THE CAUSE FACTORS OF LARGE PROJECT'S COST OVERRUN: A SURVEY IN THE SOUTHERN PART OF PENINSULAR MALAYSIA

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Abstract

Construction cost overrun has become a global concern amongst the practitioners and academic researchers because the construction projects are very rarely completed within the estimated cost limit. There are various contributing factors to cost overrun. This study focuses on cost overrun encountered in large construction projects. Data was gathered using structured questionnaire survey among clients, consultants and contractors in the states of Johor, Melaka and Negeri Sembilan of Peninsular Malaysia. Statistical methods were used to analyze the data. The survey results show that 96% of the respondents agreed that most construction projects face cost overrun with an average amount ranging from 5% to 10% of the contract sum. Investigation on the causes of cost overrun involves 35 common factors identified through the literature. Results indicate that fluctuation in materials price, cash flow and financial difficulties faced by contractors, delay in progress payment by owner, and frequent design changes were most dominant factors causing cost overrun. Spearman correlation test was conducted on the factors showing that slow information flow was highly correlated with the lack of communication between parties (with a correlation value $\rho = 0.787$). Standardized design practices, efficient resource planning and management and proper financial management should be considered as effective tools in controlling cost overrun especially in large construction projects.

Key words*: Cost overrun, Causes of cost overrun, Relative Importance Index, Spearman correlation, large projects*

1.0 Introduction

Socio-economic growth of a country highly depends on construction industry as it provides necessary infrastructure such as such as roads, hospitals, schools and other basic and enhances facilities. Also, it contributes significantly to the county's Gross Domestic Product (GDP). In Malaysia, the construction sector has been consistently contributing to the strong economic growth of 5.8% in 2009 and subsequently 8.7% in2010 as against the overall GDP growth. Under the 10^{th} Malaysia Plan, a total sum of RM230 billion has been allocated for development and another RM20 billion for facilitation fund which is intended to create impetus in driving demand for the construction sector. Out of RM230 billion allocation, 60% (RM138 billion) was for physical development in the construction sector. As much as RM20 billion facilitation funds were allocated for attracting private sector investment ((Mansor, 2010)). Besides providing these funds, the construction industry is seen as facing a lot of challenges such as delay in completing projects in time, expenditure exceeding the budget, defects, and over dependent on foreign workers. Of these challenges, cost overrun is specifically a critical issue. As reported by (Endut, Akintoye, & Kelly, 2009)) only 46.8% of the public sector and 37.2% of the private sector projects in Malaysia are completed within the stipulated budget. This poor cost control (cost overrun) is contributed by various factors. Since there is still lack of investigation on factors of cost overrun in Malaysia ((Toh, Ali, & Aliagha, 2011)), this study focuses on investigating them. This study is limited to large projects (projects with a contract sum of more than RM 5 million) in the southern part of Penisular Malaysia.

2.0 Related Works

Cost is amongst the major considerations throughout a project management life cycle and is considered as prime factor of success. However, it is uncommon to see project completed within the estimated cost ((Azhar, Farooqui, & Ahmed, 2008)). In today's construction industry, cost overrun is very common phenomenon worldwide. This problem/issue is critical and needs to be more understood and alleviated ((Angelo & Reina, 2002)). In a study on 8000 projects, (Frame, 1997)) found that only 16% of the projects satisfied the three fundamental criteria of project success i.e. completing project on time, meeting the budgeted cost, and meeting quality standard, while in a global study on cost overrun issue in transport infrastructure projects covering 258 projects in 20 nations, (Flyvbjerg, Holm, & Buhl, 2003)) concluded that 9 out 10 projects faced cost overrun. (Azhar et al., 2008)) studying construction projects in Pakistan found that a minimum cost overrun recorded was 10% of the estimated cost. Further, the authors mentioned that this trend is sometimes more severe in developing countries where cost overrun sometimes exceeds 100% of the anticipated cost of the project. In Uganda, there was cost overrun of more than 100% of the contract price in the Northern-by-pass project as reported by (Apolot, Alinaitwe, & Tindiwensi, 2011)). In Nigeria, (Omoregie & Radford, 2006)) reported that the minimum average percentage of cost escalation was 14%. In Portugal, construction projects faced a minimum of 12% of cost overrun ((Moura, Teixeira, & Pires, 2007)).

