

Process Analysis of Material Procurement in Commercial Buildings and Recommendation

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Abstract— In the construction industry to manage a productive and cost effective site, efficient material management is very essential. An important factor that affects the performance of construction projects is the improper handling of materials during site activities. This an effort to analyze the Process analysis of material Procurement management by generating strategies to improve the procurement process in commercial projects. The methodology was applied to study several projects under execution, obtaining important data about the current situation of the procurement process in these projects. From the information gathered from these sources, and from the literature, improvement strategies were obtained and a proper strategic approach to the material Procurement process was proposed. To avoid delays mainly the material planning to be carried out on time with the relevant material details material approval, material lead time, and material delivery and to be properly tracked. One or combination of Information and Communication Technology helps in effective management of materials at various stages of construction. Application of ICT enables the maximum accuracy of estimation of requirements and it is made sure that required amount of material is procured at the project site avoiding the wastages and difficulties in storages etc.

I. INTRODUCTION

Construction projects can be accomplished utilizing management processes. These processes include planning, organizing, executing, monitoring, and controlling. During any construction project the three inter-related factors of time, money, and quality need to be controlled and managed. Successful completion of projects requires all resources to be effectively managed. Materials management is considered as a means to achieve better productivity, which should be translated into cost reduction. Procurement is the acquisition of goods or services at the best ownership cost, in the right quantity and quality, at the right time and place for the organization. Various problems are present in the material procurement during every stage of the project life and the reasons of these problems are presented material procurement management system of the contracting organizations. Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs. If materials are purchased too early, capital may be held up and interest charges incurred on the excess inventory of materials. Materials may deteriorate during storage or get stolen unless special care is taken. Delays and extras expenses may be incurred if materials required for particular activities are unavailable. Ensuring a timely flow of materials is the key challenge in the material Procurement management in material management

II. METHODOLOGY

The methodology was based on the literature review, study of cases, casual interviews, surveys, and the analysis of information sources. The study of cases was focused on going commercial building construction projects from which it was possible to obtain specific information regarding the Material procurement process. Identification of the Major problem involved in the material procurement management systems carried out through different literature case studies, case studies and study of Material Procurement management Process processed for the base building construction and the interior fit out of commercial building projects.

In the Case study the project selection for Case study selected and the preliminary site study such as general observation, General discussion with professionals and Site data collection carried out. The secondary Case study visit Secondary data collection carried out to study about the Project schedule study and the material analysis and the material procurement process study and analysis, Identify the key problems in the process, Cause and effect analysis.

This study allowed to collect the data of projects, particularly related to procurement, such as Procurement process ,approvals, purchase reports, follow-up reports, claim reports, supply reports, etc. and interview of the participants to obtain the project information.

From the information gathered from these sources, and from a literature, improved strategies were obtained and a proper strategic approach to the material Procurement management process was proposed for the commercial building projects.

III. MATERIAL PROCUREMENT

The Objectives of material procurement are stated as buying the best item at right Quality, Quantity, Time and Cost.

The effective material management system can bring many benefits for a company such as reducing the overall costs of materials, better handling of materials, Reduction in duplicated orders, Materials will be on site when needed and in the quantities required, Improvements in labor productivity, Improvements in project schedule, Quality control, Better field material control, Better relations with suppliers, Reduce of materials surplus, Reduce storage of materials on site, Labour savings, Stock reduction, Purchase savings and Better cash flow management.

Stuckhart 1995 defines the term Procurement Process as the process required to supply equipment, materials and other resources required to carry out a project. This process usually involves sub-processes such as acquisition, purchasing, logistics, monitoring, quality assurance and contract administration.

Barrie and Paulson 1992 stated the term procurement management such as procurement encompasses a wide range of activities that includes purchasing of equipment, materials, labor and services required for construction and implementation of a project and objective of procurement in materials management is to provide the materials in the right time, place, quality and an agreed budget.

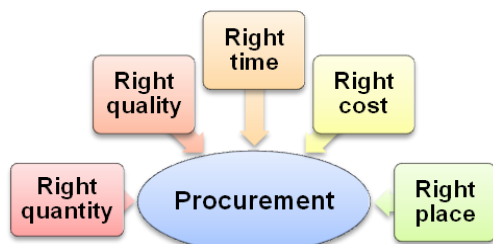


Fig 3.1 Procurement

Major problems involved in the material procurement management systems

The Major problems involved in the material procurement management systems are listed such as Lack of planning before starting of the project, False planning, Procuring material with non standard specifications, Selection of non competent vendor, Late deliveries, Wrong deliveries, Political issues, Improper track record, etc. and these problems have great impact on the time & cost of the project.

