Delays and Cost Overruns Causes During Construction of Palm Oil Refinery Projects

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Abstract. Delays and cost overruns are obviously common problems in the construction industry in several developed and developing nations. The purpose of this study is to identify factors cause delays and cost overruns in the construction of palm oil refinery projects in Malaysia. A questionnaire survey of a randomly selected sample was filled by 89 respondents. The questionnaire included 179 factors which classified into 13 groups. The degree of importance of the delays and cost overrun factors were evaluated and ranked by importance degree, based on the viewpoints of stakeholders. The data was analytically investigated by descriptive statistic methods and Relative Important Index (RII). The results of RII showed that Delays in subcontractor's work, Lack of subcontractor skill, and Poor/inadequate planning and scheduling with RII 0.78, 0.77, and 0.75, respectively, are the most important causes. These causes represent the baseline margin for project management of palm oil refinery construction and development. According to these results, it is suggested that: project client should collaborate with contractors and simplify payments procedures to mitigate delays; coordinate continuously and enhance the association among project stakeholders are obligatory in order to improve the project performance.

1 Introduction

Progressing of construction projects within predicted cost and planned timetables need sound strategies, worthy performance, and cautious decisions. Time and cost are the main worries to all project stakeholders and an issue of incessant argument and investigation. In spite of the displease of project stakeholders, several projects suffer from large delays and cost overrun. The gap between the cost and time at completion and that originally estimated budget and duration, known as the cost overrun and delay respectively, are regarded as one of the utmost important parameters reflecting project performance. Currently, due to the wide usage of sophisticated equipment and new construction approaches, construction projects are most complicated. Because of this complication, several projects suffer from the low performance which might not certainly cause project failure, but may intensely limit the chance of project success [1]. This problem is more evident in the old-style or combative kind of contracts in the majority of palm oil refinery construction projects in Malaysia. Hence, there is a need for a study to understand the reasons and factors affecting the project cost and time performance [2, 3].

This research focuses on the delay and cost overrun of palm oil refinery construction projects. Understanding of this problem which faces the builders of the palm oil refineries is critical as it affects the project final state. Palm oil industry is a very competitive sector, giant companies vying each other through better technology, best practice, and the efficiency of their assets [4-6]. Malaysia exports 46% of the world palm oil making it the world's largest exporter of palm oil and produces 39% of the world's palm oil [7]. Commonly the typical refinery construction project execution is managed in 3 major phases; (i) Pre-Contract, (ii) Execution/Construction Stage and (iii) Post Contract. This study particularly focuses on the construction phase. Identifying root causes of the low performance clearly can affect the pricing of the project and will be able to change the approach of designers, consultants and contractors, in turn, can also have a clear information about each party requirements [2, 8]. Therefore, the aim of this study is to identify the most important causes of delay and cost overruns during palm oil refinery projects construction.

A questionnaire was prepared based on causes of delay and cost overrun identified through a literature review. Responses were obtained from owners/operators, consultants, proprietary suppliers and contractors using the Likert scale. This created the basis of needs to rank the causes, based on frequency and impact so it can be prioritized and tabulated based on important. Identifying the utmost important delay and cost overrun factors will help in improving the current low-performance status of the palm oil refinery project. Future refinery builders are expected to grasp more understanding on embarking on such complex project to improve the construction plan performance through risk assessment and efficient planning.

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2 Literature review

Time and cost are two frequent problems of construction management and happen in a lot of construction projects, though, the extent of these delays and cost overruns differs significantly from project to project. Notwithstanding it's proven that most of the construction projects suffer from cost overrun when executed. Therefore, it is important to unearth the key factors of delay and cost overruns to be addressed [9, 10]. Numerous factors associated with delay and cost overruns are located in several types of projects because of the fragmented and complicated environment of construction, several issues could arise through the stage of construction [11, 12].