Cost overrun in construction project occurs due to various reasons. (Ameh, Soyingbe, & Odusami, 2010)) investigated 42 causes of cost overrun and found that the lack of experience of contractors, cost of material, fluctuation in the prices of materials, frequent design changes, economic stability, high interest rates charged by banks on loans and mode of financing, bonds and payments as well as fraudulent practices and kickbacks as the dominant factors causing cost overrun in Nigeria. (Adnan Enshassi, Al-Najjar, & Kumaraswamy, 2009)) mentioned 10 out of 42 investigated factors causing cost overrun in Gaza construction projects, namely increase of materials prices due to continuous border closures, delay in construction, supply of raw materials and equipment by contractors, fluctuations in the cost of building materials, unsettlement of the local currency in relation to dollar value, project materials monopoly by some suppliers, resources constraint: funds and associated auxiliaries not ready, lack of cost planning/monitoring during pre-and post contract stages, improvements to standard drawings during construction stage, design changes, and inaccurate quantity take-off. (Le-Hoai, Lee, & Lee, 2008) found that poor site management and supervision, poor project management assistance, financial difficulties of owner, financial difficulties of contractor & design changes were the most significant causes of cost overrun in Vietnam construction industry. Review of articles on cases worldwide has revealed 35 common causes of cost overrun, categorized into seven groups, namely contractor's site management related factors (CSM), design and documentation related factors (DDF), financial management related factors (FIN), information and communication related factors (ICT), human resource (Workforce) related factors (LAB), non-human resource related factors (MMF), project management and contract administration related factors (PMCA). The causes and their groups are as presented in Table 1

Table 1: Causes of cost overrun identified from previous studies

S.No	Factor	Description	Group
1	CSM1	Poor site management and supervision	Contractor's site management related factors
2	CSM2	Incompetent subcontractors	
3	CSM3	Schedule Delay	
4	CSM4	Inadequate planning and scheduling	
5	CSM5	Lack of experience	
6	CSM6	Inaccurate Time and Cost estimates	
7	CSM7	Mistakes during construction	
8	CSM8	Inadequate monitoring and control	
9	DDF1	Frequent design changes	Design and documentation related factors
10	DDF2	Mistakes and Errors in design	
11	DDF3	Incomplete design at the time of tender	
12	DDF4	Poor design and delays in Design	
13	DDF5	Delay Preparation and approval of drawings	
14	FIN1	Cash flow and financial difficulties faced by contractors	Financial management related factors
15	FIN2	Poor financial control on site	
16	FIN3	Financial difficulties of owner	
17	FIN4	Delay in progress payment by owner	
18	FIN5	Delay payment to supplier /subcontractor	
19	FIN6	Contractual claims, such as, extension of time with cost claims	
20	ICT1	Lack of coordination between parties	Information and communication related factors
21	ICT2	Slow information flow between parties	
22	ICT3	Lack of communication between parties	
23	LAB1	Labour productivity	Human resource (workforce) related factors
24	LAB2	Shortage of site workers	
25	LAB3	Shortage of technical personnel (skilled labour)	
26	LAB4	High cost of labour	
27	LAB5	Labour Absenteeism	
28	MMF1	Fluctuation of prices of materials	Non-human resource related factors
29	MMF2	Shortages of materials	
30	MMF3	Late delivery of materials and equipment	
31	MMF4	Equipment availability and failure	
32	PMCA1	Poor project management	Project management and contract administration related factors
33	PMCA2	Change in the scope of the project	
34	PMCA3	Delays in decisions making	
35	PMCA4	Inaccurate quantity take-off	

3.0 Data Collection and Analysis

Structured questionnaire survey was carried out to collect the data. Ordinal scale adopted by (Adnan Enshassi et al., 2009)) was assigned for level of significance instead of using abbreviation i.e. 1 = not significant; 2 = slightly significant; 3 = moderately significant; 4 = very significant; 5 = extremely significant.

Prior to data collection, preliminary study was conducted by interviewing five experienced personnel in the construction industry to validate the contents of questionnaire and confirming the relevancy of the contents related to Malaysian construction industry. Table 2 shows the profile of the experts interviewed. From the table, it can be perceived that the respondents selected for the interview had extensive experience in working with the construction industry and involved in managing projects. After the content validity interview, the questionnaire survey was conducted in states of Johor, Malacca and Negeri Sembilan of Peninsular Malaysia.

Table 2: Profile of experts interviewed for content validity

No	Organization	Designation	Experience
1	Client	Project Engineer	29 years
2	Consultant	Principal Consultant	24 years
3	Consultant	Project Manager	23 years
4	Contractor	Managing Director	22 years
5	Contractor	Project Manager	16 years

The data gathered from the survey were analyzed descriptively through a hierarchal assessment of causes and also the correlation between the causes of cost overrun.

