

PROJECT COST OVERRUNS AND RISK ALLOCATION IN PUBLIC FUNDED PROJECTS IN MALAYSIA

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Over budgeting is a recurring issue in projects. One of the main issues of over budgets is the mismanagement of risks. Risks and uncertainty should have been established, quantified and included in the cost limit of a project. Recognising the challenges of COVID posed to the current economy, it is ever more crucial for public clients to ensure the facilities are delivered with added value by eliminating the inefficient expenditure and delays, which affects the value delivery to end user. Although there are many approaches in studying cost overruns in projects, this study aims to uncover the factors driving the cost overruns and its relation towards the risks. This paper will report the first stage findings of on-going research. A total of 14 public facility projects, all delivered through traditional procurement were selected, unpacked, and analysed. The cost/m² of each project were then compared to client's developed cost plan at the selected project stage, including further investigation for factors driving the cost changes. The study revealed that most of over budgeting were contributed to misallocation of risk. Lacked quantification and identification of risk caused over budgets and delays. Traditional procurement allow certainty but less innovative platform for contractor and client to collaborate.

Keywords: cost planning; overrun; risk allocation; traditional procurement

INTRODUCTION

Public sector government agencies and commercial clients are tightening their purse and pulling budgets due to the current state of COVID19 and world economy. Clients, sponsors and funders for both public and private sectors have exhibited growing appetite for reduced spending and higher risk consideration in investing projects. Pressure to deliver public infrastructure and building facilities such as hospitals, motorways and schools to generate the economic activities, improving quality of life and the overall access to better public facilities; the government also shifted their trend for cleaner and socially desirable innovative projects. Now, the pandemic has diversified the spending focus, it is utmost crucial for government or any client to be agile and resilient to re-shape and modernise risk management approaches through quick risk identification with real time implementation and

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transparency in process to create public and the end users' confidence whilst enhancing the project delivery for better value (KPMG, 2021).

There are various structures and arrangement of financing public projects delivery through a degree of relationships of risk transfer among firms and consortium with the ultimate aim of managing and transferring the risks to the best party. Osei-Kyei and Chan (2017) analysed their data and indicated that an effective risk transfer is important to manage the project efficiently to avoid loss in public expenditures and the deliverance to the public needs. Wang *et al.* (2019) analysed the construction risks using a social network theory and listed twenty top risk factors, which includes legal structure, changes in market trends and errors in decision making as the top three main factors contributing to project failures.

The construction professionals are under much scrutiny to deliver better projects performance for better value for money; for construction projects to meet its expected targets and delivering maximised benefits to the public (NAO, 2004; Department of Transport, 2015). Most reasons of failing to deliver the project performance target of cost, time and quality are due to unclear expectations, bad communication between clients and team members, changing needs, restricted funding, shifts of needs of users and stakeholder's requirement. Dolo (2012) analysed those changes in design and scope, changes in output specification and issues with contracts are the main factors affecting the cost performance. Lack of cost control due to complex client requirement with high demands of needs multi-layered client organisation entities will reduce contractor's profit and project delays (Ashworth and Perera, 2015). One of factors argued by Flyvbjerg, Holm and Buhl (2002) are because of human errors in estimation and/or costing led to significant impact, and it is because of complexity and huge cost project delivery. The introduction of automated quantification using software, information modelling and data management models including visualisation may improve the accuracy of the quantification techniques. However, are human errors the main contributors in the overestimation of the cost and budgeting in projects? There is some consideration to think that identification, allocation, transfer and management of risk should have a significant bearing when it comes to managing the costs in projects. This paper seeks to examine: 1) what are the main drivers of over budgeting in projects and how these drivers impact risk allocation and how it's managed between parties. 2) How risks are allocated and at what costs it can be transferred, and whether it is worth to do so in relation to its impacts on client benefits and main contractor for its percentage of overhead and profit.

Cost overruns and risks in projects

Many developed countries are pushing towards zero emissions agenda; developing and underdeveloped countries are facing unprecedented struggles to rise due from health, economic and social impacts. Government should take an active stance of economic steward in by being responsive to the industries needs through innovation and initiatives (KPMG, 2021). In the UK, more emphasis to achieve the net zero target, with financial support to construction sectors to stimulate the growth and jobs opportunities as a way of creating positive start to the economic recovery.

