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ANALYSIS OF FACTOR AFFECTING MATERIAL MANAGEMENT AND INVENTORY MANAGEMTENT: SURVEY OF CONSTRUCTION FIRMS IN GUJARAT REGION OF INDIA

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Abstract: ***Construction materials usually constitute a major portion 50-60% of the total cost in a building construction project. Materials management is made problematic by materials shortages, delays in supply, price fluctuations, damage and wastage, and lack of storage space. To manage a productive and cost efficient site efficient material management is very essential. Inventory management system involves procurement, storage, identification, retrieval, transport and construction methods. This paper presents the analysis of the factors affecting Material management and Inventory management ranked in accordance with the most affecting factors based on survey.***

Keywords: **Material management, Inventory, Productive, Cost efficient, Survey, Relative Importance Index (RII), Importance Index.**

I. INTRODUCTION

Material management is a process for planning, executing and controlling the field and office activities in construction. The goal of material management is to ensure that construction materials are available at their point of use when needed. Material management is the system for planning and controlling all of the efforts necessary to ensure that the correct quality and quantity of materials are properly specified in a timely manner, obtained at a reasonable cost and most importantly, available at the point of use when required.

Poor materials management can result in increased costs during construction. Efficient management of materials can result in substantial savings in project costs. If materials are purchased too early, capital may be held up and interest charges incurred for the excess inventory of materials. Materials may deteriorate during storage or get stolen unless special care is taken. Delays and extra expenses may be incurred if materials required for particular activities are unavailable.

Effective construction materials management process is a key to success of a construction project. Costs for materials handling, may range from 30-80% of total construction costs. Therefore, there is a need for efficient materials management in

order to control, productivity and cost in construction projects. The review has been carried out to explore the local practice in the construction materials management and develop a construction materials management system to facilitate the management of construction materials mainly in the building construction.

II. OBJECTIVES OF STUDY

This paper has an objective to act as a foundation for future studies and its results will become worthwhile information in efforts to improve the Material management practicies in the construction industry. To rank causes of delay by RII (Relative Importace Index) and IMP.I. (Imporance Index) method.

III. RESEARCH METHODOLOGY

The data collected to determine the most influential factors on Material management of the project was done through a survey by explorative questionnaire to the respondents involved in daily activities of construction firms in various regions in the Gujarat region of India. The questionnaire was designed so that respondents can give the rank to their answers based on the Likert scale. The analysis of these data was done by a method named relative importance index (RII) method as well as statistical methods using the statistical package for the social sciences (SPSS) Software.

IV. DATA COLLECTION

The target population included civil engineering and buildings firms of central region of India. The conactors, project engineers, store incharge and site supervisors of various city of Gujarat were targeted for survey. The details of various stakeholders and total numbers of were collected through internet. These details were considered as size of population to decide sample size of study. To obtain a satistically representative sample of the population, the formula shown in Eq (1) ws used.

$$n = \frac{m}{1+[\frac{m-1}{N}]} \qquad \ldots\ldots\ldots(1)$$

where n,m and N = the sample size of the limited, unlimited and available population, respectively. m is estimated by Eq. (2)

$$m = \frac{z^2 * p * (1-p)}{e^2} \qquad \ldots\ldots\ldots(2)$$

where z = the statistic value for the confidence level used, i.e. 2.575, 1.96 and 1.645, for 99%, 95% and 90% confidence levels, respectively; p = the value of the population proportion that us being estimated , and e = the sampleing error of the point estimate. Because the value of p is unknown, Sincich et al. (2002)[14] suggest a conservative value of 0.50 be used so that a sample size that is at least as large as required be obtained. By using 90% confidence level, i.e., 10% significance level, the unlimited sample size of the population, m, is approximated as follows:

$$m = \frac{1.645^2 * 0.5 * (1-0.5)}{0.1^2}$$

m = 67.65

Accordingly, for the total number of stackholders as per detail available through internet, i.e., N = 1129, the representative sample size of the population required, is determined as shown below:

$$n = \frac{67.65}{1 + [\frac{67.65 - 1}{1129}]}$$

n = 63.88

n ≈ 64

As the response rate is always low, the questionnaire was distributed to various stakeholders more than the sample size requirement. Total 96 questionnaires were distributed to different respondents in Surat, Bardoli, Navsari and Ahmedabad. They were sent the reminder for sending their feedback after 10 to 15 days of sending the questionnaire. This study received 80 responces. So, the response rate (as compare to sample size = 64) is in this research is 126%, which is considered as very good in this kind of survey research.

The follwings two types of approach should be used for data analysis.

A. Relative Importance Index technique

Relative Importance Index method is used determine the relative importance of the various causes and effects of delays. The same method is going to adopted in this study within various groups (i.e. contractors, project engineers, store incharge and site supervisor). The four-point scale ranged from 1 (vey little degree affect) to 5 (very high degree affect) is adopted and transformed to relative importance indices (RII) for each factor as follows:

$$RII = \frac{\sum W}{A \times N} \quad \text{…….(5)}$$

Where, W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e. 5 in this case), and N is the total number of respondents. Higher the value of RII, more important was the cause of delays.

