
A CASE STUDY OF EFFICIENT PROCUREMENT, HANDLING AND MANAGEMENT OF MATERIAL AT CONSTRUCTION SITES

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ABSTRACT

The primary function of purchasing and procurement is to get the materials at the lowest cost possible, but keeping in mind quality requirements. Expediting is the continuous monitoring of suppliers to ensure on time deliveries of materials purchased. The purpose of materials planning is to procure the materials for the dates when they are needed, storage facilities, and handling requirements. The primary function of materials handling is to manage the flow of materials in the organization. The manager has to assure that the costs associated with handling materials are kept to a minimum. In cost control, the manager has to insure that the costs to buy materials are kept to a minimum. In other words, the manager has to insure that he is buying the products at the lowest possible price. The inventory management deals with the availability of materials. Transportation involves using the safest most economical means to transport the materials to the site where they are needed. The need for an effective materials planning system becomes mandatory. Some companies have increased the efficiency of their activities in order to remain competitive and secure future work. Many other firms have reduced overheads and undertaken productivity improvement strategies. Considerable improvement and cost savings would seem possible through enhanced materials management. Therefore, to analyse the Material handling, procurement and management, the author has taken up the following study, "A Case Study of Efficient Procurement, Handling and Management of Material At Construction Sites".

KEY WORDS: Material Handling, Material Planning, Material Procurement, Material Management

1. INTRODUCTION

The efficient procurement and handling of material represent a key role in the successful completion of the work. It is important for the contractor to consider that there may be significant difference in the date that the material was requested or date when the purchase order was made and the time at which the material will be delivered. These delays can occur if the contractor needs a large quantity of material that the supplier is not able to produce at that time or by any other factors beyond his control. The contractor should always consider procurement of materials is a potential cause for delay. Materials constitute a major cost component for any Industry. The total cost of Value of Materials may be 60 per cent or more of the total cost, even though the factory cost may be a minor part of the total, probably less than 20-30 per cent. This is because the manufactured item must be stored, transported, and restored before it is put in place or "consumed" at the site. The total cost of materials will include, in addition to the manufacturer selling cost, the cost of procurement (cost of placing processing and paying the material, physical distribution, the distributor's cost, and the transportation of materials), and the site-handling costs (cost of receiving, storage, issuing, and disposal). Poor planning and control of materials, lack of materials when needed, poor identification of materials, re-handling and inadequate storage cause losses in labor productivity and overall delays that can indirectly increase total project costs. Effective management of materials can reduce these costs and contribute significantly to the success of the project.

2. CONCEPTUAL ANALYSIS OF MATERIAL MANAGEMENT

Different researchers provide different definitions for material management, therefore different definitions can be found in different references. Basically, material management is concerned with the planning, identification, procuring, storage, receiving and distribution of materials. The purpose of material

management is to assure that the right materials are in the right place, in the right quantities when needed. The responsibility of one department (i.e. material management department) for the flow of materials from the time the materials are ordered, received, and stored until they are used is the basis of material management.

Ballot (2006) defines material management as the process of planning, acquiring, storing, moving, and controlling materials to effectively use facilities, personnel, resources and capital.

Tersine and Campbell (2004) define material management as the process to provide the right materials at the right place at the right time in order to maintain a desired level of production at minimum cost. The purpose of material management is to control the flow of materials effectively.

Beekman-Love (1998) states that a material management structure should be organized in such a way that it allows for integral planning and coordination of the flow of materials, in order to use the resources in an optimal way and to minimize costs.

Chandler (2001) states that material management systems should be implemented to plan, order, check deliveries, warehousing, controlling the use of materials, and paying for materials. He adds that these activities should be interrelated.

Ammer, Dean (1991) defines material management as the process in which a company acquires the materials that it needs to achieve their objectives. This process usually begins with the requisition of materials from the supplier until the material is used or incorporated into a product.

Bailey and Farmer (2009) define material management as a concept concerned with the management of materials until the materials have been used and converted into the final product. Activities include cooperation with designers, purchasing, receiving, storage, quality control, inventory control, and material control.

