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Case study

Improving Performance in Construction Projects: A Case Study of Malaysian Public Projects

Aminah Md Yusof[1], Ali Raza Khoso[1,2]*, Samiullah Sohu[3], Shabir Hussain Khahro[4] and Chang Saar Chai[5]

[1]Department of Structure and Materials, School of Civil Engineering, Faculty of Engineering, Universiti Teknologi Malaysia (UTM), 813100 Johor Bahru, Malaysia
[2]Department of Civil Engineering, Mehran University of Engineering & Technology Jamshoro, 76062 Pakistan
[3]Department of Civil Engineering, Quaid-e-Awam University of Engineering Science & Technology, Larkana Campus, 67480 Pakistan
[4]College of Engineering, Prince Sultan University, Riyadh, 11586 Saudi Arabia
[5]Swinburne University of Technology, Sarawak Campus, Kuching, 93350 Malaysia

ABSTRACT

Studies have worked out measures to curb the poor performance problems. However, it is hard to investigate the actual reasons because of the diverse construction culture of different countries. This research aims to develop a framework for mitigating the problems triggering the poor performance via a novel classification. An empirical analysis of mean and relative importance index (RII) was performed in SPSS of collected data from 56 public projects in Malaysia from 2003 to 2014. Qualitative and quantitative data was analysed from Audit General's Reports, interviews, a pilot survey, and a full-scale experts' survey. Findings from research investigated that the most influential factors affecting poor performance are not genuinely linked with those investigated from Audit General's Report except a few. Furthermore, the study findings conclude that related financial problems and construction stage from project life cycle contribute to poor performance. The potential mitigation measures are worked out and validated via focused group discussions with experts. Finally, a framework was developed that emphasised Competent, Commitment, Communication, Comfort and Collaboration

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E-mail addresses:
aminahyusof@utm.my (Aminah Md Yusof)
raza.ali@graduate.utm.my (Ali Raza Khoso)
sohoosamiullah@gmail.com (Samiullah Sohu)
shkhahro@psu.edu.sa (Shabir Hussain Khahro)
cschai@swinburne.edu.my (Chang Saar Chai)
* Corresponding author

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(5Cs) to mitigate the poor performance issues. The study is limited to identifying factors contributing to poor performance; however, relevant responsible stakeholders should also need to be identified in the future.

Keywords: Framework, Malaysia, mitigations, poor performance, project performance, public sector

INTRODUCTION

The construction industry in Malaysia contributes to socio-economic growth and shares 4% to 6% of the country's Gross Domestic Product (GDP) (Alaloul et al., 2020). However, the industry desperately suffers from various underlying problems such as overrun of time, cost, quality, safety, and disputes that lead to poor performance in the sector. The problem of poor performance is so severe and inescapable that none of the regions on the globe is under an exception. Several past studies believe that only 2.5% of projects in the world are delivered on time and within the estimated budget (Gunnoe et al., 2016). Therefore, it is a big question mark on the performance of the construction sector.

Project performance is an indispensable goal of every project where success is measured from innumerable parameters which are still conflicting, such as the most common are time, cost, and quality (Mellado & Lou, 2020; Unegbu et al., in press). Nevertheless, due to the lack of consensus on measuring project performance, there are many diverse opinions on what to include as performance and success measurement parameters. In the past, financial indicators were seen as the sole parameters to measure project performance, and later time, quality and satisfaction of end-users were added. However, the Malaysian public sector has continuously reported a low-performance sector (Takim, 2009). Besides, Malaysia aims to boost its economy and elevate its status from a developing to a developed nation. With this aim, the government had propelled its National Transformation Plan (NTP) that includes the Government Transformation Plan (GTP) and Economic Transformation Program (ETP). GTP and ETP are designed to address all obstacles to achieve Vision 2020. This master plan brought together several mega projects in the country to boost the economy. However, several impediments hindered the road to successful project performance.

Construction projects typically suffered from severe time and cost overrun problems and quality and safety issues, especially after modern construction, which has brought more complexity. Owing to the peculiar nature of industry and modern construction challenges, the problems of poor construction are increasing at a higher pace. Therefore, the government needs to ensure that projects are completed on time, with stipulated cost, meeting designed quality and general requirements. On the contrary, the current scenario is inverted, and the Malaysian construction industry has not witnessed successful projects. Sambasivan and Soon (2007) claimed that 17.3% of projects completed in 2005 suffered severe time problems related delay in Malaysia. Data from government and industry revealed that

around 65% of public projects suffered from an overrun of time and budget, which leads to conflicts (Rahman et al., 2013). Akhund et al. (2017, 2019) found that time and cost overrun are common in many developing economies. Memon et al. (2014) identified that issues in design and documentation, finance-related problems, project management and contract problem are only factors for Malaysian construction projects. Othman and Ismail (2014) found that several projects suffered from delays in Malaysia, leading to poor performance.

A report published by the National Audit Department (2009) stated that 11 public projects in Malaysia were abandoned due to cost overrun issues, low quality, and failure to comply with specifications. Also, nine of them encountered severe delays, seven projects have problems with quality, and six were not executed according to the specification. The report further stated that the said factors are reoccurring each time, and no suitable measures have been adopted yet to counteract. However, a few past studies have identified few major reasons behind the poor performance in Malaysia, such as delay (Alaloul et al., 2020; Sambasivan & Soon, 2007; Hooi & Ngui, 2014), cost overrun (Alaloul et al., 2020; Shehu et al., 2014), and quality (Alaloul et al., 2020).

Causes, as mentioned earlier and the report of the National Audit Department (2009), triggered that public projects in Malaysia are struggling with severe problems associated with project performance. It enlightens the need to explore the actual reasons behind the poor project performance, which would overcome the weakness in the industry and further show a better insight into the industry. The study aims to explore a novel classification of poor performance causes and design a framework that is a way forward to mitigate the problems and a sound indicator of the country's economic growth. To the best of our knowledge, a similar work particularly targeting the performance of the Malaysian public sector from past completed projects is not available in the pages of literature. Also eventually, limited studies have focused on exploring the factors of poor performance in Malaysia. Further, the factors of one region could not be investigated for other countries owing to differences in culture, political situation, and economic condition. Moreover, the study is not limited to this extent. However, it contributes to the literature by designing a novel classification of poor performance factors, which were not discussed extensively. The classification exclusively targets the actors, processes, and institutions re-classified from the project life cycle phases.