Palm oil refinery construction projects are large projects with complex context and large investment which attracted many researchers to address main concerns of cost and time management techniques and proposing novel procedures for project control [13]. Based on Kaming, Olomolaiye [14] time and cost overrun are a common issue in the large project in Indonesia. He recognised that only 54.5 % of project managers finished their projects that they handled on time. Likewise, he identified only 51.7% of project managers said that their projects were finished within estimated budget. It has been discussed that it is essential to generate awareness of the causes of project timetable delays, which adversely affect project delivery. The main reasons for this problem required to be addressed to suggest appropriate contingencies and mitigations. This study reviewed the available literature to provide a clear and precise understanding of the factors causing time and cost overrun in construction projects.

Time overrun is the delay afar the planned completion times perceptible by the contractors. Ameh and Osegbo [8] deliberated that, the delay is the lapse between the approved estimation or end data and the real date of the end. Delays can be taken to be “incidents” which influence a project’s growth and defer project activities. Delay could be produced by any party to the contract and could be a straight outcome of one or more conditions e.g. unavailability of resources, design delays, unforeseen conditions, etc. Project delay has an adversarial impact on both the owner and the contractor (either in the form of reducing profits or additional costs) and it frequently increases the contentious concern of responsibility for the delay, which can consequence in dispute. Memon, Rahman [15] identified that in a context of alteration, the recognised time and cost goals of the construction project activities rarely to begin and finish precisely as planned or within cost. Variations will unavoidably appear as the project growths. Accordingly, the project dependency network should be modified as required, and controls should be updated occasionally so that the actual project schedule and the cost spending will reflect the real job experience to date [16].

Cost overrun is the excess of real cost over planned budget. The degree of cost overruns can be compared by measuring the variation in contract price divided by the original contract price. This figure can be transformed into a percentage for simplicity of evaluation. The project cost control is based on pre-contract estimate and cost plan. The project cost estimation includes recognising the needed resources, estimating the cost of those resources, emerging a project baseline according to the budget. Besides, it also includes in applying a cost control scheme, issuing cost status, investigating cost performance, defining variations to the cost baseline, handling the variations and making corrections. In the study led by Kometa, Olomolaiye [17] the factors related to cost overruns in the UK construction industry were illustrated. He discussed that the most precise budget prediction should be done with the comprehensive design material and the highest risk is driven by the design change made by the client. He further recommends spending more time in the pre-construction phase of the project to obviously describe the scope of a project and its difficulty level. Hamzah, Khoiry [18] implemented a qualitative research using semi-structural interview about main factors leading to cost overrun in the big construction projects in Malaysia. They concluded that most important contributory factors were associated with contractor’s site controlling, data and communication and financial controlling. Average index method was used to analyse the data to assess fifty-nine factors that are reflected construction cost. As an outcome, inaccurate design and delays in design scored the highest rank among the factors leading to construction cost overrun. The succeeding factors are also recognized as important factors causal the cost overrun in stage construction of the large projects: unrealistic contract time and requirements enforced; lack of practice; late transfer of materials and equipment; and the connection among management [3].

As stated by Chan and Kumaraswamy [19], the foundation for project time controlling is an existing working plan and timetables that are consonant with established project time schedule. Odeh and Battaineh [20] discussed that project time schedule is used for an efficient early warning tool for identifying when and where the project possibly will be falling behind the timetable. On the other hand, it is useful for inspection and evaluating the progress of the work and to do whatever action needed, either to bring the project back on schedule or to adjust the timetable to reproduce new work situations. In 2003, Fugar and Agyakwah-Baah [21] conducted an investigation about causes of delay and cost overrun in construction projects in Ghana. They identified 26 cost and time persuading factors, through a questionnaire which was distributed to three segments of owners, consultants, and contractors participating in construction projects. The results demonstrated that the three groups of respondents illustrated that the top five factors are “*monthly payment difficulties from agencies, poor contractor management, material procurement, poor technical performances and escalation of material prices”*. Inefficient site controlling and organising, unforeseen ground circumstances, low speed

of decision making linking all project stakeholders, client-initiated changes and essential variations of works were specified by Chan and Kumaraswamy [19] as factors for time and cost overruns in Hong Kong. Mansfield, Ugwu [22] studied the important factors accountable for delays and cost overruns in construction projects in Nigeria like inefficient contract management, material scarcities, inaccurate assessing and overall price variations. The most important delay and cost overrun factors on the word of contractors were "*preparation and approval of shop drawings, delays and cost overrun in contractors' progress, payment by owners and design changes by owner*".