Gossom (1999) indicates that a material management system should have standard procedures for planning, expediting, transportation, receipt, and storage to ensure an efficient system for materials control.

Cavinato (1994) states that material management involves the control of the flow of goods in a firm. It is the combination of purchasing with production, distribution, marketing and finance.

Arnold (2001) states that material management is a function responsible for planning and controlling of materials flow. He adds that a materials manager should maximize the use of resources of the company.

Stukhart (2007) defines material management as the activities involved to plan, control, purchase, expedite, transport, storage, and issue in order to achieve an efficient flow of materials and that the required materials are bought in the required quantities, at the required time, with the required quality and at an acceptable price.

Plemmons et al. (1995) define material management as the plan and control of all activities to ensure the correct quality and quantity of materials and equipment to be installed are specified in timely manner, obtained at reasonable cost and are available when needed.

Dobler and Burt (2009) state that material management is designed to improve the activities related to the flow of materials. They add that material management should coordinate purchasing, inventory control, receiving, warehousing, materials handling, planning, and transportation.

The role that a materials manager plays in an organization is strictly economical since the materials manager should keep the total cost of materials as low as possible. The person in charge of handling materials should keep in mind the goals of the company and insure that the company is not paying extra money for materials. The goal of every company is to make a profit. This is the basis for company's survival, costs should not exceed income, but keeping in mind customer's expectations. The typical tasks associated with a material management system are:-

- a) Procurement and purchasing
- b) Expediting
- c) Materials planning
- d) Materials handling
- e) Distribution
- f) Cost control

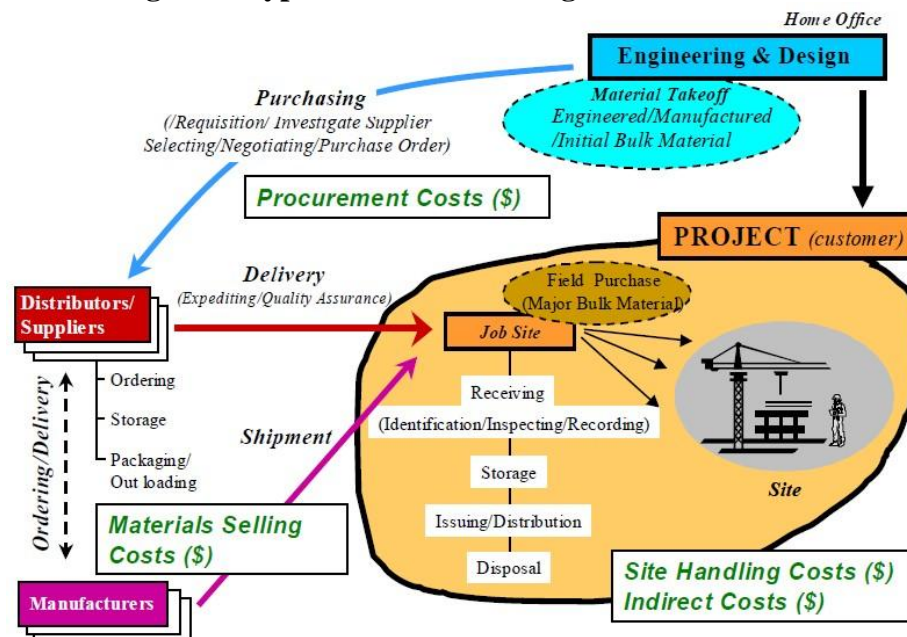
g) Inventory management / Receiving/ Warehousing

h) Transportation

Purchasing and procurement deal with the acquisition of materials to be used in the operations. The primary function of purchasing and procurement is to get the materials at the lowest cost possible, but keeping in mind quality requirements. Expediting is the continuous monitoring of suppliers to ensure on time deliveries of materials purchased. The purpose of materials planning is to procure the materials for the dates when they are needed, storage facilities, and handling requirements. The primary function of materials handling is to manage the flow of materials in the organization. The manager has to assure that the costs associated with handling materials are kept to a minimum. In cost control, the manager has to insure that the costs to buy materials are kept to a minimum. In other words, the manager has to insure that he is buying the products at the lowest possible price. The inventory management deals with the availability of materials. Transportation involves using the safest most economical means to transport the materials to the site where they are needed.