A REVIEW OF PROJECT PERFORMANCE

Poor Performance Measurement in Construction Projects

Construction projects agonise from several problems that are directly and indirectly allied with project performance. In order to investigate the performance of a project, it is vital to design the factors that affect the project performance as standard measuring guidelines or benchmarking factors (Unegbu et al., in press). Many studies in the past have worked

out factors affecting poor performance in construction in different countries (Le, 2020; Lopes et al., 2011; Shiferaw & Klakegg, 2013). For example, Ahzahar et al. (2011) found that in Malaysia, shortage of resources and low quality of materials are prevalent causes of project failure.

Puspasari (2005) revealed eight major classifications of factors that govern the project performance, i.e. characteristics owner related factors, labour and materials-related factors, contractor-related factors, consultant-related factors, project procurement, and external environment-related factors. Gamil and Rahman (2020) classified the poor performance factors into the following categories; governmental and administrative factors, management and leadership, human resources, stakeholders, and materials and machinery. Enshassi et al. (2009) worked out that delays in material availability, project leadership challenges, escalation in material prices, inexperienced and less qualified team members, poor quality of equipment, and raw materials are leading problems associated with project performance. Sweis (2013) exclusively focused on contractor related factors and believe that contractors have a prime role in project performance. It is also witnessed by Khoso and Yusof (2020), who claimed that project success is directly connected with contractors. Jaffar et al. (2011) found from review research that lack of technical capability, poor coordination, lack of integration and communication, and insufficient equipment are key causes of project failure. Faridi and El-Sayegh (2006) found that shortage of human resources, poor site management and supervision, poor leadership, and equipment failure are key causes that affect a project outcome. Enshassi et al. (2009) relate unavailability of resources, delays, leadership problems, escalation in material prices, inexperienced staff, poor equipment and, materials with project performance. Besides, Khoso et al. (2021a, 2021b) relate project performance to contractor selection issues in public projects.

The performance in construction projects also measured with different factors and performance criteria such as time, quality, cost and safety (Yeung et al., 2009), design, rework percentage, safety, time and cost (Kang et al., 2008), and customer requirements and satisfaction (Ling et al., 2006). Further, McDermot et al. (2020) listed out 12 factors affecting poor performance such as poor planning, insufficient skilled labour, wrong estimates, poor defining of scope, communication gap among stakeholders, cash flow problem, failure to estimate risks, poor change control, bureaucracy, problems in the proper ground investigation, improper project delivery system, accountability in decision-making. Other major underlying factors are incapable project manager, changes in design, related financial problems, contract management system issues, additional work, inefficient planning and scheduling, material shortage, unavailability of skilled labours, delay in construction, cite problems, wrong estimation, incapable contractor and inexperienced client, and poor team qualification (Yue, 2018). Finally, Gadisa and Zhou (2020) worked out the 58 most occurring factors and classified them into major criteria: as ineffective contract

management, incompetency of client, problems in the procurement process, construction material related problems, stakeholder's coordination problem, performance measuring indicators, external environment, and incapable contractor.

Iron Triangle in Project Performance

The success or failure of any project is evaluated on certain parameters where the time, cost, and quality (known as Iron Triangle) have a dominant role, and many researchers evaluated the performance based on Iron Triangle. Mellado and Lou (2020), and Unegbu et al. (in press) believe that time overrun is referred to as a delay, which reflects the excessive time that exceeds the stipulated time of a project. Studies believe that time overrun is a severe cause of project performance (Akhund et al., 2018; Sambasivan & Soon, 2007). Issues of time overrun are not related to a single party; however, clients, consultants, contractors related factors are responsible. Doloi et al. (2012) explored several factors related to time overrun. Many other studies have also encountered the problem of time overrun, such as Bajjou and Chafi (2020), Soewin and Chinda (2018), and Girma et al. (2017). Besides, many studies believe that construction projects have a poor record in terms of the budgeted cost. The problem of cost overrun is a global challenge, and these problems are encountered by Akhund et al. (2019), Li et al. (2011), and Niazi and Painting (2017). In addition to time, cost, quality is another major indicator of project performance. Many studies have worked out possible causes of poor quality in construction projects (Alubaid et al., 2018; Callistus et al., 2014; Khoda et al., 2016). Furthermore, Alaloul et al. (2020) also developed poor performance factors based on time, cost and quality parameters. Figure 1 summarises the reviewed factors from the literature.

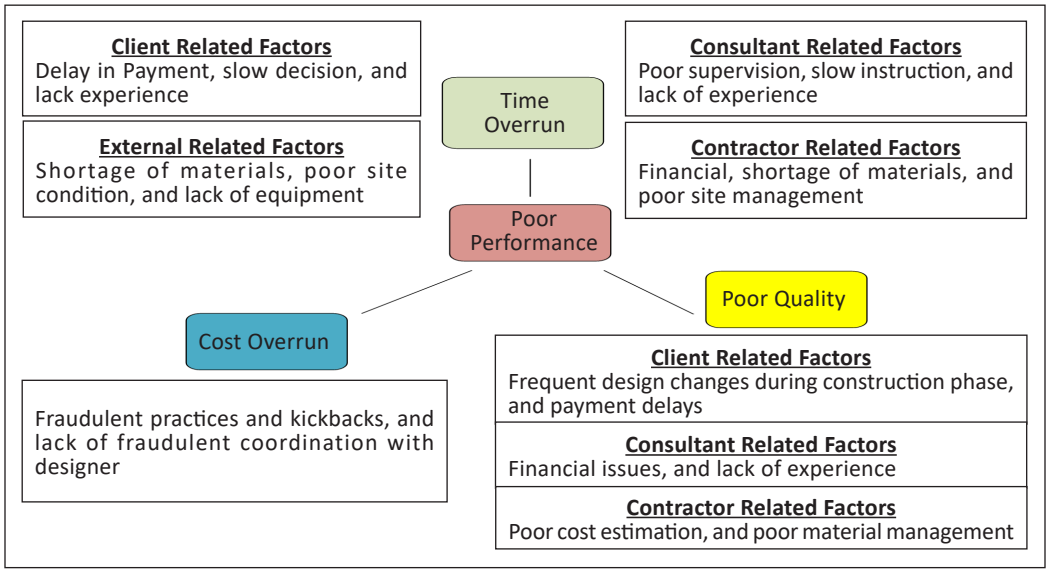

Figure 1. Time, cost, and quality related factors for project performance

RESEARCH METHODOLOGY

A project success and failure are continuously assessed with specific tools that eventually require explicit criteria or performance indicators. This study investigates the poor performance evaluating criteria or indicators, and designs a framework to mitigate the problems. This scientific research follows a mixed-mode research methodology where the essence of qualitative and quantitative are assorted together. This work employs qualitative mode during preliminary analysis, whereas the quantitative approach was applied during the survey phase.

