 'user's stability' in the definition of JIT; repetitive manufacturing ensures user's stability and JIT is thus dependent on repetitive manufacturing.

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Repetitive manufacturing is 'the fabrication, machining, assembly and testing of discrete standard units produced in volume, or of products assembled in volume from standard options' to enable the repetitive manufacture of components and subassemblies (of the product) and the product (every day and every week during a part of the planning horizon) at a constant rate. Repetitive manufacturing is characterized by long production runs, or flow of parts. Thus the end result of rigorously applying the JIT approach and of using the JIT production method is to move a manufacturing system away from batch production, characterized by lumpy demand, towards repetitive manufacturing with uniform production rate and leveled demand. Repetitive manufacturing falls in between batch production and mass production (in the product variety and production volume grid), and is the result of emulation of mass production for manufacture of large batches of products, in the automobile and appliance industries.

'Kanban' System

Kanban is the Japanese word for 'card' or 'signal'. Kanban system is a system of scheduling based on the pull system and uses kanbans, or cards, sent from a downstream operation to trigger production (or supply) at an upstream operation (or by the supplier). As noted earlier, JIT is often considered synonymous with this system, and that this system requires a stable, repetitive manufacturing environment. The pull system looks at the manufacturing process from the perspective of the finished (or end) product. The production controller works on the basis that his/her orders represent firm customer requirements. The controller checks whether sufficient components and/or sub-assemblies/assemblies are available at the highest level of the product structure, as for example on the final assembly line, to produce the finished product. If they are, the product is produced. However, if they are not, the necessary components and/or subassemblies/assemblies are pulled from the preceding work centre. A similar procedure is followed right back through each production stage, and extending all the way back to include outside vendors. The kanban system generally uses two kanbans, or cards, namely, the move and production kanbans. The operation of the system is shown in Fig. 3.7.The kanban system focusses on making only what is needed to replace components and/or subassemblies soon after they are used. The use of subassemblies from their container* triggers the issue and delivery of the move card on that container to the source work centre's IN station. The removal of a container (with components or subassemblies) from its OUT station (and the transportation of the container to the IN station of the succeeding work centre, as shown by full line in Fig. 3.7) releases a production card to the source work centre, and another lot of components is produced to fill one container. This is delivered to the OUT station when completed.

usually within one to three days. The use of components in this work centre's IN station to make the lot, in turn, triggers move cards and production cards in upstream work centres. In this manner, all production in the work centres is geared to making only what is used.

Kanbans, or cards, constitute a simple and flexible system of scheduling that promotes close coordination among work centres in repetitive manufacturing. The amount of material in the system is controlled by having a prescribed number of containers in circulation at any time. A user work centre 'pulls' containers from a supplier work centre with a move card. Thus, a supplier work centre cannot 'push' a container out to a user work centre until the user is ready, and its readiness is indicated by the arrival of the move card. Moreover, the supplier work centre cannot produce until it receives a go-ahead in the form of a production card. There are clearly some limitations to the kanban system. Kanban is intrinsically a system for repetitive manufacturing. Also, since each daily assembly schedule must be very similar to all other daily schedules, it becomes essential to be able to freeze the MPS for a fixed time period, generally at least one month. The final assembly schedule must, thus, be very level and stable. Kanban will not succeed without modification in a batch production (non-repetitive manufacturing) environment. It requires a leveled schedule, standard containers and very strict discipline. It may be considered inflexible in that it cannot easily respond to irregular changes (in the MPS) and to large unexpected changes in market demand. Also, the implementation of kanban scheduling requires great cooperation from outside suppliers (recall supplier's flexibility in the definition). Moreover, from the perspective of the manufacturing process, it places emphases on process technologies, such as product-based flow configurations, and may, therefore, require considerable investment of time and money in developing new production methods, procedures, jigs, fixtures, etc. and perhaps even new capital equipment. However, if well implemented, kanban stimulates productivity improvement, reduces inventory and manufacturing lead-time, and within the constraints of the product design and manufacturing system design, allows the plant to respond to predictable small market variations. Moreover, kanban is a simple system of flow control with a visible means of inventory control. It is simple to understand and involves very little paper work as compared to a typical MRP system.

Core of JIT

The core of JIT consists of the following three parts:

1. Flow
2. Flexibility

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3. Developing the chain of supply.

The contributors to flow include layout, material handling, cellular manufacturing, a focus on process balance, and use of a number of small machines rather than one large machine. The production steps must be tied closely together. The layout must be like a tree, where the final assembly is the trunk and the subassembly and component manufacturing steps flow smoothly into the trunk like the roots of a tree do. The order quantities of each kanban must take the same (or about the same) amount of time to manufacture. This ensures that each production step is in balance.

Flow is supported by flexibility. The time required to change over from the manufacture of one part to another must be kept to an absolute minimum, so that each production step can readily adapt to new orders. The change-over time of a given production step must also be in balance with the other production steps to avoid bottlenecks. Many Japanese companies use flexible automation to support JIT, but flexibility is more often gained by use of very small batches (made possible by reduced set-up or change-over times), flexibility in the workforce (made possible by training the workforce to be multi-skilled), and availability of spare physical capacity. Having developed flow in manufacture, companies, who have successfully implemented JIT, emphasize developing the chain of supply. This includes getting suppliers to deliver to the point of use, frequent delivery in small lots at precise times, and giving necessary data to suppliers to allow them to do so. At the manufacturer's end, this includes 'making today what is needed tomorrow', and rate – based production scheduling. Closely associated with this is the great attention paid to developing good forecasts and production plans. MPS is prepared very carefully and used to drive JIT manufacturing.

Enabling of JIT

The striking aspect of JIT implementation by the Japanese companies is the extent to which the necessary preparatory steps are taken to enable JIT to occur. The following are the important enablers of JIT:

1. **Maintenance of plant and equipment.** This removes the need for buffering against machine breakdowns. In the Japanese companies, the routine maintenance tasks were handed over to machine operators, and the role of the maintenance function included maintenance planning, major repairs, training of machine operators, and ensuring that the new machines are properly installed and fully debugged. Thus, the implementation of productive maintenance and TPM is an enabler of JIT.
2. **Management of product and process quality.** Minimization of

scrap, rejections and rework also removes the need for buffering against poor product quality and quality losses. Quality assurance (the *implementation of a quality system* like ISO 9000, or QS 9000), statistical process control, and use of participatory approaches like 'kaizen' and quality circles are necessary pre-requisites and *implementation of* TQM *is an enabler of* JIT.

3. **Design of manufacturing process and selection of production equipment.** Although flexible automation is widely use, the selection of equipment should lay greater stress on having appropriate and properly used plant and equipment rather than going in for unnecessary and heavy automation. Also, instead of having special purpose machines and a few large 'super' machines, it may be better to use general purpose machines and have many small machines. This will enable a high degree of routing flexibility. Moreover, the stress should be on developing flexible tooling and simplified set-ups.

4. **Development of people and training of the workforce.** The steps under this head include the following:

   (*i*) development of teamwork,

   (*ii*) education, particularly of supervisors and also of operators,

   (*iii*) on-the-job training to develop appropriate levels of skill in *the workforce, and*

   (*iv*) flexibility of work practices and development of flexibility in skills, through multiskilling.

   A necessary pre-requisite for these is a management which understands manufacturing systems and production methods.

5. **Design for manufacture and wide use of modular designs** Design for manufacture and assembly reduces much of the uncertainties in manufacture, and the use of modular design enables the production of a large variety of finished products, while maintaining simplicity in manufacturing. These two together contribute to greater flow and flexibility in manufacture and at the same time maximizing responsiveness to customer needs.

6. **Provision of adequate technical support.**

7. **Development of management controls.** Management controls are essential for minimization of machine breakdowns and quality losses in the form of rejections, scrap and rework. As a philosophy, JIT's primary goal is the elimination of waste in the production system. Rework and scrap, and loss of production capacity due

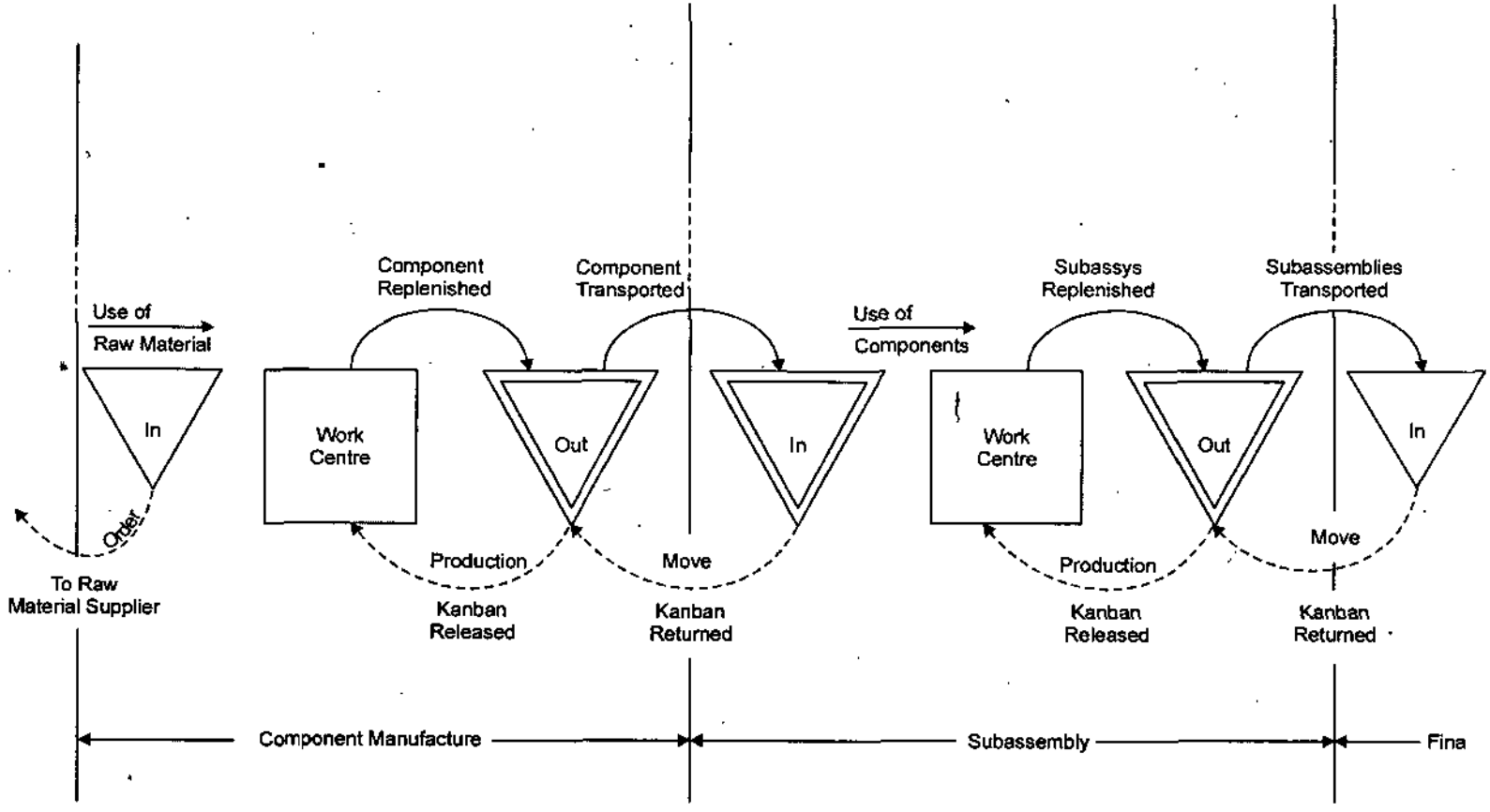

Fig. 3.7. Operation of the 'KANBAN' Scheduling System

to machine breakdowns are very visible forms of waste and should quite obviously be eliminated. However, as a source of waste inventory is less obvious. The name just-in-time epitomizes the objective of minimizing inventory and this is done by getting the material to the next work centre, or (internal) customer, just in time for the next production step. This way the inventory build-up between production stages (work-in-process, or WIP, inventory) is minimized. Moreover, the JIT philosophy carries with it an objective of continuous improvement. The goal is to be getting better, and the way to measure a plant's performance is to see how little WIP inventory it requires to operate. Since inventory protects a plant in case of problems, in essence it hides the problems; so they go unnoticed, and unsolved. Problems must be found before they can be solved, and a sure way to find these problems is to reduce the WIP inventory.

SUMMARY

- Production and manufacturing are terms used to describe a set of processes used for converting raw materials into finished products.
- Materials management is very closely tied with production and manufacturing and, as a mater of fact, the requirement of materials originates from production, or manufacturing.
- The materials management concept stems from the need to integrate the planning for purchasing of the needed materials, their conversion and flow, and the inventories of finished products.
- The objective of materials management is to have the right material required for manufacturing, or production, in the right amount, at the right place, and at the right time.
- The most important input to the technique, or algorithm, is the MPS, which specifies the quantities of the end products to be produced in each time period of the planning horizon.
- Materials planning and control is done in the final analysis, to ensure that the end products of the company are produced as per the MPS.
- Push and pull systems are the two possible systems of linking the production of work centres in a manufacturing setup/ organization.

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- MRP provides disaggregation of the MPS into the resultant detailed plans for each manufactured and purchased part number.
- Just-in-time production system (or JIT) is also known as the Toyota Production System, since it was developed in Japan at the Toyota automobile plant in the 1960's.
- JIT is a disciplined programme for improving overall productivity and reducing waste.
- The basic objective of the pull system is to produce the right components/ subassemblies needed, at the time needed, and in the quantities needed.
- Kanban system is a system of scheduling based on the pull system and uses kanbans, or cards, sent from a downstream operation to trigger production (or supply) at an upstream operation.

REVIEW QUESTIONS

1. What is involved in material planning and budgeting? Briefly explain the importance of material planning citing the critical questions, or the important decisions called for.
2. Explain with the help of a schematic (flow diagram) the required activities of manufacturing planning and control (MPC) system.
3. The fundamental principles of the MPC system are: a) the overall direction setting must be done before the detailed materials and capacity planning activities can be accomplished, and the latter, in turn, must be done before the execution of plans, and b) management decision can be improved with better information systems. Are these two principles justified? If yes, then why? Explain your answer with examples.
4. Differentiate between independent and dependent. Dependent demand inventory items do not need to be forecast. Why not? Explain with the help of examples.
5. Explain the material requirement planning (MRP) algorithim with the help of a flow chart. Discuss the importance of the master production schedule (MPS) and the roles of the bill of materials (BOM) and the inventory status files. How is the net requirement derived after the gross requirement of the components and raw materials are determined?
6. Discuss the use of material requirement planning (MRP) in continuous process industries. The use of computer can greatly ease the problems of implementation of MRP in such industries. Discuss.

7. Material requirements planning (MRP) is based on a few concepts. Briefly explain these four basic concepts.
8. Briefly explain the reason for the evolution of MRP II from MRP. How does MRP II differ from MRP? Explain the difference with the help of a flow diagram.
9. In manufacturing planning and control (MPC) systems, why is detailed capacity requirements planning necessary, even when aggregate planning (or, rough-cut capacity planning) has been carried out earlier? Explain, preferably with the help of the flowchart of MRP II.
10. How does JIT differ from MRP II? Briefly discuss the basic requirements and assumptions of JIT implementation. Note : These are covered under the core and enabling of JIT.
11. Discuss the concept of repetitive manufacturing. Also explain the underlying concept and the working of the Kanban system.
12. Compare the push and pull methods of coordinating work centres.
13. The primary goal of the pull system is the elimination of all kinds of waste in the production system. Discuss briefly the actions/activities which enable the attainment of this objective. How do small lots contribute to flexibility? To high quality? To cost efficiency?

FURTHER READINGS

Applied Materials Management: S Chatterjee, Response Books, 2005.

Materials Management: Preeti Oberoi, Sarup, 2001

Materials Management: K. Shridhara Bhat, Himalaya Publishing House, 2011.

Materials Management: Planning and Control: Nand Kishore Sharma, DND Publications, 2011.

Purchasing and Materials Management: Anand Kumar Sharma, Anmol Pub, 2006.

UNIT 4 INVENTORY POLICIES AND SYSTEMS

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★ STRUCTURE ★

4.0 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- define inventory system
- know functions of inventory system
- describe modelling of inventories, its advantage and disadvantage.
- know about types of spare parts and their management
- define stores accounting
- understand various inventory flow methods.

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4.1 INTRODUCTION

Every organization requires some type of materials for production, business or day-to-day use. Storing these materials, which may be raw materials, used to make the product, materials in process, parts, components, and finished products. Sub-assemblies and assemblies directly entering in to the production and final product, indirect materials used for maintenance etc. like fuels and lubricants, any general purpose materials and equipments. All of them are stored for future use. These stock of materials stored are called Inventories.

Inventory System: Definition

Stock of goods, which must be carried and stored in order to ensure smooth and efficient running of affairs of production and business, is called Inventory. All these materials and goods have value and cost and they are the assets purchased and used to produce the products or sold to carry out some service and business to earn the profit for an organization. The materials as inventory are stocked to maintain the operations and processes in production and business. Its purpose is for transaction, precautions against shortage and speculation. The transaction is to synchronize inflow and outflow of materials as a precautionary measure for safety against demand increase and supply and speculation against rise in price.

Necessity and Reasons for Inventory

1. The demand and supply of materials fluctuate and therefore the production is to be controlled as per the demand fluctuations. The excess production is stocked as inventory for future sales. Materials are stored to meet the production fluctuations in the organization.
2. The business people stock the materials as inventory for speculation, rise in price or shortage occurring because of sudden rise in demand.
3. Inventories are valuable assets and the different parts and components are made in a lot. They may be more than requirements because the production in a lot is more economic. They are to be kept as inventories temporarily till next lot is produced after its consumption. The materials planning necessitates inventory planning and storing them.
4. Marketing and production planning requires purchase and inventory planning decisions for an organization to control expenses and finances. The amount of inventory plays an important role in materials decision to control purchase of materials.

