Factors Affecting Construction Cost in Mara Large Construction Project: Perspective of Project Management Consultant

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ABSTRACT

Project cost is one of the most important criteria of success of project and is of high concern to those who are involved in the construction industry. However, studies show that rarely projects are complete within stipulated budget. This study is focusing on identification of significant causes affecting construction cost in MARA large projects. This paper presents the results of a questionnaire survey conducted among the personnel of Project Management Consultant (PMC). Data was analyzed with statistical tools to determine the rank of factors affecting construction cost. It is concluded that cash flow and financial difficulties faced by contractors, contractor's poor site management and supervision, inadequate contractor experience, shortage of site workers, incorrect planning and scheduling by contractors are most severe factors while changes in scope of project and frequent design changes are least affecting factors on construction cost. Spearman correlation analysis showed that incorrect planning and scheduling by contractor has strong positive relationship with contractor's poor site management and supervision, inadequate experience of contractors has strong positive relationship with incorrect planning and scheduling; and contractor's poor site management and supervision, changes in scope of project has strong positive relationship with frequent design changes; and vice versa.

Keywords: *Construction Industry, Construction Cost, Factors Affecting Cost, PMC*

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1.0 INTRODUCTION

In Malaysia like other countries construction industry is one of major industry contributing significantly in the growth of socio-economic development. Achieving project completion on time and within budget at specified quality standards is major criterion of success of project [1, 2, 3]. Although in Malaysia a lot of money has been spent in construction, the industry is facing a lot of challenges such as the expenditure exceeding the budget, delay to complete the project in time, the building defects and over dependent of foreign workers [4].

MARA (Majlis Amanah Rakyat) is one of the government agencies of Malaysia that plays important role in implementing the government policy and was formed on March 1, 1966 under the Rural and National Development Ministry [http://maranet.mara.gov.my/ Am/sejarah_mara_dari_rida_ke_mara.htm]. It is currently placed under the Rural and Regional Development Ministry after briefly controlled by the Entrepreneur and Co-operation Development Ministry. MARA has spent about RM 12 billion in its development since 1st Malaysian plan [5]. A portion of this allocation was spent on construction. The major issue in MARA large construction project is the delay resulting with significant time overrun and cost overrun. This study focused on identifying the factors that affect construction cost. However, this study is focused on large construction projects controlled by MARA. It is difficult to define large constructions. In as study of Vietnam projects with a total budget of $1 million were considered as large projects [6]. Similarly, in Malaysia a project of budget RM 5 million and above is considered as large construction project [7].

2.0 RELATED WORKS

Cost is among the major considerations throughout the project management life cycle and can be regarded as one of the most important parameters of a project and the driving force of project success. Despite its proven importance it is not uncommon to see a construction project failing to achieve its objectives within the specified cost. Cost overrun is a very frequent phenomenon and is almost associated with nearly all projects in the construction industry [8]. The problem of cost overruns is critical and need to be study more to alleviate this issue in the future. They also point out that cost overruns are a major problem in both developing and developed countries [9]. The trend is more severe in developing countries where these overruns sometimes exceeds 100% of the anticipated cost of the project. There are several factors that affect the construction cost and various studies have been conducted to address these factors. Low quality materials cause higher construction cost than expected because of the loss of materials during construction. This results from a lack of standards for materials and management systems. Lack of ability to prevent cost overruns or to control construction costs causes many Thai construction companies to fail [10].

A study of delays and cost increase in the construction of private residential projects in Kuwait showed that the amount of time-delays and cost-increases was greater when the total cost of a residential project was higher. A major factor contributing to the time-delay and cost-increase was the inadequacy of money and time allocated to the design phase. The three main causes of time-delays were, in order, the number of change orders, financial constraints and owners' lack of experience in construction. The three

main causes of cost overruns on the other hand were, in order, contractor-Elide and material-related problems and, again, owners' financial constraints [11].