Unfolding of the literature revealed a few studies focused on poor performance measurement; therefore, to have a larger set of previous research for the sake of more reliability of primary data, the Malaysian Audit General's Report (2003-2014) (www.audit.gov.my) was reviewed together. Both printed and electronic documents were collected and profoundly reviewed. Likewise, in other analytical methods, the analysis of the documents requires data that is suitable to examine, with meaningful interpretation, elicit meaning, high understanding, and empirical knowledge. The Malaysian Audit General's Report formed a basis for this study where in addition to other past studies, factors influencing poor performance were listed out. Extracted factors were clustered into phases of the project life cycle. Figure 2 illustrates the followed methodology.

Preliminary Data Collection

The preliminary data source includes the auditor report from 2003 to 2014. A systemic documents analysis followed this step. The reviewed audit institution was established to strengthen the government financial management system. This institution aims to carry out audits of public projects self-regulating and submits the reports to State legislatures. Since the institution audits 25 ministries, this study only focused on a limited part related to building construction and factors related to poor performance were extracted. From 2003 to 2014, a total of 56 projects were selected from the reports. Only the most frequent occurrence factors from past projects were compiled together for better understanding purposes. It adds the tally to the 75 most influential factors. The preliminary data was validated from this report, followed by site visits and meetings with experienced personnel.

Questionnaire Design

A larger set of data can easily be gathered via a questionnaire survey method within a short period. Compared to interviews, the survey is a more reliable tool that removes the chances of data biases. The data obtained from literature and Audit General Reports together facilitated in designing of the questionnaire. The survey tool was originally reviewed by an academic team consisting of university professors. The collected preliminary data assimilate in a quantitative format where respondents were expected to reply on a numeric five-point

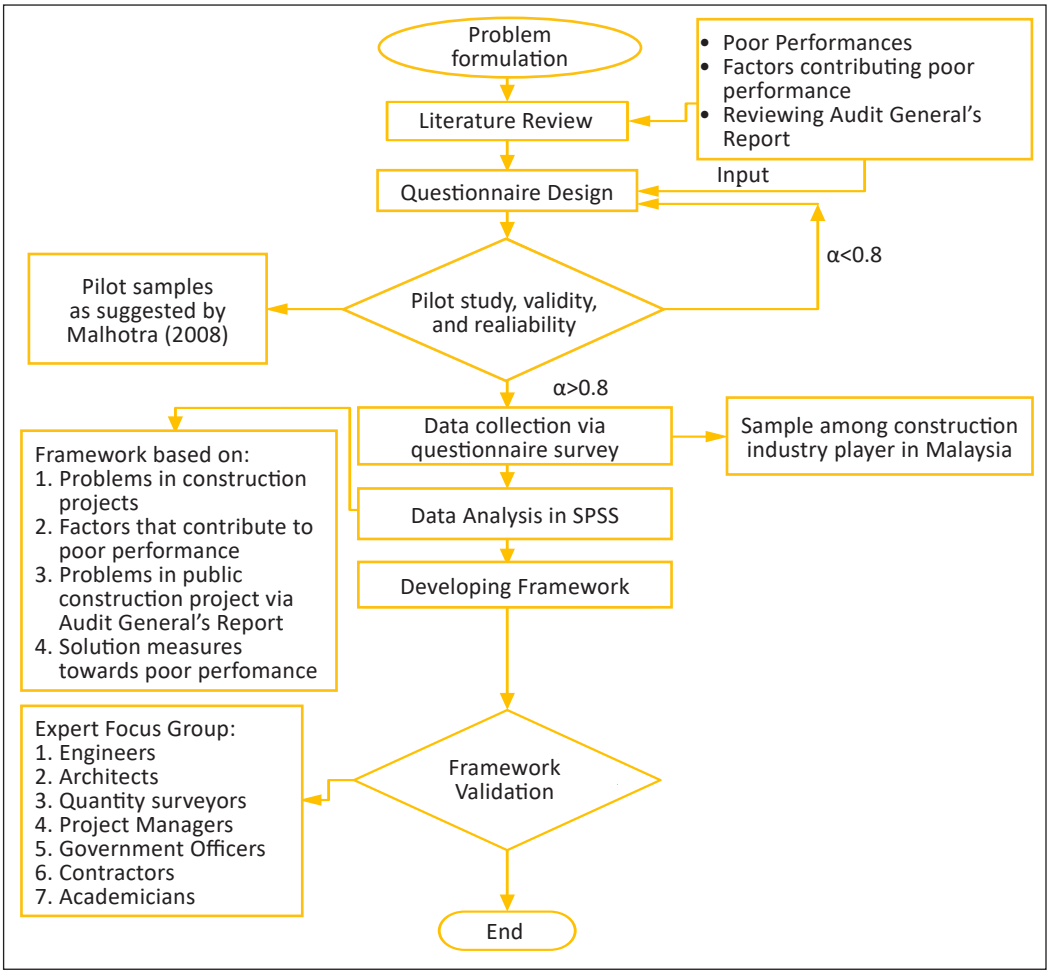

Figure 2. The research methodology

Likert scale of equal interval (where; 5>4>3>2>1; 5: strongly agree;1: strongly disagree). The questionnaire was designed in the following three sections.

Part 1: This part aims to collect the respondent demographic background such as their organisation type, experience, project description, and designation.

Part 2: In this section, respondents were asked to provide their opinions based on a five-point Likert scale. This part aims to identify the most influential factors leading to poor performance in the public construction project. The factors were classified into five phases of the project life cycle.

Part 3. This section aims to cover the potential mitigation measures to improve the poor performance in the public construction project in Malaysia. Responses were gathered on a similar five-point Likert scale where 5>4>3>2>1; 5: extremely important; 1=not important.

Pilot Survey and Data Reliability

The questionnaire was tested on a smaller group before floating to a larger sample. Therefore, a pilot study offers insight for the researcher, which further clarify the research directions. It is constructive as it also warns whether projects could fail if research protocols are not followed. For this research, a pilot survey was conducted among 40 respondents, according to Hill (1998), who suggested 10 to 30 responses are positive for survey-based research. Cronbach's alpha test was performed in SPSS to validate the research data.

Data Collection from Surveys

The samples from a larger population working on various construction projects in Malaysia were determined. Since it was impossible to target all populations, a targeted population method such as the purposive sampling method was adopted, marking the specific responses based on the researcher's judgement. It also assures that only the person with specific knowledge and experience are followed. Client, consultant and contractor groups were involved in this survey. A total of 210 questionnaire surveys were sent via physical meetings, emails, WhatsApp, and an online survey tool. The survey took more than two months to complete where 137 successful responses were gathered.