With many targets set to achieve, the resources always remain scarce and constrained. Cutting down the waste and removal of unnecessary expenses and waste to ensure the money is invested innovatively into more socially desirable outcomes is the overarching the points in project. It is aimed to improve user's experiences, functionality and value for the long term for both clients and facility users. One main

issue affecting success project delivery is data unavailability. This will affect design and decision making, as the main issue causing the over budgets (Jackson,2002). Issues dealing with uncertainty due to the lack of information, this affects the organisation strategy and may affect the risk appetite of the client (William and Samset,2010) which may affect the whole process in managing the project. This complexity of problems may cause projects to be cost overruns, delays and loss of investment and profits in organisation. Andersen, Samset and Wilde (2016) advocated for increased transparency, estimation cost to include the uncertainty and increasing the uncertainty provision in project costing as few of the methods that can be employed to avoid cost overruns and the project failure.

Another important step in managing project to ensure meeting the budget, time and quality, is by being responsive to change. Projects, clients and their organisations are separate living entity with different set of needs. Each organisation procurement of the project is done through a complexity of risks and the uncertainties to deliver their needs and aspiration. Being agile to change while managing the uncertainty in projects seem to be a complicated process as it requires the team to have familiarity and knowledge of surrounding, the activities and processes which may differ to each client, projects and organisations within the projects (Dubois and Garde, 2002). However, it is worth pointing out that it is an understatement to exclude the fact that uncertainty needs time and having past experiences with the clients or previous similar projects should build up the organisation's knowledge. The organisation may require this reusable project knowledge to help them in decision making and managing the changes.

Having less experience in planning can be one of the main factors pushing the project cost boundary which is the case for Dlamini and Cumberlege (2021) for South African construction industry. While evidence from Nevada projects suggested that project size and duration have influence to create more complexities in pushing the increase if costs, will increase regardless of the project type and type of users (Shrestha *et al.*, 2013). Ethiopian rail and road projects have shown that technical issues, volatile economy and changes in government policy are the main elements contributing to increased costs in projects (Kassa, 2020).

In developing countries, stakeholder's competency and slow technology adoptions as the most common issues in projects in developing countries such as Thailand, Vietnam, South Africa and Afghanistan (Yap *et al.*, 2019). Specifically, for Malaysia, Ofori (2000) discussed the element of risk included in many factors such as delay for completion, design changes, payment delays and overrun, which are the common problems and analysis discovered that culture and leadership plays vital role in managing communication, technology adoptions, risk appetite, sustainability uptake and social wealth creation.

Update research in Malaysian projects to discover the top three causes were due to changes in material prices, cash flow or delayed payment (Memon *et al.*, 2012). Other factors such as communication, increased working hours and technical plant and equipment failures were identified as the least common factors contributing to project cost overruns. It is shown that cost overrun is not a linear cause; but a plausible causal combination and it is crucial to get to the root causes of cost overruns (Ahiaga-Dagbui *et al.*, 2017). However, without the identification of the recurring problems based on observation, whilst using the existing and collated data it would be a challenging process to overcome issues to project overrun. It imperative for the client and team

members to create reusable project knowledge to assist in efficient project delivery (Egbu *et al.*, 2003).

In this first stage of research, the overall main research question is how do we determine whether we are operating within the right guidelines in managing cost within projects by identifying and quantifying projects risks during project delivery to the agreed cost, time and quality? Are we using the efficient method in the project delivery and contract administration by identifying and rationalising the cost attached to the risks, what do we know from the analysis of the issues and factors contributing to overruns? What are the key metrics of costings and how can we revamp our current working processes? Are we employing the best procurement strategy or bespoke procurement need to consider? These are questions that we aimed to uncover during the investigation.

METHODS

In this first stage research, we are conducting a desk study on the government funded projects. We are examining Terengganu, one of the rich oil states in Malaysia to evaluate the causes and issues of project overrun. The official data was provided by client includes the background of projects and its cost management. In this stage, the aim is to identify the main causes of cost overruns by auditing the project final account statement. The projects are procured through traditional procurement strategy with competitive tendering and not the lowest tendered projects were awarded the projects. The award of tenders based on the performance during pre-qualification questionnaire (PQQ) with emphasis on project cost that near to the Client's cost plan. The type of projects includes schools, administration facility, religious facility, recreation centre, and young children's centre facilities. Only four out of all projects design teams were having external consultant whereas as the rest are in-house consultant.

