International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)
ISSN: 0976-1353 Volume 13 Issue 1 –MARCH 2015.

EVALUATION AND ASSESSMENT OF PERFORMANCE MEASURES FOR MATERIALS MANAGEMENT PROCESS IN RESIDENTIAL CONSTRUCTION PROJECTS

[1]V A NARMADHA and [2] Dr .S. THENMOZHI,
[1] PG Scholar, ME Construction Engineering and Management, Sree Sastha Institute of Engineering and Technology, Chennai-123
[2] Head of the Department, Department of Civil Engineering, Sree Sastha Institute of Engineering and Technology, Chennai-123.
naru.ce@gmail.com

***Abstract*— This study considers the management of materials on residential building construction sites. In the study, factors affecting material management on construction site and factors causing inventory management risks as well as causes wastages on construction sites are to be determined. The aim of this study is to suggest measures for effective material management in construction site and also finds the problematic areas causing material wastage. This study will further suggest measures for controlling material wastage. Among other problems, materials management has continued to cause a major obstacle to the success and profitability of many construction projects. Effective management of materials represents an area with great potential for improving productivity of work and also controlling cost. Determining the key effectiveness of performance measures will benefit the construction industry. This study will reveal the importance and practicality of performance measures for materials management process in residential construction projects.**

***Index Terms*—Performance Measures, Inventory Control, Procurement, Material Wastage.**

I. INTRODUCTION

Construction sector is very essential and an integral part of infrastructure development which gives tremendous boost to India's economy. At the same time, this sector consumes more resources for its tremendous development. The most important resource which occupies a major portion of this industry is materials. Broadly, the term materials denotes all purchased items utilized at the project site including construction materials, supporting plant and equipment, and administrative facilities and stores. Construction materials cover all types of materials used in construction including electrical and mechanical fittings, fixtures, devices and instruments that are incorporated during the construction of permanent works and supporting works at site.

A. Material Management

[Ref 5] Material management can be defined as a process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material.

B. Performance Measure

A performance measure is used to calculate the effective working of a function [As in 7]. These performance measures may differ from system to system. The measures divide the materials management system into parts and make the working of the system more efficient. When joined, the measures make the complete materials management system. Research has been done in the past by Plemmon's and Al-Darweesh (1995) about the effectiveness of performance measures in materials management. Plemmon's developed a list of performance measures for use in industrial construction projects and proposed a model for benchmarking the materials management process in industrial construction. The Plemmon's performance lists are to be used in this study to assess its importance, and practicality of implementation in residential construction projects.

II. LITERATURE REVIEW

Articles from journals were reviewed in detail in order to gain an insight in the study done in the field of materials management and its improvement. An exhaustive Literature survey has been conducted. Major highlights from the various literatures are discussed below. These highlights paved a way of understanding of the complete materials management process.

Patel and Vyas (2011) are of the view that for managing a productive and cost efficient site efficient material management is very essential. Research has shown that construction materials and equipment may constitute more than 70% of the total cost for atypical construction project. Therefore the proper management of this single largest component can improve the productivity and cost efficiency of a project and help ensure its timely completion. One of the major problems in delaying construction projects is poor materials and equipment management.

Madhavi et al. (2013) states that the objective of the present study is to understand about all the problems occurring in the company because of improper application of material management. In construction project operation, often there is a project cost variance in terms of the material, equipment, manpower, subcontractor, overhead cost, and general condition. Material is the main component in construction projects. Therefore, if the material management is not properly managed it will create a project cost variance. Project cost can be controlled by taking corrective actions towards the cost variance.

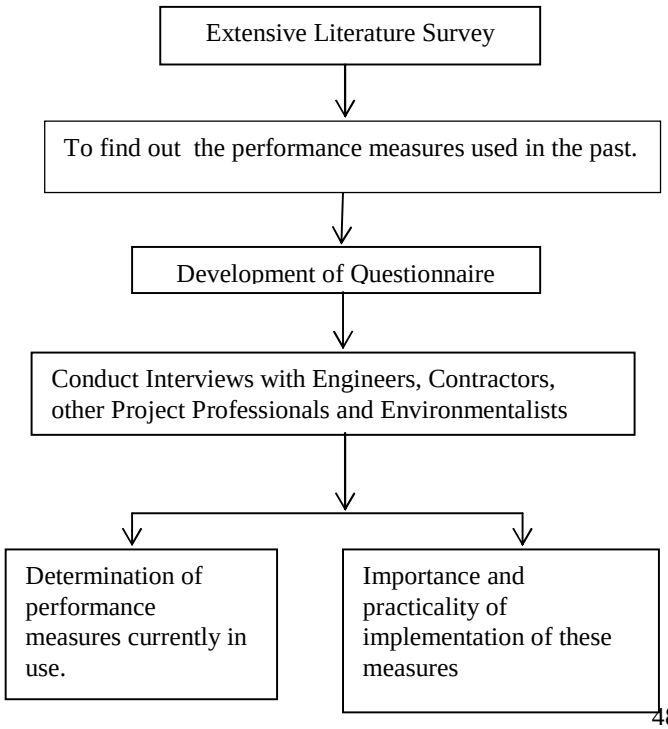
Kareem and Pandey (2013) are of the view that now days, the increased economic growths as well as urbanization in developing countries have led into extensive construction activities that generate large amounts of wastes. Material wastage in construction projects resulted into huge financial setbacks to builders and contractors. In addition to this, it may also cause significant effects over aesthetics, health, and the general environment.

