Categorization of potential project cost overrun factors in construction industry

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Abstract. Cost overrun has been severely hit down the economy and reputations for many construction industry around the world. Many project management tools developed to control the budget of a project. However, the cost management is still considered poor as there are many cost overrun issues occurred in the construction industry. Thus, this paper aims to identify and cluster the potential construction project cost overrun factors according to their originating groups using the thematic approach. Basically, through literature review, all the potential factors that may cause cost overrun were screened thoroughly before they were clustered into seven (7) groups of the originating factors, namely project, contract, client, contractor, consultant, labour and external. Each potential factor was explained clearly with some examples based on the Malaysian case studies to illustrate the cost overrun scenario. These findings may aid in the future to highlight on how to mitigate the critical potential factors of cost overrun to reduce or overcome its impact on all the stakeholders involved.

1. Introduction
A construction project is conventionally designed by the consultants according to a client’s desire and it will be executed by the appointed contractors to build the desired design works. Poor cost control management in the construction industry may cause the project fails to meet its objective to complete the project on time and within the budget with expected quality. When an organization fails to manage the finance outflow of a project, then the final construction cost will tend to exceed its initial contract budget [1] as the cost of correcting error increases as the project goes along [2]. Cost control is necessary to ensure the money resource does not deplete during the project construction phase which could lead to unnecessary additional expenses to overcome the excess cost. Thus, it is necessary to conduct the post-mortem on construction projects to provide lessons for continuous improvement in project performance [3]. Most of the studies put a great effort to identify and evaluate the potential factors that may have caused the construction cost to overrun in the last decades [4-6] and some other related their studies on the effect and cause of the cost overrun factors [7, 8]. However, a deeper understanding is necessary to understand the originating factors of the poor cost management in the construction industry. Therefore, this paper focuses on identifying and clustering the potential cost overrun factors according to their originating groups through literature reviews to clearly understand how the cost performances of the construction project are actually being affected. Based on the clustering, a few examples of cost overrun scenarios were included to illustrate the impact of cost overrun on Malaysian construction industry.

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2. Related works
An extensive literature on the construction project cost overrun factors has been reviewed internationally. Cost overrun crisis exists in both developed and developing countries for a very long time [9]. Most of the studies figured out that more than 50 cost overrun factors are the most commonly exposed to the construction industry [10-12]. Delay in schedule and increase in the cost are the two common concerns in the worldwide construction projects. According to [13], time and cost overrun factors are inseparable since the extension of time normally leads to the overrun of cost.

Different researchers share different opinions on the poor cost performance factors. The Malaysian construction projects were reported to experience the overruns (time and cost) by 92% [14]. At least about 90% of the People’s Trust Council (MARA) large construction projects have been facing delay in a large scale since 1984 [7]. Some blamed the poor working enthusiasm of the lower grade contractors who do not have proper planning on their cost control strategy, as the general cause of their failure to achieve the project’s objectives in completing within budget, quality and time [15, 16]. Meanwhile, another portion pointed out that most of the construction industry nowadays had undergone extensive complexities in terms of convoluted design, adopting advanced technologies as well as new standards leading the organization fail to manage their finance [17]. Another study emphasized that the final cost of a project turns uncertain if the size and nature of the project are larger and complex [18] and one such example is the road or highway construction projects. Unpredictable geographical location or project topology, bad weather and inaccurate site investigations are the most common factors faced by the contracted project parties for infrastructural projects [18]. This study is even similar with the analysis survey conducted by [19] on large construction projects in Malaysia and with an international comparative assessment analysis performed by [20] on the electricity infrastructure.

Cost overrun factors can be categorized into several groups. The group of cost overrun factors can be adapted from [21], for instance, (i) non-compensable factors (unavoidable circumstances faced by the project parties due to involvement of external parties or environment) and (ii) compensable factors (circumstances that can be avoided by parties from causing cost overrun). Meanwhile in another study which is concurrent with the study of [22], [23] also categorized the factors into two similar groups, but they differentiated the groups as (i) internal cause (circumstances caused by the construction stakeholders itself) and (ii) external cause (unavoidable circumstance that occurs beyond the control of the parties involved). In present days, a group of researchers had refined and categorized the factors into several groups based on the causative factors of the cost overrun factors as tabulated in table 1.

Table 1. Categorization of cost overrun factors by previous researchers.

