

Survey of Tools And Methods of Material Management In Construction Industry

Mr. Shubham Raibole¹, Prof. Ashish Waghmare²

Department of Civil Engineering

¹PG Student, Department of Civil Engineering, Dr. D. Y. Patil School of Engineering and Technology, Lohegaon, Pune, India

² Professor, Dr. D. Y. Patil School of Engineering and Technology, Lohegaon, Pune..

Abstract- Construction Industry in India is one of the major job generators and a major source of investment. But improper management leads to cost-overruns. Two major factors affecting project performance is time and cost. Construction materials and equipments may account for more than 60% of project cost in construction industry and has a bearing on labour productivity also. Material management directly affects the cost and duration of the project and hence is a vital part of project and construction management but remains understudied and its effects are not given due scrutiny.

Material handling, inventory management, planning, scheduling, procurement, receiving, monitoring, tracking and controlling are all part of material management. All these aspects of material management are inter-related and inter-dependent and form a complex system. This study aims to shed light on techniques and current trends in construction industry.

It also aims to find out whether traditional method of construction management is still predominant or new technology and software is being used. Whether a clear plan to manage material onsite is in place is surveyed, the obstacles in implementation of new techniques have been found out. An assessment of contemporary trends of material management in Construction Industry. Also S-curve analysis is carried out to study the deviation of actual material cost from planned material cost.

Keywords- Cost-overrun, productivity, material management.

I. INTRODUCTION TO MATERIAL MANAGEMENT

Material management is defined as the planning, acquiring, storing, moving and controlling of materials as per the requirement of the organization. Materials management is basically related with the smooth flow of materials. The major activities covered under materials management are the anticipation of the materials required in the organization from time-to-time. It involves ordering and obtaining materials from the suppliers, introducing the materials to the organization and monitoring the status of materials. It helps to optimize the usage of facilities, personnel and funds and to provide service to the user in the line with the organizational aims. Materials

management is the coordination and control of the various material activities.



The key material activities are:

1.1 Purchasing Activities

It involves mainly identification of materials needs, market research, maintaining materials records etc.

1.2 Procurement Activities

It involves material specifications, materials studies, receiving materials etc.

1.3 Inventory Management

It involves planning and controlling of materials handling, storing materials and managing material supplies etc. Excess inventory is a cost burden to industry in terms of capital tied up, the cost of obsolescence Notes and the cost of servicing product in the supply chain. However, having the right amount of inventory to meet customer requirements is critical. Inventory management is about two things: not running out, and not having too much
When to Order?

This problem of inventory control deals with the point of time when the order for fresh inventory is to be given. The problem of 'when to order' is solved by fixing the appropriate re-order level of each type of inventory. It is determined by compromising the cost of maintaining these stocks and the disservice to the customer if this order is not delivered in time
How Much to Order?

Economic Order Quantity EOQ is an important technique of inventory management. The EOQ refers to the optimal order size that will result in the lowest total of order and carrying cost for an item of inventory given its expected usage, carrying cost and ordering cost. By calculating an economic order quantity, the firm attempts to determine the order size that will minimize the total inventory cost.

D = Annual demand

C_i = Ordering cost per order

P = Unit price

C_c = Carrying cost per order

$$EOQ = \sqrt{2 D C_c / P C_i}$$



FIGURE 1: ECONOMIC ORDER QUANTITY

1.4 Supply-Chain Management

A supply chain is a system of organizations, people, technologies, activities, information and resources involved in moving a product or service from supplier to customer.

Value Analysis Lawrence Miles conceived of Value Analysis (VA) in the 1945 based on the application of function analysis to the component parts of a product. Component cost reduction was an effective and popular way to improve “value” when direct labor and material cost determined the success of a product. The value analysis technique supported cost reduction activities by relating the cost of components to their function contributions. Value analysis defines a “basic function” as anything that makes the product work or sell. A function that is defined as “basic” cannot change. Secondary functions, also called “supporting functions”, described the manner in which

the basic functions were implemented. Secondary functions could be modified or eliminated to reduce product cost.

A brief description specifically about each stage is explained below.