Design changes, inadequate planning, unpredictable weather conditions; and fluctuations in the cost of building materials are common factors causing cost overruns [12, 13]. In Ghana study 26 factors that cause cost overruns in construction of ground water projects in Ghana. According to the contractors and consultants, monthly payments difficulties was the most important cost overruns factor, while owners ranked poor contractor management as the most important factor. Despite some difference in viewpoints among the three groups surveyed, there is a high degree of agreement among them with respect to their ranking of the factors. The overall ranking results indicate that the three groups felt that the major factors that can cause excessive groundwater project cost overruns in developing countries are poor contractor management, monthly payment difficulties, material procurement, poor technical performances, and escalation of material prices [14].

3.0 DATA COLLECTION AND ANALYSIS

The study was carried out in two phases. First phase was pilot study. Through literature a questionnaire was developed containing 24 factors affecting construction cost and a pilot questionnaire survey and interviews were conducted among three groups of respondents i.e. clients (6 responds), project management consultants (9 responds) and contractor (6 responds). Data gathered was analyzed and top 10 factors of each of the respondent group were combined which resulted 15 significant factors. In the second phase a structured questionnaire survey was conducted among Project Management Consultants (PMC) personnel.

3.1 Questionnaire Development

A comprehensive literature was conducted to identify the major factors affecting construction cost. Table 1 shows the frequency of factors affecting construction cost.

Table 1: Frequency of factors affecting construction cost

S.No	Causes	6	8	14	15	16	17	18	19	20	21	22	23	24	25	26	Frequency
1	Incorrect planning and scheduling by contractors		√	√	√				√	√	√		√	√	√	√	10
2	Fluctuation in prices of materials	√	√	√	√	√			√	√				√		√	9
3	Frequent design changes	√	√		√	√			√	√		√		√			8
4	Unforeseen ground conditions	√		√			√					√	√	√	√	√	8
5	Shortages of materials	√		√		√					√	√	√		√	√	8
6	Inadequate contractor experience				√					√			√	√	√	√	6
7	Change in the scope of the project		√			√		√		√	√			√			6

8	Low speed of decisions making			√						√			√	√	√	√	6
9	Cash flow and financial difficulties faced by contractors	√		√									√	√		√	5
10	Contractor's poor site management and supervision	√											√	√	√	√	5
11	Practice of assigning contract to lowest bidder		√	√						√				√			4
12	Lack of communication among parties												√	√	√	√	4
13	Shortage of site workers	√		√							√			√			4
14	Delay in Material procurement			√						√				√		√	4
15	Owner interference												√	√	√	√	4
16	Equipment availability and failure			√							√				√	√	4
17	Labor productivity										√				√	√	3
18	Mistakes during construction	√		√											√		3
19	Social and cultural impacts				√				√		√						3
20	Underestimate project duration resulting Schedule Delay							√				√		√			3
21	Incompetent Project team (designers and contractors)												√	√		√	3
22	Poor technical performance									√					√		2
23	Necessary variations of works									√							1
24	Slow payment of completed works	√															1

Based on table 1, a structured questionnaire survey was conducted to identify the significant factors affecting construction cost. A five point likert-scale of 1 to 5 was adopted to assess the degree of agreement of each cause where 1 represented 'strongly disagree', 2 'disagree', 3 'moderately agree', 4 'agree' and 5 'strongly agree'. A total of 45 questionnaire sets were distributed and 37 responses were received which formed 82.22% of responses. Statistical Package for Social Science (SPSS) version 17 was used to analyze the data.

3.2 Reliability Test

The reliability test depicts the consistency degree of the data collected. The Cronbach α coefficient is a measure of the inner consistency. Reliability is in low level when Cronbach α is less than 0.3 and it cannot be accepted. Reliability is in high level when Cronbach α is more than 0.7 where it indicates inner consistency of indexes table is in

high level and it can be highly acceptable. Nunnally the value of alpha is desirable with the range higher than 0.5 to 0.6 [27]

3.3 Ranking Of Significant Factors

The ranking of effects of construction delays is calculated based on the mean rank score. The higher the mean rank score shows the higher is the ranking. The formula used for the mean rank calculation is;

$$M_R = \frac{\overline{R}}{M_{\max}} n \tag{1}$$

Where Mr is Mean Rank, $\overline{R}$ is Individual Mean Rank of effect, Rmax is the Maximum Individual Mean Rank of effect and n is the number of effects. The determination of 'significance' of effects is based on the mean rank scored. In this study, the mean rank score of 12.6 (individual mean 3.5) is used as cut-off point for significant effect of delay.

