STUDIES ON THE MATERIAL MANAGEMENT IN CONSTRUCTION INDUSTRIES

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ABSTRACT

In construction project operation, often there is a project cost variance in terms of the material, equipments, manpower, overhead cost and other natural calamities. Material is the main component in construction projects. Therefore, if the material management is not properly managed it will create an adverse project cost variance and reduces construction productivity. Project cost can be controlled by taking corrective actions towards the cost variance. The objective of this research paper is to identify the main cause of the cost variance, construction productivity and to recommend the corrective actions. The approach to serve the objective is by conducting surveys of high rise building construction projects in order to identify the cause of project cost variance in material management purchasing and by interviewing experts in order to obtain recommendations in taking corrective actions. Responses of 25 consultants and contractors are to be analyzed. Results of which, may suggest that the planning and scheduling of organization, personnel, procurement, delivery, quality assistance, quality control, storage facilities, usage and change order are the most important factors related to materials management which creates project cost variance and construction productivity loss in construction site. On the other hand, project management as a professional service, nationality of the professional firms and involvement of the contractor in materials management are the important causes in most construction projects.

Efficient material management is essential to managing a productive and cost efficient site. Material management involves procurement, storage, identification, retrieval, transport, and construction methods. Each is indelibly linked to safety, productivity, and schedule performance. In this paper three principles were suggested for the efficient material management practices.

The timely availability of materials to work site will directly affect the productivity of labor and accomplishment of schedule. For the timely availability of material to work spot the materials has to be purchased on time.

The high variability of construction environments results in high construction-cost variation, especially in material costs. Inadequate planning may cause material shortages that delay the project schedule or, alternatively, a substantial increase in inventory costs by producing or supplying materials earlier than they are needed at the construction site.

Key Words: Material Management In Construction, Planning and scheduling of organization, procurement, delivery, quality assistance, quality control, storage facilities, usage, change order.

1 INTRODUCTION ABOUT THE PROJECT

1.1GENERAL

Materials Management is an integrated process for planning and controlling. The materials management systems combine and integrate the takeoff, vendor evaluation, purchasing, expediting, warehousing, distribution, and disposing of Materials functions. Materials

issues like waiting for material, tools, or equipment are the major non-productive categories found in work sampling and foreman delay surveys. Consequently, the use of effective materials management would potentially benefit construction productivity.

The different impacts of construction resources and methods on productivity were examined in high-rise in-situ concrete construction operations. Construction productivity loss ranged from 5.4% to a high of 56.8% and was caused by materials management problems that included late or out-of-sequence deliveries and fabrication or construction errors based on three case study projects. Efficient material management is essential to managing a productive and cost efficient site. Material management involves procurement, storage, identification, retrieval, transport, and construction methods. All the above parameters are is indelibly linked to safety, productivity, and schedule performance. In this project three principles are to be selected for the efficient material management practices.

The timely availability of materials at work site will directly affect the productivity of labor and accomplishment of schedule. For the timely availability of material to work spot, the materials have to be purchased on time. In this project the design of material module will serve as an estimator for the material requirement. The high variability of construction environments results in high construction-cost variation, especially in material costs and labor. Inadequate planning may cause material shortages that delay the project schedule or a substantial increase in inventory costs by producing or supplying materials earlier than they are needed at the construction site.

This paper is to be explains how improper material management creates project cost variance and construction productivity loss and identification of important factors causing the material management and finally to provide suggested solutions and recommendations to improve the materials management. This research covers all construction projects

2.DATA COLLECTION

Data collection is the most critical part of the study since the accuracy of the data will determine the success or failure of the research. The data‘s are obtained through literature studies and questionnaire that would be analyzed using appropriate analysis techniques in order to portray a clear perspective on the material management. Responses from questionnaire will then be compiled and analyzed. Data collected from different questions will be gathered to answer different objectives. Analysis is done by SPSS software

2.1 Questionnaire Form

The questionnaire form was designed as a tool for the assessment, in which four major interests mentioned earlier in the objective were questioned. It targeted employees from the supervisory level and above at the construction companies. They are an equally important information source. They can relate the real problems of the current practice.

The questionnaire form was designed in a Linkert scales running from strongly disagree, disagree, average, agree, and strongly agree. These five positions were given weights of 1,2,3,4 and 5 for scoring purposes. It requires the respondents to indicate the degree of agreement with each of a series of statement related to the stimulus objects. This type of question is easy to construct and administer. Respondents readily understand how to use the scale. Questionnaire development is an efficient data collection technique to measure the variable of interest.

2.2 Distribution of Questionnaire Form

There are many methods in distributing the questionnaire form. The forms are distributed by post or by hand. Meanwhile it is adequate in achieving the objectives of this study. The respondents were filling up the form at the particular time of appointment. In addition, comments, suggestion and discussion with the respondents can be done.