5. To get the purchase benefits, discounts, reduced transportation and ordering cost the bulk purchase may be economical. Inventory of such materials are stored for longer time.

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Functions of Inventories

The functions of inventories are:

1. The materials must be available in time for production.
2. The production should go on continuously and the stores supply all the materials required for production.
3. The marketing and purchasing takes time and inventories ensure the organization to handle them efficiently.
4. It helps in planning the production and consumption of its stock.
5. Inventories stabilize employment in the organization.
6. Reduction in cost of materials and inventory control reduces the cost of product.
7. Inventories of raw materials, parts, components, work in process etc. are required to meet the demand of production and to maintain line balance of assembly work.
8. The efficient store keeping and materials management is possible only by efficient inventory planning and control.
9. Planning inventory reduces and utilizes the working capital of organization properly.
10. The inventory prevents the stock out and shortages and discounts are available for large purchases.

4.2 MODELING OF INVENTORIES

The various types of inventories are classified according to the function for which they are required. Only those types of materials and items are purchased and stored in the organization to keep as inventories, which are frequently required for production. Either it directly enters in the product or necessary for production. Other types of materials which are not frequently required for production, they are purchased and consumed. They may not be kept in stores as inventories. The classification of inventories will be as follows.

- Inventories of direct materials referred to as Bill of Materials (BOM). It consists of raw materials and production inventories, parts, components, subassemblies, assemblies and finished goods.

- Inventories of indirect materials are spares, tools, general supplies, stationeries, fuels, lubricants and maintenance materials. They are given as follows.

1. Raw Materials and B.O.M. Inventories

Raw materials are purchased from outside either from manufacturer or suppliers. These materials enter in to the product. They are essential and stocked according to their functions. Functionally inventories can be stated as

(*a*) Movement inventories

(*b*) Lot size inventories

(*c*) Anticipation inventories

(*d*) Fluctuation inventories

They will be further classified and stored according to their volume, quantity, cost and category. The raw materials will be further converted into parts and components.

2. Production Inventories

They are parts, components and semi finished products stored at various places and supplied as per requirements of demand in production.

3. Work-in-Process Inventories

These are the parts, components and other items stored during production processes at various facilities and departments of production waiting to be assembled. For example, in a car manufacturing several parts of engine, gear assembly, wheels, sheet metal parts, body etc. are manufactured at different centers and stored as work-in-process inventories and supplied to assembly section as per requirement of assembly shop.

4. M.R.O. Inventories

They are the maintenance, repair and operating supplies. These M.R.O. inventories are consumed for production operation and generally do not become the part of product. For example, grease, oil, lubricant, cutting fluids , machinery and plant spares, tools, jigs, fixtures, cleaning liquids and chemicals etc. are M.R.O. inventories.

5. Finished Goods or Product Inventories

These inventories are final finished products ready for shipment to sale or temporarily stocked before being sent to market and sold. The complete vehicle as scooter, motor cycle or car is the finished product inventory of an automobile industry. The inventories can also be classified according to their functions as stated above. They are:

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- **Movement or transit inventories:** The inventories move from one place to other. They are called movement or transit inventories. The amount of these inventories will be I = i. t where I = Inventory in transit, i = rate of inventory movement per unit time and t = time of movement
- **Lot size inventories:** The materials are purchased in a lot to economize the cost of placing the purchase order and carrying them in store. The product is also produced in lot quantity to economize cost of set-up and production. The discount on purchase is obtained if the material is purchased in a particular amount or a lot size. This inventory of materials is called lot size inventory.
- **Fluctuation inventories:** When the demand fluctuates and it is certain and unpredictable the inventory stock must be sufficient to meet the fluctuating demand. These types of inventories are called fluctuating inventories. They may also be kept as safety stock.
- **Anticipation inventories:** When the demand is known certainly, it is predictable or can be found out, the amount of purchase of materials or production quantities are very well planned. The inventory of materials are also planned to economize the cost of ordering and carrying them in stores. These planned inventories are also known as anticipation inventories.

Advantages and Disadvantages of Storing Inventory of Materials

Advantages

1. Keeping inventory of materials will always allow the production to start at any time and continue it till they are exhausted.
2. In competitive situations, inventories are always necessary to supply emergency orders of product.
3. Large quantity purchases are profitable as large discounts are available. Transportation cost per item is reduced.
4. Cost of ordering is reduced, as frequent orders are not placed.
5. In case of shortages or non-availability of materials, inventory helps in production and sales.
6. In case of inflation or rise in price of materials, large amount of inventory purchased at lower prices reduces cost of production and helps in production planning.
7. Increase in production when demand increases suddenly inventory helps for rapid production.

8. The continuity in production and taking the work from workers is possible only by keeping inventory.

Disadvantages

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1. The carrying cost of inventories will be more if materials are stored for longer time.
2. Unnecessary capital is invested in materials if large inventories are purchased and stored.
3. The safety of materials and its maintenance may be costly. The insurance charges, rent of stores and other cost of storage are involved in inventory such as cost of holding and record keeping the materials in stock.
4. Wastage, pilferages, deterioration and obsolescence of materials and parts with time will unnecessarily be unprofitable to organization.
5. In case of reduction in cost of items in inventories, there will be great loss to the company.

For all such disadvantages of keeping large inventories, it is always safe to plan the inventories and store the requisite quantities of materials. The proper forecasting, inventory planning and control techniques must be used to do so. Every industry and business firms face the problem of inventory planning and control. A medium size manufacturing organization requires 5000 to 50,000 different materials and items, which are stored as inventories. The cost of warehousing and inventory carrying sometimes increases rapidly if they are not consumed in time. The management and control of inventories is therefore a basic function of materials management and is greatly concern to owners of every industry and business.

4.3 PROCESS INVENTORY

In every manufacturing organization, materials are to be kept as inventories. How much materials are to be stored and when they are required is the problem of store keeping, which will be solved by efficient inventory planning. Therefore, it is very important function of materials management how efficiently it will plan the inventories of the stores.

Objectives of Inventory Planning and Management

Since inventory planning and control is a very important function of an organization. Its objective is to make available all type of materials required in time to maintain a buffer stock and continue production schedule and business. The following are its objectives:

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(i)Ensure Availability of Materials

To maintain stock of all materials in store as inventories, so that it should be available to production department in time and required quantity. Production should not stop because of nonavailability of any material. The materials requirements planning is one of the important technique used today to plan the inventory of materials required for production.

(ii) Optimizing Inventory Levels

The quantity of inventory stored and materials purchased should have optimum level so that it must match production quantity and no shortages will be there.

(iii) Economic Ordering of Purchase Quantities

The cost of ordering and carrying the inventories must be balanced so that the quantity of materials purchased every time as an order should have benefits of market prices and discounts and they must be economic to purchase.

(iv) The Use of Capital Investment Must be Efficiently Done

Every organization wants to invest its capital efficiently in materials. It should not be held up without use. The excessive investment in inventories should be avoided by proper inventory control. The analytical models of inventory control will be used to solve these minimization problems of inventory cost.

(v) Minimizing the Wastage of Materials

There should be minimum or no wastage of materials. It is only possible through proper inventory control and good store keeping. The wastage of materials may be because of leakages, spoilages, not preserving properly, deterioration, obsolescence, theft and pilferages etc. They should be checked. The dust and rusting many a time deteriorates and spoils the materials. The cleaning and protection against them is necessary.

(vi) Service to Customers

The proper stock of goods and products in the store serves the customers better to fulfill their demands by ready sales of items to their satisfaction and needs. The proper sales forecasting is required to control the production and to maintain the availability of products in stock. It will also be objective of sales department and requirement of capacity planning the production. The production planning includes and integrates capacity planning and inventory planning. The materials and inventory planning is done using materials requirements planning which is called *MRP-I*. The integrative type of production for a manufacturing system is called *manufacturing resource planning* and referred to as *MRP-II*.

4.4 STORAGE AND MOVEMENT OF MATERIALS

The complete MRP-II is supported by MRP-I to plan and supply all materials required for production most efficiently and effectively. It has sales forecasting, inventory planning and control as an essential materials management activity.

Requirement of Sales Forecast for Operations

The demand forecast data must be available in the form that can be translated into demands for materials, time in specific equipment classification and demands for specific labor skills. The nature of production-distribution system is shown in the figure below.

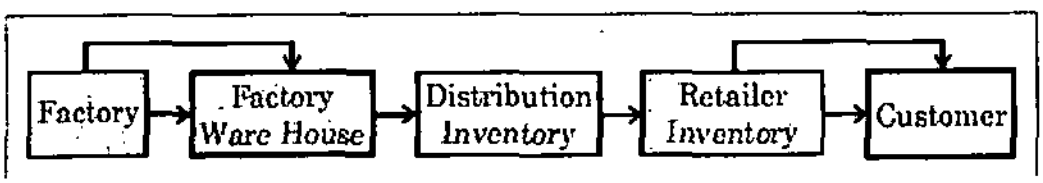

Fig. 4.1. System of Inventories

The various types of system inventories will be pipeline inventories, cycle inventories, buffer inventories and finished goods inventories. These inventories will be planned by the materials requirement planning system, which is computer-operated modern method of inventory planning and control.

Inventory Planning and Control Systems

In every manufacturing or trading concern, the planning and controlling of inventories of physical goods and materials required is of great importance. Raw materials and other parts waiting for dispatch as inventories in the stores or Work-in-progress should have perfect and up-to-date accounting.

In a production system designed either as a product layout (flow shops) or process layout (job shops), control of materials flow and its utilization is very essential. Finished components, semi-finished parts and raw materials move between departments and share scarce common resources. They are either queuing before machines as in-process inventory or waiting to be dispatched to the store, thus increasing production lead time to a great extent. The efficient inventory control for storing and issue of all these items with proper scheduled deliveries will only save the time and cost of inventories. The various types of inventory control techniques are developed for materials management department of any organization.

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First of all, materials managers should be able to classify thousands of materials stored as inventories according to their cost, characteristics, quantities, priorities, and other factors to identify and use them. The classification based on these factors is called Selective Inventory Control Analysis of Inventory Management and Control. This analysis is discussed below.

4.5 SPARE PARTS MANAGEMENT

INTRODUCTION

Margins are narrowing down, budgets are stretched and operational expenditures are rising. One must find ways to maximize revenues and reduce the operating costs. Knowing what is in your inventory is the first step. Optimal spares conditioning is a necessity for the entire types of maintenance tasks, such as inspections, protective maintenance, and repairs. With the exception of protective activities, spare parts for maintenance tasks are usually required at random intervals. Thus, the rapid and safe coordination of the demand for spare parts with the supply of spare parts at the required time is a vital factor for the prompt execution of the maintenance process.

Missing materials are one of the most frequently cited rationales for the interruption in completion of maintenance tasks. As spare parts for equipment are frequently of very high quality, merely increasing warehouse stock cannot solve this problem. A maintenance planner should know about potentially essential parts and their accessibility. Effective maintenance management results in higher productivity, better quality and reduced cost of operations. Spare parts play a vital role in these.

Types of Spare Parts

Spare parts, maintenance and operating supplies comprises of all variety of parts and materials essential to uphold the production assets in acceptable operating condition so as to accomplish desired production results in terms of quality, quantity and time. The three basic types of spares parts are:

(a) **PM spares:** Those replaced during preventive or opportunity maintenance

(b) **Repair Parts (Breakdown spares):** those required to replace parts that fail during service, and

(c) **Overhaul (Shutdown) Parts:** Those required during planned overhaul or shut down of the plant.

The quantity and the time of requirement cannot be predicted for the repair parts. Only, the chance of their requirement can sometimes be predicted. Statistical methods are needed for their inventory control.

Life Cycle of Spare Parts

Spare parts go through the following six stages in their life cycle.

(1) Design and specifications (The right spare)

(2) Determination of initial requirements (The right quantity)

(3) Procurement (The right Price)

(4) Storage and preservation (Minimum custodial and inventory carrying cost)

(5) Issue and replenishment (Minimum downtime cost through inventory control)

(6) Disposal of damaged, surplus and obsolete spares (Minimum damage and maximum disposal value)

4.6 SPARE PARTS MANAGEMENT AND OTHER SYSTEMS

Spare parts management involves numerous business processes that require application support and data from diverse classes of applications. A spare parts management system needs to interact with the following systems:

- **ERP Systems (Enterprise Resource Planning):** systems is a broad set of activities supported by multi-module application software that facilitate the organization in product planning, parts purchasing, maintaining inventory, interacting with supplier & customer, tracking order etc. The core task of this category of system is to manage transactions such as procurement, inventory transactions, returns, etc.
- **MES Systems (Manufacturing Execution Systems):** Systems that accommodates maintenance planning and implementation, capture of service history, etc. moreover time attendant systems, quality control systems, production scheduling systems, etc.),
- **SCM Systems (Supply Chain Management):** Systems for advanced planning and scheduling capabilities, the elements that affect your supply chain efficiency, including inventory reduction, supplier relationships and IT strategy. Supply Chain Management systems are an overturn of prior practices where manufacturers supplied

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spare parts to customers they required them. Now customers tell suppliers how and when they want their spare parts delivered. The driver behind Supply Chain Management is to eradicate inefficiencies, excess costs and excess inventories from the supply pipeline, which extends from the customer back all the way through his suppliers and his suppliers' suppliers and so on. By having the program driven by the customer, it is anticipated that inventories, caused by uncertainties and sluggish response, will be appreciably eliminated.

- **MIS Systems (Management Information Systems):** The MIS for spare parts is similar to that for other materials and has the same aims. Typical reports generated by the MIS are:
  - Stock and consumption status report
  - Pending indents report
  - Pending purchase orders report
  - Stock-out report (also dangerously low stock position report)
  - Over-stock/ Under-stock report
  - ABC analysis- separately for repair items and overhaul items

In addition, the computer should automatically adjust the inventory parameters, such as ROL, SS, LT for routine indenting. Special' 'alerts' may be build into the system to identify deviations from expectations e.g. sudden rise/fall of consumption rates of spares. Typically, a sudden increase in the usage rate of a component may be due to related increase in failure rate, which in turn could be due to poor quality for latest supplier. If the drop in consumption of a part is accompanied by sudden rise in the consumption of the assembly into which is goes, evidently for some reason maintenance had started replacing assemblies instead of parts. The range of spare parts is so vast that computers have to be sued for getting replies to the numerous queries that will arise in managing spare parts.

4.7 BENEFITS OF SPARE PARTS MANAGEMENT

Merger of economic, technological & market forces have made it critical for companies to promote it sales service and particular service parts supply. Spare Parts Management is a constructive way for implementing a robust in-house parts management. The supply of spare parts have turn out to be increasingly fundamental for companies wishing to stay ahead of competition This section defines the essential elements of a spare parts management process, including establishing an in-house parts

management board, developing a preferred parts list or corporate parts baseline, establishing a process for selecting and authorizing parts and establishing a process for qualifying parts etc.:

- **Condensed Acquisition Lead-Time:** When preferred spare parts are used, the government and industry keep away from the expenses and delays of designing and developing parts and the issue of acquiring a new item with no obtainable history or documentation. Using preferred spare parts diminishes the time between the purchase request and the receipt of the part.
- **Cost Savings:** Spare Parts management facilitates save design and life-cycle costs of equipment by encouraging the application of frequently used or preferred parts. Standardization of parts, replacing numerous similar parts with one universal part, results in larger part-type buys because the general parts are used in multiple applications. Larger part-type buys permit both the contractor and the customer to promote from the economies of scale. Part standardization also diminishes the contractor's cost of maintaining technical data and storing, tracking, and distributing multiple parts.
- **Enlarged Supportability and Safety of Systems and Equipment:** Preferred parts diminish risk and enhance the chances that equipment will accomplish reliably. Preferred parts have a history of established reliability; enduring rigorous testing and performing at stated levels. Their use decreases the number of part failures, reducing the number of maintenance actions and potentially precluding failures that could cause mission breakdown or loss of life.
- **Improved Logistics Readiness and Interoperability:** When items or systems allocate general components, repair time is shorter because parts are more possible to be on hand and technicians use up less time solving individual problems. Moreover, using regular components simplifies logistics support and augments substitutability because fewer parts are stocked. This translates to savings in procuring, testing, warehousing, and transporting parts.

4.8 INTRODUCTION: STORES ACCOUNTING

Any inventory item has both physical and financial characteristics. Whereas the physical characteristics (flow of goods) are factual and measurable, financial characteristics (flow of costs) are mainly subjective

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in nature. The financial characteristics associated with the flow of costs are usually emphasized in stores accounting and valuation.

The financial significance of inventory is attributable to the need to measure and analyze an organization's relative financial position, as well as the need to measure its operating performance over a particular time period (month, quarter, or year). Inventory, in an accounting sense, represents value assigned to goods either acquired or produced for subsequent sale or consumption. Inventory accounts at a particular point in time are a snapshot view of the total asset value of inventory items either on hand or in process. The valuation of these accounts is used to assess present financial state, and to anticipate future financial condition. The amounts deducted from inventory accounts during any particular time period are the basic data for determining the cost of goods sold during the period, which is a basic determinant of income. Obviously, consistent policies and methods of inventory valuation are imperative for a true and actual interpretation of a firm's financial position at any given time, and for a meaningful measurement of performance between time periods.

Inventory accounting is generally done on the basis of its cost. The cost for inventory may be determined under any one of several assumptions. No single prescribed method exists for determining inventory costs for accounting purposes. However, there are a number of standard procedures that may be used for this purpose. The major objective in selecting a method is to clearly reflect periodic performance. To determine the monetary value of inventory at any given point in time, the quantity of inventory items on hand must be known and a value must be assigned to those quantities. The value assigned to individual items is based on one of several accounting methods. The accounting method used is very important, since it can significantly affect the total dollar amount of inventory and the related cost of goods sold.

The inventory methods for accountability can be subdivided into the method of valuation and the inventory flow method. In most cases, the method of valuation is based on the original cost of the item. There may not be any problem in the method of valuation if unit costs remain constant; but during a period of time, items are frequently purchased or manufactured at different unit costs. This poses a problem, since the items sold must be costed for the income statement (cost of goods sold), and unsold items must be valued for the balance sheet (inventory).