3.4 Correlation

Before 1943, The Ordnance Department of the US Army and Ballistic Research Laboratory (BRL) done many experimental works on local impact effects of hard missile on concrete structure, based on those results Army Corp of Engineers developed the ACE formula: The strength of associations of pairs of variables understudy is determined by correlation relationships. The 3 commonly used methods for ascertaining the strength of association between 2 variables is the Pearson correlation method, the Spearman rank correlation method and the Chi square test of independence method. As data collected in this study is non-parametric and ordinal variables, the powerful method of examining the relationship between pairs of variables is by using Spearman's Rank Order Correlation [28]. These tests have the obvious advantage of not requiring the assumption of normality or the assumption of homogeneity of variance. They compare medians rather than means and, as a result, if the data have one or two outliers, their influence is negated.

The formula for Spearman $$\rho = 1 - \frac{6\sum d^2}{n(n^2 - 1)} \tag{2}$$

Where d is the difference between ranks and n is the highest weight. The correlation coefficient (or "ρ") ranges from -1.0 to +1.0. The closer ρ is to +1 or -1, the more closely the two variables are related. The value of ρ close to 1 implies there is strong positive linear relationship between the two variables while the value of ρ close to -1 is a strong negative linear relationship between the two variables [29]. Ideally, the correlation coefficient value of ± 1 is said to be a perfect correlation. Assume correlation coefficient value lies between ± 0.5 and ± 1, then it is said to be a high degree of correlation and for the correlation coefficient value lies between ± 0.3 and ± 0.5, then it is said to be moderate degree of correlation. If correlation coefficient value lies between ± 0.1 and ± 0.3 then it is said to be a low degree of correlation and suppose correlation coefficient value lies around zero, then there is no correlation [30].

4.0 RESULTS AND DISCUSSIONS

4.1 Preliminary Study

Structured questionnaire survey was conducted amongst selected senior personnel of PMC, client and contractor firms. The respondents were asked to rank the listed factors. Results are shown in table 2. Based on the results achieved in table, top 10 factors of each respondent group were selected which formed a total of 15 factors as shown in table 3.

Table 2: Preliminary Ranking Factors affecting Construction Cost

S.No	Factors affecting construction cost	PMC Respondents		Client Respondents		Contractor Respondents	
		AVG	Rank	AVG	Rank	AVG	Rank
1	Practice of assigning contract to lowest bidder	5.22	1	11.67	9	6.33	2
2	Contractor's poor site management and supervision	6.78	2	6.00	1	14.83	17
3	Cash flow and financial difficulties faced by contractors	7.78	3	6.17	2	7.17	4
4	Incorrect planning and scheduling by contractors	8.56	4	6.33	3	13.67	14
5	Inadequate contractor experience	9.44	5	8.50	6	15.17	18
6	Shortage of site workers	10.22	6	14.83	17	10.33	8
7	Delay in Material procurement	10.44	7	12.33	12	17.67	21
8	Incompetent Project team (designers and contractors)	10.56	8	10.67	8	16.17	20
9	Fluctuation in prices of materials	10.78	9	15.83	21	9.50	6
10	Underestimate project duration resulting Schedule Delay	11.33	10	7.50	5	11.17	10
11	Shortages of materials	11.67	11	18.00	23	13.67	15
12	Mistakes during construction	12.00	12	15.67	20	11.33	12
13	Lack of communication among parties	12.00	13	10.33	7	6.50	3
14	Labor productivity	12.00	14	16.17	22	11.17	11
15	Low speed of decisions making	12.22	15	12.00	10	9.17	5
16	Change in the scope of the project	12.56	16	13.00	13	10.00	7
17	Poor technical performance	14.22	17	14.67	14	13.67	16

18	Frequent design changes	15.89	18	15.50	18	10.33	9
19	Slow payment of completed works	17.00	19	21.17	24	19.83	24
20	Unforeseen ground conditions	17.22	20	6.50	4	6.00	1
21	Equipment availability and failure	17.67	21	12.00	11	19.33	23
22	Necessary variations of works	18.00	22	14.83	15	18.00	22
23	Owner interference	18.11	23	14.83	16	12.83	13
24	Social and cultural impacts	19.67	24	15.50	19	16.17	19

