

CONTRACTOR PREQUALIFICATION EVALUATION AND SHORTCOMINGS

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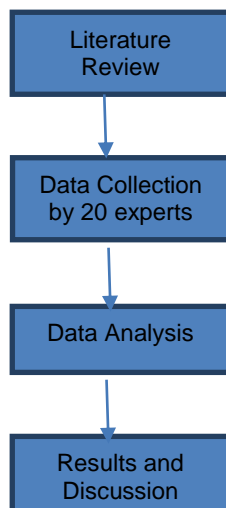
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Graphical abstract



Abstract

The selection of a suitable contractor for a construction project is one of the most important decisions a client can make for the development of the project. Prequalification is a procedure to examine and gauge the competency and skills of contractors to successfully complete a project if it is given to them. However, the evaluation employed for some prequalification is still ambiguous or highly subjective. This study aims to investigate the shortcoming of the current prequalification evaluation for contractor selection. The methodology of the study is based on a comprehensive literature review and expert survey whereby the criticality of data, obtained from the literature was analysed using expert in the field. Among the prequalification criteria, the current evaluation that employed for management capability is highly ambiguous. Two important shortcomings of current prequalification models regarding the evaluation of management capability were identified. First, the models are not comprehensive since all the variables related to the management capability are not included. Secondly, the models focused almost exclusively on time and cost performance as outcome variables, which may not be enough to evaluate the management capability of contractors. Better evaluation methods have to be developed to assess the management capability prequalification as it has a major impact on time and cost performance of contractors. Therefore future study must be conducted to develop a model that evaluates the management capability of contractors based on the relative variables for the purpose of improving current prequalification selection.

Keywords: Contractor selection, Prequalification criteria, Management Capability, Management variables

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1.0 INTRODUCTION

One of the most important tasks encountered by a client who hopes for successful project outcomes is selecting a capable construction contractor [1]. In many countries, the prequalification criteria are

commonly tailored to select competent contractors. Once a proper selection process has been completed, the client can then entrust the contractor to carry out the project. Prequalification is a procedure to examine and gauge the competency and skills of contractors to successfully complete a

project if is given to them. The prequalification process is conducting to ensure the client that their satisfaction criteria were considered [2].

The selection of construction contractor in general contains two stage namely prequalification and bid evaluations [3]. In the prequalification stage a large numbers of contractors are invited and analyzed, based on predetermined criteria and a short listed contractor is drawn by the clients. In the bid evaluation stage short listed contractors in the prequalification stage are again invited and investigated to select the appropriate contractor for the project. Capability of each applicant will be compared with the predefined sets of minimum values.

Prequalifying contractors is a critical element in project planning because it can have a huge impact on the final outcome of the project. Despite of the fact that the process of screening the potential contractors is an important feature of prequalifying, the current prequalification evaluations are often inadequate. This study aims to investigate the shortcoming of the current evaluation of different prequalification criteria for the contractor selection at prequalification stage.

1.1 Prequalification Criteria

Prequalification is a method to examine and gauge the skills of potential contractors to determine if they can perform the project properly. Researchers, such as Hatush and Skitmore [4] and Ng [5] have done much research on the usage of the prequalification process. As a result of the prequalification process, there will be a directory for clients to refer to when they need to invite contractors for tendering. To get their names on the endorsed directory, a candidate must first send in an application to the client, after which the client will carry out the necessary steps to assess the contractors' financial status, management capability, organizational structure, technical expertise and previous experiences of similar projects [6]. Hunt *et al.* [7] assert that criteria that include the technical, management and financial aspects of a contractor should be accounted during prequalification selection. Such criteria consist of the candidates' current and existing venue of business, capacity of plant and tools to carry out the project, sufficient funds to fulfill the project's needs, and aptness of technical skills and experience.

Clients [8] and executive management [9] are placing high value on contractors who are punctual in completing their construction projects. Besides that, other critical criteria were bid price, quality of work, contractor organization, previous and current experience, and financial capability. Rashvand *et al.* [10] suggested a list of prequalification criteria such as previous work experience, workloads, work records, completion time, technical knowledge, and cost.

Anagnostopoulos and Vavatsikos [11] came up with an extensive list of criteria which comprises of financial performance (credit ratio, current ratio, asset turnover

ratio), technical performance (resources and experience), safety and health policy (compensation paid to labor accidents, safety and health investment), and public work past performance (cost overruns, schedule overruns, claims issued at executed contracts). Trivedi *et al.* [3] named six prequalification criteria which are financial turnover, manpower resources, equipment resources, post experience, past performance, and affordable relatable projects. Manideepak *et al.* [12] proposed criteria such as a recommended bid amount, financial soundness, technical ability, management capability, safety and health records, and reputation to be included in the process of assessing and deciding on a contractor.