(i) **Hierarchal assessment of causes:** The hierarchal assessment of causes of cost overrun was carried out by studying the ranking of causes of cost overrun. Relative importance index (RII) method developed by (Kometa, Olomolaiye, & Harris, 1994)) was used to determine the relative significance and ranking of causes. The same approach was been used by various researchers to analyze the data collected from questionnaire survey as indicated in the literature. (Al-Tabtabai, 2002)) and (Sambasivan & Soon, 2007)) used the method to investigate the causes of delay in construction projects in Kuwait and Malaysian, respectively. RII is calculated as follows:

$$RII = \frac{\sum_{i=1}^{5} w_i x_i}{A \times N}$$

Where;

RII = Relative importance index

w = weighting given to each factor by respondents and it ranges from 1 to 5

x = frequency of it response given for each cause

A = highest weight (i.e. 5 in this case)

N = total number of participants

relationship between pairs of variables is by using Spearman's rank order correlation ((Bryman & Cramer, 2002)). The correlation coefficient (or "ρ") ranges from -1.0 to +1.0. The closer the ρ value to +1 or -1, the more

(ii) Correlation between causes of cost overrun: Three methods commonly used for ascertaining the strength of association between two variables are the Pearson correlation, the Spearman rank correlation and the Chi- square test of group independence. Since the data collected in this study were meant for non-parametric analysis using ordinal variables, the powerful method of examining the closely the two variables are related. A value of ρ close to 1 implies a strong positive linear relationship while a value of ρ close to -1 indicates a strong negative linear relationship ((Daud, Ahmad, & Yusof, 2009)). Ideally, the

correlation coefficient value of ± 1 is said to be a perfect correlation. In this study, we assume that a ρ value lying between ± 0.5 and ± 1 reflects a degree of correlation, while a ρ value lying between ± 0.1 and ± 0.3 reflects a low degree of correlation. A correlation coefficient value lying around zero means that there is no correlation ((Cohen, 1988)).

high degree of correlation, a ρ value lying between ± 0.3 and ± 0.5 reflects a moderate

4.0 Results and Discussion

A total of 150 questionnaire sets were distributed randomly amongst personnel involved in the construction industry in the southern part of Peninsular Malaysia. As many as 103 responses were received, of which, 6 questionnaire sets were incomplete and considered as invalid. Table 3 shows the summary of data collection.

Table 3: Summary of data collection

No of questionnaire distributed	150
No of response received	103
No of invalid (Incomplete) responses	6
No of valid responses	97
%of of responses received	68.7
%of of valid responses against questionnaire distributed	64.7

The respondents involved in the survey have a range of years of experience in handling various types of projects. The characteristics of the respondents participated in survey as summarized in Table 4 indicate that majority of the respondents were working with contractor's organizations (57.7%), followed by consultant's organizations (25.8%) and client's organization (16.5%). The respondents were involved in handling both types of project i.e. building and infrastructure. Majority of the respondents (80.4%) had a working experience of more than 5 years, 21.6% of the respondents were engaged in construction industry for more than 10 years and less than 20 years, while 21.6% and 18.6% of the respondents had a experience of less than 5 years and more than 20 years, respectively. This shows that the respondents were competent enough and capable to participating in the survey.

Table 4: Demographic characteristics of respondents

	Frequency	%age	Cumulative %
Type of Organization			
Client	16	16.5	16.5
Consultant	25	25.8	42.3
Contractor	56	57.7	100.0
Type of project			
Building	44	45.4	45.4
Infrastructure	15	15.5	60.9
Build-Infra	38	39.1	100.0
Size of Project			
6-10 Million	33	34.0	34.0
10-50 Million	39	40.2	74.2
Above 50 Million	25	25.8	100.0
Level of qualification			
BE	86	88.7	88.7
BSc	2	2.0	90.7
Diploma	7	7.2	97.9
ME	2	2.1	100.0
Work Experience			
0-5 years	19	19.6	19.6
6-10 years	21	21.6	41.2
11-15 years	24	24.7	66.0
16-20 years	15	15.5	81.4
More than 20 years	18	18.6	100.0

Data regarding factors affecting causing cost overrun were analyzed statistically using statistical software package SPSS v17.0.

4.1 Reliability analysis

Reliability can be equated to stability, consistency, or dependability of a measuring tool. The Cronbach α coefficient is widely adopted to measure the inner consistency. The alpha value ranges from 0 to 1. 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 high-level inner consistency of index table and it can be highly acceptable ((Yang & Ou, 2008), (Wong & Cheung, 2005)). (Li & Wang, 2007)) argued that the Cronbach α of between 0.3 and 0.7 is still acceptable. The values of α ranging from 0.6 to 0.7 are also acceptable ((Wong & Cheung, 2005), (Meeampol & Ogunlana, 2006)). Table 5 shows the results of the reliability test.

Table 5: Reliability test results

	Group / Category	Reliability
ALL	Overall Data	0.953
CSM	Contractor's site management related factors	0.873
DDF	Design and documentation related factors	0.892
FIN	Financial management related factors	0.892
ICT	Information and communication related factors	0.874
LAB	Human resource (workforce) related factors	0.804
MMF	Non-human resource related factors	0.798
PMCA	Project management and contract administration related factors	0.747

Table 5 shows a high value of Cronbach α for each category of the questionnaire and also for the entire questionnaire. The Cronbach α values ranged from 0.747 to 0.892 for all categories. For overall data, the alpha value was 0.953 which was higher than all groups' data and which was higher than the desirable value. Hence, it can be concluded that the questionnaire was valid and highly reliable.