Figure 1 depicts the different phases of the material management process including the relationship and interdependency between the different activities in each phase. From this figure it can be seen that decisions taken at each phase in the system, directly affect the activities of the phases that follow:

Figure1: Typical Material Management in Construction



Source: Thabet, 2001

As a result, a successful implementation of a material management system needs to consider the different decisions made at various phases of the supply chain.

3. CATEGORIES OF MATERIAL MANAGEMENT

The Webster's dictionary defines materials as "the elements, constituents, or substances of which something is composed or can be made." Ballot (2006) defines materials as the physical materials that are purchased and used to produce the final product and does not suggest that materials are the final product. In other words, materials are the parts used to produce the final product. Bailey et al. (2009) define materials as the goods purchased from sources out of the organization that are used to produce finished products. Stukhart (2007) defines materials as the items that are used to produce a product and which include raw materials, parts, supplies and equipment items.

Manufacturing materials can be classified into five categories. These categories are:

a) **Raw materials**- materials that the company converts into processed parts. This might include parts

- specifically produced for the company and parts bought directly off the shelf (i.e. bolts, nuts).
- Purchased parts-** parts that the company buys from outside sources (i.e. rubber parts, plastic parts).
 - Manufactured parts-** parts built by the company (i.e. tower case for a computer).
 - Work in process-** these are semi-finished products found at various stages in the production process (i.e. assembled motherboard).
 - MRO supplies-** maintenance, repairing, and operating supplies used in the manufacturing process but are not part of the final products (i.e. soap, lubricating oil). Construction materials can be classified into different categories depending on their fabrication and in the way that they can be handled on site. He classifies the materials into five categories. These categories are
 - Bulk materials-** these are materials that are delivered in mass and are deposited in a container.
 - Bagged materials-** these are materials delivered in bags for ease of handling and controlled use.
 - Palletted materials-** these are bagged materials that are placed in pallets for delivery.
 - Packaged materials-** these are materials that are packaged together to prevent damage during transportation and deterioration when they are stored.
 - Loose materials-** these are materials that are partially fabricated and that should be handled individually.
- Table 1 presents some examples of commonly used materials in construction and their classification.

Table 1: Classification of Materials

Material	Bulk	Bagged	Palletted	Packaged	Loose
Sand	X				
Gravel	X				
Topsoil	X				
Paving Slabs					X
Structural Timber					X
Cement	X	X	X		
Concrete	X				
Pipes				X	X
Tiles				X	
Doors			X		
Electrical Fittings				X	

Source: Chandler, 2001

Some other Experts like Stukhart (2007), state that the main categories of materials encountered in a construction project are engineered materials, bulk materials, and fabricated materials.

- Bulk materials-** these are materials manufactured to standards and are purchased in quantity. They are bought in standard length or lot quantities. Examples of such materials include pipes, wiring, and cables. They are more difficult to plan because of uncertainty in quantities needed.
- Engineered materials-** these materials are specifically fabricated for a particular project or are manufactured to an industry specification in a shop away from the site. These materials are used for a particular purpose. This includes materials that require detailed engineering data.
- Fabricated materials-** these are materials that are assembled together to form a finished part or a more complicated part. Examples of such materials include steel beams with holes and beam seats.

4. IMPORTANCE OF MATERIALS FOR A PROJECT

Problems related to managing the flow of materials can be found in every organization. The efficient management of materials plays a key role in the successful completion of a project. The control of materials is a very important and vital subject for every company and should be handled effectively for the successful completion of a project. Materials account for a big part of products and project costs. The cost represented

by materials fluctuates and may comprise between 20-50 per cent of the total project cost and sometimes more. Some studies concluded that materials account for around 50-60 per cent of the project cost. Materials are critical in the operations in every industry since unavailability of materials can stop production. In addition, unavailability of materials when needed can affect productivity, cause delays and possible suspension of activities until the required material is available. It is important for a company to consider that even for standard materials, there may be significant difference in the date that the material was requested or date when the purchase order was made, and the time in which the material will be delivered. These delays can occur if the quantities needed are large and the supplier is not able to produce those materials at that time or by any other factors beyond the control of the company. The company should always consider that purchase of materials is a potential cause for delay. Unavailability of materials is not the only aspect that can cause problems. Excessive quantities of materials could also create serious problems to managers. Storage of materials can increase the costs of production and the total cost of any project. When there are limited areas available for storage, the managers have to find other alternatives to store the materials until they are needed. Some of these alternatives might require re-handling of materials, which will increase the costs associated with them. Provisions should be taken to handle and store the materials adequately when they are received. Special attention should be given to the flow of materials once they are procured from suppliers.