Despite the large number of research on the causes of delays and cost overruns in construction projects, few research has been conducted specifically for palm oil-related projects whilst Malaysia being the biggest stakeholder for the world's refined palm oils. There is very limited information on the palm oil refinery construction projects. Most of the information retrieved is highly confidential due to the nature of the industry and corporate company protocol. It is commonly known that on-going palm oil refinery projects will not share their problems due to their declaration of secrecy contract with their employer and client.

3 Research Methodology

In order to achieve the study objectives, a two-stages descriptive survey method has been adopted to collect a numerical data represent the perspective of participants which is steady with the exploratory nature of the study [23]. The sampling approach for the data collocation included the key stakeholders of palm oil refinery projects in Malaysia. In the first phase, interviews were conducted with a convenience sample of 3 contractors and 3 project managers that were keen to dedicate time for in-depth dissuasion and interviews. Ideas produced during the interviews led to design close-ended questionnaire to be used for the second phase quantitative data collection. In the pilot study stage, the questionnaire was pretested for before being distributed to the selected sample. This assisted to enhance the quality of the questionnaire and increase the response rate. All proposed advice and comments from the pilot study were considered and discussed. The previous methodology led to the final data collection stage using the questionnaire survey as shown in Figure 1:

Earlier studies about time and cost controlling in many countries discussed in literature review, were considered as benchmark to make the pilot study [2, 9, 24]. A comprehensive list of delays and cost overruns causes was compiled. It was found that around 179 factors caused the time and cost overruns in large construction projects in several states around the world and at different points in time.

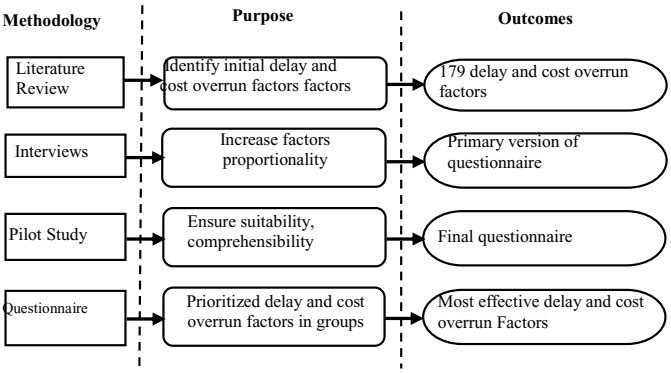

Fig. 1. Research framework of the study.

However, not all of these factors are reliable for the circumstances in the palm oil refinery projects in Malaysia, e.g. the economic scope, the category of projects and geographical area. Therefore, factors commensurate with the nature of palm oil refinery construction projects were from the above 179, shortlisted for this paper. Adjustments and different questions were included as a consequence of the interviews with qualified contractors to suit the local construction business in Malaysia. Based on the previous studies and personal interviews, the causes are grouped into 13 categories: (G1) project-related factors; (G2) client related factors; (G3) consultant/design related factors; (G4) contractors related factors; (G5) labour related factors; (G6) plant/equipment related factors; (G7) sub-contractor related factors; (G8) planning related factors; (G9) material related factors; (G10) contract related factors; (G11) financial related factors; (G12) co-ordination related factors; and (G13) other related factor. The questionnaire was comprised of two main sections. For section 1, there are questions related to the respondents' profile and the organizations' characteristics. Section 2, included 13 groups assigned to the delay and cost overrun factors. The targeted population of this study as specified in the scope is the contractor, consultant, owner and proprietary supplier which includes large and complex construction projects. The total numbers distributed to contractor, consultant, owner and proprietary supplier were 50, 33, 37, and 20 questionnaires, respectively, of which 89 were returned. Based on the collected data, RII and mean were

calculated to show what factors had a greater effect on project performance and lead to time and cost overrun in palm oil refinery construction projects. The questionnaire has been validated by the criterion-related reliability test which accesses the correlation coefficient among the factors influencing the time and cost overrun of palm oil refinery construction projects in one field and the whole field, and structure validity test (Spearman test).