4.2 Extent of Cost Overrun

Respondents were asked about the extent of cost overrun in terms of approximate percentage over and above project's contractual cost for the projects they were involved in the past ten years. The results are summarized in Table 6. The results show that quite a small number of responses (4.1%) mentioned that the projects were completed within estimated cost i.e. facing 0% cost overrun. On the other hand, a significant number of respondents (60.8%) agreed that project's cost overrun of approximately 5-10% is more common, 15.5% of respondents mentioned that cost overrun is normally in the range of more than 1-5%, while 19.6% of respondents stated that construction projects used to face budget overrun of above 10% of the contracted amount.

Table 6. Extent of cost overrun

Scale	Extent of Cost Overrun	Frequency	Percent	Cumulative percent
1	0%	4	4.1	4.1
2	1-5%	15	15.5	19.6
3	5-10%	59	60.8	80.4
4	10-15%	8	8.3	88.7
5	More than 15%	11	11.3	1000

Also, the mean value of responses was calculated as 3.07, which can be concluded that there was common agreement among the respondents that construction projects face cost overrun between 5-10% of the contractual cost.

4.3 Ranking of causes of cost overrun

Ranking of causes of cost overrun was assessed with Relative Importance Index (RII) method. The results of the ranking are presented in Table 7.

Table 7: Ranking of causes of cost overrun

Causes of Cost Overrun	RII	Rank	Group
Fluctuation in prices of materials	0.83	1	MMF
Cash-flow and financial difficulties faced by contractors	0.79	2	FIN
Delay in progress payment by owner	0.76	3	FIN
Frequent design changes	0.74	4	DDF
Shortage of materials	0.74	4	MMF
Poor financial control on site	0.74	4	FIN
Schedule delay	0.73	5	CSM
Financial difficulties of owner	0.73	5	FIN
Incompetent subcontractors	0.73	5	CSM
Incomplete design at the time of tender	0.73	5	DDF
Poor site management and supervision	0.73	5	CSM
Delay in payment to supplier /subcontractor	0.72	6	FIN
Inadequate monitoring and control	0.72	6	CSM
Delay in decision-making	0.72	6	PMCA
Contractual claims, such as, extension of time with cost claims	0.72	6	FIN
Inaccurate quantity take-off	0.71	7	PMCA
Inaccurate time and cost estimates	0.71	7	CSM
Mistakes and errors in design	0.71	7	DDF
Shortage of site workers	0.71	7	LAB
Poor design and delays in Design	0.70	8	DDF
Mistakes during construction	0.70	8	CSM
Shortage of technical personnel (skilled labour)	0.70	8	LAB
High cost of labour	0.70	8	LAB
Inadequate planning and scheduling	0.70	8	CSM
Delay in preparation and approval of drawings	0.70	8	DDF
Poor project management	0.70	8	PMCA
Lack of coordination between parties	0.69	9	ICT
Lack of experience	0.69	9	CSM
Slow information flow between parties	0.68	10	ICT
Labour productivity	0.68	10	LAB
Owner’s interference	0.68	10	PMCA
Late delivery of materials and equipment	0.68	10	MMF
Lack of communication between parties	0.67	11	ICT
Severe overtime	0.66	12	LAB
Equipment unavailability and failure	0.65	13	MMF

Results from Table 7 shows that fluctuation in the prices of material, cash flow and financial difficulties faced by contractors, poor site management and supervision, lack of experience of contractors, schedule delay, inadequate planning and scheduling, and poor financial control on site are the major causes of cost overrun. These significant factors were from three major groups of cost overrun i.e. Non-human related factors (MMF), financial related factors (FIN) and design & documentation related factors (DDF). This finding was supported by findings of numerous other researchers.

In the MMF group, the significant factors also included material-related problems. Materials are considered as the backbone of construction projects, accounting for nearly 70% of the total value of project ((A. Enshassi, Lisk, Sawalhi, & Radwan, 2003)). Therefore, any problem related to construction materials would significantly affect the project ((Adnan Enshassi et al., 2009)). This is also concur with (Koushki, Al-Rashid, & Kartam, 2005)) study on the construction of private residential projects in Kuwait that discovered that material-related problems were the main factor of cost increase.

Other significant factors belong to financial performance on site category which include contractor's financial problem as well as level of financial control. Financing is a fundamental resource that contributes to the success of a project, hence effective financial management and control is very important ((Memon & Zin, 2010), (Memon & Zin, 2012)). Cash flow affects the progress of project significantly and very critically which, in turn, may influence other factors such as contractor's poor site management, shortage of site workers and ineffective planning and scheduling. Settling this issue may well settle other issues simultaneously ((Memon, Rahman, Abdullah, & Azis, 2010)). Hence, contractors are recommended to have enough cash before beginning any project to minimize financial problems ((Adnan Enshassi et al., 2009)). This can be resolved by the selection process of a good-practice contractor i.e. not only on the lowest bidding price, but also the previous working experience and reputation of the contractors and subcontractor ((Lo, Fung, & Tung, 2006)). Also, a detailed financial plan for project should be prepared ((Le-Hoai et al., 2008)) and financial spending be monitored to avoid cost overruns ((Adnan Enshassi et al., 2009)).

