

A Factual Case Study on Crucial Role of Material Management in Various Construction Phases

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Abstract -- The project management life cycle is broadly broken down into four different phases that are initiation, planning, execution and closure. These phases make up the path that takes your project from the beginning to the end of project. Some methodologies also include a fifth phase, controlling or monitoring. Material management processes involve the planning, procurement, handling, stock and waste control surrounding material on construction projects. A good material management environment enables proper material handling on sites. In order to better understand material management the processes should be discussed planning, procurement, logistics, handling, stock and waste control. Classification provides a mechanism for identifying various construction items that will have significant impact on overall inventory cost. Also providing a mechanism for identifying different categories of stock that will require different policy and inventory control.

Indexed Terms -- Inventory Management, ABC analysis, Productivity, Material Management

I. INTRODUCTION TO MATERIALMANAGEMENT

Material management involves logistics of the material components of a supply chain which involves the process of planning, implementing and controlling of the movement and storage of raw material, work in process inventory, goods from point of origin to point of inject. The management of material should be considered from the phases of construction process and throughout the construction period. Generally, construction material are bulky

and expensive are supplied in large amounts to construction sites. Therefore there is a need for management system for handling material.

The construction industry is most significant industry in the economy and the successful measure with completion in time, budget and accordance with specification and satisfaction of stakeholders. Construction is the process of physically erecting the project and putting construction equipment, material, supplies, supervision and management necessary to accomplish the task. Construction projects are very complex, with many organizations involved such as clients or owners, architects, engineers, contractors, suppliers and vendors. This includes heterogeneous and often complex process of producing unique, large and immovable products with a supply of the resources (money, equipment, material and labour). The management of material in construction projects is an important function that significantly contributes to the success of project. As projects grow in scale and complexity, the material management becomes more difficult and often requiring the use of appropriate tools and techniques to ensure, amongst other things, that material are delivered on time, stock levels are well managed, the construction schedule is not compromised and that wastage is minimized. Material management is especially problematic for massive and complex projects, where sophisticated tools and techniques are very necessary.

Material constitutes a major cost component for any Industry. The total cost of installed material may be 60% or more of the total cost, even though the factory cost may be a minor part of the total, probably less than 20-30%. This is because the manufactured item must be stored, transported and

restored before it is put in place at the site. The total cost of material 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 material) and the site-handling costs (cost of receiving, storage, issuing and disposal). The efficient procurement, handling of material represents a key role in the successful completion of the work. It is important for contractor to consider that there may be significant difference in 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 material is a potential cause for delay. Poor planning and control of material, lack of material when needed, poor identification of material, re-handling and inadequate storage cause losses in labour productivity and overall delays that can indirectly increase total project costs. Effective management of material can reduce these costs and contribute significantly to the success of the project.

Material management can deal with planning and building design for the movement of material or logistics that deal with the tangible components of a supply chain. Specifically, this covers the acquisition of spare parts and replacements, control of purchasing and ordering such parts and the standards involved in ordering, shipping and warehousing the said parts. Material management is the function responsible for the coordination of planning, sourcing, purchasing, moving, storing and controlling material in an optimum manner in order to provide pre-decided service to the customer at a minimum cost.

II. VARIOUS CONSTRUCTION PHASES OF LIFE CYCLE OF PROJECT

1. Initiation Phase of Construction Project:

This phase is often broken into two: one for initiation and one for planning. The former involve budget outlines, timeline needed for project delivery as well as the overall goal of the construction project. The phase is essentially about laying out the project's

mission. In sum, it is a formalization of the project's core idea. The planning phase delves into a little more detail. Managers will consider that what specific steps, tasks needed for project completion. Each step, task will have its own estimated costs and time. Although these estimations don't need to be entirely accurate, it gives project managers a general idea about the project's feasibility and delivery time. 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 that this can be a business problem or opportunity.