The literature identifies several prequalification criteria which can be used in the selection process. The most cited prequalification criteria for contractor selection from the literature are: management capability, technical ability, financial capacity, and occupational health and safety.

1.2 Practices for Evaluation of Prequalification for Contractor Selection

According to the literature, the current prequalification contractor selection criteria are: management capability, technical ability, financial capacity, and occupational health and safety [13-15]. In contractor evaluation, numerous criteria are taken into account, which, in turn, are characterized by the right sub criteria. In fact, the prequalification criteria were assessed based on the related sub-criteria. Table 1 displays the list of basic and sub-criteria of contractor prequalification evaluation by Plebankiewicz, [14].

As can be seen in Table 1, most of the criteria are evaluated based on the evidence provided by the contractors for each prequalification criterion. Prequalification criteria, such as financial capacity, occupational health, and safety and technical ability are assessed by the evidence that are provided by the contractors such as credit rating, banking arrangement, bonding and financial status for the issue of financial capacity; occupation health and safety incident rates for the health and safety performance of the contractor, questionnaire is another method for the occupation health and safety performance; equipment by the resources and tools for the technical ability. Anagnostopoulos and Vavatsikos [11] established the criteria and sub-criteria according to their hierarchy for the purpose of prequalification evaluation which consist of financial performance (credit ratio, current ratio, and asset turnover ratio), technical performance (resources and experience), safety and health policy (compensation paid to labor accidents, and safety and health investment), and management capability (cost overruns, schedule overruns, and claims issued at executed contracts). These have been shown in Figure 1.

From Table 1 and Figure 1, it can be concluded that while the sub criteria are often based on direct

objective evaluation, However, the evaluations employed for some prequalification processes are still inadequate or highly subjective [14]. Huang [15], for example, noted that questionnaires can be used to collect the required data for the prequalification process, argued that contractors may be tempted to answer the questions to their best advantage. For example, the contractor may bluntly answer 'yes' to a question that asks whether a safety issue is the top priority in their businesses, though it is actually not being practiced. In another study conducted by Aje [16] on the impact of contractors' prequalification on project performance, results showed that the evaluation of the contractor's technical ability is not applicable because the contractors had gone out of their way to prove that their manpower resources were sufficient to execute and complete the project. However, upon qualification and selection, it became clear that many contractors, wishing to maximize profit, did not engage enough workmen on site, resulting in serious project delays. Also in a construction prequalification questionnaire [17] published by British standard institution, the contractor management capability as one prequalification was not evaluated completely as only few variables relating to this prequalification were considered i.e. quality

monitoring and training program which is not comprehensive.

Table 1 Prequalification Evaluation [14]

Criteria	Sub-criteria
Financial Standing	1. Financial stability 2. Turnover, profit, obligations, amounts due 3. Owned financial funds
Technical Ability	1. Experience 2. Plant and equipment 3. Personnel
Management Capability	1. Past performance and quality 2. Quality control policy 3. Project management system 4. Experience of technical personnel 5. Management knowledge
Health and safety	1. Accidents 2. Health and safety management system 3. Insurance policy
Reputation	1. Past failures in completed projects 2. Number of years in construction 3. Past client relationships 4. Cooperation with contactors