Design is one of the most important aspects of a successful project. Survey results showed that frequent design changes were a dominant cause of cost overrun. Hence, it is very important to use standardized design on a construction project to avoid changes in design. Any modification in the design will affect the budget allocated for the project, the volume of required materials, type of required materials and labour. Sometimes, design changes cause a re-work of already completed items, which means increasing project durations and loss of materials ((Adnan Enshassi et al., 2009)) and result in change orders causing extra cost ((Ameh et al., 2010; Chimwaso, 2001; Kaming, Olomolaiye, Holt, & Harris, 1997; Le-Hoai et al., 2008)).

As presented in Table 7, the most dominant cost-variance factors in construction projects was fluctuation in prices of materials (RII = 0.83). This is a common problem of cost overrun in many countries ((Ameh et al., 2010; Azhar et al., 2008; Adnan Enshassi et al., 2009; Le-Hoai et al., 2008)). Fluctuations in the cost of construction materials are one of the major factors causing cost overruns ((Chimwaso, 2001; Elinwa & Buba, 1993)) and can be attributed to various reasons. Monopoly of suppliers

could be one main reason of fluctuation in prices. Unavailability of construction materials locally can also affect the cost of material. It has severe effects when material is in short supply. To stabilize the cost of materials, increase in the supply of materials can be useful to break the monopoly of few suppliers controlling the supply chain of the market ((Azhar et al., 2008)). (Adnan Enshassi et al., 2009)) stated that a contractor often estimates prices of the tender according to the present prices in the local market. It is known that the tendering phase is quite long. So, there is a higher chance of price fluctuation. In case of high prices, the contractor would face the problem of cost overrun at the execution phase.

4.4 Correlation Test

Spearman correlation test was prformed to examine the relation between the factors affecting construction cost. Results are presented in Table 8 and it can be considered that inadequate planning and scheduling was highly correlated with inadequate monitoring and controlling with correlation value of 0.683, while slow information flow was highly correlated with the lack of communication between parties (0.787) and with the lack of coordination between parties (0.702). Similarly, frequent design changes have a high positive correlation with incomplete design at the time of tender, change in the scope of the project and mistakes and errors in design. It has a moderate correlation with inadequate monitoring and control, contractual claims, such as, extension of time with cost claims and poor project management. The summary of high correlation between the factors is presented in Table 8.