<table>
<thead>
<tr>
<th>Sources</th>
<th>Groups of causative factors</th>
<th>Number of groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Le-Hoai et al. (2008)</td>
<td>Owner, consultant, contractor, material/labour, project and external</td>
<td>6</td>
</tr>
<tr>
<td>Ameh et al. (2010)</td>
<td>Environmental, construction, construction item, cost estimation and financing</td>
<td>5</td>
</tr>
<tr>
<td>Aziz (2013)</td>
<td>Owner, designer, contractor, miscellaneous</td>
<td>4</td>
</tr>
<tr>
<td>Derakhshanalavijeh &amp; Teixeira (2017)</td>
<td>Owner, consultant, contractor, project, and material/labour</td>
<td>5</td>
</tr>
<tr>
<td>Niazi &amp; Painting (2017)</td>
<td>Client, contractor, consultant, labour, material/equipment and external</td>
<td>6</td>
</tr>
<tr>
<td>Zewdu &amp; Aregaw (2015)</td>
<td>Cost estimation, construction item, project participant, environmental and financing</td>
<td>5</td>
</tr>
<tr>
<td>Polat et al. (2014)</td>
<td>Contract, time, cost, quality, human resource, communications and risk</td>
<td>7</td>
</tr>
</tbody>
</table>

3. Research method
An extensive literature on the common factors influencing the project cost overrun in construction
industry all over the world has been reviewed. In order to fully comprehend the meaning of each causative factor of cost overrun found in the literature, it is extremely important to relate them in the context of construction project management activities throughout the construction project life cycle. The causative factors are then clustered and classified carefully into its associated groups. Based on the aforesaid Table 1, using the thematic approach, the classification or taxonomy of groups of the causative factors have been refined and presented in Table 2 to fit into seven (7) main categorizations as shown. The frequency of the repetitive originating factors is taken into consideration to understand which group well as which originating factor within its associated group is mostly referred to by previous researchers. Based on Table 2, the descriptions of the related causative factors are delineated as the followings:

Table 2: Categorization of the cost overrun originating factors’ group.

<table>
<thead>
<tr>
<th>Originating Groups of Potential Cost Overrun Factors</th>
<th>References</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Le-Hoai et al. (2008)</td>
<td>x x x</td>
</tr>
<tr>
<td></td>
<td>Ameh et al. (2010)</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Azz (2013)</td>
<td>x x x x x</td>
</tr>
<tr>
<td></td>
<td>Derakhshanalavijeh et al. (2017)</td>
<td>x x x</td>
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<tr>
<td></td>
<td>Nazi (2017)</td>
<td>x x x x x</td>
</tr>
<tr>
<td></td>
<td>Zewdu et al. (2015)</td>
<td>x x x x x</td>
</tr>
<tr>
<td></td>
<td>Polat et al. (2014)</td>
<td>x x x</td>
</tr>
</tbody>
</table>

4. Potential cost overrun factors

4.1. Project-related factors (PF)

This group defines the uncertainties of project complexities that is being noticed or faced by the contracted parties only after the contract has been signed [20]. The uncertainties of a project normally happen due to the presence of unforeseen circumstances during the project life cycle. However, it can be controlled in the early stages with proper investigations and communications among the construction stakeholders. Unresolved project uncertainties may cause extension of time which directly can affect the cash flow. The sudden eruption of disputes due to miscommunication or relationships problem among the contracted parties are also one type of unexpected uncertainties that may occur during a construction project.