A suitable response to need is documented in a business case with recommended solutions. A feasibility study is conducted to determine whether option are identifies the project objective and 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. When a solution is approved, a project is initiated to implement the approved solution. For this, a project manager is appointed. 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. Then approval is required by the project manager to move on the detailed planning phase.

2. Planning Phase of Construction Project:

The planning phase involve development of the project in detail to meet objective of the project wants to execute. The team identifies all of the work to be done. The task and resource requirements are identified along with the strategy for producing them. In this identification of each activity as well as their resource allocation is to be 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 project estimate by providing cost estimates for equipment, labor and materials costs. This is mainly carried out by project scheduling software like Primavera and MS Project. This scheduling charts would help us to track the stages of our project as time passes. This is also referred as scope management. The budget of construction project estimate is used to monitor and

control cost expense 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 and 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.

3. Execution Phase of Construction Project:

This is the third implementation phase where the project plan is put into motion and the work of the project is performed physically on site. It is essential to maintain control and communicate as needed during implementation stage. Progress should be continuously monitored and appropriate adjustments are made and recorded as variances from the original plan. A project manager is the one who spends most of the time in this step. This third stage often overlaps with the second stage. Specifically, project monitoring and control involves managers making sure that task deadlines are met and costs are within the allocated budgets. Most projects will encounter problems along the way and such problems are rectified at this stage. Throughout the project implementation people used to carry out the task and progress information is being reported through regular project team meetings. The project manager use this information to serve control over the direction of the project by comparing the daily progress reports with the project plan. This is done to measure the performance of the project activities. If any deviation is found from the already defined plan then corrective measures are made. The first action should always to bring the project can back to the original plan. If that cannot happen then the team should record variations from the original plan and record and publish modifications to the plan all through this step and project sponsors and other key stakeholders are kept informed about the project status as per the agreed rate and format of communication. The plan should be updated and available on a regular basis.

4. Closure Phase of Construction Project:

No matter how many phases there are in a project, the closing stage is always the last. The phase involves two elements. The first report that gives how the project ran over the previous three phases. The report will analyze the project's initial goals compared to its

current state and identify any problems encountered along the way and what steps were taken to address these problems. The second element of this phase is the project review, which is the project team meeting where team members can put in their own input regarding the project's implementation. During the final closing period, the importance on providing the final deliverables to end user that are follows:

- Handing over project documentation to the client.
- Termination of all supplier contracts.
- Releasing all the project resources.
- Communicate the closure of the project to all stakeholders in the project.
- Last lessons are learned studies to examine, what went well and what did not.

III. MAJOR BENEFITS OF MATERIALS MANAGEMENT

1. The better accountability part of the material, as well as other departments and no one can blame others.
2. As materials management by a single authority, which can lead to better coordination, because it became the central point of any substance-related problems.
3. Materials management departments to ensure better quality materials provide request in a timely fashion department. This can lead to a better performance of the organization.
4. A materials management system is usually controlled through a system, therefore, can help decision-making related to the material in the organization.
5. An indirect use of materials management is the development of good quality material, ethical and moral standards in an organization.

IV. LIMITATIONS OF MATERIALS MANAGEMENT

1. Inaccurate or partial Bill of Materials listing from the engineering firm
2. Engineering requisition issues
3. Purchase order revisions and inaccuracies
4. Shipping and receiving errors causing inaccurate inventory levels

5. Inaccurate material inventory counts
6. Efficient inventory control methods can reduce but cannot eliminate business risk.
7. The objectives of better sales through improved service to customer that reduces inventory cost, reduces size of investment and reducing cost of production by smoother production operations are conflicting with each other.
8. The control of inventories is complex because of the many functions it performs, it should be viewed as shared responsibilities.

V. PROBLEMS OF MATERIAL MANAGEMENT

a) Organization Structure:

The coordination and communication between estimating department, research and development department, purchasing department and plant, equipment and machineries department should be maintained at highest level. Main issues in organization structure are as follows.