Table 3: Top-10 Analysis Responses by All Selected Respondents

S.No	**Factors affecting construction cost**	**PMC**	**Client**	**Contractor**
1	Practice of assigning contract to lowest bidder	√	√	√
2	Contractor's poor site management and supervision	√	√	
3	Cash flow and financial difficulties faced by contractors	√	√	√
4	Incorrect planning and scheduling by contractors	√	√	
5	Inadequate contractor experience	√	√	
6	Shortage of site workers	√		√
7	Delay in Material procurement	√		
8	Incompetent Project team (designers and contractors)	√	√	
9	Fluctuation in prices of materials	√		√
10	Underestimate project duration resulting Schedule Delay	√	√	√
11	Lack of communication among parties		√	√
12	Low speed of decisions making		√	√
13	Unforeseen ground conditions		√	√
14	Change in the scope of the project			√
15	Frequent design changes			√

Questionnaire sets containing 15 factors affecting construction cost were distributed among the personnel of project management consultants. A total of 45 questionnaire sets were distributed out of which 37 with a percentage of 82.22 were received. Data was analyzed with SPSS 17 and results are presented in following sections.

4.2 Respondent Profile

Distribution of respondents in terms of experience is shown in figure 1. Figure 1 indicates that majority of respondents i.e. 30 out 37 (81.08%) were experienced more than 10 years in the construction industry while only 7 (18.92%) had experience between 6-10 years.

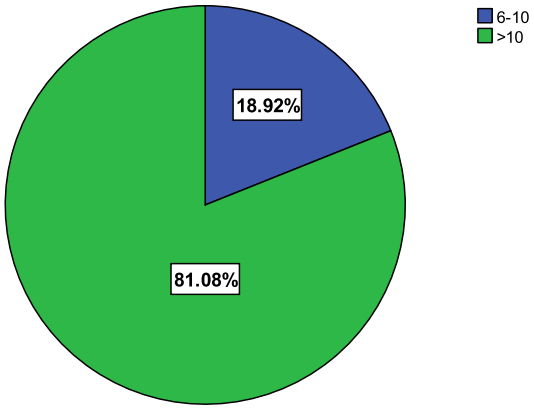

Figure 1: Respondents working experience

4.3 Reliability Resulst

Table 4 shows reliability analysis for factors affecting cost overrun. Results indicate that Cronbach's Alpha is 0.630 which is slightly low, however Cronbach α of between 0.3 and 0.7 is still can be accepted. There is a common agreement that the data is acceptable if the Cronbach α reaches 0.6 [27].

Table 4: Reliability Statistics

No of Cases	No of Variables	Cronbach's Alpha
37	15	.630

4.4 Ranking Of Factors Affecting Construction Cost

Data collected through questionnaire survey was analyzed with SPSS 17 to identify the significant factors affecting construction cost. Results are presented in figure 2 and table 5.