3.DATA ANALYSIS

The data were analyzed by using mean values. In addition, SPSS software was used to help in presenting the result of the study into a more attractive form.

The classification of the index scale is as follows:

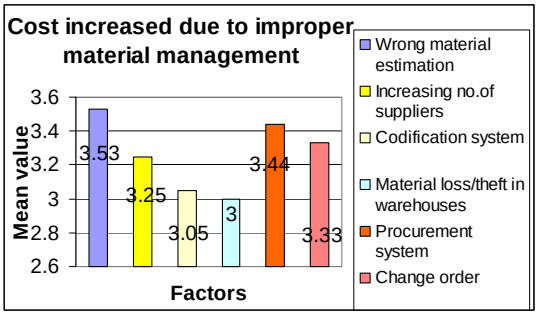
3.1MEAN VALUE

The mean value is used to classify the answer given by the respondent

1. Strongly disagree $0.00 \leq$ mean index < 1.50
2. Disagree $1.50 \leq$ mean index < 2.50
3. Average $2.50 \leq$ mean index < 3.50
4. Agree $3.50 \leq$ mean index < 4.50
5. Strongly agree $4.50 \leq$ mean index < 5.00

3.1.1RESPONDENTS PERCENTAGE

A total of 70 questionnaire forms have been distributed to the contactor in Coimbatore, Erode and Salem areas. The distribution was done by hand, mail, posts. It makes a total of 51 out of 70 questionnaire forms return and it give to an overall of 73% respondents that filling up the questionnaire forms completed.
According to the analysis done in wrong material estimation is shown as having the highest mean value among the five factors surveyed



3.2 PROCUREMENT SYSTEM

According to the analysis scarcity of materials in the market is shown as having the highest mean value among the five factors surveyed, In general, all factors are in the range of between 3 to 4, which is in between the Average and Agree answers. In average, the values are above than 3.5 means it can be concluded that in average the respondents agreed that factors are the causal of the cost increasing factors due to improper material management system.

From the analysis done, it shows that the scarcity of materials in the market is the main procurement factor that increasing the construction project cost. Thus, it has to be taken into consideration seriously by the project manager in order to plan Utilize material optimization/material substitution and adjust price accordingly based on the material selected. In the existing literature, weather, the major subset of procurement system, is typically treated as a direct cause of increasing cost. However instead of improper procurement system may leads difficult to maintain the quality of materials and difficult to finishing the project at the decided time.

Table:3.2.1

Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
Scarcity of materials in the market	1	5	3.85	1.147	1.315	1
Changes in material source condition	1	5	3.84	1.087	1.182	2
Deviation in materials quality purchased and ordered	1	5	3.13	.873	.762	6
Delay in material payment	1	5	3.23	1.017	1.035	5
Changes in company purchasing policy	1	5	3.61	.875	.765	3
Deviation of scheduling	1	5	3.30	1.079	1.164	4
Poor purchasing strategy in selecting vendors	1	5	3.11	.997	.995	7

3.3 CHANGE ORDER

According to the analysis incomplete drawing and design is shown as having the highest mean value among the five factors surveyed, which is 3.54. This mean value is close to 4 values that is the Agree answers. It is followed by owner's intervention during project as mean value of 3.41, frequent out of job flow with the mean value of 3.25 and schedule compression as the mean value of 3.05. In general, all factors are in the range of between 3 to 4, which is in between the Average and Agree answers.

From the analysis done, it shows that the incomplete drawing and design main procurement factor that increasing the construction project cost. Thus, it has to be taken into consideration seriously by the project manager in order to develop evaluation during tender explanation meeting

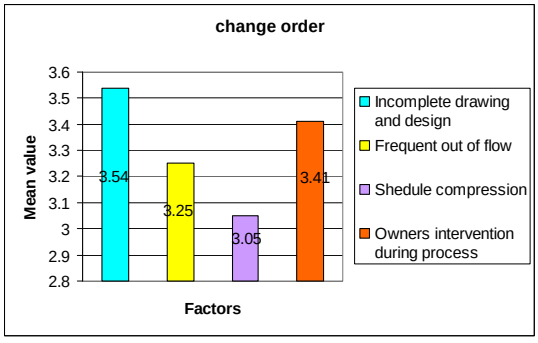
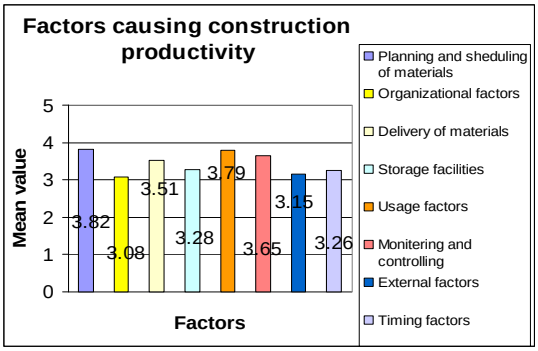