III. METHODOLOGY

The step by step methodology for the work carried out and the future work to be done further has been provided as a theory explaining the whole process. The process flow has also been depicted in the form of a flowchart for the better understanding of the process in a precise manner.

An extensive literature review was done to find the past and currently used performance measures and the impact of materials wastage has also been studied [Ref 7].

The Sequence of works done and works to be carried out is depicted below in the form of a flowchart in Fig.1



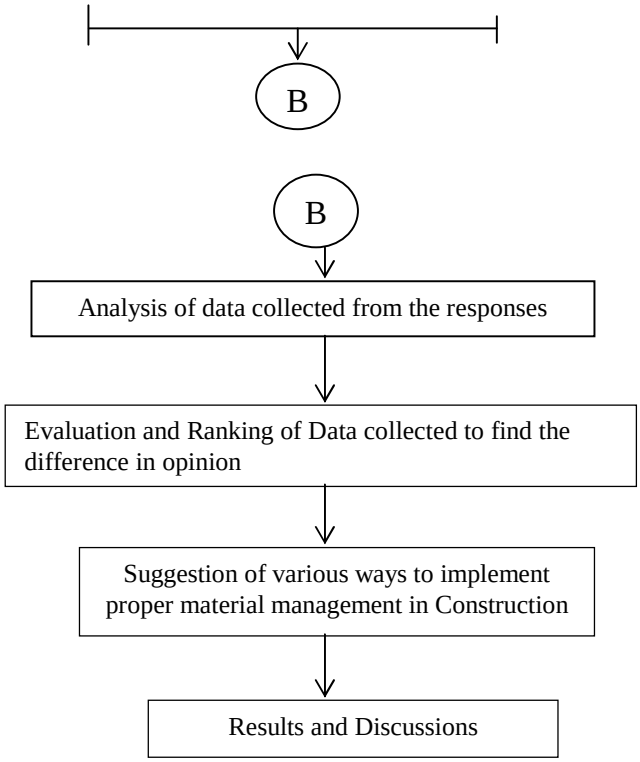


Fig.1 Flowchart of Work Methodology

IV. QUESTIONNAIRE DESIGN

The questionnaire to obtain the desired information consists of six parts. First part is regarding the respondents' general information; the second part of the questionnaire is for determining effectiveness of performance measures in materials management, the third part of the questionnaire is regarding material management process, the fourth part is regarding material management software, [Ref Annexure I] the fifth part is regarding materials management procedures, the sixth part is regarding the waste and recycling and the seventh part is for determining the factors affecting improper material management . The respondents are specifically reminded of the importance of observing consistency in their answers. Their responses should not be biased towards any particular project whether it was highly successful or disastrous. Any information obtained through this questionnaire will stringently be used for educational use.

V. RESULTS AND DATA ANALYSIS

The information obtained from the 6 respondents formed the basis for the study analysis. Table 1 shows the respondents profile. The profile of the respondents showed that 4 out of the 6 respondents had an

experience in the range of 10-15 years, with the rest having an experience of less than 10 years in residential construction materials management system. This represents a wide range of experience of the participants. Grade 01 firm represents their major experience in residential construction and Grade 02 of firm represents their major experience in Commercial Construction.

Table 1: Respondent's Profile

No.	Position	Grade of firm	Experience in materials management (in years)
1	Project manager	01	Over 20
2	Project manager	01	10-15
3	Project manager	02	Less than 10
4	Project manager	01	Less than 10
5	Project manager	02	10-15
6	Project manager	02	10-15

A. Importance and practicality of performance measures:

The importance of performance measures was calculated using an importance index. The importance levels of the performance measures were classified into five categories ranging from 5 (extremely important) to 1 (not important):

- Extremely important : the assigned weight of 5
- Very important : the assigned weight of 4
- Important : the assigned weight of 3
- Somewhat important : the assigned weight of 2
- Not important : the assigned weight of 1

The following equation is used to calculate the importance index of the performance measures:

Importance index of a measure = (X1*5 + X2*4 + X3*3 + X4*2 + X5*1) / N

Where X1, X2, X3, X4, X5 represent the frequency of responses in a particular rating.