Analysis Method

Scientific research follows a suitable analysis approach to convert the data into information and later into knowledge by interpretation. Collected data were analysed using average index (A.I) and relative important index (RII) methods. A.I approached was applied to compute the most influential factor. A factor is treated according to its respective value of A.I according to Rogers (2003), A.I value above 3.1 is considered significant. Later, the RII was calculated, where a value of above 60% (0.6) was considered agreed (Jarkas & Bitar, 2012).

ANALYSIS AND DISCUSSION

Analysis on Poor Performance Factors from Audit General's Report Past Projects

This section demonstrates poor performance factors from the past 56 projects overviewed and investigated from Auditor General's Report. Analysis of the top ten factors based on their occurrence is presented in Figure 3. The analysis from the report witnessed that the quality of construction deteriorates in almost every project with the highest rate of re-occurrence (n) (i.e. n=53/56). It is followed by 'construction not accordance with contract specification' (n= 45). There is a clear relationship between the first two factors. The quality deteriorates owing to ignoring the terms and conditions as prescribed in the documents. Such events lead to conflicts among parties and results in delays and overrun of budget.

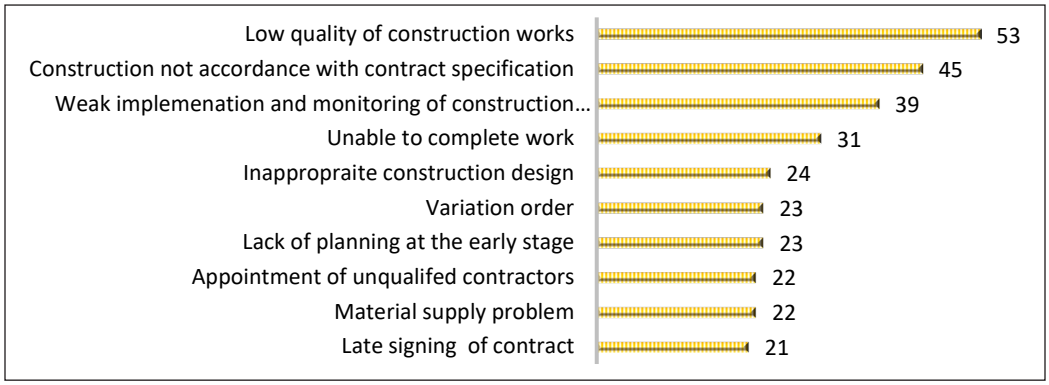

Figure 3. Poor performance factors in Malaysian public project from 56 projects

The third most occurred factor is also related to the second one. The problem of weak implementation and monitoring is the result of non-compliance with contract conditions. Also, results show that contractors could not perform work in more than 50% of selected projects. It is also witnessed from the data that construction design was inappropriate in n=24 projects. There is a linear relationship between these two causes. The majority of projects are abandoned or delays due to problems in design. It leads to time and cost overrun problems, which are later resolved through variation order as shown in n=23 projects from the investigation of the report.

The further analysis found that in Malaysia, most problems related to poor performance are due to lack of planning which is triggered owing to the incapable contractor. In n=22 projects, the capable contractor was not chosen. These findings also witnessed that many problems occur due to contractors' improper selection during the contract stage of the project life cycle. The least cited factor, i.e. late signing of the contract, is also considered one of the major reasons. It leads to delays in construction.

Analysis on Poor Performance Factors based on Stages of Project Life Cycle

Five stages of the project life cycle were considered, and factors were classified to each stage according to the suitability with the stage. Each stage was analysed individually and discussed below. The reliability was measured in SPSS using Cronbach's alpha method as an internal measure of consistency. For this case, the reliability of each data of the project life cycle stage was computed independently. As a result, data reliability varies from 0.808 to 0.972 in different stages of the project life cycle.

Early Investigation Stage Factors

This stage is critical for a project as it involves feasibility, early project planning, seeking funding sources, and various decisions involve in this stage. The data on the poor performance factor is analysed via A.I and RII as shown in Table 1.

Table 1
Analysis of poor performance factors of early investigation stage

Factors (Cronbach's alpha=0.808)	A.I.			RII	Ranking
	Contractor	Consultant	Client		
Land acquisition delays	3.80	3.95	4.00	78.60	1
Poor early stage planning	3.90	4.00	3.80	78.00	2
Lack of project funding	3.95	4.05	3.60	77.85	3
Ignoring experts' views during early planning	3.80	3.60	3.71	73.90	4
Delays in drawing, and bill of quantities	4.00	3.30	3.73	72.90	5
Late appointment of consultant	3.60	3.50	3.50	70.45	6
problems in understanding requirement from client	3.40	3.47	3.70	70.40	7
Poor site location	3.30	3.45	3.66	69.00	8

Land acquisition is ranked the highest poor performance factor. This problem generally requires a longer time to resolve because of several stakeholders such as landowners, government, and court of law. Furthermore, the agreement of the owner on offered compensation is also seen as a fundamental problem. These complications were unswervingly linked with the delays as construction could not be underway unless site ownership was transferred to the government. Poor early-stage planning is another crucial reason found from the analysis. The right planning predicts the future events of the entire project, and a contingency plan can also be prepared to mitigate any unwilling event in the future. On the other hand, poor planning affects the entire project with respect to time, cost, and quality and ultimately leads to project failure. Lack of project funding is ranked third most influential problem. Public projects often suffered from this problem as poor planning in an early investigation to seek the fund leads to delays in project completion. The delay is also directly linked with a cost overrun and other contractual problems such as change orders and extension of time. The ranking of the remaining poor performance factors is shown in Table 1.

Design Stage Factors

Table 2 illustrates the analysis results of the design stage. From the analysis, it is found that the public projects in Malaysia are frequently suffered from site investigation issues. Site investigation is the responsibility of all parties such as clients, consultants and contractors. The majority of problems in site investigation are often due to the geotechnical or ground investigation, such as related to deep soil investigation, which decides the choice of foundation. As a result, there is a likelihood of large variation in project cost comparing to early estimation. It happens when the client and its partner, i.e. consultants, overlooked the site and appropriate investigation is not performed. Besides, the mistakes in design

are seen as another major reason. Without proper drawing, it is not possible to carry out construction work. It often leads to re-work as consultants re-design the project in the middle of construction, and the project again goes back to the approval stage. This process affects the entire structure of the project, and many problems of time, cost overrun, and conflicts occur between the parties. Also, delays in the preparation of drawing is another major reason revealed from the analysis. Such delays often result in delays in projects, and further problems happen when a project contract is awarded to the contractor, and still, the drawings are incomplete.