Table:3.3.1

Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
Incomplete drawing and design	1	5	3.54	1.051	1.105	1
Frequent out of flow	1	5	3.25	1.069	1.142	3
Schedule compression	1	5	3.05	1.066	1.136	4
Owners intervention during process	1	5	3.41	.966	.933	2

4. CONSTRUCTION PRODUCTIVITY LOSS DUE TO THE FOLLOWING IMPORTANT FACTORS RELATED TO MATERIAL MANAGEMENT IN THE CONSTRUCTION SITE:

According to the analysis planning and scheduling of material is shown as having the highest mean value among the 8 factors surveyed, which is 3.82, it is followed by usage factor, monitoring & controlling and delivery of materials are having the mean values of 3.79, 3.65, 3.51. These mean values are close to 4, so there are assigned as Agree answers. Then it is followed by storage facilities, timing factors, external factors and organizational factors are having the mean values of 3.28, 3.26, 3.15 and 3.08. In general, all factors are in the range of between 3 to 4, which is in between the Average and Agree answers. In average, the value for the first four factors above mentioned is greater than 3.5. So it can be concluded that in half of the respondents are agreed that both factors are the causal of decreasing construction productivity due to improper material management system.



4.1 Planning and scheduling of materials

Among of all factors, it shows that wrong market prediction have the highest mean value of 3.82. Second highest with mean value of 3.73 is difficulty in forecasting field condition and application of standard work procedure as the mean value of 3.62. It is followed by planning in scope of work, scheduling of materials and data & information of activity and materials are having the mean values of 3.48, 2.85 and 2.99 respectively. The minimum average value is 2.85 that is scheduling of materials.

In overall, only three factors have reached above than 3.5 for the mean value, which close to an Agree answer. It can be concluded that the mean values for the top three factors are above than 3.5 which indicate that in half of the respondents agreed that the three factors are the causal of de-motivating factors affecting the construction productivity. However, the factors ranked from the third to sixth place are ranges from 3.0 to 3.5, which indicate that the factors are averagely agreed as the causal of de-motivating the construction productivity.

Planning and scheduling of materials plays an important role in performing the work at the construction site. However, they are not properly done means it will give a problem to the entire construction team in many aspects in the all stages of project. It should be rectified by conducting detailed and perfect surveys towards the field condition and previous weather data, accurately study the job items, sequences and methods of the job activities, Prepare a detailed materials schedule planning in accordance with scope of work, Prepare an accurate and detailed budgeting based on direct market surveys, evaluate the available standard method in accordance with the scope of work, situation, condition and environment, Conduct data acquisition to make a good and complete data & information.

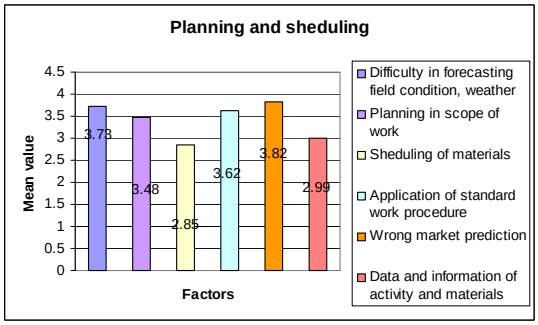


Table:4.1.1

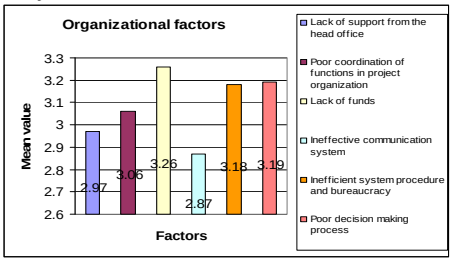
Si.no	Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
1.	Difficulty in forecasting field condition, weather.	2	5	3.73	.761	.580	2
2.	Planning in scope of work.	1	5	3.48	.998	.996	4
3.	Scheduling of materials.	1	5	2.85	1.200	1.439	6
4.	Application of standard work procedure.	1	5	3.62	.886	.785	3
5.	Wrong market prediction.	2	5	3.82	.923	.852	1
6.	Data and information of activity and materials.	1	5	2.99	1.054	1.110	5

4.2 Organizational factors

There are six sub factors under the organizational factors which affects the construction productivity. Table shows all sub-factors are ranked to the respondent's point of view. According to their rank third factor is the highest factor among all which is third factor having the mean value of 3.26, followed by factors 6, 5, 2, 1 and 4 are correspondingly having the mean

values of 3.19, 3.18, 3.06, 2.97 and 2.87. The six factors are having the mean value in between 3.0 to 3.5. This shows that the factors are averagely agreed as the causal of de-motivating the construction projects productivity.