3.1 Structure validity of the questionnaire

Structure validity is the statistical check applied to exam the validity of the questionnaire structure via calculating the validity of every field and the validity of the whole questionnaire. It computes the correlation coefficient between one group and all other groups of the questionnaire that have similar Likert scale [25]. Table 1 shows the correlation coefficient for each group of the time and cost overruns and the whole questionnaire. The P-values (sig.) are less than 0.05 or 0.01, so the correlation coefficients of all the group are significant at a 0.01 and it can be said that the groups are valid to check what is intended to fulfil the objectives of the research.

Table 1. Correlation Coefficient of time and cost overrun.

Group	Spearman Correlation Coefficient	P-Value (sig.)
Project Related Factor	0.950	0.000*
Client Related Factor	0.845	0.000*
Consultant/Design Related Factor	0.924	0.000*
Contractors Related Factor	0.781	0.000*
Labour Related Factor	0.885	0.000*
Plant/equipment Related Factor	0.791	0.000*
Sub-Contractor Related Factor	0.823	0.000*
Planning Related Factor	0.921	0.000*
Material Related Factor	0.765	0.000*
Contract Related Factor	0.896	0.000*
Financial Related Factor	0.841	0.000*
Co-ordination Related Factor	0.832	0.000*
Other Related Factor	0.792	0.000*
Correlation is significant at the *0.01 level (one-tailed)		

3.2 Reliability of the questionnaire

The reliability of the questionnaire was examined to realize whether it was suitable of getting alike results if respondents filled it in again. Cronbach's alpha was applied to check the reliability of the questionnaire. The reliability of a tool is the level of consistency with which it checks the feature it is supposed to be checked [26]. A smaller amount of variation the tool has in repeated measurements of a feature, the greater its reliability. Table 2 presents high values of Cronbach's for every group of the questionnaire and the whole questionnaire; and indicates the high reliability of each group of the questionnaire, as well as high reliability for the whole questionnaire [6].

Table 2. Cronbach's alpha for each group of time and cost overrun factors.

Group	Cronbach's α
Project Related Factor	0.842
Client Related Factor	0.875
Consultant/Design Related Factor	0.946
Contractors Related Factor	0.939
Labour Related Factor	0.875
Plant/equipment Related Factor	0.921
Sub-Contractor Related Factor	0.857
Planning Related Factor	0.940
Material Related Factor	0.897
Contract Related Factor	0.939
Financial Related Factor	0.918
Co-ordination Related Factor	0.953
Other Related Factor	0.953

The outcomes were in the ranges of 0.840 and 0.953. This range is reflected high reliability, and this assures the quality of the questionnaire [19]. Cronbach's equals 0.911 for the whole questionnaire indicating a very good overall reliability. It can be concluded that the questionnaire was valid, reliable, and complete for distribution to the targeted sample [26].

3.3 Relative Importance Index (RII)

The relative importance index (RII) technique was used herein to calculate owners, consultants, contractors and proprietary supplier insights of the frequency and impact of the identified time and cost overrun factors. The RII was computed as in Equation 1:

$$\mathbf{RII} = \frac{\sum W}{A*N} = \frac{5n_5+4n_4+3n_3+2n_2+1}{5N} \quad (1)$$

where W is the weight given to every factor by the participant and ranges between 1 and 5; A is the highest weight = 5; N is the total number of respondents [3].

After calculating the RII for the frequency and the impact of each factor, the mean value of both of them was calculated to express the final important level of the factors. The rank was decided based on this final mean value.

4 Findings and Discussions

4.1 Respondents' Profiles

Invitations for the questionnaire survey targeted sample were distributed to 140 participants according to sampling research criteria. By the cut-off date set for the questionnaire, 89 valid questionnaires were collected; this covered around 63.50% reply percentage. Majority of the responses (i.e. 38.20%) were from contractor party. An Exhaustive analysis of the demographic profiles of the participants showed that most of them (i.e. 64%) have high experience (10 years or more) in the construction industry. The profile of the respondents is shown in Table 3 added confidently to the quality level of the response and the results of the research.

Table 3. Respondents' profiles, frequency and percent.