Originally, interviews are intended with few cost management personnel to get a clearer picture of the factors leading to cost overruns and their impact towards project. The interview would support understanding of client and project team risk appetite in managing project and its risk. The aim is to triangulate the analysis from the official data provided by the client. However due to lockdown and most personnel working from home, contacts were struggling to be interviewed for this data collection. The interviews will be included in the next stage of this research. Therefore, this has become this research limitation, the qualitative rich data from the Main Contractor and Subcontractor will triangulate and support further analysis of "why" and "how" in this study. The official data in this study (the preliminaries cost, contract sum, final account cost, tendered cost) are considered as abstract in variation of numbers and would require sense of meaning to understand relationship between the cost and their impact including identifying risk within projects to create clarity of definition, translation into specific observables to measure the indicators of the variations (Gill and Johnson, 2002). For this study, the variables were analysed to create understanding about the relationship between cost, risks and impact of management of risk to projects, which is described in introduction section.

Firstly, the analysis starts with selecting the cases for the study. At the beginning of the study, the sample size is 34 projects with the datasets contained cost limit, gross floor area, awarded tender sum or total turn-out cost at tender stage, preliminaries and final account of each project. These formed a set criterion of selection, and the projects must have records of detailed and evidenced causes of overrun for project

with its cost breakdowns, supplied with evidence of claim certificates and variation orders. This is important to identify the issues, the cost impact of the issues including other impact such as delays and social implications such as delay in school openings and delay opening access to road closure to supplement the missing context of human interaction from qualitative study can offer. The screening process selected only 14 projects.

Secondly, the process of evaluating the impact of risks started with analysing the differences between client estimated project cost and real turn out cost at the end of the project. Whether the difference would be the overrun (or underbudget), due to issues faced during project delivery which revealed the causes of the issues. The client's estimated project cost has included provision of 15% for Overhead and Profit (OHP) for main contractor. Then, the preliminaries cost was compared against the total turn-out cost to get the percentage difference. One of the main challenges to create the rigour of the analysis is to identify and link the numbers and the problems faced in the projects because of the lack of qualitative data. The final account of the projects was analysed by breaking down each of the costing into five principal headings: work estimate, project and design team fees, other development estimate, risk allowance and inflation estimate (Benge, 2014) to analyse the impact of project cost overruns.

The third stage include the analysis of the factors that caused the over budgets based on the information requested from client. The overrun or underbudget factors were analysed based on seven categories factors identified by Memon *et al.* (2012). It is because of suitability of the nature of the projects and locality of the research as Memon *et al.*, (2012) research was based on public projects in Peninsular Malaysia.

RESULTS

Table 1 shows the analysis of the percentage difference of final account of the cost of the project, percentage of preliminaries and percentage of OHP. The formula of the calculation included in the table heading. No separate allocation of risk and inflation included in the calculation of the tender sum, project cost and final account. To reflect the effect of inflation and fluctuation material prices in the market; the monthly payment made by Client to Main Contractor will be multiplied by material index cost. The positive figure indicate that it is within client estimated cost and negative figure meant the percentage of overrun. First observation on the spreadsheet for each case before starting the analysis revealed that there is no allocation for risk allowance estimated in the cost plan. So, this would require the researcher to determine whether the cost overruns are due to misallocation of risk or increased OHP. This will be our next of research agenda as we are still in the process of critically analysing whether the differences reflected the OHP of the main contractor or the percentage of difference representing the missing risk allowances for the project.

This would require conversations with project team and the client. In Malaysia, it is an uncommon practice for main contractor to reveal their OHP in application of tender. Risk allowances such as for design development, construction, employers change, and employers' other risks are absorbed in the rate of the work. Therefore, due to the absence of risk allowances, the Client as the Government has assumed the 15% allowances in the project cost as the OHP for each project to the main contractor. Referring to the second column from the left in Table 1, there were eight projects within the client's estimated cost. Off all these projects, all have issues with design changes, technical issues on site apart from MO2. M04, M11, M12, M13, M14 had

scope reduction which reduced the total cost. Other issues include extreme weather such as flooding, facilitation works for coastal treatment and demolition works.