Table 4.2.1 shows factors averagely agreed by the respondent to be the causal of de-motivating factors affecting the construction projects productivity. It should be rectified by the following ways. Employ a correct procedure and apply the procedure with high level of discipline, optimize cash flow in accordance with the requirements, planning and applying Management Information System, routine evaluation of all procedures to adjust procedures effectiveness and efficiency, conduct routine/regular coordination meeting and develop a procedure regarding decision making, develop a good, simple and easy to understand system to regulate coordination procedures and responsibility of units.



Si.no	Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
1.	Lack of support from the head office	1	5	2.97	1.111	1.233	5
2.	Poor coordination of functions in project organization	1	5	3.06	1.091	1.189	4
3.	Lack of funds	1	5	3.26	1.089	1.187	1
4.	Ineffective communication system	1	5	2.87	1.222	1.493	6
5.	Inefficient system procedure and bureaucracy	1	5	3.18	1.017	1.035	3
6.	Poor decision making process	1	5	3.19	1.188	1.411	2

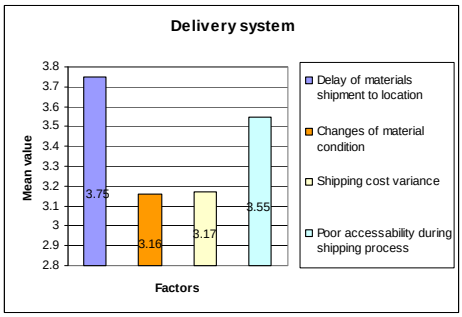
Table:4.2.1

4.3 Delivery of materials

Table 4.3.1 shows that respondent's point of view pertaining to factors affecting the construction projects productivity by rank according to their mean values. Among of all factors, it shows that delay of materials from shipment to location have the highest mean value of 3.75. Second highest with mean value of 3.55 is poor accessibility during shipping process. It is followed by change of materials condition during shipping process and shipping cost variances are having the mean values of 3.16 and 3.17 respectively. The minimum average value is 3.16.

In overall, only two factors have reached above than 3.5 for the mean value, which close to an Agree answer. It can be concluded that the mean values for the top two factors are above than 3.5 which indicate that in half of the respondents are agreed that these factors are the causal of de-motivating factors affecting the construction productivity. However, the factors ranked from the third to fourth place are ranges from 3.0 to 3.5, which indicate that the factors are averagely agreed as the causal of de-motivating the construction productivity.

Delivery of materials plays an important role in performing the work at the construction site. However, they are not properly done means it will give a problem to the site engineers and supervisors in many aspects in the all stages of performing the structural work. These factors are rectified by preparing Procurement Schedule (including delivery) must be routinely monitored, following the material maintenance procedure during procurement/delivery , delivery cost is determined based on budget requirements, preparing proper temporary storage facilities.



Si. No	Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
1.	Delay of materials from shipment to location	1	5	3.75	1.185	1.404	1
2.	Changes of material condition	1	5	3.16	.966	.934	4
3.	Shipping cost variance	2	5	3.17	.935	.874	3
4.	Poor accessibility during shipping process	1	5	3.55	.949	.901	2

Table:4.3.1

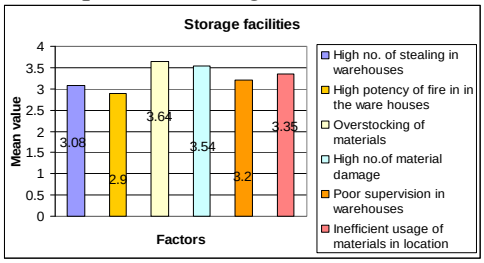
4.4 Storage facilities

There are six sub factors under the storage facilities which affect the construction projects productivity. Below table show that all sub-factors are ranked under respondent's point of view. Overstocking of materials is the highest factor among all which have the mean value of 3.64, followed by high no. of materials damage in ware houses which have the mean value of 3.54. The above two factors have the mean value

is greater than 3.5 which is close to the 4 value that is Agree answers. Meanwhile, the remaining four factors with the average value ranges from 3.0 to 3.5. This shows that the factors are averagely agreed as the causal of de-motivating the construction projects productivity.

Table 4.4.1 shows the factors agreed by the respondent to be the causal of de-motivating factors affecting the construction projects productivity due to the storage facilities. These problems are reduced by the following ways.

1. Provide state of the art security system to support competent and honest security personnel.
2. Provide the necessary equipments for storage fire safety and provide training for safety personnel.
3. Create Storage and facility management, material maintenance procedure and discipline storage unit.
4. Create Storage and facility management, material maintenance procedure and discipline storage unit.
5. Create good storage system conform to warehouse standards for material storing.
6. Conduct periodic storage control.