4.9 WHY STORES ACCOUNTING?

Stores accounting plays a very important role for the estimation of the cost of a product for pricing decisions. Material costing is very important in terms of the valuation of the cost of materials consumed by say, the

production department during a given period of time as well as in terms of the estimation of the value of materials held in stock. In this context, two important aspects, viz., costing of the materials receipt and of materials issue, are considered in stores accounting.

Costing of the Receipt of Materials

The factors that are to be included in building up the cost of the materials received are material price, freight charges, insurance, and taxes. Price usually refers to the price quoted and accepted in the purchase orders.

Prices may often be stated in various ways, such as net prices, prices with discount terms, free on board (FOB) and cost insurance and freight (CIF). For costing purposes the actual cost incurred needs to be calculated by taking price quoted by supplier as the basis, subtracting the discounts and adding any other expenses not covered.

The freight costs incurred in transporting the goods are usually collated under a separate head. Goods in transit are mostly covered by insurance. All such insurance expenses must be calculated and added to the base cost and transportation cost.

Under the miscellaneous head, costs incurred are classified under customs duties, taxes, and packages. Such a classification provides a better framework for cost control. Thus, the cost of the materials received is equal to the price quoted less discounts plus freight, insurance, duties, taxes, and package charges. Very often such detailed classification helps in quicker analysis and effective control. In the absence of a detailed classification, it becomes very difficult to make a cost analysis of this nature.

Costing of the Issues of Materials to Production

There are several methods that are in use for costing the issues of materials to the production and other departments of an organization. First in first out (FIFO), last in first out (LIFO), average cost, standard cost, base stock method, market price at the time of issue, latest purchase price, and replacement or current cost methods are a few of the methods used for this purpose.

4.10 FLOW OF COSTS

The flow method refers to the way inventory items are added to and taken from the stock of inventory. The assumed flow for accounting purposes may not be the same as the actual physical flow of goods. The selection of the assumed inventory flow method by management

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determines the flow of costs. There are various inventory flow methods in practice today. The most widely used methods among them are as follows:

(i) FIFO (First-In-First-Out) method,

(ii) LIFO (Last-In-First-Out) method,

(iii) Average Cost Method, and

(iv) Specific Cost Method

4.11 STOCK VERIFICATION

It is the process of physically counting, measuring or weighing the entire range of items in the stores and recording the results in a systematic manner. Stock Verification is usually carried out by the materials audit department, reporting to either the materials manager or the internal audit. One person is usually given the exclusive responsibility with adequate facilities and authority. The main objectives of stock verification are as follows:

i. To reconcile the stock records and documents for their accuracy and usefulness,

ii. To identify areas which require more disciplined document control,

iii. To back up the balance sheet stock figures, and

iv. To minimize pilferage and fraudulent practices.

The physical verification of stock may be carried out either as a periodic or continuous basis. These two methods are briefly discussed below.

Periodic Verification

Under this system, the entire set of inventory items is verified at the end of one period, which is usually the accounting period. In large organizations, this cannot be done in a day, and usually several days are taken to complete this task. As no transactions can take place during the verification, this could pose some problems. Physical verification requires careful planning and execution. The steps involved in the verification require many activities to be carried in a systematic manner.

A detailed program should be chalked out giving complete breakdown of the process storewise and itemwise. This should be done in consultation with the materials management and finance departments. Necessary stock verification cards and checksheets must be prepared in adequate numbers. All material audit personnel must have clear-cut instructions on their jobs and schedules for proper accountability. During the verification process

all transactions must be stopped. In other words, there should not be any receipts or reference and control. Separate provisions must be made available for items, which are damaged or deteriorated. Selected areas and items must be allocated to each stocktaking person so that orderly completion of the job without duplication or omission is ensured. It will be necessary to separately verify items, which are under inspection, items sent out to suppliers for processing and stocks at various stockyards.

Appropriate forms and documents are designed for each item and values are worked out for different classification. The total of such values gives the value of the stock on hand as verified. The value is compared against the book figures or stock records.

Discrepancies, if any, are noted down. Minor discrepancies need further analysis so that the causes can be identified and remedied. Allowances regarding acceptable margins of tolerances for conversion, weighing and measuring, as well as for evaporation must be clearly laid down. Top management's sanction may then be sought writing off deficiencies or valuing surplus.

Continuous Verification

Under this system, verification is done throughout the year as per a predetermined plan of action. For example, important items may be verified thrice a year, moderately important items twice a year and other 'trivial' items once a year. It, therefore, presupposes that a perpetual inventory record for each item is maintained showing all transactions so that reconciliation can be done. The advantages of this system are as follows:

i. Work verification can be independently carried out by materials audit department staff,

ii. Investigation with regard to discrepancies are spread over the year and hence detailed analysis is possible,

iii. Final accounts can be prepared expeditiously if continuous verification is done as per plan,

iv. There is no need to 'freeze' the entire operations of the stores as verification is done throughout the year based on perpetual inventory records, and

v. any time stock records are more up-to-date when compared with the periodic verification system.

Process of Verification

Items are verified by counting in the case of bearings, by weight in the case of sheets, by measuring in the case of lubricants and so on. However, when large stocks of items such as sand, scrap and ore fuel need to be

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verified, it is based only on estimates, as exact measurement is not possible. In the actual process of stock verification, the stores personnel should be involved, as they intimately know the locations of various items, which result in quicker identification of items. For instance, some items may be located in many places. By virtue of their experience, only stores personnel are able to locate them. Hence, the material audit people are required to work in close coordination with them. Discrepancies must be discussed with stores so that any omissions may be rectified and then only they should be reported to top management. Major discrepancies may require a re-verification. Such discrepancies may be due to pilferage on a large scale, wrong posting of records, and inefficiency in documents control. Thus, careful analysis and corrective actions are called for in all such cases.

In consideration of all the discrepancies as noted, appropriately designed stocks adjustment documents need to be prepared by the top authority of the organization. In the whole process of stock verification, material audit section plays a crucial role. It is specifically responsible for identification of weak areas and taking remedial actions. It assists the stores personnel in accurate records keeping and smooths finalization of annual accounts.

4.12 INVENTORY RECORDS

No inventory systems are expected to perform efficiently unless records are accurate. The decisions on when and how much to order for an item is based on its inventory balance. If the inventory balance is overstated, there is a risk of stockouts. If the inventory balance is understated, there is likely to be excess inventory. Inaccurate inventory records may result in a number of problems, such as lost sales, shortages, missed schedules, low productivity, late delivery, excessive expediting, and higher freight costs. To overcome these problems, organizations frequently order more than needed, creating excess inventory, high obsolescence, and non-moving inventory.

Appropriate control of inventory items and record-keeping accuracy require a verification of items and their records. Inventory items should be classified and properly identified so they can be located for verification. This means that proper control over inventory must also include the methods of storage and handling. Control is necessary to ensure against errors in item status, such as inaccurate counts and items lost to embezzlement, damage, spoilage, and obsolescence. Control usually is accomplished through a series of inventory records and reports that provide information on usage, balances, and receipts. It is desirable for record verifications and physical counts to be conducted by an independent agency with no interest of its own in the operations.

Some of the basic data required keeping meaningful and useful inventory

records are as follows:

(i) Item identification and/or classification,

(ii) Item location(s),

(iii) Unit costs and net prices,

(iv) Interchangeable and/or substitute items,

(v) Shelf life,

(vi) End item (what it is used on or with),

(vii) Dates item entered inventory,

(viii) Dates of withdrawal,

(ix) Supply sources, and

(x) Unit balance.

Accurate inventory records are an important aspect of financial accounting inventory control system. The foundation of any inventory control system is the information contained in records upon which decisions are made. Without record accuracy, the best-designed system is destined for major problems in future.

While every inventory system must be concerned with inventory record accuracy, it is not uncommon for more attention to be given to the more interesting technical aspects of a system while overlooking the tedious aspects of inventory record accuracy.

Whether the system is manual or computerized, record accuracy is critical to operations. An accurate inventory record results only when the following three requirements are made:

(i) A good system for recording all receipts and disbursements,

(ii) A good system for auditing record accuracy that discovers and corrects the causes of errors,

(iii) Trustworthy, responsible, and honest human resources engaged in the whole function.

The condition of inventory records is influenced by the personnel involved, the physical control, and the verification system. The *personnel involved* are the people who physically receive, issue, and store material as well as their first line supervisors. The stockroom supervisors must accept responsibility for and take pride in maintaining record accuracy. Without their full support, their subordinates cannot be expected to strive fully for record integrity. Operatives must be instructed and trained in stockroom operating procedures so that they recognize the importance of accuracy. It is desirable to set accuracy goals, measure accuracy, and post records of performance in comparison with goals.

An important aspect of *physical control* is to limit and control access to the storeroom. Each time a part is added to the stockroom or withdrawn

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from it, the transaction should be logged in the appropriate record. Unauthorized and undocumented transactions must be stopped else control is virtually impossible. An enclosed and locked storeroom accessible only to authorized personnel can do much to control undocumented transactions. It is desirable for all parts to be identified by part number and geographical location in the storeroom. A clean and well-ordered storage area will reduce lost and misplaced items.

An efficient way to utilize space in the stockroom is to use a locator system. The stockroom is divided into sections and subsections with an appropriate numbering scheme. Parts are stored in the same location or in an available section, with the location noted on the receipt record along with the part number. As part issues are required, the warehouseperson proceeds to the designated location of the part. A well-devised locator system can contribute much to data integrity. Fixed locations, random locations, and zoned locations can be used to store inventory items. With *fixed locations*, each item is permanently assigned a specific, single location (space). This minimizes problems in finding items but can lead to inefficient space utilization. With *random locations*, items do not have a specific location but are assigned to the easiest open space, and the same item may be stored in more than one location. While space is utilized more efficiently, the location of an item must be updated with each transaction (receipt or withdrawal). Naturally, this method of location requires exact records and careful reporting of stock location. *Zoned locations* are a hybrid of fixed and random locations. A grouping of similar items is assigned to a designated zone. An item is located anywhere in the space available within the given zone. Space is used more efficiently, and each item has a general but not a specific location.

A physical count of items is necessary to verify the integrity and accuracy of inventory records. Differences between book (record) and physical inventories must be ascertained. Any differences (variances) must be adjusted and the amount of overage or underage properly accounted for. A periodic physical count of inventory can be made for all items, or a cycle count program can be instituted. A physical count of all items usually involves closing the facility for a time while the quantities of all items are substantiated and the records are updated. The cycle or perpetual count method involves the continuous counting of inventory throughout the year. Inventory accuracy is a fundamental requirement of any inventory system. True record integrity requires a management policy like intolerant of errors. Management must establish a climate of accuracy and the necessary tools for its achievement.

4.13 INVENTORY SECURITY

Security requirements vary widely among organisations, and are dependent upon the nature of the material, its value, size, weight, application, utility, and resalability. In general, the more valuable an item, the greater the need for security. However, some expensive items require relatively little protection because of their size, weight, and limited utility (large castings, special molds etc.).

Materials can be safeguarded by establishing and enforcing storeroom regulations. Periodic auditing of storeroom operations can reveal existing or potential security problems. The following security measures should apply to storeroom operations:

(i) Limit access to storage areas to authorized personnel,

(ii) Count, weigh, or measure all materials or receipt,

(iii) Require authorized orders and requisitions for all transactions,

(iv) Store valuable items in locked cabinets or in safes if necessary,

(v) Keep storerooms locked and enclosed except during working hours,

(vi) Periodically spot-check stock on hand against inventory records,

(vii) Investigate unusual consumption for improper use,

(viii) Periodically check the authenticity of signatures and authorizations, and

(ix) Provide security bonds for storeroom personnel to protect against losses through negligence or theft.

The effort, time, and money spent on the security of inventory should be allocated among the items in proportion to their relative importance. At no time should the cost of security exceed the benefits that accrue from it.

SUMMARY

- Stock of goods, which must be carried and stored in order to ensure smooth and efficient running of affairs of production and business, is called Inventory.
- The inventory prevents the stock out and shortages and discounts are available for large purchases.

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- Inventories of direct materials referred to as Bill of Materials (BOM).
- Work- in-process inventories are the parts, components and other items stored during production processes at various facilities and departments of production waiting to be assembled.
- Product inventories are final finished products ready for shipment to sale or temporarily stocked before being sent to market and sold.
- Spare parts management involves numerous business processes that require application support and data from diverse classes of applications.
- Stores accounting plays a very important role for the estimation of the cost of a product for pricing decisions.
- The flow method refers to the way inventory items are added to and taken from the stock of inventory.
- Stock verification is the process of physically counting, measuring or weighing the entire range of items in the stores and recording the results in a systematic manner.

REVIEW QUESTIONS

1. What is Inventory Planning?
2. Define inventory. Give its types and functions.
3. Why the inventories are necessary?
4. What is the aim of spare parts inventory management? In what way does it influence the different stages of the life cycle of spare parts?
5. What are the different types of spare parts, and when are they used?
6. Which problems are unique to spare parts that other materials do not exhibit? Why do these problems occur?
7. What is the financial significance of inventory valuation? Briefly elaborate.
8. Upon what factors does the selection of an inventory flow method depend?
9. Which valuation method is most suitable for goods that are subject to deterioration and obsolescence? Why?

10. Name three types of averages that can be used in the average cost inventory flow method. To which types of inventory systems do each apply?

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FURTHER READINGS

Applied Materials Management: S Chatterjee, Response Books, 2005.

Materials Management: Preeti Oberoi, Sarup, 2001

Materials Management: K. Shridhara Bhat, Himalaya Publishing House, 2011.

Materials Management: Planning and Control: Nand Kishore Sharma, DND Publications, 2011.

Purchasing and Materials Management: Anand Kumar Sharma, Anmol Pub, 2006.

UNIT 5 WAREHOUSING

NOTES

★ STRUCTURE ★

5.0 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- define standardization, classification and codification
- understand location and structure of warehouse
- know about storage system and method of preservation of different materials.
- explain types of losses due to warehouse systems.
- understand the concept of material management
- describe functions of material information system.
- know about different approaches to performance appraisal.

NOTES

5.1 INTRODUCTION

In this unit we will learn about standardization for quality, performance, service and materials of the product etc. Apart from this simplification and Codification have been discussed elaborately.

Warehousing is important aspect in effective operations of the company, warehousing management is concerned with carrying the right kind of materials or goods in right quantity neither in excess nor in short supply and also keeping it safe against any kind of deterioration, pilferage or theft. We will discuss other aspects of warehousing in detail in present unit.

5.2 STANDARDIZATION

Setting up standards for quality, quantity, sizes, performance, service and materials of any product made for consumer and the process used in any industrial organization is called standardization. Standardization helps in evaluating the quality performance and value of a product, process or service. The International Organization for Standards (ISO) is set up for standardization of any product or process of any organization. According to ISO, ISO 9000 is the process for registration for quality standards internationally accepted to produce standard items. This is developed in Europe in 1987. The ISO 9000 criteria are recognized as the required quality standards for the European Union (EU) and many other parts of global market place have adopted these standards including India. It has some limitations. The criteria address only standards related to the quality assurance, which include variables related to process control, design, documentation, supplier control and assessment. They provide an indicator that the supplier has complied with process requirements. There is no way guarantee that the supplier produces quality products or services that actually meet customer requirements. Registration ensures that a quality system is in place but provides no absolute measures of quality results or customer satisfaction. Therefore, ISO has completely modified ISO 9000 process in 2001.

Dr. Walter A. Shewhart first introduced quality control technique to be used in industry through statistical method called SQC (Statistical Quality Control) technique. Standardization and quality control go hand in hand. The quality control is necessary in various manufacturing stages including design of product. The product quality will be established by

- quality at design of product stage.
- quality at the production stage.
- quality in the function and performance of the product.

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The standardization of product is also done at all these stages. The close tolerances in the design stage are for better design but may not be economic to produce. The standardization selects the tolerance values accepted in economic production process. The requirement of customer is also the factor considered in standardizing the product.

There are no written and acceptable standards but customer creates them. Large-scale consumption of products leads to mass production and standardization sets the quality in mass production of products and interchangeability of parts. Statistical quality control techniques are used for controlling the quality performance of mass production items and set the standards of sizes, types, dimensions, operational characteristics and life of products.

ISO 9000 consists of series of process quality standards but not the product quality standards. The product quality is a result of process quality. ISO 9000 is a series of standards ISO 9001, ISO 9002, ISO 9003 and ISO 9004. ISO 9000 simply provides guidelines for using ISO standards. ISO 9004 is an internal quality management document that provides help in implementing ISO 9001 through ISO 9003. ISO 9003 is least restrictive of the three primary standards requiring conformance only to final inspection and test standards within a production environment ISO 9002 requiring the same standards as ISO 9003, also includes standard requirements for purchasing, production and installation capabilities. ISO 9001, which requires every thing that ISO 9003 and ISO 9002, requires. It also includes standard requirements to ensure conformance in design and servicing a full range of manufacturing and support activities. The Total Quality Management (TQM) concept is followed by ISO 9000 which describes and defines the fundamental nature of work process necessary for an organization. It is a critical first step in implementing TQM system in the organization and recognizes discrepancies between what employees are doing and what the documentation stage is being done. It helps in removing discrepancies of employee's action, documentation and re-engineering the process.

Suppliers can have many benefits from pursuing ISO registration and customers are also benefited to buy ISO certified products. Since ISO 9000 is accepted as a common standard of quality assurance, it has been adopted by various industries in India and other countries like USA and European countries for their production.

Aims of Standardization

- In order to manufacture standard products all the tools, equipments, materials and processes used in it should be standardized.
- All the machines used for production and operation should be standardized.

- To specify quality of the product and maintain it.
- Aims of standardization at the International level of marketing is to make and import and export goods and services which are having standards internationally accepted. The cooperation in scientific and technological development is needed for this.
- The goods produced to sell at national level or locally should also have the quality standards.
- To achieve economy in cost, labor and material used in production.
- Standardization ensures maximum convenience in use of products by simplification, rationalization and interchangeability of parts and components.