Table 1: Project's information and percentage difference of Gross Floor Area (GFA), Final Account Contract Sum, Accepted Tendered Sum

	Gross Floor Area (GFA)in m ²	% difference between Final Account and Contract Sum (Final Account- Contract Sum)/ Contract sum	% Preliminaries (Preliminaries / Final account) x 100%	% Risk allocation (Final account - total preliminaries- building cost)/Final account)
M01	2,485	7.2	9.4	6.7
M02	1,598	-1.5	5.2	-1.6
M03	1,572	2.8	5.7	2.7
M04	879	-21.3	6.4	-27.1
M05	1,572	8.5	3.1	7.8
M06	1,512	-2.9	3.7	-4.0
M07	1,752	11.3	4.0	10.1
M08	883	-5.2	7.0	-5.5
M09	1,988	5.6	5.6	5.3
M11	1,972	-1.3	3.2	-1.5
M12	1,988	-11.95	2.1	-13.6
M13	1,000	-6.8	5.3	-7.2
M14	883	-10.7	6.7	-11.9

During this analysis, the researcher thought the differences between final account and total cost of projects (building cost + preliminaries) would be the OHP for the client, which is in the last column. However, it is not really the case for the Malaysian cost management procedure, and it is not the correct terminology to name this percentage of difference as the Main Contractor OHP. This percentage contains the changes to designs, provisional sum, design scope creep, enabling work and facilitating work such as demolition of existing building on site which is included in the package and changes in material prices which is called variation of price, which are related as financial management issue. This later described as the percentage of risk allocation. The negative amount doesn't necessarily mean that the risk has been included correctly in the rates submitted to the client. But further evaluation indicated it was mainly due to reduction in work packages or value engineering approaches implemented in the projects. On the other hand, it also shows how well the contractor priced the element of risk in their project. For example, M02 provides cost savings to the client with less 1.6% of client estimated cost.

The collated factors are analysed based on the factors identified in Memon *et al.* (2012) based on the information provided by the client. The factors are contractor site management, design and documentation, financial management, information and communication, workforce and labour, non-human resource factors and project management. In this study, all these projects have sufficient supply of labour. Only nine projects (M02, M04, M06, M08, M10, M11, M12, M13 and M14) were under budgets and it is due to reduction in work packages, design changes, unspent provisional sum (provisional sum was included during the award of tender) and value engineering implementation by material substitution (M14). Nearly all project faced financial management issues due to fluctuation in market prices for materials. Malaysia has no issue of labour shortages for these projects. The main factors causing the project cost overruns is changes in contract which have consequence to the design and documentation. Nearly all projects, except M03 have the changes to architectural or structural design. The changes to design either to reduce the scope or to expand the

design to meet the project's needs. Another important recurring issues with changes in design are the design error and uncertainty issue such as earthwork. Uncertainty such as the earthwork which require temporary support or extra earthworks caused delay in project programmes. Another uncertainty and risk recurring in this study is the enabling works (categorised in project management) where work to decant existing occupant or removal of existing building to another location, have big impacts to the programme and the budget. Facilitating work such as demolition work to buildings on site took extra time and increased the budget (M05).

DISCUSSION AND ANALYSIS

Procedure and working process in managing cost in projects.

All these projects in this study are delivered in traditional procurements where clients have more control in projects. The tenders are selected competitively and not awarded to lowest tender. The selection criteria based on main contractor's proposed project cost and less emphasis on the overall main contractor's performance during PQQ. This indicated that the client placed high importance on best project cost (at that time) to suits the traditional procurement strategy as well as the contract administration in projects. Is cost the main driver of the project? The analysis of the spreadsheet revealed that no data was revealed to the submitted tender. This may need further analysis as it is not a linear cause effect since the element cost in projects linked with many other entities which cause the project complexities.

Experiences have impacted in managing projects. Being an experienced client and having in-house consultants, the client team must have vast experience and data of many different types of projects which would aid in project delivery and establish relationship with supply chain partners (main contractors, nominated suppliers and specialist). The client is locally based, therefore must have local information and experiences of the state. Some of the identified risks are recurring risks such as issues with technical design on site, design changes and material delays. This would lead to questions of systematic database of previous projects as a lesson learnt in avoiding recurring issues? Each project is unique, but the construction technology of building would be similar. For bespoke designs, extra time allocation must have been included earlier in the tender's stage. Fluidity of design changes either the design expansion or reduction may affect the overall quality of the project. The project will deliver the intended function set for the facility, but it may compromise the true value and vision set by client which was agreed and tendered. Intended value such as social and economy impact is something to be considered in the next stage of study. Value engineering approaches has been adopted in one of the projects(M14). Changing the type of material through whole life costing consideration shows that value added has been included in the project delivery. What are the reasons for all projects not implementing the value engineering? Could it be due to limitations in varying levels of knowledge and appreciation across the project team?

Risk allocation is not really the percentage of Main Contractor OHP?

