Analysis of Factor Affecting Material Management in Building Construction Projects

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Abstract- *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. The objective of this study was to find out the major factor affecting of Material management. A literature review was conducted to compile a list of factor affecting of Material management. The collected data were analyzed through statistical techniques and indices (RII and IMPI).*

Keywords- Material management (MM). Building, Construction, Projects. Relative Importance Index (RII).

I. INTRODUCTION

Materials management is the branch of logistics that deals with the tangible components of a supply chain. Specifically, this covers the acquisition of spare parts and replacements, quality control of purchasing and ordering such parts, and the standards involved in ordering, shipping, and warehousing the said parts.

It is the planning, directing, controlling and coordinating those activities which are concerned with materials and inventory requirements, from the point of their inception to their introduction into the manufacturing process. It begins with the determination of materials quality and quantity and ends with its issuance to production to meet the customer's demand as per the schedule and at the lowest cost.

Construction projects depend rest on having the right people with right skills and equipment that are able to deliver the project on time and on budget. Having the right materials, in the right place at the right time equally is important and having the cash flow and capital to procure the labour and materials is also important.

Materials management is the System for planning and controlling to ensure that the right quality and quantity of materials and equipment are specified in a timely manner (Donyari and Flanagan, 2009). Material management is a system that integrates purchasing, shipping and material control from suppliers. Based on those definitions, generally materials management can be defined as a process of planning, executing, and controlling the right source of materials with the exact quality, at the right time and place suitable for minimum cost construction practice.

Selection of personnel for marketing, purchasing, inventory control, stores management and materials handling and their training and placement is also to be observe by the materials management department. This indicates that it is very essential to have a materials management department in any organization to support the management in the production activities.

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II. OBJECTIVES

The objectives of this study are as follows;

1. To study the factors affecting material management in local construction projects.
2. To determine factors affecting material management.

III. LITERATURE REVIEW

According to Dr. Kevin Okorocha, a good management system for materials management will lead to benefits for . Cash flow has become crucial for the survival of any business. If materials are purchased early, capital may be tied up and interest charges incurred on the excess inventory of material. Material may deteriorate during storage or be stolen; also delays and extra expense may be incurred if materials required for particular activities are not available.

N.B. Kasim states that it is clearly important to manage all materials from the design stage to the construction stage. Poor handling of construction materials affects the overall performance of construction projects in terms of time, budget (cost), quality and productivity. The wastage of materials should also be minimized during construction in order to avoid loss of profit for construction companies. There is a need to develop new approaches to materials management

in fast-track construction projects in order to improve the efficacy of the production process.

Khyomesh V. Patel & Chetna M. Vyas (2011) the study shows the prolific and cost efficient material management practices that are essential in construction industry. The research indicates that construction materials constitute about 70% of the total cost for a typical construction project. Proper management principles and practices are required for this component which will improvise the productivity and cost efficiency of the project and thereby helping the timely completion of the project

IV. RESEARCH METHODOLOGY

The research methodology for present study contains two stages. Initially literature review was made in order to find out the factor affecting material management in construction project. From the literature review, 55 factor of affecting on MM were found in order to make a questionnaire survey with the respective participants (contractors, owners, consultants and others) of Indian construction industry. Framework of the factor is given in Table no. 1

4.1 List of Factor Affecting on the Material Management

Table No.1 Factor Affecting on the Material Management

No	Major Factor	Sub Factor
1	**PLANNING**	Material Requirements Planning
2		Organizing& Scheduling Procurement
3		Site Work Schedule
4	**SUPPLIER**	Identifying & Selecting Suppliers
5		Skilled Negotiation with Supplier
6		Cooperation between Contractor & Supplier
7		Sub-Contracting
8	**FINANCE**	Proper Cash Flow Control
9		Non-Delay of Payments
10	**STAFF**	Skill & Experience of Material Management team
11		Presence of Shopkeeper & Security Personnel
12	**TRANSPORT**	Planning Delivery of Materials to Site
13		Site Location & Layout
14	**STORAGE & HANDLING**	Proper Storage Practices
15		Safety during Handling Materials
16		Storage Space Available
17		Control of Material Usage & Wastage
18		Management of Surplus Material
19	**MANAGEMNT**	Use of Material Management Software
20		Proper Inspection & Documentation of Materials Ensuring Quality of Materials
21		Implementing a Safety Program
22	**Severe Weather Conditions**	Severe Weather Conditions
	Material Planning	
23	Cost	waste from uneconomical shape of material
24	Communication	Misunderstanding of owner's requirements by design engineer
25		Insufficient instructions about handling materials on site.
26		Unclear and in adequate details in material specification
27	Human Resource	Poor use of advanced software
28		Poorly defined roles and responsibilities
29	Procurement	Impossibility to order small quantities
30		locating source of procurement
31		Forecasting materials price in market
32		storing materials in faraway stores
33		Poor store layout.
34	Risk	Severe weather conditions
	Vendor Analysis	
35	Quality	Manufacturing defects on materials Re Work Due To Poor Material Quality Used Before