Advantages and Disadvantages of Standardization

Advantages

- It delivers better quality of products.
- Automation in manufacturing makes the product economic to produce.
- Reliability and performance of product is improved.
- Overall economy can be obtained in production.
- It makes purchasing easy and selection of materials of particular specification and availability is ensured.
- Management of production is easily controlled and higher efficiency can be achieved.
- Customer satisfaction improves.

Disadvantages

- The cost may sometimes be increased in adopting standardization and manufacturing quality products.
- Sometimes more rejection may be there because of lack of maintenance in highly mass producing companies.
- There may be restriction to freedom of choice.
- If the customer-demanded items are produced, it is difficult to standardize the choice.

Classification of Standardization

The various products and services are classified according to their standards. His classification of standards can be as follows.

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(*i*) **Material standards:** The raw materials used in production are standardized for their quality and characteristics.

(*ii*) **Parts standards:** They are standardized for their physical characteristics and performance. They are known for their technical specifications.

(*iii*) **Equipment standards:** If the parts and components used to make the particular equipment are standardized, the equipment made by them will also be a standard product.

(*iv*) **Process standards:** The various manufacturing methods and operations are standardized for economy in production and making them efficient.

(*v*) **Safety standards:** They are the rules and regulations formed to operate the machines and prevent any accidents. They are for the safety of human beings and other things in the organization. The safety standards and rules must be followed very strictly in every organization for the benefit of all.

(*vi*) **Office standards:** The administration work in the offices is also standardized to follow prescribed office procedures to avoid delays in work and to properly control it by the authority.

Levels of Standards

The standards adopted for various things are also different and their level depends upon their use. About five different levels of standards are used in routine operations.

(*i*) **Individual standards:** It is laid down by the individual person, builder, corporate body or a Government department for their own specific purchases or work, such as furniture house building, fabrication or road construction.

(*ii*) **Company standards:** It is prepared by various departments of a company together to carry out their work or purchase of various items in the company.

(*iii*) **Industry standards:** The trading association or industrial professional bodies prepare the standards for common interest of a group of industries or trading organizations for marketing their products are called Industry Standards. They have common agreement to produce these standard products to deliver to customers.

(*iv*) **National standards:** The National Standard Organization establishes the National Standards. It may be Government department or recognized by the Government. This organization in India is called Indian Standard Institution (ISI) or Bureau of Indian Standards.

(v) **International standards:** Those countries who are co-operating in international trade imports and exports of goods amongst each other are using international standards like ISO 9000. They have an agreement to purchase and sell their products manufactured in that country as per international standards.

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5.3 SIMPLIFICATION

Variety reduction using standardization leads to simplification. It means elimination of unnecessary things not essential for functioning an equipment, elimination of variety of items used for a particular purpose and making and using few standard products. The simplification brings economy in manufacture by reducing inventory and variety in materials and operations. It is beneficial to manufacturer, businessman and customer all together.

Advantages of Simplification

The advantages of simplification by reducing the complexity in the product and in its manufacturing processes and reducing the number of different products produced of some type are obtained by manufacturers, traders and users.

(i) Advantages to Manufacturer

1. In elimination of manufacturing those products, which are not profitable.
2. In reducing variety of products, their size and types reduces the complexity in manufacturing processes.
3. If variety is less, large lots of same product are produced using special types of machine tools.
4. Manufacturing cost is reduced by reducing the production of variety of products.
5. Inventories are reduced and capital involved in storing large variety of items can be used for increasing plant capacity.
6. Quality of less variety of products can be improved by using precision methods of manufacturing.
7. Technology improvement is possible.
8. Training of workers is easy. Skilled workers produce less variety of items more efficiently and productively.
9. There will be less wastages, obsolescence and scrap.

10. Manufacturing cost is reduced by reducing variety in products.
11. Better market control and prompt delivery of products is achieved by increased production.

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(ii) Advantages to Traders and Businessman

1. Less variety of items are to be kept by traders.
2. Less money is inversted by businessmen in one type of product. They can sell more number of products and different products.
3. Selling becomes easy if variety of products is less.
4. As selling expenses are reduced in keeping less variety of products and less handling expenses, profit of the traders will be increased.
5. Large show rooms will not be required and storage spaces will also be reduced.
6. Stores records, accounting and office work will be less.

(iii) Advantages to Consumers

1. Standard and simplified products are available at cheaper rates.
2. Good quality products will be available.
3. After sales service given by supplier will be better and repair cost will be less.
4. Reliability and performance of standard and simplified products are also high.

Difference between Simplification and Standardization

This difference is given below:

1. Standardization means setting up standard measurements in the form of specification for the size and shape of the product and defining performance of it as quality, reliability, functionality of product produced by standard operations and methods.
2. Simplification means reducing the complexity and variety in manufacturing types of products and stopping the production of non-saleable items.

Because of reducing sales of large variety of watches made by HMT, they have simplified their production to produce less models of watches at reduced cost. The Philips company is making the standard electrical and electronic items at higher cost compared to locally made or imported items. Though these non-standard items are available at cheaper cost but their life will be less. The imported equipments if fail, their spare parts will not be available at cheaper cost. They will also be not available so easily to repair them.

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5.4 CLASSIFICATION AND CODIFICATION

All the industries and other organizations require different type of materials, goods and items for manufacturing the products and providing the various types of services to their customers. These materials and goods are to be identified by the purchase and stores department for supply to the various facilities of production and other departments in the organization so that materials management can function most efficiently. In order to identify, supply and store all the materials and goods properly, the classification and coding them systematically is essential part of materials management. Using proper methods of classification and coding the materials helps all the departments in locating, requisitioning and handling them in the organization. It also helps materials management people to select proper suppliers to purchase the proper materials at appropriate time.

Classification of Materials

The materials can be classified in different ways as follows:

- Those materials and parts that are used as direct materials for production. They are raw materials, parts, semi-processed materials, components, sub-assemblies, assemblies, spare parts and finished products.
- The other type of materials will be indirect material used to support the production systems. They will be tools used for machining like cutting tools for lathe, milling cutters, drills, hand tools as files, hammers and measuring tools.
- Jigs, fixtures and various types of dies and equipments used to hold the jobs and tools required for production work.
- There can be several type of supporting materials required for different purposes in manufacturing as mechanical, electrical and electronic processes. The example is various types of nut-bolts, screws, washers, wires, electrical fittings, resistors, capacitors, printed circuit boards and bulbs etc.
- Various types of chemicals, lubricants, binding materials, paints, packing materials, coolants, oils, fuels, cotton waste, cleaning materials, grease protecting materials and washing materials etc.
- The office materials, paper, stationary and computer materials like floppies, printers, CDs, laboratory materials and inspection and checking items can be classified in separate categories.

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The various types of materials and items as stated above can be placed in separate categories, groups and subgroups depending upon their nature and use.

Advantages of Classification of Materials

1 The various departments can prepare their requisitions giving the proper identification number and codes to their requirements.

2 Stores department will separate all the requisitions and put the materials in a group to prepare purchase orders.

3 The purchase orders will be further scrutinized by the purchase department after separating the various categories of materials so that the tenders and quotations will be prepared for selecting the suppliers of a particular group of materials and items.

4 The classification and coding is very helpful when materials are purchased and received in the receipt section of stores for correct identification of them as per purchase orders to verify them.

5 Inventory of materials will be easily located, recorded and stored if properly classified. The bin cards and stock cards can be grouped according to particular group of materials. Inventory control of items becomes easy when they are classified in particular category. Materials can be kept in stores according to their category. Their classification and code numbers will do receipts and issues of materials and their entry in stock registers.

6 The classification of materials is very useful for accounting purposes. The allocation of funds and budgets for different categories of materials are separately prepared.

The different organizations classify and code their materials required differently. They prepare the manuals and catalogues when they use different coding systems. These manuals and catalogue contain various information about the materials used, such as code number, name, use, characteristics, prices, suppliers and manufacturers names and addresses.

Materials management department also keeps the different catalogues, manuals, journals of various categories of materials of other firms and suppliers to facilitate in purchasing them.

5.5 CODIFICATION

The code numbers can identify the various materials used in any organization. The codification is defined as giving a symbol or a numerical code to a particular item. This number or symbol is the unique code number of the item. After classification of different items in the store in to sub-groups

and groups according to their characteristics and use for exact identification of that material or item a code is allotted. This code can be a number or symbol consisting alphabets and numbers together.

For example, the blue color for painting iron parts is used and its code number can be Pb2054. The suppliers or manufacturers also use their trade names and numbers for the items, which they sell. But these trade names or brand names of companies are many a time confusing. They supply various items in the trade names.

For example, Bajaj company sell large variety of goods by its trade name and symbol. Therefore, to avoid the confusion and to purchase, store and supply to production department a specific item of required quality and characteristics the materials management identify every item by a unique code. All the organizations follow some method of standard coding system. There are different types of coding systems used to suit different firms depending upon the type of materials they are using and selling. Whichever method is used for coding, it should be flexible and simple to adopt. It should not be confusing.

Advantages of Codification

The systematic coding has number of advantages for purchase, stores and production department. It is the part of materials management activity.

- The long names and description of items need not to be repeated every time when an item is referred by code.
- It helps in accurate identification of a particular item.
- Duplication of material is avoided.
- It helps in standardization of materials and products and reduces variety of them.
- The storing of materials, sorting and documentation becomes easier.
- It helps in location of materials.
- It helps in accounting and costing.
- It is useful for purchase department to select suppliers.
- It is useful for communication of information about materials.

Disadvantages of Codification

- The mistakes may be there in writing codes and it is difficult to find out correct codes.
- Codes may be misunderstood.

- When large number of codes is used for different materials, there may be confusion and it may be difficult to locate the materials without knowing the codes.

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Stores Vocabulary

When large number of materials have been given codes, it becomes difficult to remember them. For easy reference, the organization is publishing the codes and names of materials in books. This publication is called Stores Vocabulary. The stores vocabulary may be published in number of volumes of books when large number of materials are required in the organization. Number of volumes of books may be categorized depending upon group of materials required in the organization.

For example, in the Railways, the categories of materials required are in lakhs.

System of Codification Used

The various types of systems of codification used in the materials management are as follows.

(*i*) Numerical system

(*ii*) Alphabetical system

(*iii*) Mnemonic system

(*iv*) Alpha-numeric system

(*v*) Decimal system

(*vi*) Color codification

(*vii*) Kodak system

(*viii*) Brisch system

5.6 LOCATION AND STRUCTURE OF WAREHOUSE

Warehouses play a vital role in the effective operations of a company. Incoming materials and supplies, in process goods, and finished goods are important assets to a business enterprise. In a majority of manufacturing organizations, materials constitute the major fraction of cost, i.e., 40 to 80% of total cost. The cost of capital blocked in inventories is substantial. Since production and consumption cycles rarely match, the success of any business, besides other factors, depend largely on the process of efficient storage and material control of these assets in order to provide uninterrupted supply to the points of use or consumption and the warehouse

is the place for the operation of this process. Warehouse management is concerned with carrying the right kind of materials or goods in right quantity neither in excess nor in short supply and also keeping it safe against any kind of deterioration, pilferage or theft. Warehouse is the custodian of the organization's money, as money is locked up in stocks.

Business organizations utilize warehouses for a variety of needs. It may serve as a storage point and /or a transit facility for incoming, in process or outgoing goods and also for receipt trans-shipment of finished goods when located at some point between the company's plant and its customer.

Warehouse Location

The location of the warehouse is a crucial decision which has to be taken with utmost care as the process of relocation, once the facilities are installed and made operational, can be an expensive exercise. The optimal location of warehouses result in the following advantages:-

- Minimization of total transportation, handing and other related costs.
- Minimization of delays in providing materials and goods to the point of use or consumption.
- Maximization of effectiveness of warehouse operations.
- Conservation of efficiency of human, machine and equipment.
- Better Facility planning.
- Lending flexibility and adaptability to the organisations futuristic outlook.

The factors that influence the location of warehouse:

- The point of use or consumption
- The Size of the plant
- The nature and classification of materials
- Material handling consideration
- Locational factors for transit warehouses
- Models of facility planning

Warehouse layout

Warehouse layout is the internal design or the functional design. An efficient layout and design is very important from the point of view of its functioning which is in turn, linked to the functioning of the plant.

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A good layout helps in easy receipt locating, packing, issuing and inspection of goods, dispatching the goods, effects proper storage and preservation and also simplifies stock taking. The efficiency of the storage system may be compared and assessed in terms of unit cost (per volume or weight) of moving goods through storage sites or storage area over a given period. It usually takes into account the elements of labour, space and equipment needs and costs.

In any specific storage system design, these may be some advantages in sacrificing the accessibility to stocks in favour of getting more stores in less space, or *vice versa*. Thus, while it is not possible to arrive at any absolute criterion for the efficiency of one storage system over another, the selection of the right system will depend upon assessing and evaluating the requirements in terms of the manufacturing strategy or the distribution strategy. The size, design and layout of warehouse must, therefore be an integral part of a wider systems design and management strategy. It must also be realized, that what happens in a warehouse affects the whole range of other activities.

The objectives of a good warehouse layout are to achieve the following:

(1) Maximum ease of operation with ready accessibility of major materials.

(2) Straight line or semi-circular flow of materials from receipt to dispatch with minimum back tracking.

(3) Maximum use of space for storage

(4) Minimum handling of materials

(5) Minimum traverse distances while materials get transported into and transported out.

(6) Lowest possible need and use of material handling devices.

(7) Preservation and protection of materials by ensuring adequate environmental conditions internally and externally.

(8) Elimination of pilferage and thefts.

(9) Easy, prompt and seedy physical verification and stock taking.

(10) Flexibility of operations with a futuristic outlook.

The information needs while planning the layout are as follows:

(1) Classification of store items by size, number, weight, frequency of handling, handling arrangements required and perishability.

(2) Floor space and height required to store the items.

(3) Deciding in advance whether to go for fixed location: Random location or Zoned location of stocks or a combination of these.

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Warehouse Structure

The warehouse structure can be decentralized or centralized depending upon the organizational requirements. In decentralized stores system, each section of the industry has a separate stores attached with it, whereas in centralized stores system, the main store is located centrally.
Advantage of Centralisation of Warehouse:

- Better supervision and control
- Requires less personnel to manage
- Better layout of stores
- Inventory checks are facilitated
- Optimum stores can be maintained
- Fewer obsolete items
- Better security arrangements can be made
- Less risk of loss by fire or theft
- Less chances of production stoppages due to prompt availability of materials.
- Reduced material handling and associated costs.
- Convenient for user departments

Disadvantages of Centralized Warehouse Systems:

- Congestion in the storeroom
- Chances of misappropriation and thefts of particular items
- Possible delays in service to user departments
- Advantage of decentralization of stores

Disadvantages of Decentralization of Warehouse:

- Greater inventory carrying cost
- Difficulty in supervision and control.

The warehouse structure should emphasize on centralized control and decentralized activity. The principal sections of a warehouse are generally:

- The receipt section
- The storage section
- The issue section

5.7 INCOMING MATERIAL RECEIPTS

The receiving section of a warehouse is responsible for the receipt, identification and general inspection of all incoming materials. Receiving is also responsible for notifying all interested parties of the arrival

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and condition of incoming materials. The importance of the receiving function is often underrated. It is only at the receiving desk that the purchasing control document actually meet the physical materials. Any problem or error in a specific purchase transaction should come to light during the receiving operation. If the problem (shortage in quantity, damaged material, wrong items shipped etc.) is not detected and corrected during the receiving operation, then the cost to correct the mistake later may be much higher.

The receiving report which is upon the receipt of a shipment contains the details of the material which has actually received. This document is used as the basis for invoice payment, for continued purchasing negotiation and for closing the order. Accuracy of this report is, therefore, essential. For this reason, the receiving should be carried out by competent people who are reasonably familiar with the physical characteristics of the materials and also capable of exercising sound judgement in situation where a choice of alternatives must be made.

Receiving is an important control point in a firm's materials system. The receiving section can detect those suppliers who meet only the minimum standards of quality and service. Receiving records show suppliers are consistently late in their deliveries, which have the maximum number of rejects, and which deliver the greatest number of split shipment. Any of these supplier failure is costly to the buyer and therefore close coordination between purchasing and receiving is always important in the context of material management.

The Receiving Procedure

The receiving procedure of incoming material involves the following stages:

(a) **Unloading and checking the shipment:** The number of containers unloaded from the carriers vehicle should be checked against the carriers consignment document to make certain that the full consignment has been delivered. All containers should also be inspected for external damage, if any, any damage found should be inspected along with the carriers representative and noted on the receipt which the receiving personal signs. Failure to follow this procedure before accepting a shipment can relieve the carrier of all liability for concealed damage not evident until the container is unpacked.

(b) **Unpacked and inspecting the material:** The receiving personnel is responsible for three verification. First, the material received is checked against the sellers packing slip and against a copy of the firms purchase in order to verify that the correct items have been shipped. Second, the quantity is to be verified in the same manner. Finally, the general condition of the material is inspected

to determine whether any external damage was incurred during shipment.

(c) **Completion of the receiving report:** A receiving document or report is prepared as a by-product of the purchase order. Upon completion of the inspection, the report is prepared to mention what has been actually received indicating the items of the total order which have not been supplied. The different work groups who generally require notification about the receipt of the materials are the requisitioner (or the inventory control section in case of stock material), the purchasing department, the accounting department, and the incoming or receiving inspection department.

(d) **Delivery of the materials:** in case of non-stock material, the receiving department is usually responsible for delivering them to the reqisitioner or for releasing them to an internal delivery service that transports them to the requisitioner. In case of inventory materials, the practice varies. In some firm, the receiving department is responsible for deliveries, while in other this function is performed by transportation service. In some firm, the stores personnel are responsible for picking up their own materials. This delivery system depends somewhat upon the relative location of the receiving and the store area. Upon delivery of the material, the recipient signs the receiving report as a confirmation of acceptance.