Si.no	Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
1.	High no. of stealing in warehouses	1	5	3.08	1.036	1.074	5
2.	High potency of fire in the ware houses	1	5	2.90	1.005	1.010	6
3.	Overstocking of materials	1	5	3.64	1.050	1.104	1
4.	High no. of material damage	1	5	3.54	1.031	1.064	2
5.	Poor supervision in warehouses	1	5	3.20	1.149	1.321	4
6.	Delay of posting in inventory system	1	5	3.35	1.293	1.673	3

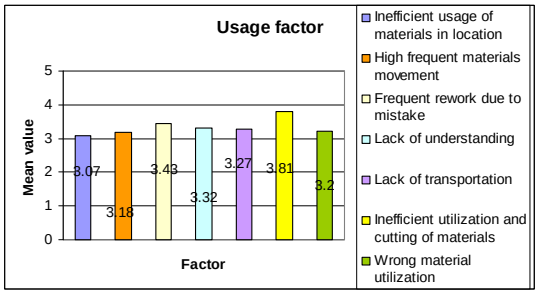
Table:4.4.1

4.5 Usage of materials

Table 4.5.1 shows that respondent's point of view pertaining to factors affecting the construction projects productivity by rank according to their mean values. Among of all factors, it shows that inefficient utilization and cutting of materials have the highest mean value of 3.81. Second highest factor with mean value of 3.43 is frequent rework due to mistake and lack of understanding between engineer, supervisor and labors as the mean value of 3.32. It is followed by the factors lack of transportation, wrong material utilization; high frequent material movement, and inefficient usage of materials are having the mean values of 3.27, 3.20, 3.18 and 3.07 respectively. The minimum average value is 3.07 that is inefficient usage of materials.

In overall, only one factor has reached above than 3.5 for the mean value, which close to an Agree answers. However, the factors ranked from the second to seventh place are ranges from 3.0 to 3.5, which indicate that the factors are averagely agreed as the causal of de-motivating the construction productivity.

Usage of material plays an important role in performing the work at the construction site. However, they are not properly done means it will give a problem to the entire construction team in many aspects in the all stages of structural work. It should be rectified by developing effective material usage procedure and material usage control, develop accurate material transfer method and adequate temporary facilities site, Clear design with good material plan contents and according to scope of work, Environmental and site evaluation sequence, Provide accurate estimation for mobile equipment plan and placement schedule, Provide clear bar bending/ cutting schedule, Provide clear work method with available facilities.



Si.no	Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
1.	Inefficient usage of materials in location	1	5	3.07	1.061	1.126	6
2.	High frequent materials movement	1	5	3.18	.973	.947	5
3.	Frequent rework due to mistake	1	5	3.43	1.023	1.047	1
4.	Lack of understanding	1	5	3.32	.961	.923	2
5.	Lack of transportation	1	5	3.27	.978	.956	3
6.	Inefficient utilization and cutting of materials	1	5	3.81	.999	.997	7
7.	Wrong material utilization	1	5	3.20	1.099	1.209	4

Table:4.5.1

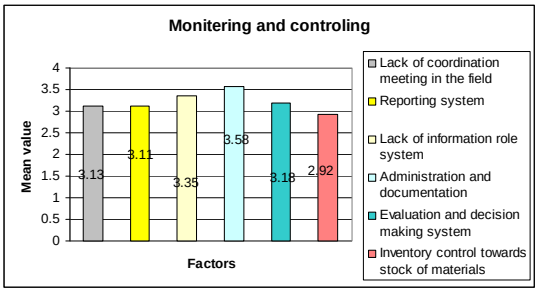
4.6 Monitoring and controlling of materials

There are six sub factors under monitoring and controlling which affect the construction

productivity. Table show that all sub-factors are ranked under respondent's point of view. Administration and documentation is the highest factor among all which have the mean value of 3.58. The above factor have the mean value is greater than 3.5 which is close to the 4 value that is Agree answer. Meanwhile, the remaining five factors with the average values are ranges from 3.0 to 3.5. This shows that the factors are averagely agreed as the causal of de-motivating the construction productivity.

Below figure shows the factors agreed by the respondent to be the causal of de-motivating factors affecting the construction projects productivity due to monitoring and controlling. These problems are reduced by the following ways.

1. Operation that regulate Coordination meeting.
2. Develop procedure and execute the procedure with discipline.
3. Develop appropriate Information system with proper Communication procedure.
4. Provide Manual and procedure that govern administration and documentation.
5. Conduct coordination meeting for project evaluation to reach effective and accurate decision making.
6. Create a procedure and implement the procedure with discipline.