Table 2
Analysis of poor performance factors of design stage

Factors (Cronbach's alpha=0.897)	A.I.			RII	Ranking
	Contractor	Consultant	Client		
Poor site investigation	3.90	3.80	3.70	76.00	1
Design mistakes and overlooked	4.00	3.55	3.80	75.20	2
Design preparation delays	3.90	3.63	3.67	74.60	3
Incomplete drawings	3.86	3.65	3.60	74.00	4
Lack of project information	3.75	3.65	3.70	73.75	5
Non cleared specification	4.00	3.45	3.57	73.45	6
Poor construction design	3.80	3.60	3.54	73.15	7

Contract Stage Factors

Poor performance factors under the contract stage are demonstrated in Table 3. The problem of incapable selection of a contractor is observed as the most significant in public sector construction. Typically, the public sector selects the contractor based on the lowest bid award, which is under criticism for the last two decades. As a result, the technical capabilities of contractors are given less weightage over their bid price. Incapable contractors often quote less bid price, which attracts the public client owing to the funds belonging to the public. However, it is never a wise decision in the long run and not suitable for a project as the contractors want more profit later, so reduce the quality and seek more change orders and other reasons to pay them more. Besides, budget estimation mistake is another problem during contract stage. There are two different but interlinked scenarios related to this problem; the prior is related to the client and later with the contractor. The prior scenario transpires when a client with its partner consultant estimates a wrong project cost and prepare their bill of quantities accordingly. At the same time, in the latter case, the incapable contractor quotes already a minimum budget to win the contract. Therefore, mistakes in budget and resource planning alongside a selection of incapable contractors further trigger poor performance. Such factors lead to conflict among contractor and client as the contractor would cry for additional budget seek more change or variation orders.

Late approval is is another crucial factor contributing to poor performance. It is considered the main problem in the public sector as the procedures there are very complex. The public sector is burdened with additional formalities than the private sector. Also, in public sector, funds belong to public. Therefore, thorough audit and monitoring have often delayed the process. The factor of the inaccurate bid price is also linked with mistakes in budget and resources. The contract is a major stage that mostly leads to severe problems if it does not handle properly.

Table 3
Analysis of poor performance factors of contract stage

Factors (Cronbach's alpha=0.903)	A.I.			RII	Ranking
	Contractor	Consultant	Client		
Selection of incapable contractor	3.95	4.00	4.00	80.00	1
Mistakes in budget and resource planning	4.10	3.90	3.60	78.00	2
Late approvals	4.00	3.80	3.82	77.00	3
Inaccurate bid price	3.91	3.80	3.75	76.50	4
Weak contract system	3.80	3.70	3.50	73.30	5
Late appointment of contractors	3.79	3.75	3.29	73.20	6
Inappropriate methods by contractor	3.72	3.60	3.50	72.10	7
Late in singing of contract documents	3.50	3.40	3.50	68.32	8

Construction Stage Factors

Construction is seen as the most challenging job as it involves the highest resources in terms of human resources, budget, equipment, time management, and monitoring jobs. The analysis results of factors of poor performance in the construction stage are shown in Table 4. Furthermore, the A.I. values of the top 5 factors are illustrated in Figure 4.

The related financial problems are the most persuasive in the construction stage, such as cash flow issues and payment delays. Since construction consumes the highest amount of resources, any interruption in cash flow can harm project progress. The contractor relies on regular payment from the client, and when payment is delayed, the entire project gets affected. Such issues lead to time delays and later transpire into conflicts. Variation order is also observed as the most critical factor in the construction stage. Several factors are correlated to variation order, such as changes in design, method, and scope. When variations are proposed in the construction stage, the contractor seeks variation orders that ultimately cause delay of work, overrun of cost, chances of conflicts, and lower the quality. The client must ensure that early planning is performed prudently and sensibly so that the problems in the construction stage may be avoided.

Effective decision-making has a key role in a project, and any delay in decision making directly impacts a project. All processes such as endorsing drawings, contract documents,

terms and conditions, work orders, and payments are based on clients' decision. Slow decision making indicates that delays in the entire project as the factors act as a chain. Therefore, the client must ensure that there is no due pending decision. Apart from this, quality is also seen as a top factor affecting poor performance. Quality is always connected with cost and time. Problems of cash flow, late payment, variation order and slow decision making increased the time and cost and parallel affect the quality of a project. Whenever a project is affected by delays or an overrun in the budget, the contractor would reduce the quality to expedite the work and meet the budget. Several other reasons were found as the most critical factors in the construction stage. See Table 4 for further details.

Table 4
Analysis of poor performance factors of construction stage

Factor (Cronbach's alpha=0.972)	RII	Ranking	Factor (Cronbach's alpha=0.972)	RII	Ranking
Issues related to cash flow	83.00	1	Coordination issue between contractor and supplier	75.91	19
Late payment delivery	81.00	2	Incompetency to complete work	75.81	20
Variation order	80.00	3	Coordination issue between contractor and sub-contractors	75.50	21
Slow decision making	79.51	4	Non-availability of technical supervisor	75.29	22
Low quality work	79.32	5	Changes in sub-contractor's appointment	75.20	23
Changes in design	79.00	6	Escalation in material prices	75.00	24
Lacking in project monitoring	78.55	7	Appointment delay in sub-contractors	74.50	25
Less workers	78.44	8	Work permits problem	74.47	26
Site management issues	78.40	9	Site problems	73.60	27
Delay in approvals	78.27	10	Issues in material supply	73.58	28
Non-compliance with standards methods	77.83	11	Training issues of team	72.30	29
Delay in design approval	77.40	12	Problems in proper and timely instructions to workers	71.70	30
Non-availability of qualified personnel	77.30	13	Delays in issuing documents	71.40	31
Delays from sub-contractors	77.10	14	Higher extension of time (EOT) approvals	71.00	32
Communication gap between local authorities	77.00	15	Safety negligence on site	68.70	33
Delay in starting work	76.49	16	Non-availability of workers' accommodation	68.63	34
Ignoring contract specified conditions	76.18	17	Security problems at site	68.50	35
Contractor and consultant coordination problem	75.91	18	Lack of storage capacity at site	68.47	36