The Receiving System

This can be divided into receipts from outside suppliers and receipts from internal division. System for receipt start even before the time when the material actually reaches the plant. When a purchase order is placed, a copy is sent to the stores indicating quantity and delivery date. These should be arranged in a chronological sequence so that the stores manager can, at any time, estimate the volume of receipt. This also helps in planning labour requirements when unloading activities take place.

After dispatching the goods, the suppliers normally send a advice note to the stores indicating the data of dispatch carrier details, the description of the consignment and value. A packing slip detailing with the contents in the package is also sent by the suppliers. These are sent in advance so that quick and easy clearance may be done. The transporter usually sends consignment notes to the stores concerned.

These three documents, namely, the copy of the purchase order, the supplier's dispatch advice note and the consignment note enable the stores manager to organize and plan for expeditious clearance of materials and minimize costly demurrages.

When the consignment arrives, it is identified and physically verified.

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A receiving report or a provisional goods inward notes is prepared as soon as the materials are cleared from the receiving section and then it is sent for inspection. Once the inspection is completed then the inspection department either endorses the PGI (Provisional Goods Inward) note indicating quantity accepted and quantity rejected or sends a separate inspection report and a discrepancy report.

This forms the basis for the preparation of a "Final goods inword Note Payment" to suppliers and this is made only after the FGI notes are made available. In case of materials received from internal divisions or returned from user departments, usually Transfer Notes are prepared

Materials Received Report

Received — Purchase Order .....

At..... .... — Date:

Delivery point: — Sl. No.

From.....

Vendor Address

Quantity Received	Description	Grade	Condition of Goods

Counted by: — Approved by:

Inspected by:

Example 1

Goods Inward Note

Provisional/Final

Material Part No.: — Purchase Order No.

Sl. No.

Description: — Date:

Carrier details	Supplier details	Inspection report
Truck/Wagon R/R; Consignment Note	Supplier Code Supplier Name	Test Results Conclusions

Quantity received — Damage/Shortage

Quantity accepted — Shortage claim ref:

Quantity rejected

Sign Central Receiving Station	Sign Inspection Deptt.	Sign Stores Deptt.

Example 2

NOTES

Discrepancy Report

From	To

Consignment Note Ref.: Invoice No.

P.O. Ref.: Date

Dear Sir,

We have received ..... Packages against the above consignment note on ..... The consignment was extremely in good condition. The consignment was opened on ..... and the following discrepancies have been found.

Description	Quantity Invoiced	Quantity Received	Shortage	Excess

1) Please arrange adjustment of excess/shortage.
2) We have deducted the value from the invoice for the shortage.
3) We have arranged to return the excess and shall adjust the invoice value.

Yours sincerely,

Example 3

Material Clearance/Rejection Note

Purchase order No. Sl. No.

Material Ref.: Date:

Supplier Ref.:

The above mentioned materials have been passed/rejected during inspection.

Details of examination	Reason for rejection

Example 4

5.8 INCOMING MATERIALS: INSPECTION AND CONTROL

The materials manager is responsible for ensuring supplies of materials in right quantity with right quality to the user departments. For better materials planning, better buyer-seller relations and vendor rating,

NOTES

awareness of the inspection schemes is necessary. In all organizations, the stores department ensures inspection of all incoming materials.

The use of statistical sampling schemes enables the management to decide upon tolerable levels for the risk of undesirably rejecting good materials and accepting bad materials when information is based upon sample inspection.

Quality control inspection is undertaken in industries to ensure that products conform to the specified or pre-established standards. Such quality control inspection is carried out in the purchase of new materials, in the inter-departmental flow of materials or components from one department to another and in the final acceptance of finished products for distribution. Incoming and in-process inspection helps to prevent sub-standard items from reaching the next user department and the final inspection prevents defective items from reaching the consumer. Through this process, it becomes possible to detect the various sources or factors which cause defective production and then to take appropriate remedial actions.

When a consignment reaches to the buyer, the following three alternative are available in deciding upon the inspection method. To accept the lot without any inspection – This would depend upon the confidence placed on the supplier or on the assumption that the items have been inspected and passed at the supplier's end.

To inspect each and every one of the items in the lot – Such 100% inspection is not always practicable due to the considerations of time, cost, perishability and fatigue. To choose appropriate sample of the lot on the basis of sampling techniques and undertake planned inspection to identify items which conform to the standards and segregate items which are found to be defective. On this basis, the acceptance or rejection of the lot can be decided upon. In case of rejection through sampling techniques, the entire lot can be returned to the supplier or it may be subjected to 100% inspection and only defective items found are returned to the supplier. This method is called acceptance sampling. The sample size should be true representative of the lot.

Acceptance sampling is of two types. One is single sampling and another is double sampling. In single sampling, one sample of n-items is drawn from a lot, the lot is accepted if the number of defectives in the sample is less than the acceptance number and the lot is rejected if it is more than the acceptance number. In double sampling, the final decision of acceptance or rejection is to be postponed till a second sample has been taken. This method is used when the first sample is neither good nor bad and then the decision has to be taken on evidence of first and second samples combined.

Sampling Inspection

Sampling is an act of drawing samples from a batch on random basis. Sample should be collected at regular intervals from the entire lot. The

purpose is to obtain a sample truly representative of the lot. The sample size normally increases with the lot size and depends upon the degree of quality to be assured. The sample size can be obtained from reformulated statistical tables. Different types of sampling are:

Random Sampling: It means taking samples at random from the entire lot.

Two-stage sampling: In the first stage, take primary units from a lot. Next in the second stage, take secondary samples from the sample of primary units.

Stratified sampling: The lot is divided in several strata and samples are taken from each. However, the samples from each strata are taken at random. The closer the strata homogeneity, the more precise the overall samples will be.

Cluster sampling: Here if the clustering is not proper, precision will be poor, or bias will appear. To make good clusters, all parts of the lots must be represented in the cluster in equal proportion.

Selected sampling: To find the mean value of the whole lot, rather than take a representative sampling of the whole lot, a sample, can be taken from only own special part and, on the basis of that value, the lot value is estimated. This is very commonly used in process control for manufacturing.

Sampling inspection is a technique to determine whether a lot or population should be rejected or accepted on the basis of the number of defective parts found in a random sample drawn form the lot. By going into details, one finds that there is always some probability or doubt associated with the sampling inspection. It is quite possible that by chance the sample may contain all good components, but the remaining pieces in the lot may have a big number of defective components or all the sample pieces may turn out to be defective but otherwise the lot may be excellent. So it involves a risk both to the purchaser as well as to the manufacturer. But certain risks will have to be borne by the two parties if they go for sampling inspection.

Situations where sampling inspection is necessary are:

(i) Destructive testing

(ii) Inspecting long length of goods

(iii) Inspecting large amounts

(iv) When lower inspection costs are desired

(v) When there are many items/areas to be inspected.

When it is desired to stimulate the maker and/or the buyer. As compared to 100 per cent inspection, the sampling inspection claims the following advantages:

NOTES

(i) It involves less amount of inspection to achieve a pre-decided degree of quality,

(ii) It assumes less time and is less expensive

(iii) Fatigue and boredom incurred by the inspectors are much less thus operating efficiency remains high.

(iv) It is more accurate because in 100 percent inspection, errors get introduced because of the fatigue and boredom incurred by the inspectors due to large inspection work of repetitive nature.

(v) Rejection of a complete batch on the basis of sample decidedly pressurizes for improvements in quality.

(vi) Since few pieces are inspected, no damage is done to the remaining pieces of the lot as they are not handled during inspection.

(vii) In certain cases where the components are to inspected by destructive testing or where powder is to be analysed chemically, 100 per cent inspection can never be used.

5.9 RETRIEVAL AND TRANSACTION PROCESSING SYSTEM

Warehousing system has been divided into three important sub-systems (i) Receiving and inspection sub-system (ii) Storage sub-system (iii) Issuing distribution sub-system. After completing the receiving and inspection procedures stocking follows. Although this is the most underrated function in warehousing management, it involves routine activities liking sorting out materials coming at the end of inspection process, maintaining the record of each and every item, with proper codification and location either by manual method or using computerized technique. Stocking is very important for easy location, proper identification and speedy issue to the consuming departments. This process is very crucial in warehouses where thousands of items are stocked for meeting the requirement of plant or for outside consumers. A good system of storekeeping is important in any system of warehouse management.

It is assumed that inventory records agree with the physical stocks of materials in the stores. If however it is found that they do not agree, they must be adjusted after periodical physical verification of stores. Needless to say that no amount of inventory control will work successfully if accurate records are not maintained and much of its value will be lost if stores are badly maintained.

STORE RECORDS SYSTEM

Development of appropriate recording system for stores is important to provide right information regarding the physical inventory and accounting

of the organization. Two records are usually kept of materials and other goods received issued or transferred, namely, Bin (or stock) card and the store ledger.

(a) **Bin Card:** For each kind of material, a separate record is kept on Bin Card which shows details of quantities of each type of materials received, issued and on hand each day. A storekeeper maintains Bin Cards up-to-date and usually in duplicate. One card is attached to each bin on shelf containing the material and the other record remains with the storekeeper for reference.

(b) **Stores Ledger:** This is similar to bin card except that there money values are shown. The store ledger may be maintained by a separate material accounting department. The entries regarding the materials ordered, received and issued are made from the purchase order, receiving section report and material requisitions respectively. Today most of the stores are maintaining the data of Bin-Card and Stores Ledger with the help of computer, which has made the retrieval process much simpler and economical.

BIN CARD

Bill No. ..... Maximum Quantity .....

Material ..... Ordering level .....

Code No. ..... Minimum Quantity .....

Stores Ledger Folio.....

Date	Quantity Received	Quantity Issued	Balance	Remarks

Example 1

STORES LEDGER ACCOUNT

Material ..... Code..... Maximum Quantity .....

Bill No..... Folio ..... Minimum Quantity .....

S.No.	Ordered			Received				Issued					Balanced		
	Date	PO No.	Q.D.E	Date	P.O. No.	Unit Cost	Total Cost	Date	R No.	Dept	Q	Unit Cost	Total Cost	Q	Unit Cost	Total Cost

P.O.No.: Purchase Order No.

Q : Quantity

D.E. : Date Excepted

R No. : Requisition No.

Example 2

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The Storage System Processing System

Selecting the most suitable storage system means dealing with a number of interacting, and often conflicting factors. The degree of mechanization affects layout, while scarcity of space affects height. The need for rapid over-picking means on easy accessibility to stock, it weighs against space economy. Any storage system is therefore, a compromise between the use of space and use of time.

The storage and retrieval are matched processes. The quick location of any item in the stores is required to minimize the retrieval delays. It is possible only where there is definite place for keeping each item and it is kept there. Moreover, the address of that place is conveniently defined.

Every item carried have a specific store location address in the form of a code which may be written in the inventory catalogue, or a separate store location index may be prepared. The location code should not be confused with material identification code. Three basis ways of storing:

(a) Fixed location

(b) Random location

(c) Zoned location

The first means that while stock can be found immediately without a complex system of recording there can be a considerable waste of space. The second system means space is better utilized, but good and elaborate records have to be kept about where the materials are:

Zonal location means that goods of a particular product group are stored in a given area. They may be randomly stored in a zoned location or stored according to fixed location.

Particularly in a large highly mechanized or automated store-house fast-moving or high turnover goods and sometimes, medium and slow-movers are also grouped together. The purpose is to assign most suitable types of storage and materials handling equipment to different kinds of stock movement. Fast-moving lines are usually positioned near the input and output end of a stores with the object of reducing the travel time.

Physical Control of Stores

The commonly followed systems for physically controlling stores materials are:

(a) Closed stores system

(b) Open stores system

(c) Random access stores system

Some of the firms follow a combination of these systems depending upon the nature of production operation and the use of materials.

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(a) **Closed Stores System:** In such a system all materials are physically stored in a closed or controlled area, usually kept in physical control by locking. Only stores personnel are permitted to enter the stores area. Entry and exist of material from the store is permissible only with the accomplishment of authorizing document. Maximum physical security and tight accounting control of inventory material are ensured by such a storage method.

(b) **Open stores system:** In this system no separate store room exists. The material is stored as closed to the point of use as is physically possible. Such a system find applicability in the highly repetitive mass production type of system, such as automobile assembly plant. The storage facilities are arranged at each work station as per requirement and availability of space.

(c) **Random Access Stores System :** This is a typical kind of closed stores system in which no materials has a fixed location. All materials are stored at random locations throughout the storeroom. When an item enters the stores. It is stocked at first available storage location or that particular group, and when it leaved the storage, location becomes empty for any other item of the same group.

The storage facilities are open and worker has direct access to it. The open type of storage system expedites the activities and cut down the retrieval time. Due to rapid use of material, it is not subject to high-rate of deterioration or obsolescence. The system places little emphasis on the security of materials. The materials used in open system should not be easily damaged or pilfreged.

The responsibility, of stores in this system is to deliver the material to production areas and to device satisfactory physical storage arrangements with production supervisors. The further responsibility is to store material in production areas with the production supervisors. The paper work is also considerably less to open system: It places less emphasis on accounting control. No perpetual inventory records are kept. The actual usage can be determined by finding the difference between the number of items in the beginning and end of the period. Usually a paper-work control system using electronic data processing equipment is employed when the material entered into the store, is loaded into the store, and loaded into the computer giving details of code number description of material, location in the stores etc. This system is very popular in modern store.

The most significant advantages of this system is that it utilizes the space more efficiently than a fixed location system. Further, it provides greater flexibility by accommodating different materials. This type of

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storage system has got certain disadvantage too. It is feasible for large scale operating and requires a costly control system using electronic data processing equipment. The preservation of record is very important. The physical stock verification without this is very cumbersome.

Automated Storage/Retrieval

Significant developments have taken place in the area of stores management in the past few decades. The concept of a totally automated storage and retrieval system has been inviting the attention of professionals to match the storage system with the rapid development in the technology. High rise storage systems have been commonly used in advanced countries. Automated material handling systems are used for the unit load type storage retrieval system. But for the systems in which different quantities of different item are to be retrieved the semi automatic kind of material handling with manual operator are used. Some of the system to improve the efficiency of automated storage/retrieved systems are as follows:

(i) Sequencing in a optimal way by picking stocks in a signal picking tour.

(ii) Allowing a single operator to perform all storage and order picking operations in an aisle.

(iii) Make a picking list based on a single customer's order.

(iv) Stores items in pairs such as nuts, bolts, washers etc.

(v) Locating items from the rack as per the structure and importance of orders.

(vi) Allocating all items related to a specific facility to a single aisle.

Method of Storing Various Items

(a) All small items of stores and parts should be kept in bins. An identification level showing location, part number/material code no. and description of the item would be affixed to one piece of the item in the bin. Another lable indicating the same information should also be affixed to the front of the bin. Also, the same information may be loaded in the coupular. The location has to be designated in row-way bin system. For example, if the item is kept in the row 3, way 4 and bin 2 the location would be designated as 03-04-02.

(b) Where heavy items are stored on the ground in a shed, identification boards showing the class, art no. material code no. and description of the material should be kept in the vicinity of the items. The materials should be arranged in such a way that the oldest materials can be selected first for issue, where large quantities of bulky

item are involved. It will be preferable to store them as pallets. This will permit more compact and efficient storage for the quick handling by forklight trucks.

(c) Similarly iron and steel, timber etc. should have identification boards attached to the stocks.

(d) Items of special steel like tool steel, carbon steel etc. will be marked by a colour code. Both the ends of the items should be colour painted so that even if an item is issued from one end, it should be possible to identify the cut piece from the colour code at the other end. It is referable to mark the specification of the special steel through out the lengths of rod, bars etc.

Advantages of Good Storage Method

A well laid out and organized store having good storage methods yield following benefits:

(a) Accessibility to materials, permitting efficient service to users.

(b) Minimization of material deterioration and pilferage.

(c) Efficient utilization of space and height.

(d) Easy physical counting

(e) Quick location of items

(f) Better control on stock

Materials Position in the Stores

Initial analysis of components, parts and materials should be made to store them in an organised manner. The following table gives the position of materials in the stores.

(a) High usage items	Near the dispensing window
(b) Heavy items difficult to transport	Near Broad Gangways near gate
(c) Inflammable and dangerous items	Open isolated and stored in a fire proof place with sprinkle system.
(d) Minsy items like oils, grease, paints etc.	Dry chamber in airtight container stored separately.

Preservation of Materials

Cost of deterioration is one of the element constituting "inventory carrying cost and it is necessary that the same is kept to the minimum

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dampness and humidity cause corrosion of metals and metallic stores and change their physical character. Common causes of deterioration of materials in storage are:

(a) Corrosion of metals and metallic items and scaling.

(b) Bacterial attack

(c) Timber is therefore, on the items which is most suspectable to deterioration.

Preservation Methods

Although there are large number of example, of preservation methods, a few important examples are mentioned below.

- **Cement and lime** should be stocked in separate godown to obviate the lime dust from setting on cement.
- **Rubber Hoses :** To be stored in cool and dry places and kept away from direct sunlight and high temperature. Rubber hoses should never be hung on mails or hooks as such method are likely to cause damage due to bending strain and consequent cracking. They should be kept in coil on ground.
- **Conveyor Belting:** Always to be kept in upright position in factory packs under covered accommodation. To be stored in a cool dry room and should be stored in coils.
- **V- Belts :** They should never be hung up on nails to obviate strain and cracking.
- **Wire Ropes :** External surface should be greased to prevent seeping of moisture. They should also be stored under covered sheds.
- **Bearings :** Mineral jelly may be used as preservation .
- **Tyres :** These should be stored in vertical position. Tyres and other rubber goods will preferably be stored in rooms with controlled temperatures and air conditioned.
- **Batteries :** Charged batteries are liable to self discharge while in storage. These should be stored in very cool place away from hot air ducts and direct sunlight. If kept for long more than three months there should be discharged and charged periodically.

New developments have been made in the field of preservation of stores and prevention of pilferage, for example electrodes must be stocked in dry place. Bearings must be properly greased. Industries have taken several measures to cut down losses through pilferage. Large organizations have found it useful to maintain intelligence squads security personnel and electronic alarms. Scrap yards in the jet age scrap such as tungsten, copper etc. are dumped are even guarded by clog squads.