B. Importance Index technique

In this technique, for each cause/factor two questions were asked: What is the frequency of occurance for this cause? And what is the degree of severity of this cause on project delay? Both frequency of occurance and severity were categorized on a four-point scale. Frequency of occurance is categorized as follows: always, often, sometimes and rarely (on 4 to 1 point scale). Similarly, degree of severity was categorized as follows: extreme, great, moderate and little (on 4 to 1 point scale).

1) Frequency index: A formula is used to rank causes of delay based on frequency of occurance as identified by the participants.

Frequency Index (F.I.) (%) = ∑ a (n/N) * 100/4 …….(4)

Where, a is the constant expressing weighting given to each response (ranges from 1 for rarely up to 4 for always), n is the frequency of the responses, and N is total number of responses.

2) Severity index: A formula is used to rank causes of delay based on severity as indiacated by the participants.

Severity Index (S.I.) (%) = ∑ a (n/N) * 100/4 …….(5)

Where a is the constant expressing weighting given to each response (ranges from 1 for little up to 4 for severe), n is the frequency of the responses, and N is total number of responses.

3) Importance index: The importance index of each cause is calculated as s function of both frequency and severity indices, as follows:
Importance Index (IMPI) (%) = [F.I. (%) * S.I. (%)]/100 ……(6)

A total number of 80 respondents were surveyed from the Gujarat region, namely cities like Ahmedabad, Bardoli, Navsari and Surat out of which 25 respondents were contractors, 21 were Project Engineers, 16 were Store Incharge and 18 were Site Supervisors. A ranking of the factors was achieved from the Relative Importance Index (RII) method and statistical package for the social sciences software (SPSS). Also ranking comparision between contractors, project enginer, store incharge and site supervisor are shown below.

V. RESULTS AND FINDINGS

The all ranking indices explained earlier were used to rank factor affecting material management and inventory management from viewpoints of the contactors, project enginners, store incharge and site supervisor. These respondents included 25 contactors, 21 project enginners, 16 store incharge and 18 site supervisor.

A. Top 10 causes ranked by Relative Importance Index (RII) technique (based on all respondent):

The relative importance index, RII, was computed for each cause to identify the most significant causes. The causes were ranked based on RII values. From the ranking assigned to each cause of delays, it was possible to identify the most important factors or causes of delays in Indian construction industry.

Base on the ranking, the 10 most important causes of material management by RII were:

(1) Misunderstanding of owner`s requirements by design engineer.[RII=0.6975];
(2) Poor quality of materials.[RII=0.6850];
(3) Unclear and in adequate details in drawings.[RII=0.6775];
(4) Poor use of advanced engineering design software.[RII=0.6775];
(5) Poor quality site documentation.[RII=0.6750];
(6) Underestimation of complexity.[RII=0.6550];
(7) Mistakes and delays in project design documents.[RII=0.6525];
(8) Design errors.[RII=0.6550];
(9) Lack of materials.[RII=0.6550];
(10) Poor communication.[RII=0.6475]

Base on ranking, for inventory management by RII were:

(1) A responsible official authorizes purchase.[RII=0.6250];
(2) You pay maximum attention to those inventories whose value is highest.[RII=0.6000];
(3) Goods are inspected on receipt.[RII=0.5975];
(4) All store staff are highly skilled.[RII=0.5750];
(5) Experiences under stock situations.[RII=0.5650];
(6) Get damaged goods from it stored.[RII=0.5575]

B. Top 10 causes ranked by Importance Index (IMPI) technique (based on all respondent)

The importance index of each cause is calculated as a product of both frequency and severity indcies. Based on the ranking, the 10 most important causes of material management by IMPI were:

(1) Design errors.[IMPI=65.2559];

(2) Unclear site drawing supplied.[IMPI=54.1602];
(3) Waste from uneconomical shape.[IMPI=50.9883];
(4) Unclear and inadequate details in drawings.[IMPI=50.0879];
(5) Slow response from the consultant team to contractor inquiries.[IMPI=50.0117];
(6) Unclear specification.[IMPI=49.3203];
(7) Space.[IMPI=49.2168];
(8) Shortage of unskilled labour.[IMPI=49.2129];
(9) Price and Contract.[IMPI=48.7813];
(10) Insufficient data collection.[IMPI=48.7754]
Base on ranking, for inventory management by IMPI were:
(1) A responsible official authorizes purchase.[IMPI=44.0781];
(2) Goods are inspected on receipt.[IMPI=43.8867];
(3) You pay maximum attention to those inventories whose value is highest.[IMPI=52.1016];
(4) All store staff are highly skilled.[IMPI=43.8555];
(5) Experiences under stock situations.[IMPI=38.2852];
(6) Get damaged goods from it stored.[IMPI=45.7324]

VI. SUMMARY

It is studied through field survey. It should frequency, severity and importane of the material management. The importance index of each cause is calculated as a product of both frequency and severity indices of each cause. 78 causes were identified through research. The field survey included 25 contractors, 21 project engineers, 16 store incharge and 18 site supervisor. Data collected were analyzed by frequency, severity importance and relative importance. Results shows that out of top 10 factors total 2 factors were common in ranking by both methods.they were design errors and unclear and inadequate details in drawings. It is hoped that the findings of the paper will help the stakeholders to act on material management and invenotory management to reduce it in their projects.

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