Si no	Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
1.	Lack of coordination meeting in the field	1	5	3.13	1.158	1.342	4
2.	Reporting system	1	5	3.11	.976	.953	5
3.	Lack of information role system	1	5	3.35	.973	.946	2
4.	Administration and documentation	1	5	3.58	.924	.853	1
5.	Evaluation and decision making system	1	5	3.18	.892	.796	3
6.	Inventory control towards stock of materials	1	5	2.92	.895	.801	6

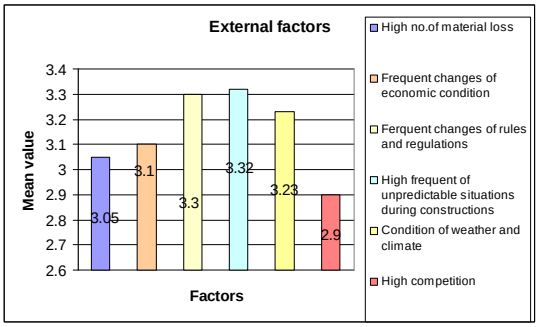
Table:4.6.1

4.7 External factors

There are six sub factors under external factors which affect the construction productivity. Table 4.9; show that all sub-factors are ranked under respondent's point of view. High frequent of unpredictable situation is the highest factor among all which have the mean value of 3.32 ranges from 3.0 to 3.5. The other factor is high competition having the minimum mean value of 2.90. The remaining four factors with the average values are ranges from 3.0 to 3.5. This shows that the factors are averagely agreed as the causal of de-motivating the construction productivity.

This shows the factors agreed by the respondent to be the causal of de-motivating factors affecting the construction projects productivity due to the external factors. These problems are reduced by the following ways.

1. Well Implementation of Safety and security system and discipline in material utilization.
2. Periodic evaluation of project. Create addendum to minimize losses and impact from planning if needed.
3. Make contract changes with binding condition and according to the applicable agreement.
4. Include force major clausal in contract to predict and anticipate unexpected conditions.
5. Apply accurate construction method.
6. Improve effectiveness, efficiency and productivity by implementing SWOT analysis.



Si no	Factors	Minimum	Maximum	Mean	Std. Deviation	Variance	Rank
1.	High no. of material loss	1	5	3.05	1.098	1.205	5
2.	Frequent changes of economic condition	1	5	3.10	1.033	1.067	4
3.	Frequent changes of rules and regulations	1	5	3.30	1.033	1.067	2
4.	High frequent of unpredictable situations during constructions	1	5	3.32	1.009	1.017	1
5.	Condition of weather and climate	1	5	3.23	.967	.935	3
6.	High competition	1	5	2.90	1.141	1.301	6

Table:4.7.1

5.FACTORS AFFECTING MATERIAL MANAGEMENT DEPENDS UPON NUMBER OF DEPARTMENTS RESPONSIBLE FOR THE MATERIAL MANAGEMENT

5.1. Procurement system

Numbers of departments responsible for the materials management		Scarcity of materials in the market	Changes in material source condition	Deviation of shedduling	Delay in material payment	Changes in company purchasing policy	Poor purchasing strategy in selecting vendors
1	Mean	2.67	3.05	3.10	3.10	2.71	3.10
	N	21	21	21	21	21	21
	Std. Deviation	1.238	.921	1.091	.995	.845	.889
2	Mean	2.94	2.65	3.18	2.59	3.06	2.82
	N	17	17	17	17	17	17
	Std. Deviation	1.144	1.272	.951	1.176	.899	1.237
3	Mean	3.50	2.75	3.25	3.25	3.75	3.25
	N	4	4	4	4	4	4
	Std. Deviation	1.291	1.500	.957	1.258	.500	.957
4	Mean	2.78	2.67	3.56	2.67	3.33	2.89
	N	9	9	9	9	9	9
	Std. Deviation	.833	1.000	1.424	.707	1.000	1.054
Total	Mean	2.84	2.82	3.22	2.86	3.02	2.98
	N	51	51	sss51	51	51	51
	Std. Deviation	1.138	1.090	1.083	1.040	.905	1.029

5.2. Handling of materials

Numbers of departments responsible for the materials management		Wrong material estimation	Codification system	Material loss/theft in warehouses	Increasing no.of suppliers
1	Mean	3.29	3.10	2.90	3.24
	N	21	21	21	21
	Std. Deviation	1.102	1.091	.995	1.091
2	Mean	3.41	2.88	2.88	3.24
	N	17	17	17	17
	Std. Deviation	1.228	1.054	1.111	1.033
3	Mean	4.50	3.25	3.75	3.00
	N	4	4	4	4
	Std. Deviation	1.000	.500	.957	.816
4	Mean	3.00	2.56	2.89	2.89
	N	9	9	9	9
	Std. Deviation	1.225	.882	.782	1.537
Total	Mean	3.37	2.94	2.96	3.16
	N	51	51	51	51
	Std. Deviation	1.183	1.008	.999	1.120