It is obvious that materials should be obtained at the lowest cost possible to provide savings to the company. In the late 1970's, construction companies experienced an increase in costs and a decrease in productivity. Owners of these companies thought that these increases in cost were due to inflation and economic problems. Further research concluded that these companies were not using their resources efficiently and that the decrease in productivity was also attributable to poor management. Material Management has been an issue of concern in the construction industry. 40 per cent of the time lost on site can be attributed to bad management, lack of materials when needed, poor identification of materials and inadequate storage.

The need for an effective materials planning system becomes mandatory. Some companies have increased the efficiency of their activities in order to remain competitive and secure future work. Many other firms have reduced overheads and undertaken productivity improvement strategies. Considerable improvement and cost savings would seem possible through enhanced materials management. Timely availability of materials, systems, and assemblies are vital to successful construction. Materials management functions are often performed on a fragmented basis with minimal communication and no clearly established responsibilities assigned to the owner, engineer or contractor. Better material management practices could increase efficiency in operations and reduce overall cost. Top management is paying more attention to material management because of material shortages, high interest rates, rising prices of materials, and competition. There is a growing awareness in the construction industry that material management needs to be addressed as a comprehensive integrated management activity.

5. NEED FOR MATERIAL MANAGEMENT SYSTEM

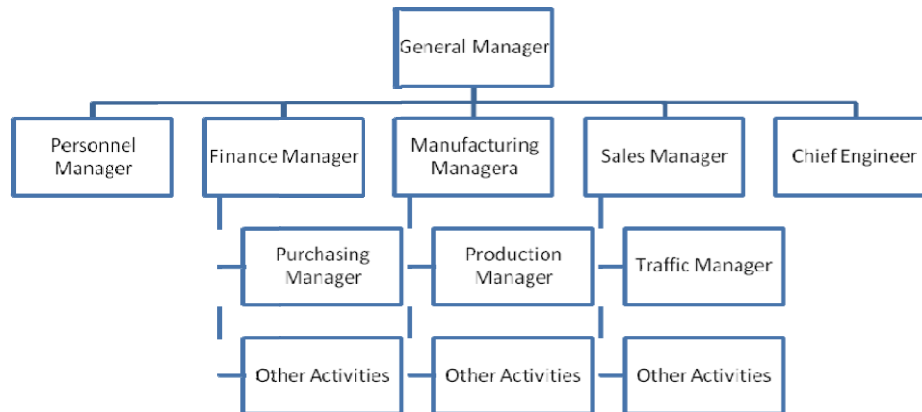
The costs associated with material management are hidden in other activities or included as overhead costs. Stukhart (2007) states that studies from the Construction Industry Cost Effectiveness Project (CICEP) concluded that senior management have not recognized the contribution of material management to cost issues in projects, that personnel involved in material management activities do not receive an adequate training, and that the computer systems used by companies are not good sources of information for materials control. Historically managers had paid more attention to the costs associated with personnel, equipment and plant and little attention has been given to materials. For manufacturing organizations, the costs related to materials have increased and had become the largest expenditure of the organization; therefore more attention has been placed into activities related to materials. The cost of materials has escalated to twice the cost of labor between 1975 and 1980 inducing companies to pay more attention to activities related to materials.

Traditionally the responsibilities for activities related to materials flow have been divided between different departments. Figure 2 depicts the division of responsibilities for material management. The

activities related to material management are divided between different departments. For example, the finance department is in charge of the purchasing activities while the manufacturing department is in charge of the control of materials during production. This division of responsibilities makes it difficult to coordinate the activities related to materials. In addition, this division can make the control and identification of materials extremely difficult.