1.5.1 Initiation Phase of Construction Project

Feasibility Study

We have to create and evaluate the project in order to determine if it is feasible and if it should be undertaken, at the beginning of the project. Here the project objective or need is identified; this can be a business problem or opportunity.

A suitable response to the need is documented in a business case with recommended solution options. A feasibility study is conducted to examine whether each option clearly identifies the project objective and a final recommended solution is determined.

Many questions related to the issues of feasibility i.e. “can we do the project?” and justification like “should we do the project?” are mentioned and faced.

At this stage, the major deliverables and the participating work groups are identified. This is the time when the project team begins to take shape. Approval is then required by the project manager to move onto the detailed planning phase.

Role of Material Management:

It is one of the key factors in deciding the feasibility of a project. Whether the project is feasible or not depends on the availability of materials and their distance from project site. If the distance is very large then project cost would be enormous. Also if the required materials are not available then the project is not feasible.

1.5.2 Planning Phase of Construction Project

The planning phase involves further development of the project in detail to meet the project’s objective. The team identifies all of the work to be done. The project’s tasks and resource requirements are identified, along with the strategy for producing them. In a broader sense identification of each activity as well as their resource allocation is also carried out. A project plan outlining the activities, tasks, dependencies, and timeframes is created.

The project manager is the one who coordinates the preparation of a project budget by providing cost estimates for the labor, equipment, and materials costs. This is mainly carried out by project scheduling software like MS project. These scheduling charts would help us to track the stages of our project as time passes. This is also referred to as “scope management.”

The budget of the project already estimated is used to monitor and control cost expenditures during project implementation. Finally, we require a document to show the quality plan, providing quality targets, assurance, and control measures, along with an acceptance plan, listing the criteria to be met to gain customer acceptance. At this point, the project would have been planned in detail and is ready to be executed.

Role of Material Management:

Material Management is the most crucial part of this phase because proper execution depends on proper planning. This phase includes material planning when a particular stock should be ordered and what quantity should be ordered is calculated. Wrong planning will lead to heavy losses

1.5.3 Execution Phase of Construction Project

This is the implementation phase, where the project plan is put into motion and the work of the project is performed

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Progress should be continuously monitored and appropriate adjustments are made and recorded as variances from the original plan.

The project manager uses this information to preserve control over the direction of the project by comparing the progress reports with the project plan to measure the performance of the project activities. If any deviation is found from the already defined plan corrective measures are made.

Status reports should always highlight the probable end point in terms of cost, schedule, and quality of deliverables. Each project deliverable produced should be reviewed for quality and measured against the acceptance criteria.

When deliverables have been produced and the customer has agreed on the final solution, the project is said to be ready for closure

Role of Material Management:

Material Management plays a crucial role in this phase. The aspects which are significant in this phase are

1. Material handling
2. Material Testing
3. Material storage.

From the above it is clear inventory management and control play a key role in this phase. Improper inventory management will lead to delays and financial losses.

1.5.4 Performance and Monitoring Phase of Construction Project

This stage is all related to the measurement of progress and performance to make sure that items are tracking with the project management scheduling. This phase regularly happens at the same time as the execution phase.

Role of Material Management:

A track on material consumption is kept in this phase. The deviation of actual material usage from planned usage is found to minimize the losses. Also the causes which also include theft are inquired into.

1.5.5 Closure Phase of Construction Project

During the final closure, the importance is on providing the final deliverables to the customer, that is:

- Handing over project documentation to the business
- Termination of supplier contracts
- Releasing project resources
- Communicate the closure of the project to all stakeholders.
- Last and final is to conduct lessons-learned studies to examine what went well and what didn't.

Role of Material Management:

Materials do play a role in this phase because of defect liability period clause.

A defects liability period is a set period of time after a construction project has been completed during which a contractor has the right to return to the site to remedy defects.

A typical defects liability period lasts for 12 months. If substandard or defective materials have been used the builder will have to incur additional costs in this period.