5.3. Change order

Numbers of departments responsible for the materials management		Incomplete drawing and design	Frequent out of flow	Shedule compression	Owners intervention during process
1	Mean	3.62	3.38	2.81	3.29
	N	21	21	21	21
	Std. Deviation	1.024	.973	.981	1.007
2	Mean	3.47	2.94	3.41	3.35
	N	17	17	17	17
	Std. Deviation	1.179	1.249	.939	1.222
3	Mean	3.75	3.50	3.75	4.25
	N	4	4	4	4
	Std. Deviation	.957	1.000	.957	.500
4	Mean	3.33	3.33	2.89	3.22
	N	9	9	9	9
	Std. Deviation	1.323	1.118	1.269	.833
Total	Mean	3.53	3.24	3.10	3.37
	N	51	51	51	51
	Std. Deviation	1.102	1.088	1.044	1.038

5.4. Planning and scheduling of materials

Numbers of departments responsible for the materials management		Difficulty in forecasting field condition, weather	Planning in scope of work	Scheduling of materials	Application of standard work procedure	Data and information of activity and materials	Wrong market prediction
1	Mean	3.05	3.48	2.62	3.38	3.00	3.24
	N	21	21	21	21	21	21
	Std. Deviation	.669	1.078	.865	.921	1.049	.995
2	Mean	3.12	3.24	2.65	2.88	2.65	3.24
	N	17	17	17	17	17	17
	Std. Deviation	.781	1.251	1.498	1.054	1.169	.831
3	Mean	3.75	4.00	4.00	3.75	3.50	3.50
	N	4	4	4	4	4	4
	Std. Deviation	.957	.000	1.155	.957	.577	1.291
4	Mean	3.22	3.56	2.78	3.22	3.11	3.00
	N	9	9	9	9	9	9
	Std. Deviation	.972	.726	1.394	.833	1.167	.866
Total	Mean	3.16	3.45	2.76	3.22	2.94	3.22
	N	51	51	51	51	51	51
	Std. Deviation	.784	1.045	1.242	.966	1.085	.923

5.5. Organization factors

Numbers of departments responsible for the materials management		Lack of support from the head office	Poor coordination of functions in project organization	Lack of funds	Ineffective communication system	Poor interpersonnel communication sbility
1	Mean	2.81	2.76	3.00	2.62	2.86
	N	21	21	21	21	21
	Std. Deviation	1.078	1.044	1.183	1.284	1.062
2	Mean	2.94	3.24	3.47	2.65	2.88
	N	17	17	17	17	17
	Std. Deviation	1.249	1.251	1.007	1.169	.928
3	Mean	3.50	3.00	3.00	3.75	3.25
	N	4	4	4	4	4
	Std. Deviation	.577	.816	.816	.957	1.258
4	Mean	3.11	3.22	3.78	2.67	3.22
	N	9	9	9	9	9
	Std. Deviation	.928	1.093	1.093	1.323	.972
Total	Mean	2.96	3.02	3.29	2.73	2.96
	N	51	51	51	51	51
	Std. Deviation	1.076	1.104	1.101	1.234	.999

5.6. Delivery of materials

Numbers of departments responsible for the materials management		Delay of materials shipment to location	Changes of material condition	Poor accessibility during shipping process	Shipping cost variance
1	Mean	3.14	3.05	2.81	3.24
	N	21	21	21	21
	Std. Deviation	1.195	1.024	.928	.995
2	Mean	2.71	2.88	3.12	2.88
	N	17	17	17	17
	Std. Deviation	1.359	1.111	1.054	.857
3	Mean	3.25	3.75	2.50	3.75
	N	4	4	4	4
	Std. Deviation	1.258	.500	1.000	.957
4	Mean	3.56	3.56	3.22	2.89
	N	9	9	9	9
	Std. Deviation	.882	1.130	.972	.782
Total	Mean	3.08	3.14	2.96	3.10
	N	51	51	51	51
	Std. Deviation	1.214	1.059	.979	.922

5.7. Storage facilities

Report

Numbers of departments responsible for the materials management		High no.of stealing in warehouses	High potency of fire in in the ware houses	Overstocking of materials	High no.of material damage	Poor supervision in warehouses	Delay of posting in inventory system
1	Mean	3.14	2.95	3.05	3.24	3.24	3.33
	N	21	21	21	21	21	21
	Std. Deviation	1.153	1.071	.973	1.044	1.136	1.494
2	Mean	3.06	2.71	3.29	3.00	3.12	3.41
	N	17	17	17	17	17	17
	Std. Deviation	1.029	1.047	1.160	1.118	1.111	1.121
3	Mean	3.50	3.50	3.75	3.50	4.25	2.50
	N	4	4	4	4	4	4
	Std. Deviation	.577	1.291	.500	1.000	.957	1.000
4	Mean	2.78	2.89	3.33	3.56	2.78	3.67
	N	9	9	9	9	9	9
	Std. Deviation	.972	.601	1.225	.882	1.202	1.225
Total	Mean	3.08	2.90	3.24	3.24	3.20	3.35
	N	51	51	51	51	51	51
	Std. Deviation	1.036	1.005	1.050	1.031	1.149	1.293