5, 4, 3, 2, 1 represent the numerical score of the respective rating.

N is the number of responses.

For Example, the index for materials availability was calculated as:

$$(10*5 + 4*4 + 1*3 + 0*2 + 0*1) /15 = 4.60.$$

The calculated importance indices for all the performance measures are shown in Table 2, in descending order of importance. Based on the index score for each of the performance measures, they were categorized into four different groups with a range of 1:

1. Extremely important : 4.25-5.0
2. Important : 3.25-4.24
3. Moderately important : 2.25-3.24
4. Somewhat important : 1.25-2.24

It can be observed from Table 2 that seven performance measures; materials receipt problems, PO to materials receipt duration, commitment home office, Home office requisition ratio, material availability, commitment field and commodity vendor timeliness are extremely important.

The same type of analysis that was used in determining the importance index was used to determine the practicality index. Table 2 shows the results of the practicality indices of the performance measures. Materials receipt problems and Stock out analysis have been found to be extremely practical in terms of implementation.

Table 2: Importance and Practicality Index of Performance Measures

S. No	Measure Description	No. of Respondents	Importance index(1-5)	Practicality Index(1-5)
1	Materials receipt problems	6	4.67	4.5
2	PO to materials receipt duration	6	4.67	4.33
3	Commitment home office	6	4.5	4.17
4	Home office requisition ratio	6	4.5	4
5	Material availability	6	4.5	3.83
6	Commitment field	6	4.33	3.83
7	Commodity vendor timeliness	6	4.33	3.83
8	stock out analysis	6	4.17	3.67
9	Electronic	6	4	3.67

	funds transfer payments			
10	Commodity timeliness	6	4	3.67
11	Jobsite rejection of tagged equipment	6	3.83	3.67
12	Materials receipt problems – internal	6	3.67	3.5
13	Procuremen t lead –time	6	3.67	3.5
14	Warehouse inventory accuracy	6	3.33	3.5
15	Material receiving processing time	6	3.17	3.33
16	Backorders	6	3.17	3.17
17	Home office PO ratio	6	3	3.17
18	Payment discounts	6	3	3
19	Materials withdrawal request	6	2.83	3
20	Constructio n time lost	6	2.83	3
21	Total surplus	6	2.83	2.83
22	MWR processing time	6	2.67	2.83
23	Sole source purchase	6	2.5	2.83
24	Minority suppliers	6	2.33	2.5
25	Average man hour per PO	6	2	2.5
26	Freight cost percent	6	2	2.33
27	Release value breakdown	6	2	2.17
28	Average line items per release	6	1.83	2
29	Warehouse safety incident rate	6	1.83	2
30	Express deliveries percent	6	1.83	1.83
31	Min/Max release activity	6	1.5	1.67

B. Importance of factors affecting improper material management

The identified factors which contribute to improper material management are Late delivery of materials, Shortage of materials, Non-availability of materials as per contract specification and Delay in approval of materials/samples. The importance of these factors was determined using a 5 point scale. Based on the responses the following graph has been drawn.

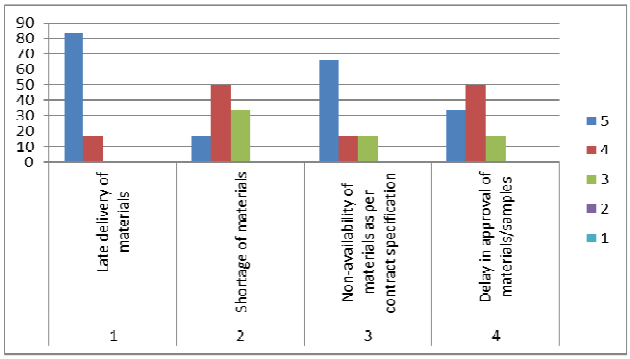


Fig. 2 Percentage of Importance of factors

Based on the graphical representation it has been found that Late delivery of materials and Non-availability of materials as per contract specification are the factors which extremely contribute to improper material management.

C. Importance of Inventory Management Risks

The identified inventory management risks are Lack of Storage Space, Problems with de-centralized processing, Inadequate training Practices, Improper financial support in ordering of materials and Difficulty in delivery of long lead materials. The importance of these factors was determined using a 5 point scale. Based on the responses the following graph has been drawn.