II. METHODOLOGY

Relative Importance Index technique:

The Relative Importance Index method is used to determine the relative importance and role that materials and their management play in the project. The problem areas related to material management are identified. The effect each problem area has on the project is found in terms of RII. Greater the impact on cost and time greater would be the RII The five-point scale ranged from 0 (not important) to 5 (extremely important) will be adopted and will be transformed to relative importance indices (RII) for each factor as follows:

$$RII = \sum W/A * N$$

Where, W is the weighting given to each factor by the respondents (ranging from 1 to 4), A is the highest weight (i.e. 4 in this case), and N is the total number of respondents.

FACTORS	RII
Incomplete or drawing or drawing with errors	0.2
Frequent design changes	0.2
Improper supervision by inexperienced site engineer or Supervisor	0.4
Over-ordering Material	0.2
Not carrying out the required tests	0.4
Improper Inspection	0.2
Lack of Teamwork and proper organization	0.6
Manufacturing defects (pipe, sanitary ware)	0.1
Lack of efficient utilization of temporary material (shuttering, scaffolding)	0.2
Damage due to lack of adequate protection from weather	0.4
Theft	0.4
Rework due to mistakes	0.4
Inadequate space for storage	0.4
Transportation damage	0.1
Wrong methods and regulations in Material Usage	0.1
Poor Planning and scheduling	0.8
Unnecessary Materials	0.1
Delay in material supply	0.6
Shortage of Materials	0.4

TABLE 1: RELATIVE IMPORTANCE INDEX

The Case Study is a SRA (Slum Rehabilitation Authority) in Dattawadi, Pune. To assess the problem areas in material management a questionnaire survey is carried out. The survey includes discussions with Site Supervisors, Vendors, and Contractors etc.

Also a survey is carried out to find out the prevalence of ERP (enterprise resource project) softwares and study the effects on projects.

III. RESULTS AND ANALYSIS

The S-curve analysis of materials was done using Microsoft Project software.

Also the effect of material management of duration and thus labour productivity was studied.