5.10 SECURITY AND LOSS PREVENTION

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Security is an important factor of business efficiency. The objective of security management is loss prevention. LOSS is always a resource that gets wasted and therefore this is one of the most detested word to making. LOSS is a cost and all efforts have to be undertaken to minimize it or preferably eliminate it. LOSS in warehouses seriously erode the profitability of any organization as huge amount of money is locked up in stores.

The principal aim of security management is to protect the assets of the company and devise adequate counter measures to create secure conditions within the company. Security problems in warehouses are dependent upon the Nature and Value of the materials stored, and in general, it may be said that more valuable the item, the Greater is the need for tightened security. The security measures should be commensurate with the potential threats following a through and professional assessment of the risks. Having established the extent of the threat to the company the policies of denial, detection and deterrent need to be implemented i.e., denial of the company's assets to the potential threats by good physical and mechanical protection , detection of any undesirable activity within the company by the direct methods of good security checks, alarm systems or other physical means. All the procedures and practices should be examined frequently to ensure that they are adequate and that the person responsible for carrying out these duties is observing the procedures. Loss analysis should be done based on reliable figures. LOSS analysis charts should be supplied as matter of routine to people to ensure that the problems are tackled when they are first apparent and not when they have been allowed to magnify.

If we accept that a manager is not only responsible for the motivation, direction and control of staff, but is also charged with the prevention and profitable use of the assets of a business, then, the importance of security to him is obvious and this manager will be successful in applying security to his business.

The degree of security measures adopted in warehouses are dependent upon the following factors:

1 Warehousing systems of inventory management, receipt, storage, dispatch, handling and housekeeping

2 Shrinkages/pilferages

3 Fire

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Types of Losses Due to Warehousing Systems

Let us discuss various type of losses that can be found due to improper warehousing systems. The different types of losses generated in warehouses due to improper systems of inventory management, receipt, storage, dispatch, handling and housekeeping are as follows: Obsolete items, Surplus items, Damaged Materials and Scrap items.

Reasons for the generation and accumulation of the above mentioned losses:

(a) **Changes in product design:** After a product have been in the market for sometime, it requires to be replaced with new products. Such needs for replacement calls for new product design and development, and this process may render many inputs obsolete.

(b) **Rationalisation:** There can be a need to rationalize inputs required through standardization, simplification and variety reduction with an objective of achieving operational efficiency. This may render some items surplus or obsolete.

(c) **Human Errors:** In many cases, generation of obsolete, surplus and scrap can due to human errors in implementing and maintaining proper warehouse systems.

(d) **Faulty Purchase:** Sub-optimizing decisions like buying in bulk to take care of discounts and transportation economy, without taking into account storage space requirements and technological changes, lead to the accumulation of surplus, obsolete and scrap.

(e) **Faulty Planning:** Wrong indenting by the user department or wrong sales forecast may also lead to accumulation of undesirable stocks.

(f) **Improper Storage and Handling Methods:** Faulty store keeping methods, without adequate preservation and protection lead to spoilage. Inferior material handling practices, improper codification and poor manufacturing methods also result in obsolete, surplus and scrap.

(g) **Cannibalization:** When a machine breakdown occurs, sometimes it is rectified using parts of an identical machine which is not functioning due to various reasons. This process of cannibalization if continued unchecked result in obsolete and scrap items.

Prevention and Control

The steps involved in prevention and control of the losses are as follows:

(a) Whenever changes in production programme, design or product

lines are contemplated, a representative of materials management department should be kept informed.

(b) Periodic review of stock records should be done on a systematic basis so that the entire list of materials are covered once or twice a year.

(c) Standards may be set to indicate the basis upon which an item should be declared surplus.

(d) Process losses should be decreased by proper examination of specification and standards.

(e) Use of standard parts should be encouraged wherever possible.

(f) Selection control based on ABC analyses, accurate forecasting techniques and proper prevention techniques should be adopted.

The combing process of combing the stock records and movement analysis have been found to be effective in locating undesirable stocks in the total inventory. Stock issue cards should be combed and items which have not been consumed for period of 1 year, 2 years, 3 years, 5 years and above may be isolated. A list of such items and their value in terms of money and time must be made. Such lists of disposal decision can be put up before the top management. Such combing and movement analysis must be done on a continuous basis.

Effective Point Advice (EPA)

Many organizations have introduced formal documentation in introducing changes in design and is known as EPA. The proposed changes, the details of new inputs required and details of items rendered obsolete is mentioned along with the approximate date of introduction of the change. This document is circulated to concerned department. EPA, therefore, helps in tapering off the stock of obsolete items, cancellation of orders of such items and placing order or manufacturing new required items.

Disposal Action

Once the items have been identified a obsolete, surplus, damaged or scrap, the next step is to find methods to get rid of them. Disposal actions when handled judiciously can result in good returns to the organization.

An effective disposal requires a compact organization for disposals, continuous market survey on the prices, constant interaction with other industries generating similar type of losses and with the end users.

The disposal action can be as follows:

NOTES

- **Use within the firm:** The greatest value is obtained from surplus materials, if it can be reclaimed for further use in the firm with minor modifications
- **Sell directly to end users:** In practice, it has been found more profitable to dispose the scrap directly to end users rather than to middlemen.
- **Return to the supplier:** To get maximum return, surplus materials *should be returned to the original supplier.*
- **Sell to Dealer/Middlemen:** Dealers or brokers are specialised middlemen who collect, sort and process surplus materials, especially surplus scrap. This approach is utilized when it has been determined that scrap quantities are too small to justify direct sale to the original supplier.
- **Sell to the employees:** In case the items have an end use value to the employee, many firms make it a practice to sell such surplus items directly to their employees.

Certain points to be remembered during disposal of the materials:

(a) The procurement department should be made responsible for disposal because they are much more familiar with the suppliers, end-users and the current market trends.

(b) Before disposal action the materials should be segregated according to their characteristics. Mixed materials yield lower returns.

(c) Regular collection/segregation of obsolete surplus and scrap should take place.

(d) Physical verification of the materials should be done in order to know the amount of generation in a particular time period i.e. the material volume, weight or number should be ascertained.

(e) Decide upon the best policy and method of sale whether through tendering, auction or negotiation.

Type of Losses Due to Shrinkages/Pilferages

One of the important loss to warehouses is pilferage which is generally due to improper attitude of the employees. It has been rightly said that security its an attitude of mind. Pilferage gradually expands into a vicious circle and can eat up the profitability of the organization even after proper systems of warehouse management has been implemented, inventory planning has been done meticulously, adequate recording of receipt, storage issues and reconciliation has been done and also the valuable waste is accounted properly.

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Shrinkages

LOSS in warehouse is concerned with the disappearance of materials and stocks. Warehouses take a physical inventory periodically. When the count is completed, the difference between the actual inventory on hand and what is should be according to receipt and issue records, is called shrinkage.

Some of the reasons of shrinkages are:

(1) Internal theft

(2) Unauthorized mark downs

(3) Manipulation of receipts and issue records.

(1) **Internal Theft:** Warehouses employ many unskilled people who work for minimum wages. Whatever the motivation, a fair percentage of such workers succumb to temptation and steal.

(2) **Unauthorized mark downs:** Some of the dishonest employees can intentionally damage or change the tags and markings of the good materials in order to down grade them to declare it unfit for internal use for to reflect a lower value of inventory. The material which are declared unfit for use can be sold profitably in the market through under invoicing those materials. Also by reflecting a lower value of inventory, a shortage can be created and fresh purchases made from suppliers in lieu of monetary favours.

(3) **Manipulation of receipts and issue records:** Receiving and issuing employees can falsify the various receiving and delivering document. Sometimes this is done in conspiracy with transporters or material handlers. Bulk consignment receipts and issues are vulnerable to collusion between the transporters and warehousemen as the loss is easier to conceal than the theft of individual items.

Prevention and Control

(1) Improve morale of employees through implementing positive programs of employees relations build around fair compensation, proper surroundings and employer sponsored activities.

(2) There should be a highly visible security program and a rigid company policy of prosecuting any employee caught stealing.

(3) Pre-employment screening should be done to secure information regarding the education, background, experience and ethical code of the employees.

(4) Wherever possible employees should be required to used a

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designated entrance when coming to or leaving work and security personnel should be posted at such location.

(5) Periodic checking of garbage areas and remote corners as employees find them ideal place to hide the stolen goods.

(6) Strong tamper resistant locks should be provided at important location particularly where valuable items are stored.

(7) Incoming shipments should be physically counted and verified against the accompanying documents. Receipts given to delivery people should indicated any shortage found. Test counts can be done randomly as a security measure.

(8) Under cover investigation should be carried out. Investigators posing as employees are placed within the warehouse.

(9) All employees should be involved in the security management programmes.

(10) Awards and incentives can be provided to employees to encourage interest and participation in case of no shrinkage found.

(11) The marking and tags should no be loose or easily removable.

(12) Frequent stock taking of valuable items should be carried out to reconcile stocks.

(13) Wherever possible loads should be planned so that vehicles leave or enter the warehouse filled to capacity and gross weight ascertained.

(14) Ensure good housekeeping – A place for everything and everything in place.

(15) Install electronic alarm systems and closed circuit TV for ensuring security within the warehouse.

(16) Conduct training programmes of employees on attitudinal development and security awareness.

Type of Losses Due to Fire

Fire safety is critical element in any warehouse safety programme. Consideration must be given to emergency programmes, sprinkler protection, fire hoses, fire extinguishers and flammable liquids and gases. Fire protection is a serious subject, which if not addressed, could result in a catastrophic loss of property and life.

Many warehouses handle or store flammables. When storing a chemical always consider the flash point. The lower the flash point, the greater is the danger. Flammables in container may leak as a result of handling or damage and it can get ignited from static sparks, friction sparks or

electrical sparks. Another source of ignition is heat generated from rapid compression.

Following actions need to be taken for prevention and control of fires:

- Select and install fire extinguishers that are appropriate for the workplace hazard.
- Fire extinguishers should be installed at places where they are easily accessible.
- Make arrangement for portable extinguishers also.
- Ensure regular inspection of the extinguishers for signs of wear and potential malfunctioning.
- Fire extinguishers with Carbon dioxide units have not gauge and, therefore, have to be weighed to determine if they are full.
- Install sprinkler system as it is one of the most reliable form of fire fighting protection.
- All employees should be trained in fire fighting techniques.

Stock verification in warehouse

It is the process of physically counting, measuring or weighing the entire range of items in the stores and recording the results in a systematic manner. Stock verification is done for the following reasons:

- To reconcile the stock records and documents for their accuracy and usefulness.
- To identify areas which require more disciplined document control.
- To back up the balance sheet stock figures.
- To minimize pilferage and fraudulent practices.

Physical verification can be carried out periodically or on continuous basis.

Periodic verification: Under this system, the entire cross-section is verified at the end of one period, which is usually the accounting period. Necessary stock verification cards and check sheets must be prepared. During the verification process all transactions must be stopped. It is necessary to verify items which are under inspection, items sent out to suppliers for processing and stock at stock yards. Separate provisions must be made for items which are damaged or deteriorated. The stock in hand is tallied against the stock records. Discrepancies, if any, are noted down.

Continuous verification: Under this system, verification is done throughout the year as per pre-determined plan of action. A class items may be verified thrice a year, B class items twice a year and C

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class items once a year. It therefore presupposes that a perpetual inventory record for each item is maintained showing all transactions so that reconciliation can be done. Investigation with regard to discrepancies are spread over the year and hence detailed analysis is possible. There is no need to "freeze" the entire operations of the store. Any time stock records are more up-to-date when compared to the periodic verification system.

5.11 MATERIALS MANAGEMENT AND ITS ORGANISATION

Materials Management is an organizational concept whose primary objective is to integrate and manage the sourcing, flow, and control of materials using a total systems perspective across multiple function reports to a different executive, which can result in each function or activity pursuing conflicting organizational goals and objectives. A Materials Management structure traditionally separate materials functions to report to an executive responsible for coordinating the entire inbound materials process, and also requires joint relationships with suppliers across multiple tiers. The Materials management executive can design and manage a system that meets a firm's performance objectives at the lowest total cost.

The greatest organizational growth of the supply chain management concept occurred during the mid-1960s to late 1970s. However, that the materials concept began during the period and the origins of materials management date back to the 1800's During the 1970s, most firms experienced shortage of vital materials as well as rising materials price. Firms embraced the materials concept as a means to coordinate diverse material functions and to control material-related costs, quality, and supply. A concern to same purchasing professionals was that the creation of a material that purchasing naturally assumes a lower position when management creates an executive materials position. Furthermore, if a non-purchasing professional heads the materials position, this reduces purchasing importance with in the organizational structure even further.

Regardless of the background of the materials manager, most firms today recognize the importance of Materials Management. Firms that develop a coordinated approach to materials management show a greater interest in the control of material costs. This can only increase the importance of purchasing with in the organizational hierarchy because of purchasing influence on cost and quality. The Material's Manager must constantly balance tradeoffs between the functions making up the materials organization. What does managing tradeoffs mean? Consider, for example, material control (often part of purchasing) and inbound transportation. Materials

control tries to maintain raw material and work-in-process inventory levels as low as possible while still meeting production schedules, which allows a firm to minimize high inventory carrying costs It is not difficult to see why companies support the Materials Management concept. The materials management approach provides tangible benefits to an organization. These benefits include

- Providing greater direct control over material costs
- Developing Personal awareness of the total system approach instead of a narrow and restrictive functional approach.
- Opening channels of communication and stimulating the sharing of ideas among the various material functions.
- Supporting the career paths of talented personnel by providing then the means to develop well-rounded expertise. The material concept supports the movement of personnel across functional boundaries.
- Developing greater operating efficiencies as material functions work together to create material systems, coordinate procedures, and streamline the movement of material and data among themselves.
- Encouraging an overall synergistic effect as functions cooperate towards common goals.

The management of all inbound, production, and outbound activities is materials logistics management or total systems management. In this exhibit, a materials manager is responsible for all inbound and materials control functions to the point where work-in-process becomes finished-goods inventory. The physical distribution manager is responsible for moving, storing, controlling, and distributing finished goods to field warehouses and the final customer. The actual point separating materials management and physical distribution often becomes blurred. For example, a manager responsible for the storage and movement of work-in-process inventory is probably responsible for the initial movement and storage of finished goods, often the case when finished goods and in-process inventory exist in the same facility. Materials logistics management is the control of material throughout the entire pipeline. While conceptually appealing, few firms have an executive position specifically responsible for the entire material system for supplier to end customer.

Materials Management Organizational Structure

The actual functions under the materials umbrella can vary widely between firms. Also, the reporting level of the materials management executive can be higher or lower than shown here. Materials executives are generally higher in the organizational hierarchy today than

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15 years ago because of the increased importance of the materials function, especially for firms with large material budgets. The materials executive often reports directly to the executive vice president or president. In figure 5.1, the vice president of materials management is responsible for production planning and scheduling, traffic, purchasing and operations. In this example, materials quality reports directly to purchasing, which is common given the relationship between supply base management and materials quality. The director of operations is responsible for receiving and storage, materials controls, and materials handling. This illustration shows only one possible materials structure. Many organizations now have purchasing vice president, whose responsibilities extend beyond those of the Materials manager.

The Materials function is now equal in importance to manufacturing and marketing in many organization. Historically, purchasing, usually reported to manufacturing, as it still does in some manufacturing firms today, particularly those without a Materials executive. However, most firms now recognize the need for an independent purchasing and materials function free of outside influence. While purchasing must support manufacturing, it should do so by placing personnel directly at manufacturing facilities. These personnel locally report directly to purchasing personnel with only a dotted-line reporting relationship to manufacturing management.

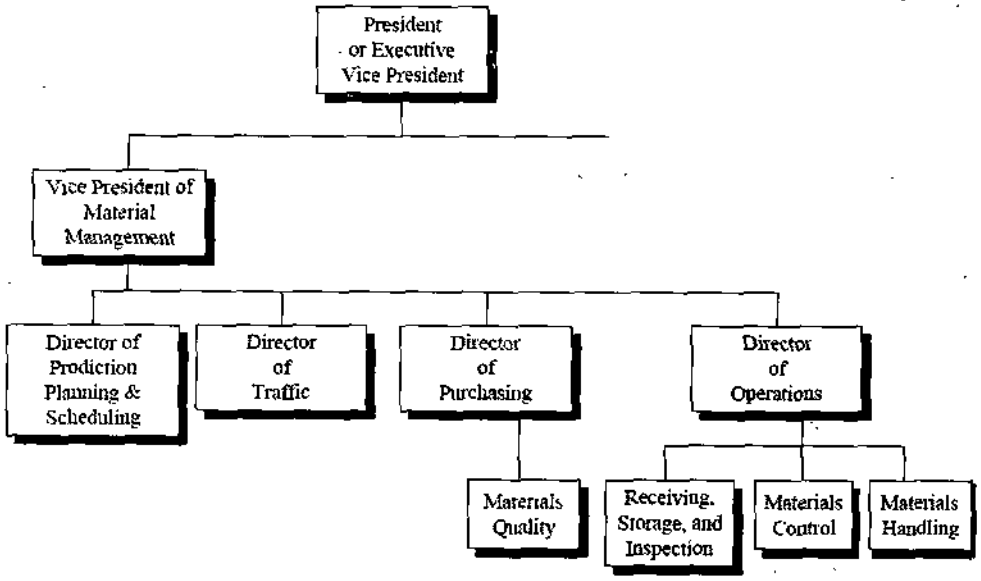

Figure 5.1: A Typical Materials Management Organisation Structure

In recent years, organizations have evolved from the concept of Materials management, which refers to an integrated set of functions within an organization spanning inbound and outbound logistics, to the concept of supply chain management (SCM).

Lower inventories throughout the chain, shorter cycle times, improved planning, and lower costs. While Materials management is often discussed in theory, very few organizations are able to achieve this level of integration

and success. One reason for this—the difficulty in developing the level of trust required to share information with so many parties—will remains a challenge for purchasing and logistics managers in the future.