The research scoured the datasheet to uncover the level of OHP from the analysis of the cost impact to quantify the percentage of risk. It is not within the Malaysian industries culture to reveal the OHP of the projects during tender which raise the next question of what is the percentage of profit for Main Contractor? The analysis in Table 1 shows that many projects (M02, M04, M06, M11, M12, M13, M14) exceeds the client's estimated cost with 15% OHP. Most of these projects faced the recurring issues such as design changes, technical issues on site and demolition work.

However, those projects meeting the client estimated cost also have similar issues. This revealed that the misallocation of risk.

The predominant issue within this study is that it lacked clarity in risk quantification, nearly all projects have design changes either to meet the structural requirements or substructure work involving piling and earthwork or roof works for superstructure work. This is one of the cost drivers for cost overruns including the main driver which are the design changes and technical issues. Earlier, we mentioned about 15% allocation for OHP for projects set by client. Is 15% tailored for each of projects sufficient? As some of the projects with negative value for risk allocation had work package reduction and time delayed. Consideration of work package capacity including main contractor capability should have been considered. Risk is tailored to the projects and main contractor should ensure all risk have been included in the rates for tender's consideration.

The fluctuation in prices for material is important. Though Malaysia has included the factor for all main material, this should have been anticipated and included in the total project cost. This would allow the smooth delivery of projects without relying for payment for the price variation, which can affect main contractor with lacked financial stability. Malaysia construction industry requires the resilience in confronting the volatile world oil prices which have direct impact towards steel and concrete due to increased demand. In this context, the Government and the Client taking the ownership of the risk by supporting the financial differences and awarding extra financial payment termed as variation of price payment to ensure the supply agencies are able to continue and complete the projects. The disparity of oil prices and material requires a monthly index adjustment, and it certainly creates uncertainty towards clients' cash flow for their programme of projects.

Identification and quantification of risk in management of projects

Based on the analysis on the factors of project cost overruns, most issues relating to the over or underbudgets are due to design changes. Since it is traditional procurement, the client should ensure the design would work on site. Has the client considered the early involvement of contractor? Any issues relating to design would go to client but the buildability on site should be with the contractor. The element of innovation could have been promoted during tendering to allow for an innovative approach from contractor. The traditional single stage tendering may restrict innovation in projects, other variations such as design and build may reduce client governance and control. However, selected main contractor should offer an early participation through two stage traditional procurement tendering. This may increase front end period of the project, but it may offer buildability and certainty. The early involvement also provides opportunities for the main contractor to manage its supply chain.

The missing element for design risk, construction risk and design development risk and the ownership of the risk involved in changes in policy. The absence of the risk allowances would expose client to cost overruns, delays and lower quality. Each type of risk would compel the main contractor to unpack each task to identify the risk and rationalise the cost attached to risk.

CONCLUSIONS

The aim of this paper is identifying the main driver of cost overruns in projects and finding the link on how these drivers impact risk allocation and how they are managed

between parties. The analysis revealed that the main factors driving the cost overruns are due to design changes and technical issues. This type of controllable risk should be classified as design risk and included with the design element of the work with the distribution and work package workload. Client may need to unpack the work package of the project based on contractor capacity and capability with the availability of resources to ensure minimum disruption to the projects. Being responsive and agile in forecasting external risk such as inflation, world oil prices and sudden increase in material prices such as steel and concrete will be the crucial driving force that changes the certainty of the agreed tenders sum, which was proposed earlier by Dubois and Garde (2002). The use of factor index may offer security from the client however it is not a win-win situation for the client as clients bear the risk of price variation in order to have the project completed. The client has policies in regard to the support of the external risk however, the organisation needs to create risk culture with their supply chain partners to be clearly communicated and promoted. Reward and initiative have been one of approaches to promote organisations to work efficiently. Value engineering should have been the essence at the idea generation stage and promoted across the projects with all tenderers. The client may consider including value engineering as one of the prerequisites for tender's acceptance to promote innovation.

In this current climate, the main question is our affordability to deliver the project sustainably with socially desirable values. The client and project teams will need to be agile and transparent in appraising for better options for projects. The Pandemic had taught us about emerging risks and the clients including project teams needs to reconsider the project settings and changing strategies in project priorities. Creating risk profile to produce risk taxonomies would assist the client and team to identify risk and criteria for project delivery. In this study transparency about profits and others is one of the hardest challenges as advocated earlier in literature by Andersen, Samset and Wilde (2016). This requires a culture change where everyone would be in a win-win situation. This study will be the springboard for the next analysis and evaluation by gathering more data from projects to update the risk categories to form the taxonomies. This would create usable knowledge for the risks and the uncertainties to assist in the quantification of risks and ultimately the cost management of a project.

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