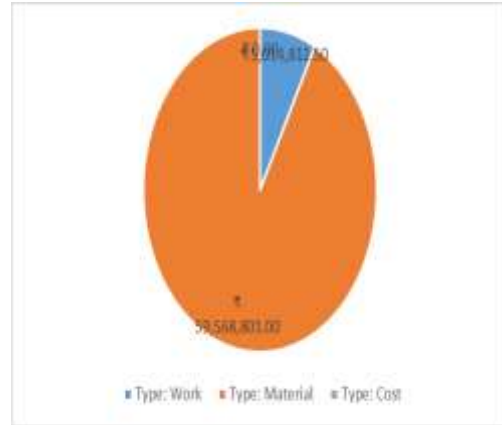


FIGURE 2 : MATERIAL VS LABOUR COST GRAPH

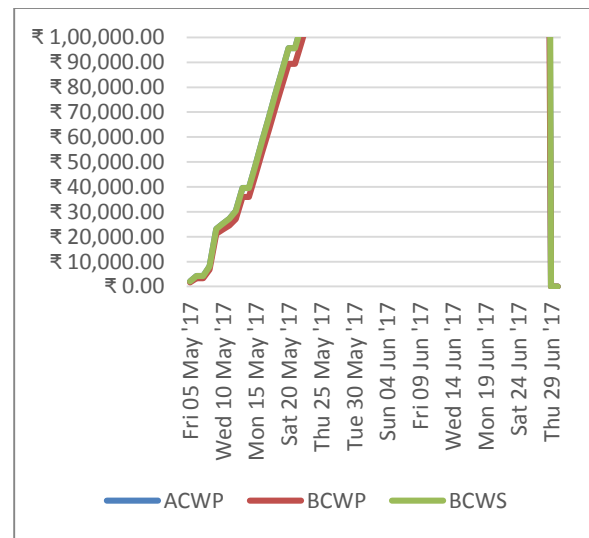


FIGURE 3 : S-CURVE FOR TIME PERIOD OF MAY-JUNE

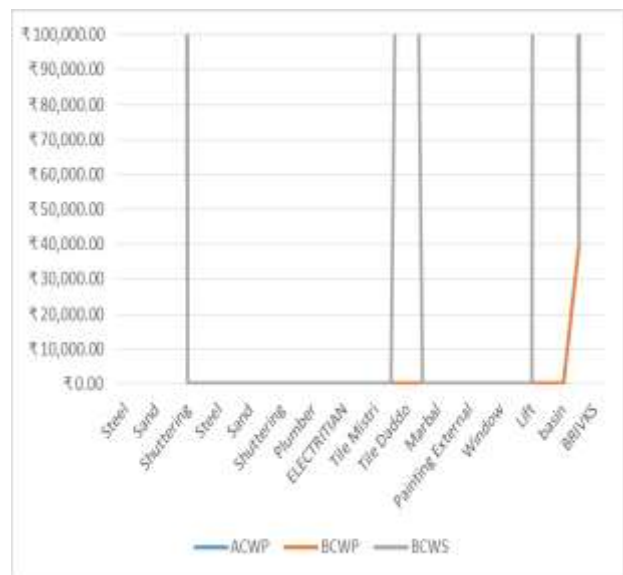


FIGURE 4: S-CURVE FOR MATERIALS

TABLE 2 : MATERIAL COST ANALYSIS

Name	Baseline Cost	BCWP	Actual Cost	CV
Steel	₹ 5,962,720.00	₹ 5,829,386.67	₹ 5,962,720.00	(₹ 133,333.33)
Cement	₹ 16,651,950.00	₹ 6,851,950.00	₹ 6,851,950.00	₹ 0.00
Sand	₹ 1,767,000.00	₹ 1,662,000.00	₹ 1,662,000.00	₹ 0.00
Aggregate	₹ 4,585,500.00	₹ 4,338,000.00	₹ 4,351,500.00	(₹ 13,500.00)
Shuttering	₹ 150.00	₹ 150.00	₹ 150.00	₹ 0.00
Sanitary fitting	₹ 4,000,000.00	₹ 4,000,000.00	4200000	200000
Steel	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Cement	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Sand	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Aggregate	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Shuttering	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Brick	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Plumber	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Plumber WC	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
ELECTRICIAN	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Water proofing	₹ 20,401,071.00	₹ 20,401,071.00	20800800	₹ 0.00
Tile Mistri	₹ 515,232.00	₹ 0.00	₹ 0.00	₹ 0.00
Tile Box	₹ 1,792,000.00	₹ 0.00	₹ 0.00	₹ 0.00
Tile Daddo	₹ 420,000.00	₹ 0.00	₹ 0.00	₹ 0.00
Tile Antiskid	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Marbal	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Painting Internal	₹ 18,457,856.00	₹ 0.00	₹ 0.00	₹ 0.00
Painting External	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Door Frame	₹ 716,800.00	₹ 716,800.00	₹ 716,800.00	₹ 0.00
Window	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
Lift	350,0000	₹3500000	₹ 355,0000	₹ 0.00
w/c	₹ 3,000,000.00	₹ 0.00	₹ 0.00	₹ 0.00
basin	₹ 1,000,000.00	₹ 0.00	₹ 0.00	₹ 0.00
Shuttering	₹ 1,007,710.00	₹ 39,600.00	₹ 479,710.00	₹ 0.00
BRICKS	₹ 4,860,000.00	₹ 4,779,000.00	₹ 5,520,000.00	(₹ 651,750.00)

MATERIAL RESOURCE



FIGURE 5 : MATERIAL COST VARIANCE

IV.CONCLUSIONS

- Using RII it has been found the most crucial factor of material management plays most crucial role is
- As of now softwares such as SAP are not widely used because of their high cost. In Pune only 3 companies were found to be using it: 1.Abil 2.Guardian 3.Marvel.And the use of softwares leads to greater accuracy and reduction in cost and time.
- The major advantage of using a software is security and accountability. Since all data is digitalized and records maintained there can be no theft.
- The S-curve analysis shows significant deviation of actual cost from planned cost. Causes were found out to be of faulty execution such as inadequate and substandard storage facilities, delay in procurement, theft, required testing of materials not done etc.
- Another factor that affects costs is fluctuations in market price of materials which cannot be predetermined and hence can cause heavy losses.

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