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5.12 ORGANIZATIONAL CHOICE

When the need for some form of organizational structure has been established, there are basic choices from witch a firm may select. These can be categorized as:

(1) Informal,

(2) Semiformal

(3) Formal

None these types dominates among firms, nor is one type more popular than another for firms of like characteristics. Organizational choice for any particular firm is frequently a result of evolutionary forces operating within the firm. That is, the logistics organizational firm is often sensitive to the particular personalities within the firm, to the traditions regarding organization, and to the importance of logistics activities.

The Informal Organizational Form

The major objective for logistics organization is to achieve coordination among logistics activities for their planning and control. Given a supporting climate within a firm, this coordination may be achieved in a number of informal ways. These typically do not require any change in the exiting organizational structure but rely on coercion or persuasion to accomplish coordination among activities and cooperation among activities and cooperation among those who are responsible for them. For firms that have designated separate areas of responsibility for such key activities as transportation, inventory control, and order processing, an incentive system can sometimes be created to coordinate them. Whereas the budget, witch is a major control device for many firms, is often a disincentive to coordination, it can sometime be turned into a mechanism for effective coordination. The budget may be a disincentive because a manager of transportation, for example, would find it unreasonable to incur higher-than-necessary transportation costs in order to achieve lower inventory costs. Inventory costs do not fall within the transportation managers budget responsibility. The transportation manager's performance is measured by how transportation costs compare with the budget.

One possible incentive system to encourage cross-activity cooperation is to establish a number of cross charges or transfer costs among the various logistics. Consider how a transportation selection decision might be made

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when it indirectly affects inventory levels, but the transportation decision maker has no motivation other than to seek the lowest possible transportation costs.

Another incentive is to establish some form of cost-savings sharing arrangement. All managers of the separate logistics activities that show conflicting cost patterns could poll their cost savings. A predetermined schedule could be established to divide the savings for redistribution to salaries. There is incentive for cooperation because the greatest potential savings comes about when cooperation leads to a balancing of activities having conflicting cost patterns. There so-called profit-sharing plans have had limited success among firms, but a new firms have used them effectively.

The use for coordinating committees is another informal approach to logistics organization. These committees are made up of members form each of the important logistics areas. By providing a means through which communication can take place, then coordination may result. For companies in which there is a history of coordinating committees, the committees' form can be quit satisfactory. Dupont is one example of a company famous for its effective management by committee. Although committees seem to be a simple, straightforward solution to the coordination problem that do have a shortcoming in that they generally have little power to implement there recommendations.

Chief executive review of logistics decisions and operations is a particularly effective way of encouraging coordination. Top management has the necessary position in the organizational structure to easily obse.ve sub optimal decision making with in the organization. Because subordinate managers in the logistics activity areas are responsible to top management, top management's encouragement and support of coordination and cooperation among these interventional activities goes a long way toward achieving the organizational calls with out a formal organizational structure.

The Semiformal Organizational Form

The semiformal organization form recognizes that logistics planning and operation usually cut across the various functions with in a firms organizational structure. The logistician is then assigned to coordinate projects that involve logistics and that cover several functional areas. This type of structure often called a matrix organization, and it has been especially popular in the aerospace industry. The concept has been adapted to logistics system management. In a matrix organization, the logistics manager has responsibility for the entire logistics systems but does not have direct authority over the component activities. The firms traditional organizational structure remains intact, yet the logistics managers shares the decision authority and accountability with the activity area manager. Expenses for the activities must be justified by each functional department

as well as by the logistic program, which is the basic form of cooperation and coordination. (see figure 5.2).

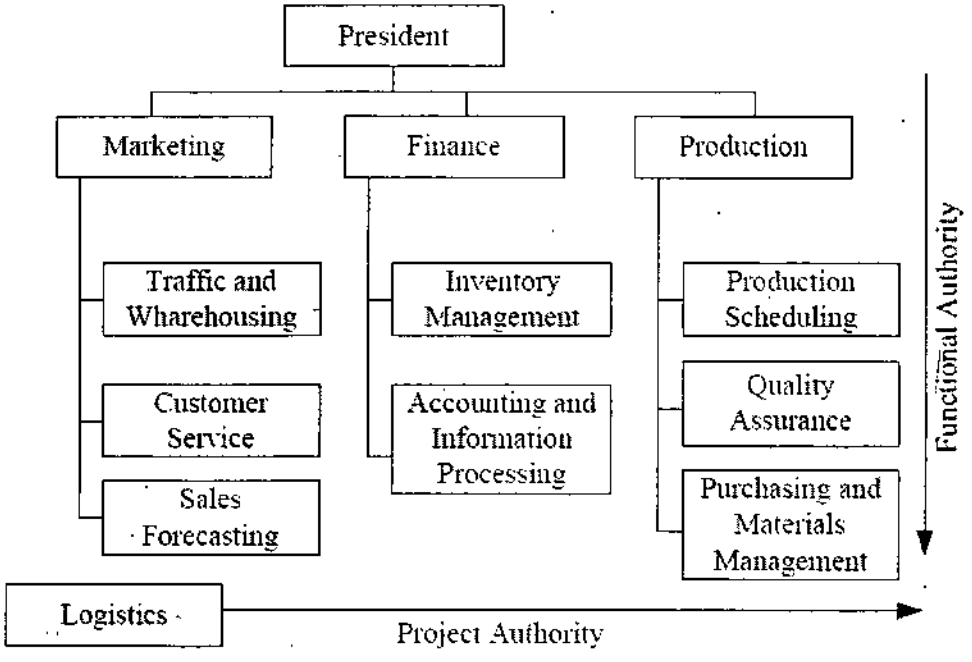

Figure 5.2: Logistics Matrix Organisation

Although the matrix organization can be a useful organizational form, we should recognize that the lines of authority and responsibility became blurred. Conflicts may arise that cannot be easily resolved. However, for some firms this choice is a good compromise between a completely informal form and a highly structured one.

The Formal Organizational Form

The formal organization is one that establishes clear lines of authority and responsibility for logistics. This typical involves (1) placing a manager in a superior position relative to logistical activities, and (2) placing the managers authority on a level in the organizations structure that allow effective compromise with the other major functional area of the firm (finance, operations, and marketing). This elevates and structures logistics personal in a form that promotes activity coordination. Firms seek the formal organizational arrangements prove ineffective or when greater attention is to be given to logistics activities.

Practitioners frequently remind us that there is no such thing as a typical organization for logistics. Organizational structure is customized to individual circumstances within a firm. However, we can develop a generalized formal organization that may good sense in terms of the principals of logistics management and also appears, in at least partial form, in enough firms to use it as a model.

This formal design accomplishes several important ends. First, logistics

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is elevated to a position in the organization where it is managed with the same authority as the other many functions. This helps to assure that logistic activities receive the same attention as marketing, operations, and finance. It also sets the stage for the logistic manager to have an equal voice in resolving economic conflicts. Having logistics on a par with the other functional areas creates a balance of power that can be for the economic good of the firm as a whole.

Second, a limited number of subareas are created under the chief logistics officer. The categories are established with a separate manager for each and are managed as a distinctive entity. Collectively, they represent the major activities for which managers are typically responsible. Why exactly five areas? Only as many areas are created as technical competencies require. It might seem desirable to combine, say, transportation and inventory activities into a single area because their costs are naturally in conflict and better coordination could be achieved. However, the technical skills required in each area are substantially different, so finding management for the combined areas having both type of skills are difficult . It is often more workable to keep such activities under a separate manager and rely on the logistics manager to establish coordination through the informal or semiformal organizational types previously discussed. Similar arguments can be offered for the other activity areas. Therefore, the formal organization structure is a balance between minimizing the number of activity groups to encourage coordination while separating them to gain effectiveness in the management of their technical aspects.

5.13 MATERIALS INFORMATION SYSTEM

Information can provide powerful tool for change. Information management is an important task to be handled carefully by the managers to keep themselves always connected to the latest developments for online decisions. Whether it is Finance, Marketing, Human Resource Management or Operations Management, all processes require a proper information system. An information center is a place where information is collected, transmitted, stored, analyzed, or compiled. The information relates to the internal operation of the firm as well as to the environment. Quite obviously, decision centers and information centers in the firm are inextricably bound together. Decision centers generally transmit decisions to others in the organization, and in a sense act as information centers. In simple terms, for an effective information management, the decision maker need to strictly systematize the procedure stated below:

(a) gathering the facts in time,

(b) Store them in an ordered way,

(c) Process for the requirement and

(d) Present them in a specified manner.

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In manufacturing process, a group of people, machines & infrastructure work together by coordinating for producing different types of products with an objective of making optimum production and profitability. A set of transaction ties together the different activities manufacturing process. They are:

(1) Request from customer to bid on special product

(2) Orders for special products

(3) Orders for standard products

(4) Production orders

(5) Move orders

(6) Purchase orders

The entire process is carried out in an organized way. The systematic approach to execute the process involved in handling of materials for various purposes through predefined steps is called Materials management system. This can be done through programmed decisions so that the cost involvement in various processes of materials management like ordering for raw materials, utilization level of the stock, overstocking of the materials etc could be done judiciously.

In any manufacturing organization, it is required to deal with different forms, reports, memos, labels and cards in use to assess the status of items movement and stock available on hand. Many of these forms have the same usage with different layouts. Each one of them has to be filed manually. It is a very time consuming and laborious intensive process. Also, the transfer of these documents among related units of the production causes delays in decision-making. The Materials Information Management System streamlines and simplifies the entire filing procedure of the Bureau of Materials, thus relevant information is integrated into an electronic data processing and management system automatically. Materials Management uses bar code technology to maintain stock levels and to re-order stock-using hand held scanners.

5.14 ADVANTAGES OF MATERIALS INFORMATION SYSTEM

In addition to the above discussions, the materials Information management has certain advantages as stated below:

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Reduces time and costs by

- Establishing direct link between the data capture system and the suppliers ordering system which reduces supply chain time and costs and reduces the ordering errors
- Simplifying ordering – the data is inputted direct to the supplier via a hand held barcode reader

The information retrieval through proper information system provides

- The data that can be used to forecast required stock
- Statistical analysis of historical data and generate reports to review product use and to identify better efficiencies

It gives flexibility to manage products by

- Helping with product standardization programmes and effective stock control, leading to more efficient use of limited storage and effective stock control
- Providing a modular storage system
- Streamlining receipting procedures, leading to improved payment systems

It saves money

- By saving on requisition costs, reducing obsolescence and waste and simplifying stock valuation for the company
- By helping to give a clear understanding of a company's spend and operating costs
- By providing realistic stock levels linked to actual usage- matching service delivery with company actual service need

Processing of a customer needs from its identification through conversion of raw materials into finished goods and the distribution of these goods is carried out by a sequence of fairly distinct activities. These activities are called the technical development of the system. Out of all other system in functional management, the sub-system used for materials manufacturing is considered to be significant in operations management. They are inventory control system, demand management system, remote electronic requisition system, warehouse management system, waste management system etc. These sub-systems operate based on the product specification, schedule, demand, availability of raw materials and assemblers.

A system to control movement and storage of materials within a warehouse is called Warehouse Management System. The role of Warehouse Management System is expanding to including light manufacturing, transportation

management, order management, and complete accounting systems.

The general function of materials information system integrates the various other subsystems as shown below:

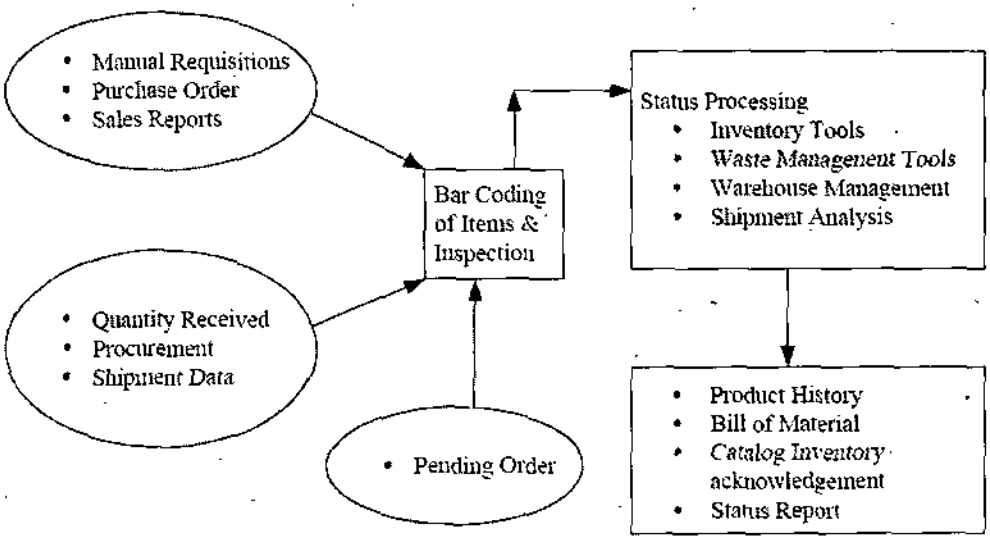

Figure 5.3: Materials Processing System

The design and the development of the materials information system require considerable research efforts. The major study topics include:

1. Identify and synthesize the operational logic and business rules in the materials testing processes to search for the best ways to organize and unify the forms, reports, approvals and all relevant documents. Use of bar code technology for locating the status of the products.
2. Identify and normalize the relational database to secure data integrity and manage data flows within existing networks using bar codes assigned to the product
3. To convert and integrate the existing electronic data for concrete decisions through proper statistical analysis
4. To protect and archive the data and outputs
5. To improve the system flexibility such that new materials and new information can be inserted
6. To minimize the data entry errors through cross checking
7. To minimize the routine workload and improve the efficiency of the data processing with customized client application programs and
8. To automate the filing processes and speed-up the closeout procedures by scheduled replication tasks and alert message service of the database. In other words, the entire closeout procedure

will be monitored by the system and the responsible person will be notified of the current project status.

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5.15 FUNCTIONS OF MATERIALS INFORMATION SYSTEM

The two main functions of Materials Information system are to generate an unordered requirements listing for input to the purchasing system and to provide a materials status and history report for use as follow up and status information. This would facilitate to:

- Identify and order long lead-time items in the early stages of requirements determination
- Reduce existing clerical work load by paper work automation to the extent practicable
- Provide a system of quick, accurate follow up and status reporting
- Provide whatever controls are needed to ensure that all required items are ordered and not duplicated
- Sketch the movement of items and report the status for further planning.

5.16 CONTROL OF MATERIAL MANAGEMENT AND PERFORMANCE APPRAISAL

Materials are one of the major inputs to the production process. It is necessary to properly manage the material for efficiency of the system and controlling the costs. Organizations have to procure it in advance and hold it for some time. For example, a super market stocks thousands of items in the shelf and wait for customers, similarly in auto manufacturing company, thousands of parts are stored as inventory. Materials management is the planning and control of the activities related to the material flow from the suppliers up to the end of the conversion/production process. Ultimately, the customers consume the finished items. In simple terms, materials management is the management of materials, right from the time when a demand originates or is expected to originate leading to a need for production, all through the various stages of the processing and manufacturing etc, until it becomes a finished product and has been dispatched to a satisfied customer. It includes the planning, organization and control of all aspects of inventory management, procurement, warehousing, work-inprogress, shipping, and distribution of finished goods.

Thus, activities in materials management include anticipating materials requirements, sourcing and obtaining materials, introducing materials

into the organization and monitoring the status of materials as a current asset. This also involves management of a huge amount of important information – for example, engineering, supplier, project management, cost, and delivery are part of materials management. Performance appraisal is periodically (usually annually) done, in which the work performance of the system is examined and discussed, with a view to identifying weaknesses and strengths as well as opportunities for improvement and system upgradation. In other words, it is the process of assessing, summarizing and developing the system's performance. Performance appraisal of material management system is necessary to ensure that there is an optimum use of materials and prompt identification of unwanted materials. System's inefficiencies like late delivery, poor customer service, etc, can be identified through performance appraisal system in material management.

Why Control Is Needed in Materials Management?

The growth in marketing, market segmentation and increased competition has caused a growth in a variety of products that firms produce and sell. This has complicated the manufacturing and materials management functions of the firms. It assumes great importance when practices like infrequent long production runs cause delays and stock outs, while another situation could be of excessive inventory its management. Situations of this kind are likely to create a conflict in marketing and planning systems. Effective management of materials is crucial to the performance of an organization as:

(a) Materials costs are usually a firm's largest expenditure.

(b) Management of inventory in line with the demand and strategy to reduce it are necessary to cost efficiency.

(c) Operating with fewer inventories offers a firm a competitive advantage.

(d) Timely execution, implementation and administration of contracts are important business needs.

(e) Supervising and/or monitoring the flow and storage of materials are important.

(f) Development of proper relationships with suppliers and with other departments within the organization is needed for long-term survival.

(g) Increase productivity is a continuous affair.

(h) Ensuring customer satisfaction i.e. *timely supply* along with *quality supply* is important.

(i) Reduction of wastage and obsolescence to a minimum is needed for cost cutting.

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Different Types of Control Needed in Materials Management

To achieve the objectives of material management, different controls are needed, depending upon the individual functions. These may broadly be categorised into following aspects:

(i) Forecasting,

(ii) Purchasing and procurement,

(iii) Stores and stock control,

(iv) Inventory planning and control,

(v) Production planning control.

Forecasting: Forecasting forms the basis for planning by establishing assessment assumptions about the future needs. Good forecasting practice and timely availability of information are crucial for good organization. Forecasting identifies the future needs in terms of demand of product and services. Based on the forecasting of what changes can be reasonably expected to occur in the business, materials managers can determine what opportunities the organization is in a position to take advantage of.

Purchasing and procurement: This is one of the key controls needed in materials management. The functions of a purchasing manager include:

(i) Reviewing procurement requests,

(ii) Soliciting and evaluating requests,

(iii) Analyzing current and potential suppliers,

(iv) Conducting negotiations with the suppliers,

(v) Executing, implementing, and administering contracts,

(vi) Developing forecasts and procurement strategies,

(vii) Supervising and/or monitoring the flow and storage of materials, and

(viii) Developing working relationships with suppliers and with other departments within the organization.