Profile alternatives	Frequency	Percent (%)
Type of organisation		
Owner	24	27.00
Consultant	17	19.10
Contractor	34	38.20
Proprietary Supplier	14	15.70
Years of experience (years)		
Less than 5 years	10	11.23
5 to 10 Years	15	16.85
10 to 15 Years	35	39.32
15 to 20 Years	20	22.47
More than 20 Years	9	10.11

4.2 Causes of delay and cost overruns

The aim of this research is to identify the causes of delay and cost overruns in the palm oil refinery projects within the Malaysian construction industry. This aim was achieved using a systematic review of the appropriate literature and adapted through the pilot study phase, where 176 cases were recognised.

Outcomes from the RII analysis and mean scale alignment above were understood as the major to the minor reasons of time and cost overrun issues. The mean results are ranked from the highest to the lowest value where the highest mean result interpreted as the major causes and the lowest mean result considered as the minor reasons. Finally, the rank of the most important 32 factors is as shown in Table 4.

Table 4. The final most important time and cost overrun factors with rank.

Grp.	Factors	Frequency	severity	Important	Rank
G1	Site Condition	0.584	0.66	0.62	30
	Poor access to the construction site	0.583	0.778	0.68	28
G2	Client-initiated variations/design change	0.667	0.737	0.7	14
	Unrealistic time/contract durations imposed by client	0.609	0.765	0.69	21
	Slow-decision making by owners	0.638	0.779	0.71	10
G3	Additional work	0.73	0.755	0.74	4
	Design delays	0.6	0.784	0.69	22
	Slowness in decision making / approval	0.638	0.756	0.7	16
G4	Poor contractor management	0.602	0.773	0.69	25
	Late delivery or slow mobilization	0.610	0.83	0.72	6
	Shortages of personnel/staffing problems	0.606	0.804	0.71	12
G5	Labourers/tradesman shortages	0.636	0.811	0.72	9
	Low productivity	0.602	0.802	0.7	19
G6	Insufficient equipment	0.611	0.793	0.7	20
	Late delivery of equipment	0.582	0.775	0.68	29
G7	Delays in subcontractor's work	0.689	0.874	0.78	1
	Unreliable supplier/subcontractor	0.620	0.820	0.72	8
	Lack of subcontractor skill	0.662	0.869	0.77	2
G8	Poor/inadequate planning and scheduling	0.669	0.822	0.75	3
	Poor judgment/inaccurate in estimating duration and resources	0.584	0.66	0.62	31
G9	Damaged materials	0.667	0.737	0.7	15
	Delay of material delivery to site	0.638	0.779	0.71	11
G10	Policy in bidding tender to the lowest price	0.730	0.731	0.73	5
	Undefined / Inappropriate scope definition	0.600	0.784	0.69	23
G11	Delay or non-payment to supplier/ subcontractor	0.478	0.725	0.6	32
G12	Low morale/ motivation	0.613	0.76	0.69	24
	Lack of communication between the parties	0.638	0.756	0.7	17
G13	Problems with neighbours	0.602	0.773	0.69	26
	Unavailability of utilities in site (such as water, electricity, telephone, etc)	0.586	0.786	0.69	27
	Delay in providing services from utilities (such as water, electricity)	0.610	0.83	0.72	7
	Poor economic conditions (currency, inflation rate, etc)	0.606	0.804	0.71	13
	Fraudulent practices and kickbacks	0.608	0.795	0.7	18

As indicated in Table 4, the sub-contractor related group (G7) have been ranked in the first (*Delays in subcontractor's work*) and second (*Lack of subcontractor skill*) rank with RII 0.78 and 0.77, respectively. This group is the greatest important group for the contractor since most of the project work packages are broken-down based on specialization to be conducted. It is not unexpected to detect that the sub-contractor related group is one of the most significant groups as the stakeholders stated on capability growth amongst sub-contractor and belonging to work effectively affect production, cost, and time performance. This factor expresses the contract and procurement significance. This outcome is harmonized with Yang and Yang [24] results as delays in subcontractor's work during project execution is a vital factor for owners and contractors in Indian construction projects. Probably, this is for the reason that resource readiness as the planned timetable can enhance time management of the project.