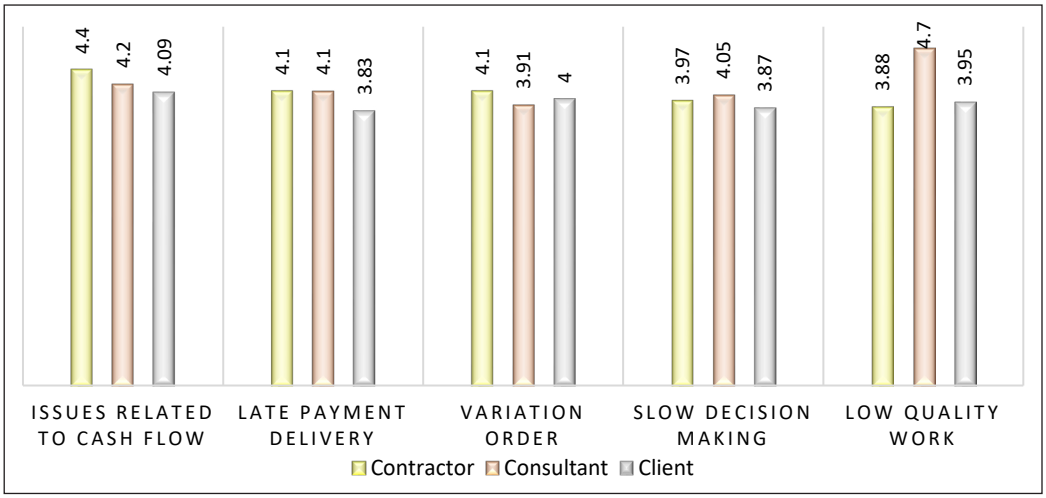

Figure 4. A.I. of top five factors of poor performance of construction stage

Handing Over Stage Factors

It is the last stage of a project life cycle. When the contractor has finalised their work, they will hand the project to the owner or client. Several factors are associated with this stage that leads to poor performance, as shown in Table 5. Financial related problems are again ranked the most critical in this stage, likewise construction. Generally, the problem of finances is equally important for all stages. During the handing over the stage, it is common to find defects in finished work. The contractor is obliged and bonded by contract to repair the defective works. Sometimes, the defects occur after handing over the stage, which in many cases is difficult to deal with and leads to conflicts and court of law. The problem of poor monitoring is found as another critical factor in this stage too. The proper monitoring at this stage may save the client from many problems which later may arise. Another pressing issue is payment to the worker. Normally, when the project is about to end, and the contractor is still waiting for the payment from the client, this issue arises. Later, the handing over goes to the delay due to the conflict between the worker and contractor. Several other factors mentioned in Table 5 are responsible for delays, cost overruns, conflicts, quality issues, and other contractual problems.

Table 5
Analysis of poor performance factors of handing over stage

Factors (Cronbach's alpha=0.951)	A.I.			RII	Ranking
	Contractor	Consultant	Client		
Financial problems	4.00	4.10	3.80	79.12	1
Defects in work	4.00	3.85	3.80	78.00	2
Poor monitoring	3.87	3.82	3.91	76.00	3

Table 5 (*continue*)

Factors (Cronbach's alpha=0.951)	A.I.			RII	Ranking
	Contractor	Consultant	Client		
Payment issue to workers	3.80	3.80	3.81	75.85	4
Inefficient supervision	3.90	3.70	3.69	74.81	5
Not completing repair work within defective liability period	3.69	3.80	3.71	74.21	6
Delays in making decision against contractors	3.80	3.70	3.70	74.18	7
Testing and commissioning in pending	3.80	3.65	3.65	73.30	8
Issuing completion certificate before actual complete	3.65	3.70	3.50	72.50	9
Poor facilities/equipment	3.55	3.50	3.60	70.75	10
Delays in issuance of certificate of non-compliance	3.66	3.50	3.51	70.70	11
Liquidated payment variation due to delay	3.60	3.70	3.30	70.40	12
Certificate of non-compliance approval by no-authorized party	3.72	3.52	3.40	69.80	13
Incomplete project report	3.60	3.50	3.45	69.50	14
Daily activity log book is incomplete	3.50	3.52	3.41	69.31	15
Overpayment to contractor	3.20	3.55	3.40	67.20	16

A NOVEL CLASSIFICATION OF FACTORS OF POOR PERFORMANCE

The analysis and discussion are based on an approach of factor identification, where classification is based on stages of the project life cycle. However, this section proposed a novel classification which is of more interest as this particular focuses on the responsible party or process behind such as stakeholder, process, or institution. Therefore, a unique classification of the factors mentioned earlier factors in the form of actor related factors, process-related factors, and related institutional factors is presented below.

Actors play a vital role in any project. Discussions with experts sorted the factors as mentioned earlieraccording to a novel classification. According to experts, 25 factors are re-classified into actor related factors. Reclassification found that 64% of actor related factors are only from the construction stage, whereas 20% are from handing over, 12% under the design phase, and the remaining 4% from the early investigation stage. Highly ranked factors under this classification are; 'issues related to cash flow', 'slow decision making', 'changes in design'. These poor performance factors are directly linked to the project actors as caused by their non-seriousness or incapabilities.

Process related factors are viewed differently as these factors are associated with sequence or chain of events. Twenty-six factors are re-classified as process-based factors, which contributes 35% of total performance-related factors. From the analysis, construction

related factors dominant the other stages with 34.61% of factors. Furthermore, six out of ten significant factors are only from the construction stage. The top three factors under this category are 'late payment delivery', 'variation order', and 'low quality work'. These poor performance factors are linked with the process, as they occurred owing to a sequence or chain of events.

Institutional factors are categorised based on norms, entity, rules, and the government or their related factors. Likewise, for actors and processes, most factors from the institutional classification are based on the construction stage with 45.83%. The top-ranked factors under this classification are 'selection of incapable contractor', 'lacking in project monitoring', and 'site management issues'. These factors are directly linked with institutional factors because they are based on weakness in norms, standards, and rules. Furthermore, the government and relevant ministry also contribute to these factors owing to their weak regulations. Table 6 illustrates the re-classification of poor performance factors into a novel classification based on actors, process, and institutional factors.

Table 6
Poor performance factors based on novel classification of actor, process, and institutional factors

Factors	RII	Stage	Overall Ranking	New Ranking
1. Actor based classification				
Issues related to cash flow	83.00	Construction	1	1
Slow decision making	79.51		5	2
Changes in design	79.00		6	3
Less workers	78.44		11	4
Defects in work	78.00	Handing over	14	5
Non-availability of qualified personnel	77.30	Construction	20	6
Delays from sub-contractors	77.10		21	7
Ignoring contract specified conditions	76.18		27	8
Poor site investigation	76.00	Design	28	9
Contractor and consultant coordination problem	75.91	Construction	29	10
Coordination issue between contractor and supplier	75.91		30	11
Incompetency to complete work	75.91		31	12
Coordination issue between contractor and sub-contractors	75.50		33	13
Design mistakes and overlooked	75.20	Design	35	14
Changes in sub-contractor's appointment	75.20	Construction	36	15
Appointment delay in sub-contractors	74.50		38	16
Not completing repair work within defective liability period	74.21	Handing over	43	17
Incomplete drawings	74.00	Design	45	18

Table 6 (*continue*)