IV. PROCUREMENT MANAGEMENT PROCESSES

Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team. Project Procurement Management includes the contract management and change control processes required to develop and administer contracts or purchase orders issued by authorized project team members. Project Procurement Management also includes administering any contract issued by an outside organization (the buyer) that is acquiring the project from the performing organization (the seller), and administering contractual obligations placed on the project team by the contract

PLAN PROCUREMENTS—the process of documenting project purchasing decisions, specifying the approach, and identifying potential sellers

CONDUCT PROCUREMENTS—the process of obtaining seller responses, selecting a seller, and awarding a contract

ADMINISTER PROCUREMENTS—the process of managing procurement relationships, monitoring contract performance, and making changes and corrections as needed

CLOSE PROCUREMENTS—the process of completing each project procurement

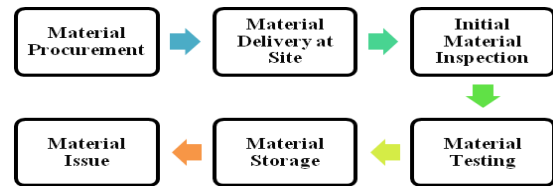


Fig 4.1 Material flow management

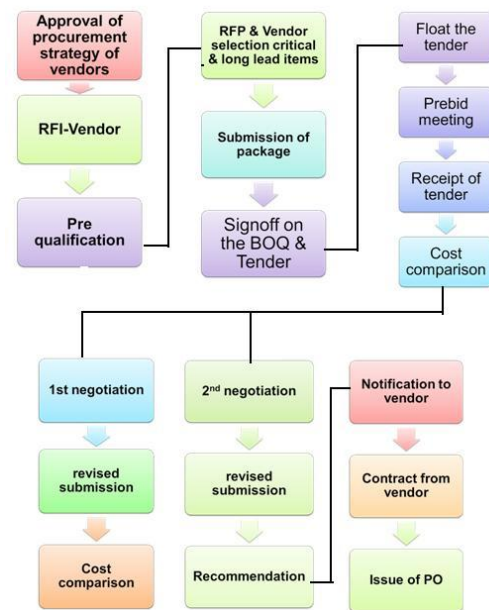


Fig 4.2 Procurement process

V. STUDY AND ANALYSIS

The study was carried out through literature study, Questionnaire survey and site case study.

CASE STUDY

The case study was carried out in two Commercial buildings in Bangalore. Based on the detail study on two case studies, factors affecting the material procurement are identified.

They factors are mentioned below.

- Ineffective planning and scheduling in the project resulted in late procurement.
- Delays in the approval of materials from client ended in late procurement.
- Delays in the issue of PO (purchase orders) resulted in late delivery of materials.
- Omission of lead time of materials ended in late procurement and delivery.

The above mentioned defects procurement process led the project in time and cost escalation.

The Procurement Delay carried out in the HVAC works are listed below as the sample of study.

HVAC WORKS				
Item of work	Start Date	Finish Date	Remarks	
Supply of Air Handling Units (AHU) and allied equipments	1-Mar-14	30-Mar-14	Time Extended	Work in progress
Supply of Air Handling Units (AHU) and allied equipments	1-Mar-14	30-Mar-14	Time Extended	Work in progress

QUESTIONNAIRE SURVEY

The Questionnaire Survey carried out with thirty members including project managers, procurement managers, contractors and consultants.

Data obtained from the survey were analyzed using simple percentages and Relative importance Index (RII) method

$$RII = \Sigma W \div A \times N$$

W = the weight assigned to each strategy by the respondents

A = Highest weight N = the total number of respondents

Factors affecting Material Management are rated as Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1).

VI. RESULT AND CONCLUSION

According to the problems that occurred in the site due to the improper material procurement management, was categorized each problem and created a cause-effect diagram, where factors such as, Consultant factors, client, contractor, inventory, procurement, material, external factors were all generally addressed.

The various factors affecting material procurement management are listed as Contractor Contributed Factors, Owner Contributed Factors, Consultant Contributed Factors, Material Contributed Factors and External Factors.

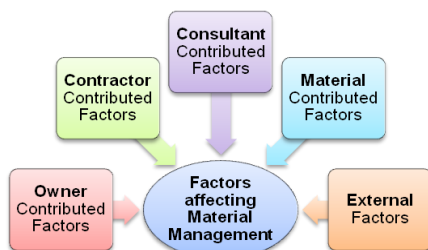


Fig 6.1 Factors affecting Material Management

Nearly fifty questions were prepared and from the answers thus obtained from them were categorized into each class of problems. In this the major factors affecting the material Procurement as the first three ranks are listed below.

Factors affecting Material Management		RII -Relative importance index	Rank order
		RII	
1	Owner Contributed Factors		
2	Change orders by owner during construction	0.88	2
3	Contractor Contributed Factors		
4	Ineffective planning and scheduling of project	0.88	2
5	Consultant Contributed Factors		
6	Delay in approving major changes in the scope of work	0.88	2
7	Unclear and inadequate details in drawings	0.86	3
8	Material Contributed Factors		
9	Late procurement of materials	0.89	1
10	Delay in material approval process	0.86	3