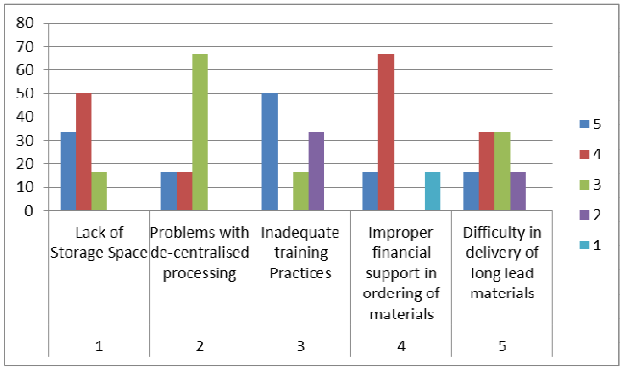


Fig.3 Percentage of Importance of Inventory Management risks

Based on the graphical representation it has been found that Inadequate training practices is the extremely important inventory management risk.

VI. CONCLUSION

The response of the respondents received is analyzed using the appropriate statistical tool. The future work involves results obtained from the questionnaire analysis will be discussed in detail and then the remedial measures have to be suggested. So far, the study had led to the following conclusions.

- Nearly 99% of the construction firms carry out the material management process at sites.
- Nearly 67% of the firms are satisfied with the current material management process.
- Mostly 84% of the firms are not aware of the Just in Time concept for effective material management process.
- Nearly 100% of the firms accept that the improper material management practices affect the project cost, Schedule, its productivity and also contribute to material wastage.
- Nearly 50% of the firms implement the concept of 3R (Reduce, Recycle and Reuse) in their projects.
- Nearly 67% of the firms are of the view that Material Procurement and Material Storage stage contributes to materials wastage.
- Nearly 50% of the firms manually follow the material management process.
- Nearly 67% of the firms implement the Quality Assurance/Quality Control plans with the suppliers of the major equipment and materials to full extent.
- To some extent nearly 50% of the firms have the adequate pre-qualification process for securing the appropriate suppliers of major equipment and materials.

ANNEXURE I

Part V

Materials Management Procedures

These questions are framed to assess up to what extent the material management procedures has been followed.

1. To what extent did this project have a designated materials management organization that was integrated across project teams?
2. How comprehensive was the written materials management plan for this project in addressing elements such as project goals, responsibility, cost & schedule, and transportation?
3. How extensively was the written materials management plan utilized throughout the life of the project?
4. How adequate was the plan for addressing the effects of change orders on materials management?
5. How extensively was an automated system (or integrated set of computer systems) used to identify, track, report, and facilitate control of project material throughout the life of the project?
6. How effective was site materials management during the construction phase?
7. How effective was the materials tracking and reporting system?
8. How effective were purchasing plans & procedures over the life of the project?
9. How adequate was the pre-qualification process for securing the appropriate suppliers of major equipment and materials?
10. How effective were receipt and inspection procedures for critical materials and equipment?
11. To what extent did the materials management plan utilize quality management practices?
12. How well were QA/QC plans implemented with the suppliers of major equipment and materials?

REFERENCES

1. Calistus Ayegba (2013),' An Assessment of Material Management on Building Construction Sites', Civil and Environmental Research, ISSN: 2224-5790, Vol. 3, No. 5.
2. Carlos T.Formoso, Lucio Soibelman, Claudia De Cesare and Eduardo L. Isatto (2002), 'Material Waste in Building Industry: Main Causes and Prevention', Journal of Construction Engineering and Management.
3. Karrar Raoof Kareem and Pandey R.K. (2013), 'Study of Management and Control of Waste Construction Materials in Civil Construction Project', International Journal of Engineering and Advanced Technology, ISSN: 2249-8958, Vol.2, Issue 3.
4. Kasim, N.B, Anumba, C.J and Dainty, A.R.J (2005) 'Improving materials management practices on fast-track construction projects'. In: Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference, SOAS, University of London. Association of Researchers in Construction Management, Vol. 2, 793-802.
5. Khyomesh V.Patel and Chetna M.Vyas (2011), 'Construction Materials Management on Project Sites' National Conference on Recent Trends in Engineering and Technology.

6. Phani Madhavi T., Steve Varghese Mathew and Roy Sasidharan (2013), 'Material Management in Construction-A Case Study', International Journal of Research in Engineering and Technology, eISSN: 2319-1163/pISSN: 2321-7308.
7. Plemmons J. K. (1995), 'Materials management process measures and benchmarking in the industrial construction industry', Ph. D Dissertation, Clemson University, Clemson, S.C.