36		Delay in performing inspection and testing by the consultant team
37	Cost	financial condition of the company
38		competitiveness of price
39	Time	timeliness of delivery
40	Communication	Poor coordination and communication among the contractor and material supplier
	Material Purchasing	
41	Procurement	Project delay due to slow delivery materials
42		Lack of materials (due to closure).
43		Ineffective control of storage
44	Risk	Local Issues causing material delays and un availability
45	Time	Too early receiving of materials
46	Integration	Usage of materials without systematic control
47	Communication	Communication to previous stages
	Storage and Inventory	
48	Human Resource	Shortage of skilled labour for handling
49	Quality	Poor storage of materials.
50	Risk	Burglary, theft and vandalism
51	Scope	Availability Of Modern Equipment & Methods for handling
	Supply, Distribution and On Site	
52	Risk	Damage of material on site
53	Integration	Using excessive quantities of materials
54		Lack of onsite materials control.
55		Existence of unnecessary materials on site.

4.2 Preparation of Questionnaire

The questionnaire consists of two parts. Part A includes the questionnaire of factors affecting MM. The four point scale ranged from 1(Strongly Disagree) to 4(Strongly Agree is adopted and transformed to relative importance index for each factor. Part B includes the questionnaire of effects of this factor. For each factor two questions were asked: What is the frequency of occurrence for this factor? And what is the degree of severity of this factor on project ? Both frequency of occurrence and severity were categorized on a four-point scale. Frequency of occurrence 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 l point scale).

V. DATA ANALYSIS

The collected data were analysed through statistical techniques and indices.

Relative Importance Index technique: Relative Importance Index method to determine the relative importance of the various factors affecting material management. The same method is going to be adopted in this study within various groups (i.e. clients, consultants or contractors). The four-point scale ranged from 1 (Strongly Disagree) to 4 (Strongly Agree) is adopted and transformed to relative importance indices (RII) for each factor as follows:

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

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. The RII value had a range from 0 to 4 (0 not inclusive), higher the value of RII, more agree to the factor of the MM. The RII was used to rank (R) the different factor.

Importance Index technique: In this technique, for factor two questions were asked: What is the frequency of occurrence for that factor? And what is the degree of severity of that factor on material management?

Frequency index:

A formula is used to rank factor of MM based on frequency of occurrence as identified by the participants.

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

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.

Severity index:

A formula is used to rank factor of MM based on severity as indicated by the participants

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

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

Importance index:

The importance index of each factor is calculated as a function of both frequency and severity indices, as follows:

Importance Index (IMP.I.)(%) = [F.I. (%)* S.I. (%)]/100

VI. RESULTS AND FINDINGS

The all ranking indices explained earlier were used to rank factor from viewpoints of the respondents. Total 6 respondents participated in this survey.

A) Top 10 factor ranked by Relative Importance Index (RII)

Table2**.** Ranking by RII Technique

Sr No.	Factor Affecting material management	RII
1	Material Requirements Planning	1
2	Proper Cash Flow Control	1
3	Skilled Negotiation with Supplier	0.958333
4	Non-Delay of Payments	0.958333
5	Skill & Experience of Material Management team	0.958333
6	Proper Storage Practices	0.958333
7	Control of Material Usage & Wastage	0.958333
8	Presence of Shopkeeper & Security Personnel	0.916667
9	Planning Delivery of Materials to Site	0.916667
10	Storage Space Available	0.916667

B) Top 10 causes ranked by Importance Index (IMPI)

Table -3: Ranking by IMPI Technique

Sr No.	Factor Affecting material management	RII
1	Material Requirements Planning	1
2	Proper Cash Flow Control	1
3	Skilled Negotiation with Supplier	0.958333
4	Non-Delay of Payments	0.958333
5	Skill & Experience of Material Management team	0.958333
6	Proper Storage Practices	0.958333
7	Control of Material Usage & Wastage	0.958333
8	Presence of Shopkeeper & Security Personnel	0.916667
9	Planning Delivery of Materials to Site	0.916667
10	Storage Space Available	0.916667

The ranking of all 55 factors which affecting on material management are given in Appendix 1

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APPENDIX 1

Ranking of factor affecting material management of Relative Importance Index and Importance Index