5.8. Usage factor

Report

Numbers of departments responsible for the materials management		Inefficient usage of materials in location	High frequent materials movement	Frequent rework due to mistake	Lack of understanding	Lack of transportation	Inefficient utilization and cutting of materials
1	Mean	3.10	3.38	3.29	3.19	3.29	2.76
	N	21	21	21	21	21	21
	Std. Deviation	1.300	.921	.902	.873	1.271	1.136
2	Mean	2.88	2.71	3.59	2.82	3.12	3.06
	N	17	17	17	17	17	17
	Std. Deviation	.993	1.160	1.326	1.237	.993	1.345
3	Mean	3.50	3.00	3.25	3.25	3.75	2.25
	N	4	4	4	4	4	4
	Std. Deviation	.577	.816	1.500	.500	.957	.500
4	Mean	2.56	3.33	3.44	3.67	3.22	2.78
	N	9	9	9	9	9	9
	Std. Deviation	.726	1.000	1.014	1.000	.667	.833
Total	Mean	2.96	3.12	3.41	3.16	3.25	2.82
	N	51	51	51	51	51	51
	Std. Deviation	1.076	1.032	1.099	1.027	1.055	1.126

5.9. Monitoring and controlling

Report

Numbers of departments responsible for the materials management		Lack of coordination meeting in the field	Reporting system	Lack of information role system	Administration and documentation	Evaluation and decision making system	Inventory control towards stock of materials
1	Mean	2.95	2.95	3.38	3.76	3.10	2.62
	N	21	21	21	21	21	21
	Std. Deviation	1.284	1.024	.973	.995	1.091	.973
2	Mean	3.18	2.76	3.06	3.53	3.29	3.18
	N	17	17	17	17	17	17
	Std. Deviation	1.286	.831	1.298	1.007	.985	1.015
3	Mean	3.00	4.00	3.00	3.25	3.00	3.25
	N	4	4	4	4	4	4
	Std. Deviation	.816	.816	.000	.500	.816	.500
4	Mean	3.00	3.11	3.33	3.11	2.89	2.89
	N	9	9	9	9	9	9
	Std. Deviation	1.118	1.054	1.000	1.054	.782	.928
Total	Mean	3.04	3.00	3.24	3.53	3.12	2.90
	N	51	51	51	51	51	51
	Std. Deviation	1.199	.980	1.050	.987	.973	.964

10. External factors

Numbers of departments responsible for the materials management		High no.of material loss	Frequent changes of economic condition	Ferquent changes of rules and regulations	High frequent of unpredictable situations during constructions	Condition of weather and climate	High competition
1	Mean	2.90	2.71	2.95	3.24	3.24	3.00
	N	21	21	21	21	21	21
	Std. Deviation	1.136	1.189	.973	1.044	.831	1.225
2	Mean	3.00	3.47	3.41	3.18	3.18	2.35
	N	17	17	17	17	17	17
	Std. Deviation	1.118	1.007	1.278	1.334	1.074	1.115
3	Mean	4.00	3.25	3.75	3.25	2.50	3.00
	N	4	4	4	4	4	4
	Std. Deviation	.816	1.258	.500	.500	.577	.816
4	Mean	2.67	3.11	3.44	3.00	3.67	3.33
	N	9	9	9	9	9	9
	Std. Deviation	1.225	.601	1.236	1.000	1.000	1.118
Total	Mean	2.98	3.08	3.25	3.18	3.24	2.84
	N	51	51	51	51	51	51
	Std. Deviation	1.140	1.074	1.111	1.090	.951	1.173

CONCLUSIONS

- Accuracy, quality, cost and availability factors can be effectively used for the measuring the performance of materials management process in an organizations.
- Evaluation of this material management process provides better means for learning past experience, improving service delivery, planning and allocating resources.
- The effectiveness of an organization is measured at particular instant, thus it cannot be permanently applicable for the project may change from time to time.
- Comprehensive understanding of field issues and problems are required before giving corrective actions recommendation.
- That way, the effect due to the cost variance and construction productivity can be presented in detail and according to the real condition. Expert's recommended corrective actions are corrective actions taken from past events. These actions are preventive actions.
- Some of the important corrective actions and its possibilities are charted as follows.

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