- Undefined scope
- Lack of communication between parties involved
- Incomplete drawings Plans are not completed and details are missing
- Lack of conformance to requirements
- Nonstandard specifications that are not commonly used
- Incomplete / ineffective meetings
- Difference between plans and specifications
- Don't communicate exactly.

b) Procurement problem:

- Availability of material
- Availability of quantity
- Price reduction to match competitor's price
- Late deliveries Materials are not delivered as per schedule
- Late or incorrect submittals
- Poor communication between parties
- Lack of conformance to requirements
- Unrealistic delivery dates
- Re handling of materials
- Storage areas are limited or are far from working area

- Theft or damaging during handling or other condition.

c) Storage Space:

Large number of materials is required depending on the magnitude of the project. And the term storage space implies both enclosed and open space that can be used to keep materials of work safe until the need for it arise. All materials need protection against many threats such as pilferage, theft, damage or loss. Material such as aggregates, bricks/blocks may not require enclosed storage protection than proper outdoor positioning and stacking. However, other materials such as reinforcement bars, steel columns, timber and galvanized steel for trusses must be protected against contact with water in order to avoid rust/corrosion. The size of proposed building may occupy 60% of the total project site, enabling the remaining 40% to be used for temporary access and site facilities.

d) Security Problem:

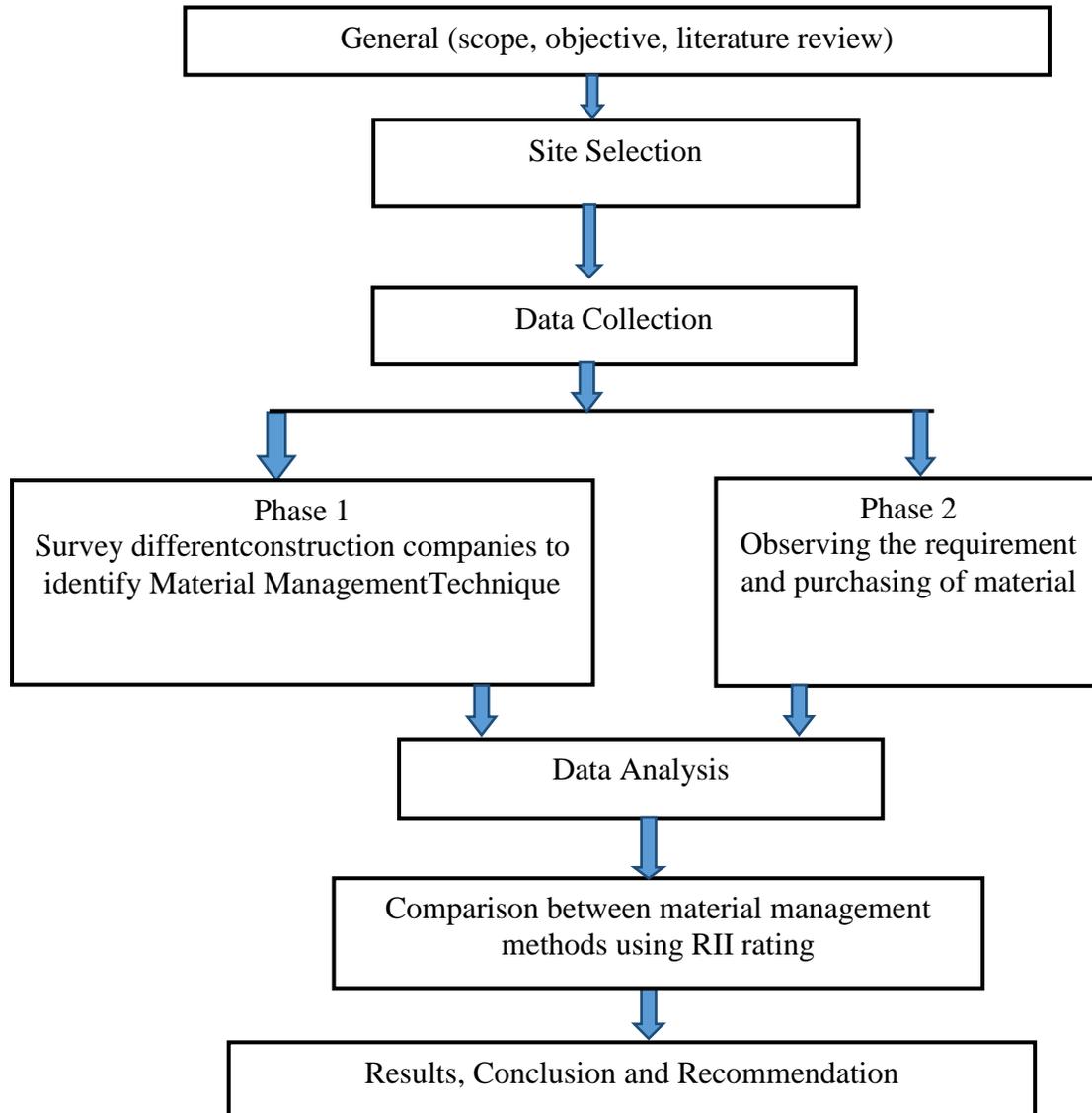
Security of materials onsite is of paramount importance. Gradual pilferage and theft are issues of concern to the project managers. Loss of materials through pilferage and theft represent financial lost to the project as a whole and in the end it increases the cost of the project. Materials are prone to be stolen despite being in store. And some materials as earlier mentioned may not require indoor storage. Therefore, a well designated vigilante must be maintained 24 hours onsite.