The design drawings are always based on the client’s requirement, the scope of a project, nature of the project and also geographical location of the project [24] and they are projected by the architects or consultants. The complications and complexities in the design drawings [12, 25] which is noticed only during the construction phase may unexpectedly lead to a different level of technologies to be adopted to construct the structure [24]. For example, hydroelectric projects or the large construction projects are commonly known for the complexity and such cases have been reported in the Bakun Hydroelectric Project in Malaysia to have undergone cost overrun against its budget around US$ 3916 million which is averagely about 417% [20]. It was ranked as the second highest cost overrun project after the India’s Sardar Sarovar Dam in Gujarat (i.e. cost overrun around 513% amounting to US$ 6773 million) [20]. Site layout and land acquisition [24, 26] are one of the
uncertainty factors that cause schedule slippage in the start of a construction project [18, 27]. Unexpected location difficulties [8, 24] and orientation of the road approach to the site entrance may cause site mobilization difficulties leading to an increased cost for the transportation services [27, 28]. These factors are the subset of an inappropriate choice of site selection [6, 27]. On the other hand, land acquisition problems mostly occur in larger construction projects such as roads, bridges, airports and railway constructions. For example, the area of Kuala Lumpur International Airport 2 (KLIA 2) was revised and extended from 150, 000 sqm. to 257, 000 sqm. during the construction phase with an increase of 71% construction area [29]. The authority made last minute decision to increase the passenger capacity from 30 million to 45 million causing delays in the construction as they had to face site acquisition problems on the reclaimed lands. The inefficient planning made by the authority causes the extension of time about two years with the project cost overrun around RM1.6 billion [29, 30].

4.2. Contract-related factors (CF)

This group defines the contract agreement process involved in a construction which directly causes the cost overrun. This happens due to the involvement of irresponsible contractor, consultant and client when signing up on an agreement. The over-budget cash flow usually starts from the tendering process itself due to the improper contract rewarding process by the consultants on behalf of their client. Awarding the lowest price tender are highly encouraged by the tendering system (procurement legislation), however, the price bid must be sensible and optimized by ensuring it fully covers the technical content of the project. Some contractors will go to all lengths (omitting the realistic figure that may cost the total project completion) just to win the tender without acknowledging the consequences of their actions by submitting the lowest bid [12, 26, 31, 32]. These type of contractors are cunning and smart enough to take the opportunities to exploit the weaknesses in the system since there is no framework for tendering mechanism and it totally depends on the market competition. The contractors know that many changes will arise in future and contractual claims such as the extension of time with extra cost claims can be claimed from the clients to cover the omitted realistic figure [8, 12, 32].

4.3. Client-related factors (CiF)

This group defines the cost overrun factors that occurs only because of the clients. For instance, design changes [24-26] or scope changes [12, 24-26] in a project normally occurs due to the interference of clients during constructions [25, 26, 31]. Any changes caused by the clients, normally, something that is acceptable if the clients have the money resource to support the changes and the contractors can claim the cost once the desired changes have been made. Another matter to be considered is that any changes related to the designs would take a lengthy period to make decisions among all the parties involved [25, 26], extra time would be needed for improvements to be made in the standard drawings [6], extra time to re-evaluate the design and will lengthen the delays in drawings approval [8, 12, 26]. Once the contractor received an approved standard redesigned drawing, additional work [8, 12, 24, 25] or rework [12] on the project would take place. Eventually, it would result in overtime issues [12, 26] in order to complete the project on schedule and the extra cost spent on the changes will be reclaimed from the clients by the contractors through contractual claims. Thus, this is an example of the sequence flow on how an actual contract sum differs from the final account of a project. Besides that, changes in owner’s brief [6, 26] could also lead to late decision makings [25, 26] and disputes among project participants [12, 26]. The longer the delay in decision making, the higher the chances for project schedule delays and cost overrun.

4.4. Contractor-related factors (CtF)

This group defines the cost overrun factors that are caused by the contractors. For example, it is the contractor’s responsibility to ensure the capability, capacity and productivity of the equipment is in compliance with the job requirement prior to the commencement of the construction phase to achieve
the highest level of job completion in a shorter period. Utilization of wrong equipment (i.e. productivity of equipment) may cause the rate of production to be lower than expected during the construction phase [12, 26]. Mishandling of equipment [26] and misuse of materials [26] may cause the generation of waste at the site. These issues occur due to the poor monitoring at site [8, 12, 26] by the appointed site supervisor. In addition, inadequate quality assurance of a project [12, 24, 26] may end up to be the main factor for the waste generation at the site. The contractors may compromise with the quality of works due to their benefit realization [6] by using low quality materials [12] or reduce the quantity of material use below its specification as stated in the design (i.e. fraudulent) [12, 24, 26] causing the construction work to lose its strength and lead to additional works [6, 12, 31] or reworks [12].