Table 8: Correlation results between factors of cost overrun

	CSM01	CSM02	CSM03	CSM04	CSM05	CSM06	CSM07	CSM08	DDF01	DDF02	DDF03	DDF04	DDF05	FIN01	FIN02	FIN03	FIN04	FIN05
CSM01	1.000	.617**	.325**	.577**	.400**	.413**	.486**	.360**	.343**	.381**	.296**	.243*	.306**	.316**	.262**	.527**	.403**	.276**
CSM02	.617**	1.000	.596**	.450**	.483**	.427**	.447**	.529**	.257*	.347**	.260*	.170	.179	.239*	.079	.438**	.319**	.058
CSM03	.325**	.596**	1.000	.397**	.330**	.337**	.334**	.525**	.356**	.429**	.380**	.351**	.416**	.126	.174	.336**	.324**	.165
CSM04	.577**	.450**	.397**	1.000	.555**	.499**	.683**	.406**	.259*	.436**	.271**	.380**	.296**	.456**	.459**	.490**	.376**	.426**
CSM05	.400**	.483**	.330**	.555**	1.000	.420**	.594**	.259*	.249*	.375**	.326**	.298**	.231*	.307**	.135	.454**	.303**	.235*
CSM06	.413**	.427**	.337**	.499**	.420**	1.000	.447**	.566**	.317**	.377**	.347**	.338**	.125	.305**	.206*	.603**	.360**	.130
CSM07	.486**	.447**	.334**	.683**	.594**	.447**	1.000	.416**	.307**	.362**	.257*	.303**	.269**	.332**	.320**	.524**	.259*	.291**
CSM08	.360**	.529**	.525**	.406**	.259*	.566**	.416**	1.000	.469**	.510**	.402**	.385**	.291**	.423**	.396**	.480**	.442**	.276**
DDF01	.343**	.257*	.356**	.259*	.249*	.317**	.307**	.469**	1.000	.600**	.731**	.551**	.414**	.322**	.273**	.365**	.451**	.385**
DDF02	.381**	.347**	.429**	.436**	.375**	.377**	.362**	.510**	.600**	1.000	.673**	.699**	.569**	.362**	.423**	.596**	.506**	.459**
DDF03	.296**	.260*	.380**	.271**	.326**	.347**	.257*	.402**	.731**	.673**	1.000	.686**	.439**	.391**	.355**	.438**	.326**	.396**
DDF04	.243*	.170	.351**	.380**	.298**	.338**	.303**	.385**	.551**	.699**	.686**	1.000	.727**	.432**	.414**	.519**	.316**	.465**
DDF05	.306**	.179	.416**	.296**	.231*	.125	.269**	.291**	.414**	.569**	.439**	.727**	1.000	.247*	.263**	.337**	.326**	.439**
FIN01	.316**	.239*	.126	.456**	.307**	.305**	.332**	.423**	.322**	.362**	.391**	.432**	.247*	1.000	.751**	.580**	.563**	.554**
FIN02	.262**	.079	.174	.459**	.135	.206*	.320**	.396**	.273**	.423**	.355**	.414**	.263**	.751**	1.000	.487**	.448**	.642**
FIN03	.527**	.438**	.336**	.490**	.454**	.603**	.524**	.480**	.365**	.596**	.438**	.519**	.337**	.580**	.487**	1.000	.604**	.346**
FIN04	.403**	.319**	.324**	.376**	.303**	.360**	.259*	.442**	.451**	.506**	.326**	.316**	.326**	.563**	.448**	.604**	1.000	.310**
FIN05	.276**	.058	.165	.426**	.235*	.130	.291**	.276**	.385**	.459**	.396**	.465**	.439**	.554**	.642**	.346**	.310**	1.000
FIN06	.370**	.307**	.405**	.501**	.156	.385**	.298**	.506**	.459**	.538**	.385**	.503**	.431**	.616**	.605**	.649**	.752**	.483**
ICT01	.597**	.631**	.383**	.555**	.514**	.430**	.446**	.364**	.372**	.354**	.306**	.174	.133	.242*	.143	.401**	.338**	.115
ICT02	.479**	.615**	.395**	.411**	.338**	.239*	.309**	.325**	.386**	.350**	.295**	.139	.157	.141	.014	.262**	.288**	.151
ICT03	.545**	.647**	.562**	.531**	.440**	.348**	.505**	.355**	.427**	.367**	.343**	.277**	.335**	.169	.106	.403**	.150	.257*
LAB01	.312**	.388**	.330**	.360**	.138	.308**	.221*	.498**	.281**	.255*	.179	.147	.180	.369**	.356**	.366**	.382**	.358**
LAB02	.461**	.471**	.327**	.469**	.346**	.482**	.313**	.464**	.351**	.326**	.264**	.298**	.251*	.517**	.332**	.539**	.639**	.283**
LAB03	.189	.095	.034	.164	.001	-.080	-.059	.055	.081	.266**	.073	.194	.341**	.209*	.352**	.178	.138	.377**
LAB04	.450**	.484**	.472**	.576**	.379**	.502**	.445**	.490**	.377**	.487**	.370**	.393**	.228*	.626**	.583**	.600**	.584**	.397**
LAB05	.317**	.265**	.370**	.389**	.223*	.180	.403**	.431**	.312**	.384**	.282**	.385**	.433**	.512**	.508**	.433**	.357**	.442**
MMF01	.457**	.442**	.290**	.452**	.164	.428**	.449**	.424**	.198	.207*	.077	.128	.093	.314**	.229*	.376**	.275**	.231*
MMF02	.283**	.359**	.324**	.327**	.128	.269**	.295**	.496**	.234*	.245*	.233*	.250*	.190	.415**	.327**	.242*	.309**	.344**
MMF03	.407**	.463**	.336**	.399**	.318**	.378**	.244*	.259*	.229*	.252*	.141	.194	.209*	.122	.046	.374**	.321**	.003
MMF04	.362**	.276**	.168	.532**	.217*	.329**	.391**	.421**	.139	.415**	.225*	.347**	.178	.434**	.524**	.421**	.232*	.387**
PMCA01	.332**	.371**	.523**	.470**	.453**	.476**	.361**	.523**	.458**	.491**	.519**	.447**	.355**	.281**	.200*	.419**	.284**	.399**
PMCA02	.199	.248*	.364**	.357**	.270**	.318**	.382**	.605**	.649**	.610**	.584**	.588**	.495**	.456**	.401**	.413**	.405**	.503**
PMCA03	.471**	.526**	.436**	.441**	.413**	.398**	.487**	.355**	.256*	.504**	.409**	.331**	.216*	.089	.210*	.381**	.098	.245*
PMCA04	.474**	.537**	.444**	.495**	.332**	.418**	.351**	.444**	.443**	.536**	.397**	.514**	.400**	.379**	.337**	.565**	.431**	.411**