e) Availability of Materials on Market:

Steady flow of materials throughout project duration is among the primary function of material management. However, this can be affected by market availability of the material of work. Occasionally manufacturers can run out of raw material or be affected by government policy to the extent that production may have to be slow or suspended. Unavailability of materials of work on market can affect material management by either increasing competition in material purchaser delay the general work progress.

VI. METHODOLOGY AND DATA COLLECTION

Flow Chart



The experimental analysis consists of theories and practical consideration of the concepts. Therefore, the present work was classified as follows.

1. Analysis of site and management
2. Analysis on Inventory controlling
3. Analysis on purchasing procedures
4. Analysis on Procurement and Tracking
5. Analysis on costs

a) Analysis of Site and Management:

The analysis was done to understand what are the problems occurring in the company because of improper application of material management. The solutions that provided in this work may cost a lot in the beginning, but it will help the company in the long run by providing solutions to the key problems like lack of specification, delay, improper procurement etc. According to the problems that generally occur in the site due to the improper material management, was categorised each problem and created a cause-effect diagram, where factors such as, inventory, purchase, procurement, were all generally addressed to procurement cycle. For this purpose, the study was done by visiting the site. Site survey was done and prepared questionnaires accordingly and problems to each above mentioned groups were analysed and solutions thus were given. Substantial evidences in the form of photos were taken to analyse the procurement problems occurring in the present case study. Questions were prepared accordingly and those prepared questions were given as a challenge to the site managers, quality control inspector, project manager, purchase manager. From the questionnaires prepared and the answers thus obtained from them were categorized into each class of problems. From those classes it was understood that lack of technological implications and scientific approach were lacking with respect to the procurement process. Thus the problems were pointed out to them and they agreed to each above mentioned problems that were occurring in their site and thus corrections would be implemented by them in their next oncoming projects.

b) Analysis on Inventory Controlling:

In the inventory process, the methodology adopted was preparing questionnaires and allocating marks for each, by categorizing them into each of their subsystem problems, such as supply, materials and

equipment, weightages were given substantially. Then, based on this the solutions were offered in the form of cause effect diagram and flow charts, graphs were also prepared, depicting problems such as delay, lack of specification, excess and lack of inspection.