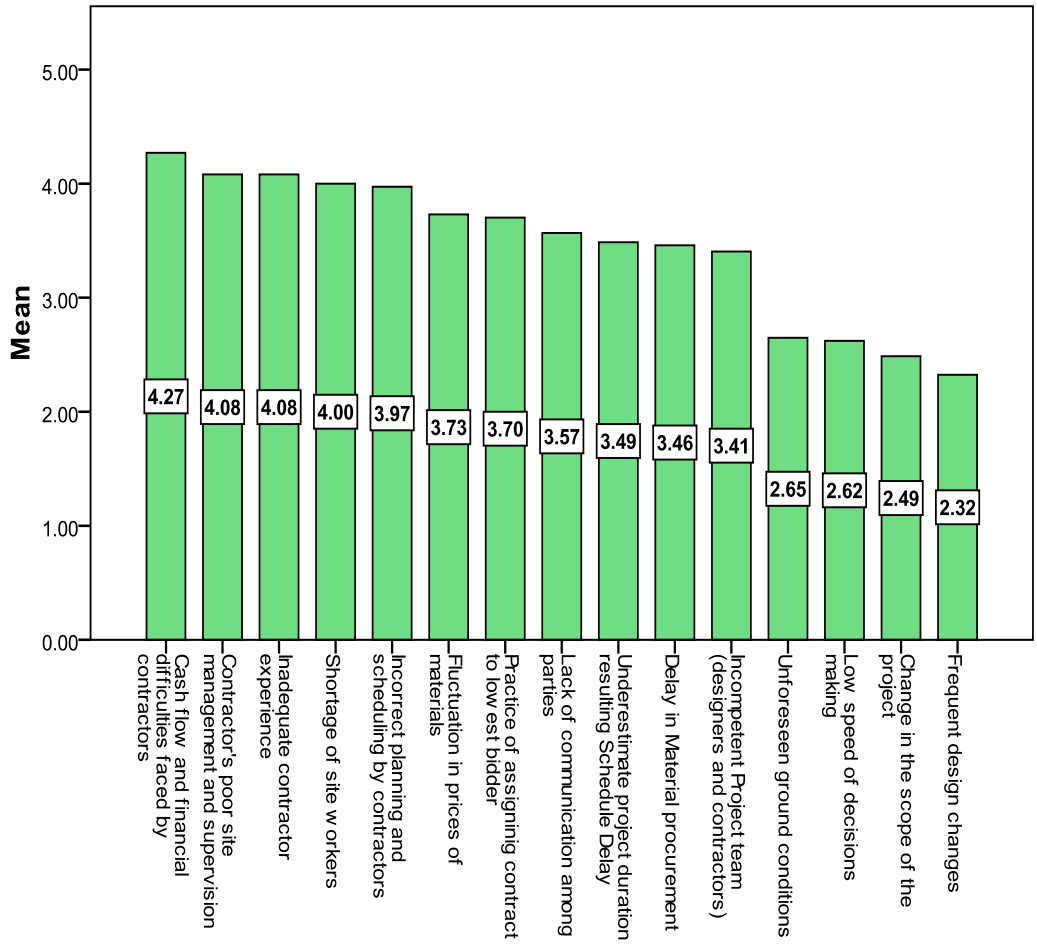

Figure 2: Ranking of factors affecting construction cost

Table 5: Mean, SD and ranking of factors affecting construction cost

S.No.	Factors affecting construction cost	Mean	S.D	Rank
1	Cash flow and financial difficulties faced by contractors	4.27	0.805	1
2	Contractor's poor site management and supervision	4.08	0.759	2
3	Inadequate contractor experience	4.08	0.795	3
4	Shortage of site workers	4.00	0.882	4
5	Incorrect planning and scheduling by contractors	3.97	0.726	5
6	Fluctuation in prices of materials	3.73	0.962	6
7	Practice of assigning contract to lowest bidder	3.70	1.051	7
8	Lack of communication among parties	3.57	0.959	8
9	Underestimate project duration resulting Schedule Delay	3.49	0.901	9
10	Delay in Material procurement	3.46	0.869	10

11	Incompetent Project team (designers and contractors)	3.41	0.956	11
12	Unforeseen ground conditions	2.65	0.919	12
13	Low speed of decisions making	2.62	0.893	13
14	Change in the scope of the project	2.49	0.870	14
15	Frequent design changes	2.32	0.944	15

From figure 3 and table Based on table 5, the mean rank score for the cash flow and financial difficulties faced by contractors is extremely high compared to other causes where as the other significant causes include contractor's poor site management, inadequate contractor experience, shortage of site workers and incorrect planning and scheduling by contractors as discussed below.

4.4.1 ***Cash flow and financial difficulties faced by contractors:*** PMC ranked cash flow and financial difficulties faced by contractors extremely high. Therefore this cause is the most significant factor affecting construction cost. PMC believes this issue is very critical where it may influence other causes such as contractor's poor site management, shortage of site workers and ineffective planning and scheduling. Settling this issue may as well settle other issues simultaneously.

4.4.2 ***Contractor's poor site management:*** PMC ranked contractor's poor site management as the second highest rank. Contractor's poor site management such as late to comply with statutory bodies requirement, poor communication with sub-contractors and material suppliers are significantly affect the progress of the project. To make matter worst, the frequent change of site manager/supervisor distracted the continuity of the site management.