4.5. Consultant-related factors (CsF)
This group defines the occurrence of cost overrun factors under the consultant responsibility. Referring to the earlier example of MRT project case as reported by [33], the involvement of incompetent and inexperienced parties, especially the consulting agencies engaged in examining the ground conditions are one of the causes of cost overrun of a particular project. The consultants assumed that the contractors could manage the ground works by piling onto the “very hard, strong rock” ground condition. Unfortunately, their assumptions failed them. The implications due to their assumptions were reworked, change in the usage of technology, delay in schedule and re-measurement of provisional works causing the project to undergone an extensive cost overrun. Apart from that, incomplete design drawings at the time of tender [8, 12] shows the poor management of consultants which lead to inaccurate cost estimation at the time of preparing tender [6, 8, 12, 24]. Delay in reviewing the design document by consultants would also lead to schedule delays and cost underestimations [6, 8, 12, 27]. Another factor that can affect the schedule delay during the design phase is lack of required data for the consultants to proceed with the design drawings [25]. The longer the delay in design, the higher the chances for project cost overrun. Poor design drawings [8, 12, 25], provision of ambiguous design details [24, 25], impractical and complicated designs [12, 26], inaccurate site investigation [12] are some of the indicators of inadequate consultant team’s experience.

4.6. Labour-related factors (LsF)
This group defines the cost overrun factors that are caused by the labours. For example, labour productivity [6, 8, 12, 24] is one of the essential requirements to ensure the success of projects in the construction industry. Without active labours, the construction could not achieve its objective to deliver on time within its contracted budget. Inexperienced labours with poor skills in work may produce a very low quality of work. Besides that, labour absenteeism [8, 12] shows the morale of workers towards the working ethics. The absence of labours at the site can be redefined as shortages of labours [6, 8, 12, 24] which directly affects the productivity of work. This directly leads to schedule delays and cost overrun. Apart from that, normally the contractors who won contract awards for the lowest tender bid may try to reduce the salary payment for site workers. This would affect the site worker’s motivation to perform better [26]. Another point worth to be noted is the cultural clash among the labours [6, 8, 12, 24]. Most of the construction industries nowadays are hiring to the foreign labours. Multiple races from different countries with different lifestyles and attitude may cause frequent arguments among them. The poor relationship among them may also cause the productivity of the construction work to turn low. Besides that, problems chaining from the financial difficulties by the clients or contractors may subsequently end up in labour strikes [12, 26]. The construction work will be abandoned till the payment is being made.
4.7. External-related factors (EF)
This group defines unexpected circumstances causing cost overrun that occurs beyond the control of construction stakeholders such as nature controlled related factors, law, and regulations related factors, or even other environmental related factors.

Such example of nature controlled related factor is the act of nature [8, 12, 24, 26] which may cause the construction work to be stopped immediately causing schedule delay and cost overrun such as weather changes, earthquake, floods and so on.

Examples of law and regulation related factors are the delay in approvals from the local authorities [26]. Refreshing to the aforesaid case study on the construction of Universiti Malaysia Kelantan, the delay in submission of the application for a time extension was not the only factor that caused the time overrun. In actual, the delay was even further prolonged by late approvals from the local authority by about 176 to 445 days [29]. The late approval from the local authority may have been caused by the law and regulatory framework of a country [12, 26]. The authority has to follow all the necessary procedures to approve the applications. The approval may even be longer if it is a public construction project. Examples of other environmental related factors are inflations [12, 24, 26] and instability of economy [6, 8, 12, 26] which may indirectly affect the construction projects all over the country. In Malaysia, [34] reported in short on the impact of financial crisis towards the construction of The Plaza Rakyat building such that “The RM1.4bil mixed-commercial development was 30% complete about 15 years ago when the developer, Plaza Rakyat Sdn Bhd (PRSB), ran into financial difficulties during the 1997/1998 Asian financial crisis”. The labour, material, equipment and transportation cost [6, 8, 12, 26] would turn unpredictable during the construction phase due to the inflations [12, 24, 26] and economic stability [6, 8, 12, 26] of the country.

5. Conclusion
In a nutshell, the intention of the paper has been achieved where the factors that cause cost overrun together with its group of originating factors have been identified. The findings were limited up to the scenarios in the Malaysian construction industries. In total, seven originating groups of cost overrun factors have been refined from previous studies with comprehensive details on how and why the factors arise with few examples of Malaysian based case study. With the identifications of the originating cause, it would be helpful in future to further the study by identifying the most critical factors of cost overrun affecting the construction project cost performances and also corrective actions for the identified critical factors.

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