The third rank factor (*Poor/inadequate planning and scheduling*) is from the planning related factors (G8) with RII 0.75. Material and equipment expenses is one of the project cost segments which affect clients cash flow and project budget. The outcomes do not bring into line with Memon, Rahman [15] and Sambasivan and Soon [1] as poor/inadequate planning and scheduling infrequently impact the cost performance of Indian and South African construction projects, respectively. This can be justified by dissimilar economic and political situations.

The fourth rank factor (*Additional work*) with RII 0.74 is from consultant/design related group. This factor straight effluences the project time performance participants managed as the design did not consent with the real situation. Once design variations occur, there is a supplementary/addendum effort; further work means further time needed to complete. The third and the fourth factors indicate the importance of the pre-construction stage preparation to grantee the smooth implementation and minimize the change orders during the construction stage. The unscrupulous project preparation affects the project performance negativity in term of cost overrun and delay.

Policy in bidding tender to the lowest price factor occupies the fifth position with RII 0.73 which is from contract related group (G10). Some of the lowest bidders can have deficiency management skills and not as much of consideration is paid to contractor's plan, cost control, the whole site controlling and resource distribution. Odeh and Battaineh [20] are in contract with this study result as this factor is very essential since it effluence powerfully on cost

and time management of construction projects. In addition, availability of personals with great experience and requirement lead to improved performance of time, cost, productivity, and safety of large construction projects.

In the contradiction, *delay or non-payment to supplier/subcontractor* factor, *poor judgment/inaccurate in estimating duration and resources* factor and site condition factor recorded the lowest rank with 0.60, 0.62 and 0.62, respectively. Cash flow is further vital for owners and contractors than for consultants since it could give a significant assessment for the owners' and the contractors' cost performance at every phase of the project. This factor can be deliberated as an essential and it has an alike rank for all parties as it affects directly on project performance such as time. On the other hand, if resources are not accessible as scheduled during project execution, the project will suffer from the issue of time and cost performance. Also, quality of equipment and raw materials in project and readiness of qualified personnel influence the quality performance of a project. In project site mobilization, most of the issues come from the municipal around the project site which did not support the project performance and project site may exist in the central of the public facility.

Furthermore, the study revealed that the performance of palm oil refinery projects can be enhanced via suitable planning, good leadership, and respectable communication. It was concluded that to enhance the performance of contractors on construction projects, suitable planning and scheduling, good management and continues coordination between the stakeholders must be enhanced.

5 Conclusion

One of the main obstacles disturbed the construction sector in Malaysia is poor time and cost performance. Determining and recognizing the main causes of time and cost overruns in the palm oil refinery projects that entice the highest quantity of investment is vital for enhancing the performance of the construction sector. In the unavailability of associated studies in Malaysia, this study purposes to fill an important knowledge gap by investigating and surveying the main causes of time and cost overruns in palm oil refinery projects. A comprehensive list of delays and cost overruns causes was amassed via literature review and a pilot study, which sought guidance from experienced construction practitioners. This process led to the identification of 176 factors that caused time cost overruns.

A total of 89 questionnaires out of 140 were collected back from the participant. The feedback from a questionnaire survey of the construction industry contractors, consultants, owners and the proprietary supplier was analysed using RII and mean value. Results showed that the first three principal contributors to time and cost overruns which were taken out from 176 factors: Delays in subcontractor's work, Lack of subcontractor skill, and Poor/inadequate planning and scheduling with RII 0.78, 0.77, and 0.75, respectively.

Based on the survey, a respectable technique/practices is required to control the project from procurement stage, construction procedure or performance until project objectives are achieved in order to reduce the delay and cost overruns. By concentrating accessible resources and influences on these main factors in relative to their degrees of influence, contractors, project managers and clients could minimize the time and cost overruns and enhance significantly the performance of the construction industry and its influence to the nation's economy. The results of this study can assist the construction sector to advantage improved sympathetic about the issues impacting budget of large-scale construction projects. By taking care of these potential factors in their future projects, construction managers can control time and cost growth in these projects no just in Malaysia, but in other countries.

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