4.4.3 ***Inadequate contractor experience:*** The third highest rank cause affecting construction cost as perceived by PMC is inadequate contractor experience. PMC believes that lack of contractor experience in the same capacity of job has resulted in difficulties in handling the project efficiently. Experience contractors will be able to achieve high standards of quality and workmanship, high percentage of success projects and have good safety records. The real issue here is the lack of experience of management team at the site. The contractor seems to hire young and inexperience personnel to work there.

4.4.4 ***Shortage of site workers:*** This cause is also quite significant as perceived by PMC. It is 4th ranked factor affecting construction cost. The PMC claims that problem between contractor and sub-contractor seems largely contribute to this cause. As most of works are contracted to sub contractors, most of the workers are hired by these sub-contractor. If there are disputes between contractor and sub-contractor, automatically this issue prevails.

4.4.5 ***Incorrect planning and scheduling by contractors:*** Like cause of shortage of site workers, PMC ranked ineffective planning and scheduling by contractors as quite significant factor affecting construction cost. This issue seems to be true as it is highly related to cash flow and financial difficulties faced by contractors, shortage of site workers, contractor's poor site management, inadequate contractor experience, lack of communication among construction parties and problems with subcontractors.

4.5 Correlation Analysis

Spearman correlation test was carried to find correlation between the factors affecting construction cost. Results are presented in table 6. From table 6, it is perceived that "Incorrect planning and scheduling by contractors with Contractor's poor site management and supervision", "Contractor's poor site management and supervision with inadequate contractor experience", "Incorrect planning and scheduling by contractors with inadequate contractor experience" and "Frequent design changes with Change in the scope of the project" have strong positive correlation with each other as shown in figure 3 and figure 4, while "Shortage of site workers with Incorrect planning and scheduling by contractors", "Contractor's poor site management and supervision with Lack of communication among parties" and "Incompetent Project team (designers and contractors) Lack of communication among parties" have moderate level of correlation with each other at 0.05 level of significance.

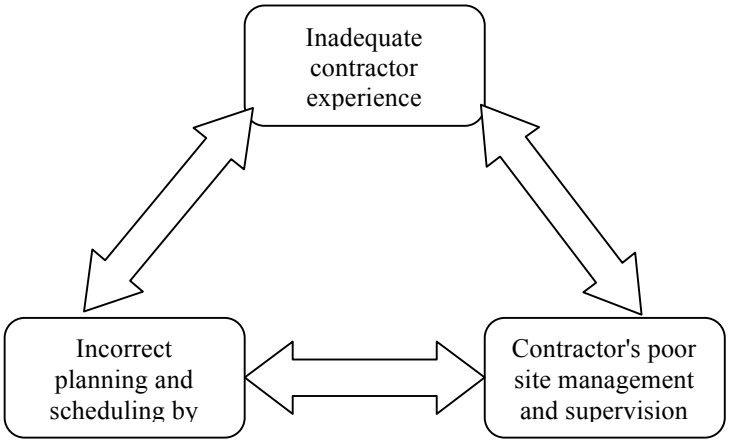

Figure 3: Strong level of correlation

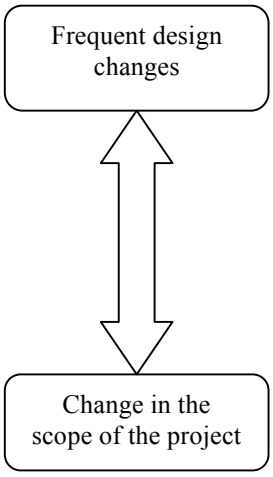

Figure 4: Strong level of correlation

Table 6: shows the results for ranking of factor affecting construction cost

10	11	12	13	14	15
0.032	0.258	0.198	0.251	0.218	0.056
-0.312	0.253	0.331*	-0.058	0.211	0.042
-0.087	0.142	0.103	0.035	0.411*	0.248
-0.239	0.063	-0.283	0.359*	0.157	0.465**
0.621**	0.083	0.071	-0.029	-0.038	-0. 313
0.3145	0.359*	0.239	0.086	0.137	0.050
0.294	-0.016	0.029	0.156	-0.052	-0.048
-0.375*	0.286	-0.054	0.282	0.362*	0.432**
-0.035	0.371*	0.362*	0.042	0.274	0.016
1.000	0.134	0.032	-0.058	-0.149	0.010
0.134	1.000	0.393*	0.381*	0.309	0.176
0.032	0.393*	1.000	-0.129	0.355*	-0.199
-0.058	0.381*	-0.129	1.000	0.299	0.465**
-0.149	0.309	0.355*	0.299	1.000	0.280
0.010	0.176	-0.119	0.465**	0.280	1.000