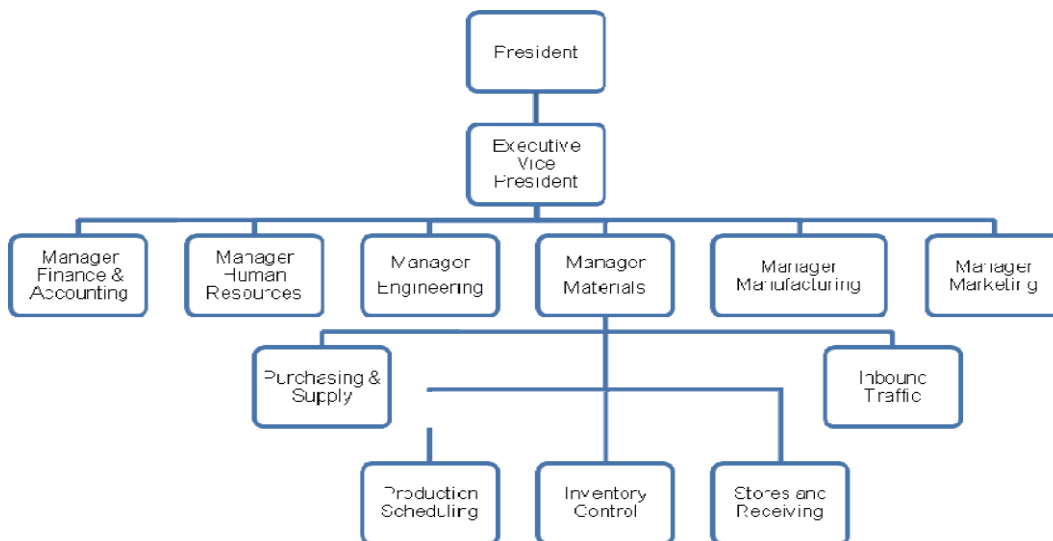
The integration of the functions related to materials into a single department makes it easier to control and identify all the activities related to material flow and costs. Figure 3 depicts the integrated approach for Material Management. Material Management is designed to coordinate and control the materials needed and activities related to those materials. In a typical organization, the material activities are interrelated.