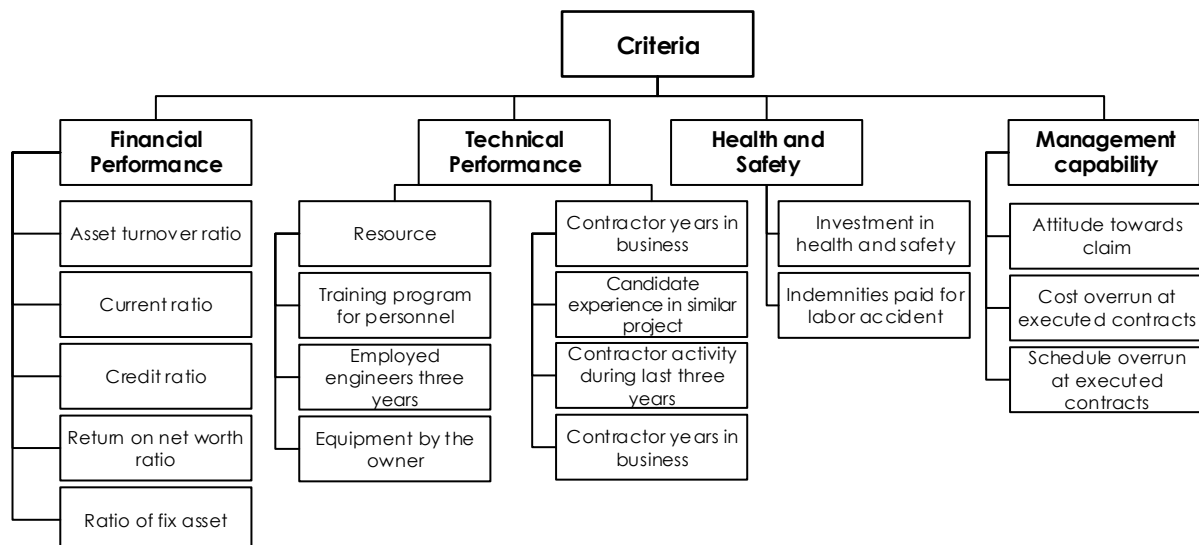


Figure 1 Contractor Selection Criteria [11]

Management capability of contractors is an important prequalification criterion that has not been considered enough among the prequalification criteria although it is an undeniable requirement during the prequalification process to assess the capabilities and competence of potential contractors [16]. Different variables were identified to evaluate management capability. According to Aje *et al.* [18], the variables of management capability, based on the analysis of respondents' ratings, are: contractors' experience; quality control program; management

knowledge; past performance and quality achieved; and number of workforce in the company. According to Wong *et al.* [19], control and monitoring procedures, ability to manage risks and adequacy of information technology knowledge are also the key variables of management capability. According to Hatush and Skitmore [13], past performance and quality, project management organization, experience of technical personnel and management knowledge are the variables of contractor management capability; however, the evaluation

employed for this prequalification relies mainly on the time and cost performance of a project which is not enough to evaluate the management capability of contractors. Management capability consists of objective (experience, quality control policy, project management system) and subjective criteria (past performance and management knowledge). The evaluation of objective criteria is based on the evidence provided by contractors; however the evaluation of subjective criteria is highly ambiguous since there is no indication for evaluation of good and bad practices.

The evaluation of management capability is critical as it can support the identification, evaluation and screening of other prequalification criteria approved by the client. To illustrate with an example: an important management capability is being equipped with the resources and tools to ensure the prequalification of strong technical ability that can be monitored by the resource management.

1.3 Evaluation of Management Capability Prequalification

As can be concluded from the previous section, the prequalification criteria were assessed based on the related sub-criteria. Management capability, as an important prequalification criterion, has both subjective and objective variables. The objective variables include years of contractor experience and quality achieved [15; 18]. These variables are assessed with evidence from the contractor's previous performance to certify and confirm the quality of work done, the nature of the project, and years of experience in similar projects. On the other hand, subjective variables typically include monitoring and controlling ability, problem solving skills, team development skill, management knowledge, and resource management. The evaluations for these variables are ambiguous.

Table 2 is the collection of various studies conducted between 2000 and 2009 that indicates the contractor's selection models. From Table 2, two important shortcomings of the previous model which is related to the evaluation of subjective management capability have been identified. Firstly evaluating the contractor's ability to realize a given project, should take into consideration with different variables of his capabilities. This shortcoming can be found in studies by Fong and Choi [20], Cheng and Li [21] and Turskis et al. [22] where the interaction between client and contractor was considered as the only subjective management variable to evaluate this prequalification. The management capability of contractors consists of both subjective and objective variables; whereas only a few variables of this capability were considered in the current evaluation

model. Secondly, the models have focused almost exclusively on time and cost performance as outcome variables, which may not be enough to evaluate the management capability of contractors. This shortcoming can be found in studies by [11], Wong [23] and Plebankiewicz [14] whereby the evaluation of past performance for management capability was related to the time and cost performance of the previous projects.

Although time and cost performance are important elements in identifying competent contractors, solely relying on these metrics may give an incomplete picture of their performance capability, particularly when time or cost overruns occur for reasons outside of the contractors' control. The overrun of time and cost overrun in the project are usual and can be the result of other stakeholder's faults. Therefore, it is important to evaluate the management capability of the contractor based on the related variables rather than time and cost only. The Impact of Contractors' Management Capability on Cost and Time Performance of Construction Projects. Hatush and Skitmore [13] recognized financial capability, technical skills, management capability, and health and safety performance of contractors as the most popular criteria during the selection of contractors. From the list of criteria, the delivery of construction materials is mostly affected by the management capability of contractors since they are the party who controls the construction resources. Ajibade [24] and Odusami [25] define management capability as the competency of contractors to manage the assets and resources responsibly to ensure that the project is kept on track financially and within the specified duration and quality. Budget Monitoring and Price Intelligent Unit [26] rated management capability as the critical criteria for contractor selection. Aje [18] studied on the impact of the contractor management capability on time and cost performance of construction project. Statistical data have proven that contractors' management capability have a strong influence over the assessment of the prequalification and tendering of contractors, expenditure performance, and project duration. This is the reason why management capability is a critical factor in the prequalification process as the cost and time performance is highly affected by the management capability of the contractors. Aje [18] suggested that the cost and duration of the project can be estimated by using predictive models which are based on the performance of the management capability of contractors. By doing so, the clients will be able to have an early indication of the contractors' performance. This practice will substantially improve the selection process of construction contractors.