Factors	RII	Stage	Overall Ranking	New Ranking
Issuing completion certificate before actual complete	72.50	Handing over	55	19
Problems in proper and timely instructions to workers	71.70	Construction	57	20
Problems in understanding requirement from client	70.40	Early investigation	66	21
Incomplete project report	69.50	Handing over	68	22
Daily activity log book is incomplete	69.31		69	23
Safety negligence on site	68.70	Construction	72	24
Lack of storage capacity at site	68.47		73	25
2. Process based classification				
Late payment delivery	81.00	Construction	2	1
Variation order	80.00		4	2
Low quality work	79.32		6	3
Financial problems	79.12	Handing over	7	4
Land acquisition delays	78.60	Early investigation	10	5
Delay in approvals	78.27	Construction	13	6
Mistakes in budget and resource planning	78.00	Contract	15	7
Non-compliance with standards methods	77.83	Construction	18	8
Delay in design approval	77.40		19	9
Late approvals	77.00	Contract	22	10
Inaccurate bid price	76.50		25	11
Design preparation delays	74.60	Design	41	12
Lack of project information	73.75		47	13
Issues in material supply	73.58	Construction	48	14
Non-cleared specification	73.45	Design	49	15
Testing and commissioning in pending	73.30	Handing over	50	16
Poor construction design	73.15	Design	52	17
Delays in drawing, and bill of quantities	72.90	Early investigation	54	18
Inappropriate methods by contractor	72.10	Contract	58	19
Delays in issuing documents	71.40	Construction	59	20
Poor facilities/equipment	70.70	Handing over	62	21
Delays in issuance of	70.66	Handing over	63	22
Late appointment of consultant	70.45	Early investigation	64	23
Certificate of non-compliance approval by no-authorised party	69.80	Handing over	67	24
Non-availability of workers' accommodation	68.63	Construction	71	25
Late in singing of contract documents	68.32	Contract	74	26
3. Institutional based classification				
Selection of incapable contractor	80.00	Contract	3	1

Table 6 (*continue*)

Factors	RII	Stage	Overall Ranking	New Ranking
Lacking in project monitoring	78.55	Construction	9	2
Site management issues	78.40		12	3
Poor early stage planning	78.00	Early investigation	16	4
Lack of project funding	77.85		17	5
Communication gap between local authorities	77.00	Construction	23	6
Delay in starting work	76.49		24	7
Poor monitoring	76.00	Handing over	26	8
Payment issue to workers	75.85		32	9
Non-availability of technical supervisor	75.29	Construction	34	10
Escalation in material prices	75.00		37	11
Inefficient supervision	74.81	Handing over	39	12
Work permits problem	74.47	Construction	40	13
Delays in making decision against contractors	74.18	Handing over	42	14
Ignoring experts' views during early planning	73.90	Early investigation	44	15
Site problems	73.60	Construction	46	16
Weak contract system	73.30	Contract	51	17
Late appointment of contractors	73.20		53	18
Training issues of team	72.30	Construction	56	19
Higher extension of time (EOT) approvals	71.00		60	20
Liquidated payment variation due to delay	70.40	Handing over	65	21
Safety negligence on site	68.70	Construction	61	22
Poor site location	69.00	Early investigation	70	23
Overpayment to contractor	67.20	Handing over	75	24

POTENTIAL MITIGATION MEASURES TO IMPROVE POOR PERFORMANCE

This section presents the potential measures that can effectively improve the poor performance in construction projects. The measures have been designed keeping in view the identified factors of poor performance in the Malaysian public sector. First, a survey from experts was conducted to identify the most effective measures. Second, the identified most suitable measures were later validated in focused group discussions consisting of engineers, architects, quantity surveyors, project managers, government officers, contractors, and academicians. Finally, the most effective mitigation measures found from the analysis are demonstrated in Table 7.

PROPOSED FRAMEWORK TO IMPROVE POOR PERFORMANCE IN PUBLIC PROJECTS

Framework development is inspired by the intention of delivering the public project on time, with stipulated cost, standard quality, with no conflicts and fewer chances of

Table 7
Mitigation measures to improve poor performance

No.	Mitigation measure	RII	No.	Mitigation measure	RII	No.	Mitigation measure	RII
1	Appropriate project planning	89.0	14	Effective supervision	84.0	27	Complete planning for preconstruction stages	82.3
2	Project focus on time, quality and cost	88.1	15	Timely site inspection	83.9	28	Inspect ground conditions during early investigation stage	82.0
3	Good communication among stakeholders	87.5	16	Maximum avoidance of communication gap	83.7	29	Need to improve contract award system	82.0
4	Appropriate management of site	87.2	17	Priority on client's need	83.6	30	Frequent training to staff	81.9
5	Committed leadership	87.0	18	Implementation of appropriate construction method	83.4	31	Inspecting past experience of team	81.5
6	Completeness of drawings	86.5	19	Hiring of experienced and skilled technical staff	83.3	32	Timely arranging of progress meetings	81.0
7	Appointment of skilled labours	85.3	20	Sound coordination between parties	83.0	33	Quality management system's implementation	80.8
8	Very clear specification	85.2	21	Strict implementation of planning	82.9	34	Clear contract terms	80.6
9	Settle land acquisition issues in the beginning	85.0	22	Strict adherence on construction ethics	82.8	35	Risk prevention strategies	80.4
10	Proper strategic planning	84.9	23	Controlling mechanism	82.7	36	Focus on HR department	79.8
11	Effective team utilisation	84.7	24	Hiring experienced sub-contractors	82.6	37	Sound design	79.2
12	Providing a clear information	84.3	25	Good quality equipment usage	82.5	38	Implementation of latest technology	78.0
13	Proper allocation of resources	84.2	26	Research, training and developments	82.5			

project failure. The framework was developed with the assistance of potential mitigation measures suggested by experts. Performance is a function of ability and motivation, where ability may be defined based on an individual's aptitude and the inputs supplied by the organisation, such as training. In contrast, motivation is a product of desire and commitment. The inability may be due to various factors such as; extremely challenging tasks, lack of skills, knowledge, and aptitude, no improvement over passage of time, and strong effort but no performance. Therefore, ability must be improved to a certain extent to meet the intended performance. Besides, motivation is a function of morale, commitment, and a high motivation drives to successful completion of the task. Henceforth, it should be ensured to motivate individual and involved parties throughout the project. This research proposed a framework where to ensure higher performance. One has to follow the mentioned sequence of activities as shown in Figure 5.

As the project begins and all the major stakeholders are identified, the client must make sure that a performance management policy has been formulated. It should encompass the project schedule, end-user satisfaction, budget performance, technical performance, training, learning, and motivation. Next, each active part must be called to share the policy.