Figure 2: Division of responsibilities for Material Management



Source: Ammer, 1999

Figure 3: General Structure of a Material Management System in a company

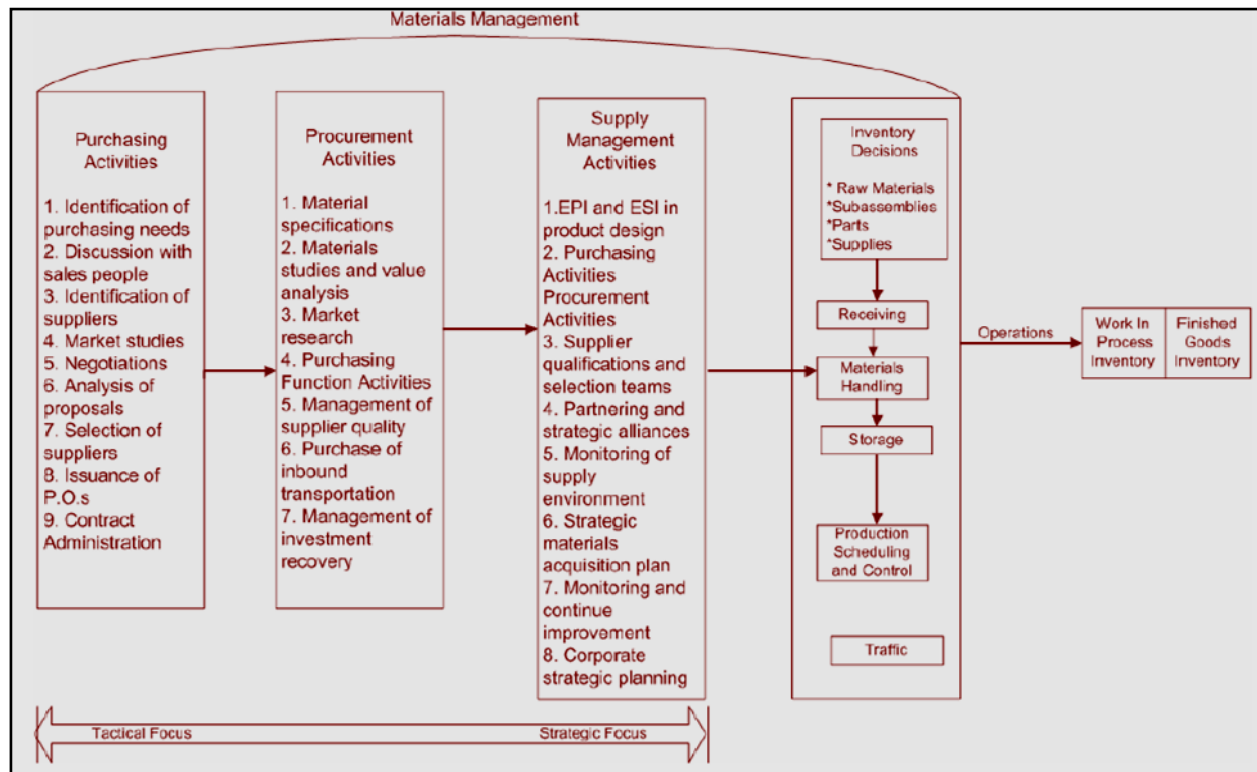


Source: Dobler and Burt, 2009

Figure 4 illustrates a typical flow of materials, and material activities in an organization. From the figure, it can be seen that decisions taken at early stages in the material management flow might affect other activities and decisions to be made in later stages. For example, if the proposals from suppliers are not analyzed (i.e.

step 6 in the purchasing activities), then the selection of suppliers might be affected (i.e. Step 3 in the supply management activities)

Figure 4: Relationship of purchasing/ Procurement/ Supply management with Material management



Source: Dobler and Burt, 2009

Coordination is needed in order to reduce the impact that a decision at a certain stage might have in other activities. Communication is essential among members of the team to avoid conflicts and to take the better decisions regarding materials flow.

6. BENEFITS OF MATERIAL MANAGEMENT

An effective material management system can bring many benefits for a company. Labour productivity could be improved by six percent and can produce 4-6 per cent in additional savings. Among these benefits are:

- a) Reducing the overall costs of materials
- b) Better handling of materials
- c) Reduction in duplicated orders
- d) Materials will be on site when needed and in the quantities required
- e) Improvements in labor productivity
- f) Improvements in project schedule
- g) Quality control
- h) Better field material control
- i) Better relations with suppliers
- j) Reduce of materials surplus
- k) Reduce storage of materials on site
- l) Labor savings
- m) Stock reduction

- n) Purchase savings
- o) Better cash flow management

7. CONCLUSION

The materials manager should obtain the materials needed at the lowest cost possible. By buying products at the lowest possible costs, operating costs can be reduced and profits can be increased. Proper handling and storage of materials can reduce the total cost of materials; therefore the materials manager should ensure that materials are handled properly and stored in the most adequate places. Quality is a very important aspect that the materials manager has to keep in mind. When specifications require a high quality product, quality could become the most important objective. Suppliers play an important role in any organization. Many companies rely greatly in outside suppliers for the materials needed for production. Good relations with suppliers might be decisive for a company to be in business. Companies that have good relations with suppliers could be more successful in attracting customers than companies that have bad relations with suppliers. When a company has good relations with its suppliers it could benefit from cost reductions, cooperative environment from the employees of the supplier, and willingness to help with materials ordered and orders pending. When a company has bad relation with their suppliers it might be possible that it experiences late deliveries or wrong materials delivered. This will have an impact in the total cost of the product, possibly increasing the total costs, and delaying the completion of the final product. Materials acquisition from the procurement time until it is received in the field can have a significant impact on the schedule of a construction project. Based on the studies presented, it is clear that effective management of materials can minimize the impact that lack of materials or improper management of materials could have in the overall schedule and cost of the project. The materials manager should assure that effective and economical transportation are used to transport materials to the site.

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