	FIN06	ICT01	ICT02	ICT03	LAB01	LAB02	LAB03	LAB04	LAB05	MMF01	MMF02	MMF03	MMF04	PMCA01	PMCA02	PMCA03	PMCA04	MMF03
CSM01	.370**	.597**	.479**	.545**	.312**	.461**	.189	.450**	.317**	.457**	.283**	.407**	.362**	.332**	.199	.471**	.474**	.407**
CSM02	.307**	.631**	.615**	.647**	.388**	.471**	.095	.484**	.265**	.442**	.359**	.463**	.276**	.371**	.248*	.526**	.537**	.463**
CSM03	.405**	.383**	.395**	.562**	.330**	.327**	.034	.472**	.370**	.290**	.324**	.336**	.168	.523**	.364**	.436**	.444**	.336**
CSM04	.501**	.555**	.411**	.531**	.360**	.469**	.164	.576**	.389**	.452**	.327**	.399**	.532**	.470**	.357**	.441**	.495**	.399**
CSM05	.156	.514**	.338**	.440**	.138	.346**	.001	.379**	.223*	.164	.128	.318**	.217*	.453**	.270**	.413**	.332**	.318**
CSM06	.385**	.430**	.239*	.348**	.308**	.482**	-.080	.502**	.180	.428**	.269**	.378**	.329**	.476**	.318**	.398**	.418**	.378**
CSM07	.298**	.446**	.309**	.505**	.221*	.313**	-.059	.445**	.403**	.449**	.295**	.244*	.391**	.361**	.382**	.487**	.351**	.244*
CSM08	.506**	.364**	.325**	.355**	.498**	.464**	.055	.490**	.431**	.424**	.496**	.259*	.421**	.523**	.605**	.355**	.444**	.259*
DDF01	.459**	.372**	.386**	.427**	.281**	.351**	.081	.377**	.312**	.198	.234*	.229*	.139	.458**	.649**	.256*	.443**	.229*
DDF02	.538**	.354**	.350**	.367**	.255*	.326**	.266**	.487**	.384**	.207*	.245*	.252*	.415**	.491**	.610**	.504**	.536**	.252*
DDF03	.385**	.306**	.295**	.343**	.179	.264**	.073	.370**	.282**	.077	.233*	.141	.225*	.519**	.584**	.409**	.397**	.141
DDF04	.503**	.174	.139	.277**	.147	.298**	.194	.393**	.385**	.128	.250*	.194	.347**	.447**	.588**	.331**	.514**	.194
DDF05	.431**	.133	.157	.335**	.180	.251*	.341**	.228*	.433**	.093	.190	.209*	.178	.355**	.495**	.216*	.400**	.209*
FIN01	.616**	.242*	.141	.169	.369**	.517**	.209*	.626**	.512**	.314**	.415**	.122	.434**	.281**	.456**	.089	.379**	.122
FIN02	.605**	.143	.014	.106	.356**	.332**	.352**	.583**	.508**	.229*	.327**	.046	.524**	.200*	.401**	.210*	.337**	.046
FIN03	.649**	.401**	.262**	.403**	.366**	.539**	.178	.600**	.433**	.376**	.242*	.374**	.421**	.419**	.413**	.381**	.565**	.374**
FIN04	.752**	.338**	.288**	.150	.382**	.639**	.138	.584**	.357**	.275**	.309**	.321**	.232*	.284**	.405**	.098	.431**	.321**
FIN05	.483**	.115	.151	.257*	.358**	.283**	.377**	.397**	.442**	.231*	.344**	.003	.387**	.399**	.503**	.245*	.411**	.003
FIN06	1.000	.280**	.268**	.278**	.525**	.663**	.265**	.599**	.525**	.299**	.359**	.305**	.422**	.383**	.492**	.198	.536**	.305**
ICT01	.280**	1.000	.787**	.702**	.173	.368**	.189	.390**	.170	.207*	.238*	.400**	.366**	.268**	.324**	.408**	.489**	.400**
ICT02	.268**	.787**	1.000	.633**	.281**	.308**	.149	.345**	.123	.297**	.269**	.390**	.211*	.283**	.343**	.496**	.480**	.390**
ICT03	.278**	.702**	.633**	1.000	.224*	.277**	.232*	.312**	.293**	.304**	.253*	.402**	.224*	.454**	.356**	.532**	.538**	.402**
LAB01	.525**	.173	.281**	.224*	1.000	.637**	.277**	.529**	.541**	.429**	.223*	.167	.326**	.434**	.399**	.203*	.265**	.167
LAB02	.663**	.368**	.308**	.277**	.637**	1.000	.240*	.615**	.501**	.442**	.290**	.362**	.403**	.433**	.348**	.198	.371**	.362**
LAB03	.265**	.189	.149	.232*	.277**	.240*	1.000	.185	.282**	.154	.181	.196	.361**	.102	.194	.049	.326**	.196
LAB04	.599**	.390**	.345**	.312**	.529**	.615**	.185	1.000	.531**	.566**	.396**	.360**	.436**	.469**	.383**	.405**	.487**	.360**
LAB05	.525**	.170	.123	.293**	.541**	.501**	.282**	.531**	1.000	.276**	.349**	-.009	.397**	.334**	.513**	.216*	.329**	-.009
MMF01	.299**	.207*	.297**	.304**	.429**	.442**	.154	.566**	.276**	1.000	.505**	.426**	.345**	.425**	.100	.324**	.361**	.426**
MMF02	.359**	.238*	.269**	.253*	.223*	.290**	.181	.396**	.349**	.505**	1.000	.073	.520**	.179	.248*	.316**	.399**	.073
MMF03	.305**	.400**	.390**	.402**	.167	.362**	.196	.360**	-.009	.426**	.073	1.000	.142	.311**	.046	.282**	.396**	1.000
MMF04	.422**	.366**	.211*	.224*	.326**	.403**	.361**	.436**	.397**	.345**	.520**	.142	1.000	.213*	.276**	.276**	.439**	.142
PMCA01	.383**	.268**	.283**	.454**	.434**	.433**	.102	.469**	.334**	.425**	.179	.311**	.213*	1.000	.543**	.326**	.379**	.311**
PMCA02	.492**	.324**	.343**	.356**	.399**	.348**	.194	.383**	.513**	.100	.248*	.046	.276**	.543**	1.000	.297**	.434**	.046
PMCA03	.198	.408**	.496**	.532**	.203*	.198	.049	.405**	.216*	.324**	.316**	.282**	.276**	.326**	.297**	1.000	.403**	.282**
PMCA04	.536**	.489**	.480**	.538**	.265**	.371**	.326**	.487**	.329**	.361**	.399**	.396**	.439**	.379**	.434**	.403**	1.000	.396**