No	Major Factor	Sub Factor	RII	Rank	IMP.I (%)	Rank
1	**PLANNING**	Material Requirements Planning	1	1	84.02778	2
2		Organizing& Scheduling Procurement	0.75	22	65.97222	6
3		Site Work Schedule	0.833333	14	56.25	11
4	**SUPPLIER**	Identifying & Selecting Suppliers	0.875	11	65.625	7
5		Skilled Negotiation with Supplier	0.958333	3	52.77778	12
6		Cooperation between Contractor & Supplier	0.791667	19	69.27083	5
7		Sub-Contracting	0.75	22	58.33333	10
8	**FINANCE**	Proper Cash Flow Control	1	1	75.86806	4
9		Non-Delay of Payments	0.958333	3	87.5	1
10	**STAFF**	Skill & Experience of Material Management team	0.958333	3	41.31944	18
11		Presence of Shopkeeper & Security Personnel	0.916667	8	41.66667	16
12	**TRANSPORT**	Planning Delivery of Materials to Site	0.916667	8	32.46528	26
13		Site Location & Layout	0.708333	29	17.1875	45
14	**STORAGE & HANDLING**	Proper Storage Practices	0.958333	3	59.02778	9

15		Safety during Handling Materials	0.75	22	36.45833	20
16		Storage Space Available	0.916667	8	65.625	7
17		Control of Material Usage & Wastage	0.958333	3	83.33333	3
18		Management of Surplus Material	0.708333	29	36.11111	21
19	**MANAGEMNT**	Use of Material Management Software	0.541667	48	33.33333	24
20		Proper Inspection & Documentation of Materials Ensuring Quality of Materials	0.708333	29	41.66667	16
21		Implementing a Safety Program	0.5	52	15.625	46
22	**Severe Weather Conditions**	Severe Weather Conditions	0.666667	35	23.4375	40
	Material Planning					
23	Cost	waste from uneconomical shape of material	0.75	22	50.17361	13
24	Communication	Misunderstanding of owner's requirements by design engineer	0.875	11	30.55556	30
25		Insufficient instructions about handling materials on site.	0.708333	29	32.46528	26
26		Unclear and in adequate details in material specification	0.875	11	30.55556	30
27	Human Resource	Poor use of advanced software	0.583333	43	12.5	52
28		Poorly defined roles and responsibilities	0.791667	19	31.59722	28
29	Procurement	Impossibility to order small quantities	0.541667	48	22.91667	41
30		locating source of procurement	0.666667	35	29.16667	33
31		Forecasting materials price in market	0.583333	43	26.73611	37
32		storing materials in faraway stores	0.708333	29	12.5	52
33		Poor store layout.	0.583333	43	9.722222	54
34	Risk	Severe weather conditions	0.583333	43	18.75	44
	Vendor Analysis					
35	Quality	Manufacturing defects on materials Re Work Due To Poor Material Quality Used Before	0.833333	14	25	38
36		Delay in performing inspection and testing by the consultant team	0.75	22	15.625	46

37	Cost	financial condition of the company	0.833333	14	36.11111	21
38		competitiveness of price	0.666667	35	36.11111	21
39	Time	timeliness of delivery	0.666667	35	22.91667	41
40	Communication	Poor coordination and communication among the contractor and material supplier	0.791667	19	13.88889	50
	Material Purchasing					
41	Procurement	Project delay due to slow delivery materials	0.833333	14	32.98611	25
42		Lack of materials (due to closure).	0.666667	35	28.125	34
43		Ineffective control of storage	0.5	52	31.59722	28
44	Risk	Local Issues causing material delays and un availability	0.583333	43	27.77778	35
45	Time	Too early receiving of materials	0.458333	54	29.34028	32
46	Integration	Usage of materials without systematic control	0.708333	29	27.77778	35
47	Communication	Communication to previous stages	0.75	22	24.82639	39
	Storage and Inventory					
48	Human Resource	Shortage of skilled labour for handling	0.666667	35	47.22222	14
49	Quality	Poor storage of materials.	0.75	22	42.88194	15
50	Risk	Burglary, theft and vandalism	0.541667	48	15.27778	48
51	Scope	Availability Of Modern Equipment & Methods for handling	0.541667	48	20.83333	43
	Supply, Distribution and On Site					
52	Risk	Damage of material on site	0.833333	14	15.27778	48
53	Integration	Using excessive quantities of materials	0.666667	35	38.88889	19
54		Lack of onsite materials control.	0.625	42	13.88889	50
55		Existence of unnecessary materials on site.	0.541667	48	6.25	55