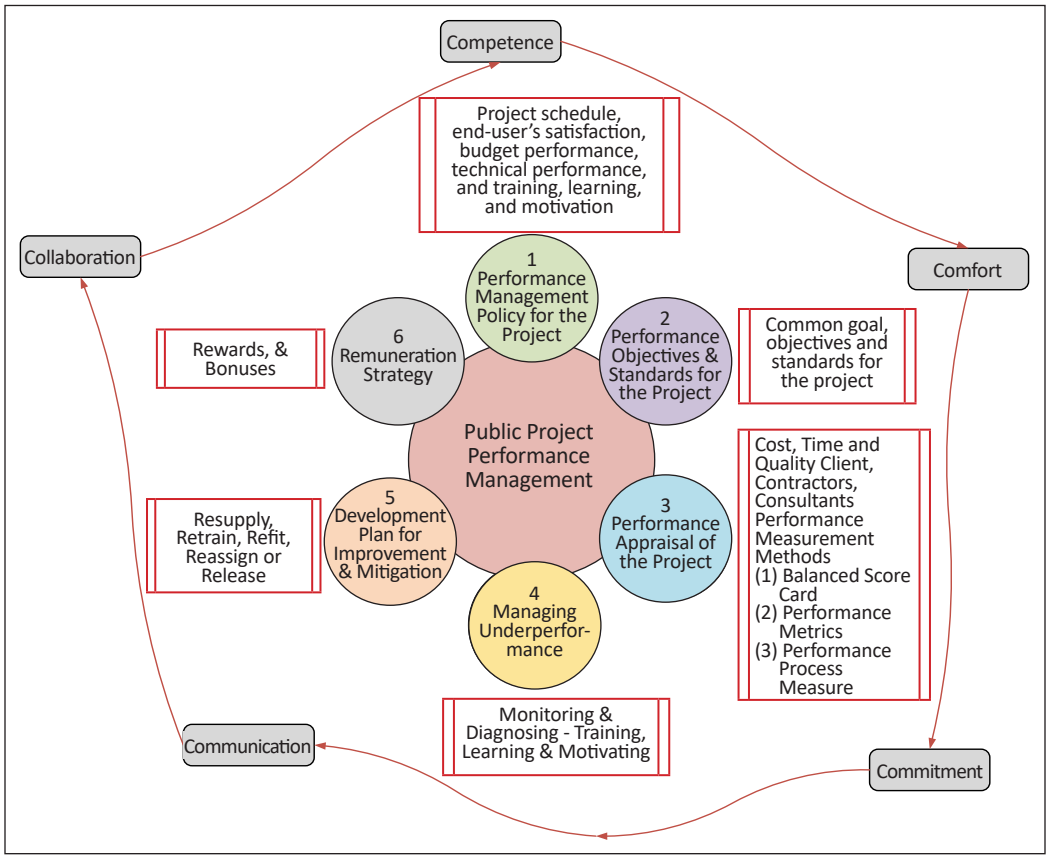

Figure 5. Framework for improving public project performance

The very next step is to establish performance objectives and standards. The performance policy, as well as the objectives, must be carefully designed based on contracts. The performance objectives must be established based on common goals, shared mission, and values that benefit the involved parties equally. It can motivate each party to work harder, and they would start owning the project. The next step in the framework process is appraising the performance for immediate actions against any mishaps. The following approaches can be achieved.

- Balanced Score Card
- Performance Metrics, and
- Performance Process Measure

The next step in the framework is measuring the underperformances. Any mishap, if identified, its alternative approach must be effectively implemented, such as a shortage of materials. The underperformance can be attributed to several factors, such as the ability. There are five possible directions to overcome performance problems that are associated with ability. It refers to the development plan and learning development activities such as; resupply, retrain, refit, reassign, and release. The final step in the framework is implementing a remuneration strategy such as bonuses, rewards, incentives, recognition, and motivation. The remuneration strategies aim to boost the morale of the individual, and this would enhance productivity.

In addition to the steps mentioned above, the proposed framework integrates the concept of Competence, Comfort, Commitment, Communication and Collaboration (5Cs). The concept of 5Cs must be the foundation of each project. *Competence* is the basis of many organisations according to which employees are the most valuable asset in the firm. A project manager is a major employee in a project, and its competency could not be overlooked. A project manager must possess enough skills such as leadership, technical, and ethics. *Comfort* is based on the concept that the resources, efforts, and leaderships align well with project performance. Besides, c*ommitment* ensures that all involved stakeholders and levels of the organisational hierarchy are willing to manage, perform, and operate the required facilities in harmony. The commitment is a driving force that keeps the project on a track that leads to performance. The dissemination of information to internal and external parties are done via *communication*. Effective communication throughout the project and especially in the early phases, have a positive influence on performance. Several conflicts and problems arise owing to the miss-communication factor. Finally, *collaboration* is also equally valuable for a project. Several collaborative tools play a vital role, such as seminars, training, workshops, and team-building activities. Such tools are also fruitful in dispute resolutions, problem-solving, enhancing a win-win scenario, and risk balancing. Therefore, collaboration is a strategy to resolve the problems mutually.

CONCLUSION

This research aims to identify factors contributing to poor performance in public projects in Malaysia and develop a framework for mitigating the problems triggering the poor performance via a novel classification. The research identified 75 most influential poor performance factors for Malaysian public sectors. Fifty-six past projects were investigated from Audit General's report (2003 to 2014). The factors were classified into project life cycle stages. From the study findings, it was concluded that the highest factors belonged to the construction stage. The related financial issues are found as the most contributing factor in poor performance. The study found a contradiction in the findings of Audit General's Report factors and those identified in this study. According to the Audit General's Report, most poor performance issues are due to low quality, contractual issues, weak implementation, and monitoring work. However, the survey results found the majority of factors related to financial issues.

Henceforth, the severity and occurrence of factors investigated in this study do not link with those available in the reports. Nonetheless, respondents agreed with some factors which were also observed critical from the survey, such as variation order, selection of incapable contractor, variation order, design issues, financial issues, and poor monitoring. Therefore, the study re-classified the factors into a novel classification based on actor, process, and institution. This classification is imperative to understand the actual and precise problems related to poor performance. Furthermore, researchers and policymakers could easily trace the problems, and responsible departments can be identified, such as actors, processes or institutions. In addition to this, other major findings of this research are in the form of mitigation measures. Thirty-eight most effective solutions are ranked from the survey analysis. Based on the mitigation measures, a framework is designed from the experts' opinion. The framework operates on the principle of performance management, which relates the ability and motivation and consisting of six major steps. Moreover, the framework is supported by 5Cs, i.e., Competence, Comfort, Commitment, Communication and Collaboration. In future, the reports from State and Federal statutory bodies may be considered for further analysis. Furthermore, detailed research could be conducted where exclusive stakeholders are identified who is responsible for poor performance.

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