Table 9: Summary of correlation between factors of cost overrun

Factor	High Correlation	Moderate Correlation
Frequent design changes	• Incomplete design at the time of tender • Change in the scope of the project • Mistakes and errors in design	• Inadequate monitoring and control • Contractual claims, such as, extension of time with cost claims • Poor project management
Poor site management and supervision	• Incompetent subcontractors • Lack of coordination between parties • Inadequate planning and scheduling	• Lack of communication between parties • Financial difficulties of owner
Cash flow and financial difficulties faced by contractors	• Poor financial control on site • High cost of labour • Contractual claims, such as, extension of time with cost claims • Financial difficulties of owner • Delay in progress payment by owner	• Change in the scope of the project • Inadequate planning and scheduling • Equipment availability and failure • Shortages of materials
Lack of coordination between parties	• Slow information flow between parties • Lack of communication between parties • Incompetent subcontractors	• Inaccurate quantity take-off • Mistakes during construction • Inaccurate time and cost estimates
Inadequate monitoring and control	• Change in the scope of the project • Inaccurate time and cost estimates • Schedule delay • Poor project management	• Labour productivity • Shortage of materials • Shortage of site workers
Incomplete design at the time of tender	• Frequent design changes • Poor design and delays in design	• Delay preparation and approval of drawings • Delays in decision-making

5.0 Summary and Conclusion

This study has focused on assessing cost-overrun problems and their causative factors by taking the southern part of Peninsular Malaysia as a case study. Structured questionnaire was used to acquire information on the relative importance of cost-overrun factors amongst the contractors, consultants, and clients' personnel which has resulted in 97 valid responses. A descriptive statistical analysis was carried out using SPSS v.17 and the following findings were discovered:

- Cost overrun was a major issue in project's cost overrun as agreed by 96% of the respondents.
- The amount of cost overrun was commonly in the range of 5-10% of project's contract price.
- The most significant cause of cost overrun included the fluctuation in prices of materials, cash flow and financial difficulties faced by contractors, delay in progress payment by owner, frequent design changes, shortage of materials, and poor financial control on site
- The most critical contributors to cost overrun were associated with material

problems, financial issue, and design and documentations.

- Frequent-design-changes factor was highly correlated with incomplete design at the time of tender, change in the scope of the project, mistakes and errors in design while it was moderately correlated with inadequate monitoring and control, contractual claims such as, extension of time with cost claims, and poor project management
- Cash flow and financial difficulties faced by contractors were highly correlated with poor financial control on site, high cost of labour, contractual claims, such as, extension of time with cost claims, financial difficulties of owner and delay in progress payment by owner and were moderately correlated with change in the scope of the project, inadequate planning and scheduling, equipment availability and failure and shortages of materials.
- Effective material management, efficient resource planning and management, proper financial management and standardized design method should be adopted for cost control of project.
- The use of locally available material and stabilizing cost material can be effective in controlling project cost.

What are the implications of this study on construction industry practice?

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