** Correlation is significant at 0.05 level (2-tailed)
2 = Shortage of site workers
4 = Contractor's poor site management and supervision
6= Unforeseen ground conditions
8= Inadequate contractor experience
10= Change in the scope of the project
12= Fluctuation in prices of materials
14= Underestimate project duration resulting Schedule Delay

	1	2	3	4	5	6	7	8	9
1	1.000	0.051	0.261	0.386*	-0.118	0.164	-0.007	0.316	-0.076
2	0.051	1.000	0.457**	0.317	-0.201	0.001	-0.399*	0.381*	0.047
3	0.261	0.457**	1.000	0.565**	-0.128	-0.076	-0.349*	0.529**	0.062
4	0.386*	0.317	0.565**	1.000	-0.207	-0.182	-0.424**	0.585**	0.039
5	-0.118	-0.201	-0.128	-0.207	1.000	0.021	0.335*	-0.519**	-0.015
6	0.164	0.001	-0.076	-0.128	0.021	1.000	0.106	0.002	0.137
7	-0.007	-0.399*	-0.349*	-0.424**	0.335*	0.106	1.000	-0.380*	0.011
8	0.316	0.381*	0.529**	0.589**	-0.519**	0.002	-0.380*	1.000	0.063
9	-0.076	0.047	0.062	0.039	-0.015	0.137	0.011	0.063	1.000
10	0.032	-0.312	-0.087	-0.239	0.621**	0.315*	0.294	-0.375*	-0.035
11	0.258	0.253	0.142	0.063	0.038	0.359	-0.016	0.286	0.371*
12	0.198	0.331*	0.103	-0.283	0.071	0.239	0.029	-0.054	0.362*
13	0.251	-0.058	0.035	0.359*	-0.029	0.086	0.156	0.282	0.042
14	0.218	0.211	0.411*	0.157	-0.038	0.137	-0.052	0.362*	0.274
15	0.056	0.042	0.248	0.465**	-0.313	0.050	-0.048	0.432**	0.016

* Correlation is significant at 0.01 level (2-tailed)
1 = Cash flow and financial difficulties faced by contractors
3 = Incorrect planning and scheduling by contractors
5= Frequent design changes
7= Low speed of decisions making
9= Practice of assigning contract to lowest bidder
11= Delay in Material procurement
13= Incompetent Project team (designers and contractors)
15= Lack of communication among parties

5.0 CONCLUSION

The comprehensive study to identify the factors affecting construction cost in MARA large projects was carried out. Study was carried out in two phases. In first phase, through a comprehensive literature 24 most frequent factors affecting construction cost were identified and a survey was conducted amongst the selected 18 senior personnel involved in construction to verify and rank the factor. Finally a questionnaire was developed by selecting top 10 ranked factors ranked by 3 groups (i.e. PMC, client and contractors) involved in the preliminary study. A structured questionnaire survey was conducted consisting of 15 factors amongst PMC personnel. A total 45 questionnaire were distributed out of which 37 were returned. Data was analyzed with SPSS 17. Results show that Cash flow and financial difficulties faced by contractors, Contractor's poor site management and supervision, Inadequate contractor experience, Shortage of site workers and Incorrect planning and scheduling by contractors were more significant factors affecting construction cost. Also, from correlation analysis it was perceived that "Incorrect planning and scheduling by contractors with Contractor's poor site management and supervision", "Contractor's poor site management and supervision with inadequate contractor experience", "Incorrect planning and scheduling by contractors

with inadequate contractor experience" and "Frequent design changes with Change in the scope of the project" have strong positive correlation with each other

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