Fig 6.2 Factors affecting Material Management

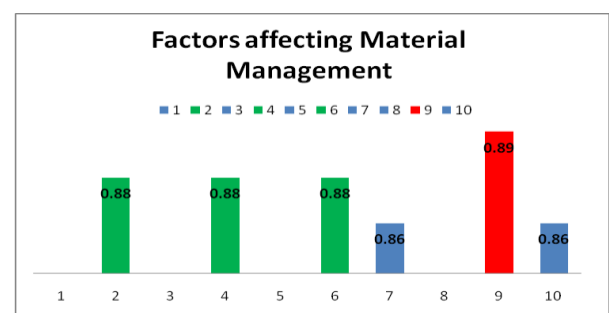


Fig 6.3 Factors affecting Material Management

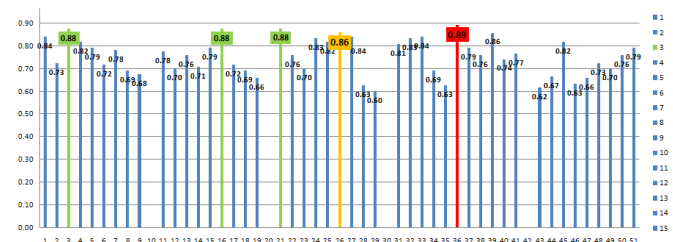


Fig 6.4 Factors affecting Material Management

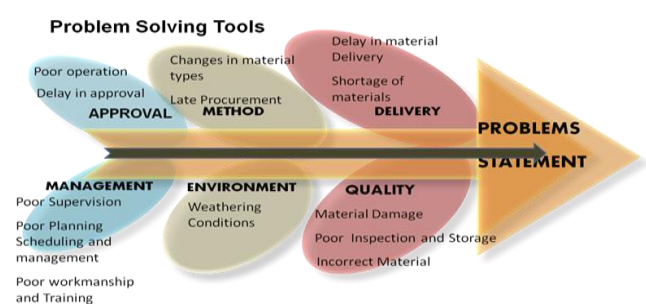


Fig 6.5 Cause and effect diagram of material procurement management

The various factors affecting the Material procurement management are to be solved by the following process.
LATE PROCUREMENT OF MATERIALS (0.89)

Lack of planning and scheduling

- Schedule is not planned before starting the project
- Material procured without planning

Improper scheduling

- Mistakes in the schedule
- Mainly the lead time is not properly calculated
- Wrong Material specification /quantity

The late procurement to be avoided by the following process

- Plan and schedule the Materials before start the project
- Correct Material Specification and Quantity
- Mainly Lead time consideration for scheduling

DELAY IN APPROVAL 0.86

- Delay in material approval by Architect
- Delay in material approval by consultants
- Delay in approving major changes in the scope of work by Client

The Delay in approval to be avoided by proper scheduling for Material sample submission and Approvals by

- Architect, Consultants, Owner and Vendor

UNCLEAR AND INADEQUATE DETAILS IN DRAWINGS

- Lack of details in the drawings
- Errors in the Drawings
- Delays in updating the drawings
- Improper coordination between the
- Drawings(Architectural, MEP , Structural, interior)

The Unclear and inadequate details in drawings to be avoided by the following process such as

- Proper Inspection and detailed study of Drawings
- Proper update of drawing revisions
- Proper filing system of drawings
- Proper coordinated drawings for services
- Advanced technology implementation Primavera, ICT
- BIM used for material applications(Clash detection, Material Specifications, revisions quantity)

The long lead time for various materials are listed below

SUPPLY OF LONG LEAD ITEMS	Duration
Supply of false floor	45 days
Supply of Chiller	120 days
Supply of PAC	90 days
Supply UPS	90 days
Supply of AHU's	90 days
Supply of finishes material	110 days
Supply of carpets	90 days
Supply of Workstation	90 days
Supply of grid ceiling	90 days
supply of networking materials	120 days
supply of loose furnitures	120 days
Supply of AV, Security materials, LSS & LMS	90 days
Supply of Electrical panels	120 days
Supply of Sprinkler flexible	120 days
Supply of Isolation transformers	90 days
Supply of BMS	45 days

Fig 6.5 materials procurement duration

Updating the database for materials procurement by using Information and communication Technology (ICT) will increase the efficiency of material procurement. The application of RFID and Bar-coding in the stages of materials management increases the efficiency.

Primavera and BIM are used during the planning stage to estimate the required amount of materials. E-mails for

placing the purchase orders and electronic invoicing for the payments are few ICT applications which can help to overcome the delays that are caused in the Project. RFID and bar coding could be effectively used in most of the stages of construction and especially to the stock and waste control.

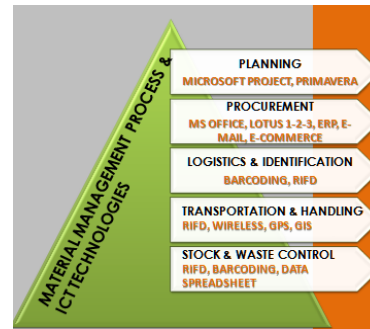


Fig 6.6 Prototype of ICT in material procurement process

Calculation for lead time should be done and used data base of previous work for the planning. One or more ICT helps in effective management of materials at various stages of construction. Application of ICT enables the maximum accuracy of estimation of requirements and it is made sure that required amount of material is procured at the project site avoiding the wastages and difficulties in storages etc. Proper planning before starting of the project and organized management system in planning of materials procurement management help to avoid any delays of works on site and reduce any extra cost for a project.

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