All these functions require control at different levels of materials management.

Stores and stock control: The store has to take care of controlling and managing the flow of materials. The important functions that need to be performed in this can be categorized into the followings:

1 Deciding on binning, raking, shelving using pallets, block staking or floor storage etc, depending upon the type of material,

2 Inspection for incoming as well as outgoing materials,

3 Stock taking and deciding appropriate policies,

4 Managing all warehouse functions.

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Inventory planning and Control: Inventory management is the most crucial issue in material management because of the apparent heavy capital directly involved with it. Efficient materials management must ensure a high service level with an inventory level at optimal cost. Planning and control are the key aspects in this. You must have studied these in earlier units.

Production planning and control: MRP (Material Requirement Planning) is commonly used in industries. It consists of tracing and priority control, expediting and de-expediting, all the works of purchasing section and in addition making an estimate of lead times, standard units, discounts, substitutes, vendors' problems and price hikes. Using product design information (like bill of material), inventory status, and master production schedule (MPS), MRP generates purchase orders on a regular basis. DRP (Distribution Requirement Planning), like MRP starts with demand for a product as captured from the customer, it then works backwards using goods on hand, planned receipts and planned order dates to establish a schedule for efficiently ensuring the supply.

Approaches to Materials Management

The Japanese View: Decision-making tends to come from bottom in Japanese firms and rely highly upon consensus decisions. Procurement is made from small vendors that are in proximity. Work-in-progress and production activities are often pulled through the system according to sales and delivery requirements. The *pull approach* is applied through a system of *Kanban* cards that travel with lots of goods. The subsequent production activities are linked with the respective location of the cards.

The US and European View: The US view focuses on JIT (Just in Time) approach. Similar to Japanese vendor supply methods, the system coordinates production plans with vendor production and transportation delivery so that goods can be removed from the carrying vehicles and placed immediately on production line. In the European view, the emphasis has been tended more towards the optimal utilization of plants capital, goods, labor and invested capital. There have been a few practices that emerged in different regions, owning to different economic and social scenarios. The current approaches are more likely to apply a mix of all the above practices in addition to various other approaches that would be suited locally and otherwise.

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ABC Analysis: Monitoring and tracking all types of inventories incur a heavy cost to firms and is a very challenging task. For example in automobile manufacturing where thousands of parts are used, it is very difficult to monitor all the inventories. Certain items may have a relatively low value and these items can often be monitored very loosely. On the other hand, items with high value must be tracked carefully and monitored. To determine which inventory items should receive the highest level of control and monitoring, a method has been proposed and called as ABC analysis. It is based upon the Pareto principle that proposes that twenty percent of items account for eighty percent of the value, while the remaining eighty percent of items accounts for only twenty percent value. The ranking of items is done as follows:

Class A

The first twenty percent of items are assigned to class A. These items carry around 80% of total material cost. These items need closest control and monitoring. Accurate inventory records are important, and there is a high potential for cutting cost through careful buying and close scrutiny of safety stocks.

Class B

The next thirty percent of the items are classified as B items. These deserve less attention than 'A ' class items.

Class C

The last fifty percent of items are C items. These have the lowest value and can be monitored loosely, with larger safety stocks maintained to avoid stockouts.

Example: Group the following stocks into an ABC classification scheme.

Table 5.1: Problem data set for ABC Classification

Material code#	Volume	Cost(Rs.)
109	200	600
222	26000	36
346	2000	55
432	20000	4
211	7000	10

Solution:

STEP 1: The total cost value of each item is calculated as follows:

Table 5.2: Calculation of Rs. Volume

Material Codes#	Volume	Cost (Rs.)	Rs. Volume
109	200	600	120,000
222	26000	36	936,000
346	2000	55	110,000
432	20000	4	80,000
211	7000	10	70,000

STEP 2: Arrange the total cost (product of volume and unit cost) of each stock in a descending order.

STEP 3: Pick up top stocks whose aggregated total cost (product of volume and unit cost) is around 80%. These are A-class item. Next, pick up the least aggregated total cost (product of volume and unit cost) from the bottom of the table so that these account for around 5-7% of the cost or around 70-80% of volume. These are C-class items. Remaining items may be placed under B-class items. The ABC classification scheme of the problem is as follows.

Table 5.3: ABC Classification Scheme

Material code#	Volume	Cost (Rs.)	Rs. Volume	Percent	Classification of Material
222	26000	36	936,000	71.1	A
109	200	600	120,000	9.1	A
346	2000	55	110,000	8.4	B
432	20000	4	80,000	6.1	B
211	7000	10	70,000	5.3	C
TOTAL			1216,000		

You have already studied *Continuous Review (Q) systems (or Reorder Point (ROP) systems) and Continuous Periodic Review (P) Systems in earlier units.* For class A and B items, *Continuous Review (Q) systems (or Reorder Point (ROP) systems)* should be used for independent material control systems. This requires constant monitoring of material levels. *P Systems* are more convenient to administer than *Q Systems.*

For class C items, *Continuous Periodic Review (P) Systems should be used for independent material Control Systems. This requires* monitoring of material at fixed intervals. *Q Systems* are more expensive to administer than *P Systems.*

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Need for Performance Appraisal in Materials Management

Basic to any program is the need to systematically review and evaluate the status and performance of the program. In planning and controlling the materials management function, it should be recognized that the success of different activities depends on the proper establishment and pursuance of a performance evaluation system. In material management, traditionally static measures like average inventory, service levels, etc are common. However, with emergence of supply chain concepts, more comprehensive approach would be needed, which can also integrate the flow of material across the supply chain partners. Different approaches such as "Balance score card," "SCOR Framework," etc are fast emerging.

Approaches For Performance Appraisal in Materials Management

Appraisals of materials management activities should concentrate on the effectiveness of programs and procedures for managing materials. Specific activities should include, but not be limited to, the following evaluations:

(i) Material quantities with respect to minimum inventory levels required to meet program objectives.

(ii) Programs, procedures, and practices for managing materials.

(iii) Forecasts related such as accuracy, thoroughness, completeness, usefulness, and compatibility with program plans and budgets.

(iv) Use of materials in the quantities and for the system.

(v) Procedures for identifying, reporting, and managing inactive materials and scrap.

(vi) Adequacy of information provided by contractors responsible for developing materials management plans.

(vii) Adequacy of materials management procedures in contracts and subcontracts issued by the contractor.

5.17 MATRICES OF PERFORMANCE APPRAISAL SYSTEM

Different matrices are common in the effective management of materials. Some of these are listed below.

Inventory Turnover Ratio

The inventory turnover ratio indicates how many times the inventory is 'turned over' in one year. In other words, it shows how quickly inventory

can be sold. Inventory turn over ratio shows how many times in a year the inventory is sold. This shows the company with high turnover ratio is able to sell inventory more frequently. With this ratio we can easily compare the companies on inventory utilization. Major disadvantage of this ratio is that we cannot compare two firms from different industries. There is huge variation in the inventory holdings of different industries and organizations. For example in one industry inventory is held for longer time for operation while in other it is requiring only short duration.

Safety Stock

Stock that is held in excess of expected demand due to variable demand rate and/or lead time is known as safety stock. Safety stock reduces risk of stockout during the lead time (Figure 5.4). As shown, the order is placed when stock depletes to reorder point (ROP). During the lead-time (LT) if there are demand fluctuations, these are covered by safety stock.

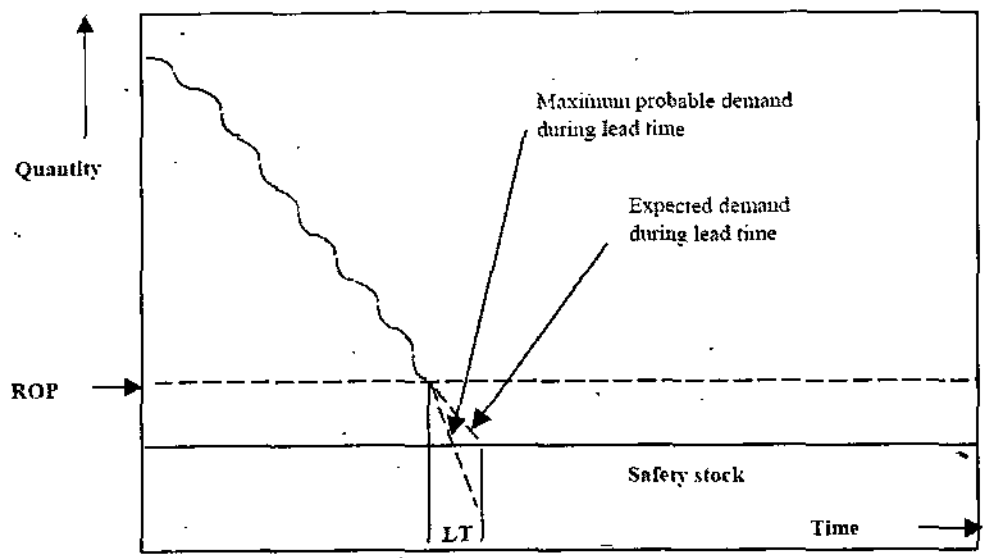

Figure 5.4: Safety stock covers the risk of stockout during leadtime (LT)

5.18 BALANCED SCORECARD APPROACH FOR PERFORMANCE APPRAISAL

The balanced scorecard is a performance measurement system that allows managers to look at the business from four divergent important perspectives: customer, internal business, innovation and learning, and finance (Kaplan & Norton, 1992, 1996). It thus links the financial and non-financial, tangible and intangible, internal and external factors, thus providing a holistic framework for performance appraisal systems (Figure 5.5).

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A performance measurement system using Balanced Scorecard allows a firm to align its strategic activities to the strategic plan. Under the balanced scorecard system, financial measures are the outcome, but do not give a good indication of what is or will be going on in the organization. Measures of customer satisfaction, growth and retention are the current indicator of company performance, and internal operations (efficiency, speed, reducing non-value added work, minimizing quality problems) and human resource systems and development are leading indicators of company performance.

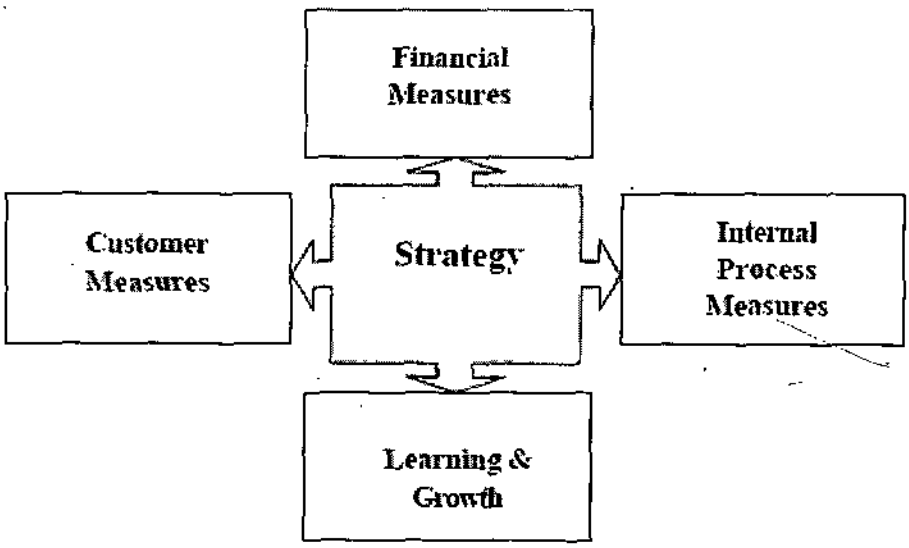

Figure 5.5: Four Perspectives of Balance Scorecard

Thus "Balance" includes

- Short and long term objectives
- Financial and non-financial measures
- External and internal measures, and
- Four different perspectives.

Purposes of the balanced scorecard include

- Clarify and translate vision and strategy
- Communicate and link strategic objectives and measures
- Plan, set targets and align strategic initiatives.

Scor Framework for Performance Appraisal

The SCOR Model (Supply Chain Operations Reference Model) was originally developed by PRTM Consulting. It is now managed and maintained by the Supply Chain Council (supply-chain.org). It provides an excellent representation of the Fulfill Order process. Other models such as the ABCD Check list (Oliver Wight Corp.) and OEE (Overall Equipment

Effectiveness) may also be used to represent the Fulfill Order process. The performance indicators are well applicable in Material Management also.

The SCOR model provides a set of performance metrics (Table 5.4) and supply chain practices where the supply chain performance is contingent on the maturity of supply chain practices. This model allows the firm to relate the weaknesses in their material management function of the supply chain practices.

Table 5.4: Matrices of Performance

Type of Performance	Performance Attribute	Performance Attribute Definition	Level 1 Metric
E X T E R N A L	Supply Chain Delivery Reliability	The performance of the supply chain in delivering: the correct product, to the correct place, at the correct time, in the correct condition and packaging, in the correct quantity, with the correct documentation, to the correct customer.	Delivery performance Fill Rates perfect Order Fulfillment
	Supply Chain Responsiveness	The velocity at which a supply chain provides products to the customer.	Order Fulfillment Lead Time
	Supply Chain Flexibility	The agility of a supply chain in responding to marketplace change to gain or maintain competitive advantage.	Supply Chain Response Time Production Flexibility
I N T E R	Supply Chain Costs	The Costs associated with operating the supply chain.	Cost of Goods Sold Total Supply Chain Management Cost Value-Added Productivityarranty Returns Processing Costs

NOTES

N A L	Supply Chain Asset Management Efficiency	The effectiveness of an organization in managing assets to support demand satisfaction. The includes the management of all assets: fixed and working capital.	Cash-to-Cash Cycle Time Inventory Days of Supply Asset Turns

SUMMARY

- Setting up standards for quality, quantity, sizes, performance, service and materials of any product made for consumer and the process used in any industrial organization is called standardization.
- Variety reduction using standardization leads to simplification. It means elimination of unnecessary things not essential for functioning an equipment, elimination of variety of items used for a particular purpose and making and using few standard products.
- The code numbers can identify the various materials used in any organization. The codification is defined as giving a symbol or a numerical code to a particular item.
- Warehouse management is concerned with carrying the right kind of materials or goods in right quantity neither in excess nor in short supply and also keeping it safe against any kind of deterioration, pilferage or theft.
- Warehouse layout is the internal design or the functional design.
- Sampling is an act of drawing samples from a batch on random basis.
- The principal aim of security management is to protect the assets of the company and devise adequate counter measures to create secure conditions within the company.
- Many organizations have introduced formal documentation in introducing changes in design and is known as EPA.
- Materials Management is an organizational concept whose primary objective is to integrate and manage the sourcing, flow, and control of materials.
- The inventory turnover ratio indicates how many times the inventory is 'turned over' in one year.

- The balanced scorecard is a performance measurement system that allows managers to look at the business from four divergent important perspectives: customer, internal business, innovation and learning, and finance.

NOTES

REVIEW QUESTIONS

1. What is Standardization?
2. Why standardization of materials is necessary?
3. Describe the methods used for standardization.
4. Differentiate between standardization and specification.
5. What do you understand by the term identification of materials?
6. Give the benefits of standardization to the organization.
7. What is simplification and variety reduction?
8. What are the advantages of simplification?
9. Explain Rationalization. Why rationalization is necessary to develop industries in India?
10. Give the classification of materials.
11. Define codification of materials.
12. Name the types of methods used for codification and discuss them.
13. Give the advantages of classification of materials.
14. Give the advantages of codification of materials.
15. What are the factors to be considered while locating the warehouse?
16. Write a descriptive note on "efficient layout of warehouse".
17. What are advantage and disadvantages of centralized warehouse and decentralised warehouse?
18. What are the objectives of a good warehouse layout?
19. Discuss the safety considerations while designing and laying out the warehouse.
20. Discuss the major functions of warehouse in an organization.
21. How would you choose the best location for a new warehouse?
22. What is the significance of receiving section of a warehouse?
23. What is the basic procedure of receiving section of a warehouse?

NOTES

24. Explain the importance of proper storage in stores management.
25. How are records maintained in stores?
26. Discuss the various methods adopted in storing different materials.
27. What do you understand by the term "Automated Storage/Retrieval" What are its advantages?
28. Discuss the recent developments in storage system.
29. Discuss the various losses in warehouses. What are the reasons of their generation?
30. Describe the procedure of preventing and controlling losses in warehouse.
31. Discuss the various alternatives available during the disposal decision making process.
32. What are the various considerations to be made for controlling fire in stores?
33. Describe the various measures that can be adopted to prevent shrinkage in warehouse.
34. Write notes on:
    (a) EPA
    (b) Obsolete, Surplus and Scrap
    (c) Stock verification
35. What does it mean when we say a firm has organized according to the materials management concept?
36. What advantages of organizing a purchasing department into specialized sub units? What are the disadvantages? How can a firm overcome these disadvantages?
37. Give an example of an organization that has benefited tremendously by Global sourcing with the help of a Global organization.
38. Discuss the importance of materials information system for a manufacturing unit.
39. Study the system followed (manual/computerized) for management of materials in a manufacturing unit and suggests the steps for system development.
40. Visit some of the websites who professionally develop the system for MIS and identify the features.
41. What is materials management and explain its importance?
42. Explain how a performance appraisal system can be used in the context of materials management.

43. What are the matrices of performance appraisal in materials management?
44. Explain balanced scorecard approach for performance appraisal.
45. Explain SCOR framework for performance appraisal and how is it useful in material management?.

FURTHER READINGS

Applied Materials Management: S Chatterjee, Response Books, 2005.

Materials Management: Preeti Oberoi, Sarup, 2001

Materials Management: K. Shridhara Bhat, Himalaya Publishing House, 2011.

Materials Management: Planning and Control: Nand Kishore Sharma, DND Publications, 2011.

Purchasing and Materials Management: Anand Kumar Sharma, Anmol Pub, 2006.