Inventory Planning

- i) Production planning requires purchase and inventory planning decisions for an organization to control expenses and finances.
- ii) 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.

c) Analysis on Purchasing Procedures:

All the organizations need an efficient and economic purchasing and procurement of its various supplies of materials from the suppliers. Process of Purchasing: The process of purchasing involves various steps to be followed as routine matter by the purchase department.

- i) Identification of materials: Identify the materials to be purchased by receiving the requisitions received from various departments.
- ii) Purchase requisitions: Purchase requisitions are documents listing the requirements of materials from the various stores written by the storekeeper received by the purchase department from various departments. The planning department for special purchases for non-stock items also prepares the purchase requisitions. The purchase requisitions are made as Bill of Materials (BOM) of a product, which specifies quantities, needed.

d) Analysis on Procurement and Tracking:

In this, the concept is based on procurement and tracking of the materials which is done with the help of RFID and bar coding scanners. In procurement tracking, the concept of tracking the material is done mainly with the help of barcode scanners, where the quality control manager can view the materials to where it is being transported. Hence a check on the materials can be done. Once the transportation has arrived at site, the material is being passed by cross checking it with the bill of quantities and bill of loading, with the consignee.

e) Analysis on Cost:

The ABC analysis is done to manage different stocked items that are not all equal in value or order frequency. A best practice is for an organization to group their inventory into three categories (A, Band C).

- A Classification: A Classification items are very important for an organization. Because of the high demand of these 'A' items, frequent value analysis is required. These are your fast moving and typically lower value items that drive the largest percentage of your target service levels and customer satisfaction rates.
- B Classification: B Classification items are important, but of course less important than 'A' items and more important than 'C' items. These are typically midrange in inventory value and order frequency.
- C Classification: C Classification items are marginally important. Typically, very low order frequency and high inventory value. These items are usually stocked with very low quantities or not at all due to the high carrying costs associated with the stock levels.

f) 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 phases of project life cycle. The five-point scale ranged from 1 (not important) to 5 (extremely important) will be adopted and will be transformed to relative importance indices (RII) for each factor as follows:

$$RII = \frac{\sum W}{A * N}$$

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.

As execution and monitoring go hand in hand they have been clubbed together.

VII. CASE STUDY

Case Study 1:

- Site: - Rastra Sant Tukdoji Cancer Hospital and Research Centre, Nagpur
- Client Name: - Cancer Relief Society
- Contractor: - A. S. Iyer Pvt. Ltd.
- Consultant: - SKA Consortium
- Architect: - Salankar and Pashine Associates
- Type of Project: - Commercial
- Material Management Technique: - Traditional
- Estimated Cost of project: - 80 Cr
- Duration of Project: - 36 months + 12 months of Defect Liability Period (DLP)
- Number of Floor: - Basement and G+5
- Location: - Tukdoji Square, near Govt. Medical College, Nagpur
- Type of Contract: - Unit Rate Contract
- Number of Wings/ Tower: - 3

CASE STUDY 2:

- Site: - Marvel Feugo, Hadapsar, Pune
- Contractor: - Marvel Realtors
- Type of Project: - Commercial
- Material Management Technique: - SAP
- Estimated Cost of project: - 55 Cr
- Duration of Project: - 26 months + 6 months of Defect Liability Period (DLP)
- Number of Floor: - 2 Basement with G+9
- Location: - Hadapsar, Pune
- Number of Wings/ Tower: - 1

CASE STUDY 3:

- Site: - SRA site at Dattawadi, Pune
- Contractor: - Kedar Associates
- Consultant: - Vijay Mahajan
- Architect: - Om Architects
- Type of Project: - Residential
- Material Management Technique: - ERP
- Estimated Cost of project: - 22 Cr
- Duration of Project: - 14 months + 6 months of Defect Liability Period (DLP)
- Number of Floor: - Basement and G+8
- Location: - Dattawadi, Near Indian Oil Petrol Pump, Parvati, Pune.
- Number of Wings/ Tower: - 1

CASE STUDY 4:

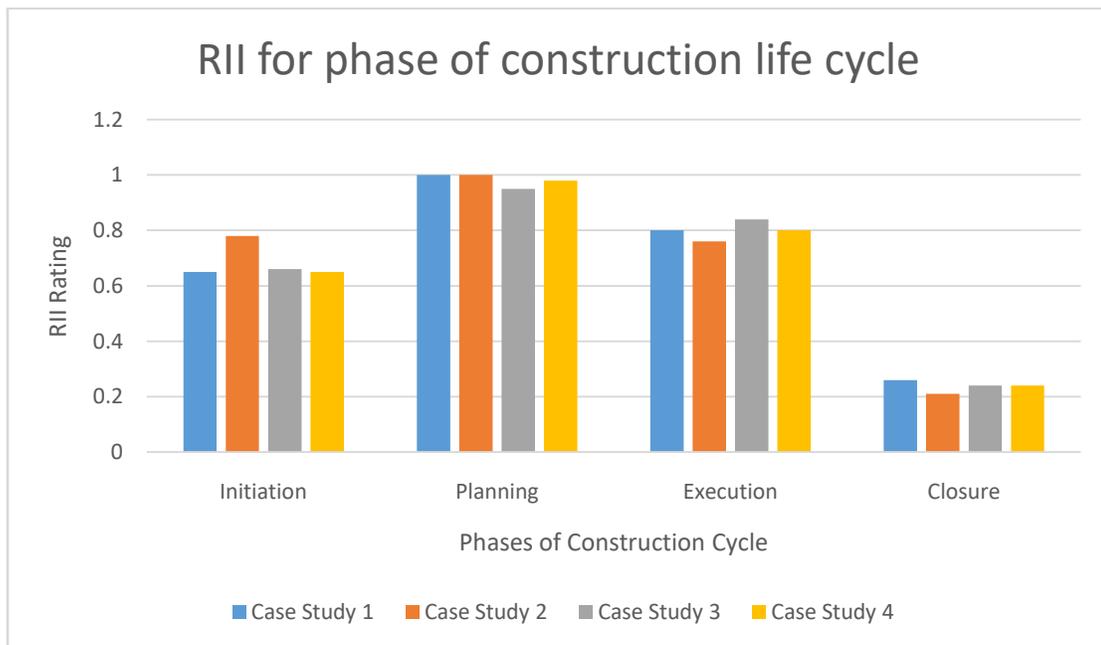
- Site: - Icon Residency, Manish Nagar, Nagpur
- Contractor: - Viraj Developers
- Type of Project: - Residential
- Material Management Technique: - Traditional
- Estimated Cost of project: - 12 Cr
- Duration of Project: - 10 months
- Number of Floor: - G+5
- Location: - Manish Nagar, Nagpur
- Number of Wings/ Tower: - 1

VIII. RESULTS AND ANALYSIS

Important Rating of Material Management In Project Phases

PHASES	RII of Materials in the Phase of CASE STUDY 1	RII of Materials in the Phase of CASE STUDY 2	RII of Materials in the Phase of CASE STUDY 3	RII of Materials in the Phase of CASE STUDY 4
INITIATION	0.666	0.78	0.66	0.65
PLANNING	1	1.00	0.95	0.98
EXECUTION AND MONITORING	0.8	0.76	0.84	0.8
CLOSURE	0.26	0.16	0.20	0.24

Table No: 1 RII Rating



RII for phase of construction life cycle

IX. CONCLUSIONS

- Using RII it has been found material management plays most crucial role in planning phase and it is of least significance in closure phase.
- Widely used material management method in construction industry is traditional method but as per now all well-known companies using SAP for better accuracy and accountability.
- The major advantage of using a software is security, accountability and transparency. Since all data is digitalized and records maintained.
- By using the software we can show the S-curve analysis, which shows significant deviation of actual cost from planned cost.
- Good planning of material management can help to avoid any delays of works on site and reduce any extra cost for a project.
- By using the material management technique standards of quality can be maintained.

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