Table 2 Review on Contractor Selection

Authors	Model	Shortcoming
Lam <i>et al.</i> [35]	Evaluate the suitability of using the artificial neural network (ANN) model for contractor pre-qualification and selection.	The linguistic evaluation were applied in the model for the issue of management knowledge and past performance as two variables related to management capability. However, the evaluation is ambiguous since the indication of good, fair and poor performance is not properly defined.
Fong and Choi [20]	Using AHP model for contractor selection which is not specifically based on the lowest bid price.	In the model, the interaction between the client and contractor is the only subjective variable related to contractor's management capability. Firstly, this criterion is not sufficient to show how effective the contractor's management capability is. Secondly, the evaluation of past performance as another management capability variable was based on the time and cost overrun that are not the right indicators for management purposes.
Wong [23]	Outlines the use of clients' tender evaluation preferences for predicting a contractor performance via a Logistic regression (LR) model.	The contractor's past performance evaluation as a variable in management capability is based on time, cost and quality from previous performances. This is not appropriate since faults from other stakeholders can lead to the extension of time and cost as well.
Cheng and Li [21]	The multi-criteria decision making (MCDM) is suggested to be a viable method for contractor selection. The AHP model has been used as a tool for MCDM.	The model is not comprehensive since the client-contractor relationship was the only subjective variable for management capability considered in the model. In addition, the indicators for past performance are time and cost overrun and there is no indicator defined for the client-contractor relationship in the model.
Anagnostopoulos and Vavatsikos [11]	Proposing a MCDM approach, based on the AHP model for supporting public authorities in contractor prequalification.	In the contractor selection process, the management capability of a contractor is evaluated against a number of important decision variables. One such criterion is past performance. The evaluation related to past performance is schedule overruns and cost overruns in executed contracts, as well as attitude towards claims.
Turskis <i>et al.</i> [22]	This article proposed an assessment model for contractor selection based on the multi-attribute methods in a competitive and risky environment.	The model is used different values such as - construction time; quality of performed projects; bid estimates and communication with stakeholders. Communication with stakeholders is the only subjective variable for contractor's management capability used in the proposed model which is not comprehensive.
Plebankiewicz [14]	Contractor prequalification model using fuzzy sets models.	The prequalification criteria such as management capability, technical ability, etc. are evaluated based on the objectives of the client which is time, cost and quality. These may not be valid since the extension of time and cost may be the result of other complications.

1.4 Management Capability Variables for Contractors

Management encompasses the organizing, planning, controlling, and leading processes executed to achieve the project objectives [27]. It also involves other aspects such as the recruitment, allocation of resources and funds to produce an outcome [18]. Contractor should equip their company with qualified and skilled staff with project management skills. The term "management" is very ambiguous in definition so, it is nearly impossible to find agreement of its nature. According to Aje *et al.* [18], the variables of management capability, based

on the analysis of respondents' ratings, are contractors' experience, quality control program, management knowledge, past performance and quality achieved, and number of workforce in the company. According to Wong *et al.* [19], control and monitoring procedures, ability to manage risks, and adequacy of information technology knowledge were regarded as the key variables.

According to Hatush and Skitmore [13], past performance and quality, project management organization, experience of technical personnel and management knowledge are the variables of contractor management capability. McCaffer [28] concluded that the effective use of the plant and

equipment can significantly impact the contractor's time performance and if it is managed well, successful projects can be delivered. Table 3 depicts the management capability variables listed in different studies. As can be seen in Table 3, problem solving skill and management knowledge, in contrast with other variables obtained the highest ranks by seven out of 10 authors. The second highest ranked was belong to 'Monitoring and controlling', as mentioned by six authors. 'Resource management' and 'Team development skill' are ranked third by four citations and the least related variables were 'organizational management' and 'planning' which were cited by three and two authors respectively. From Table 3, the seven most cited management capability variables are monitoring and controlling, planning, problem solving, team development skill, management knowledge, organizational management and resource management.

3.0 METHODOLOGY

The methodology is based on extensive literature review followed by data collection, data analysis, discussion, and conclusion. A literature review was conducted using different tools such as books, Journal and etc. related to the topic. For data collection, beside the literature review, expert survey was conducted to assess the criticality of the data gathered from the literature. This was done to ensure that the current shortcomings are exists in real practice.

Table 3 Contractor Management Capability Variables

Authors	Monitoring and Controlling	Problem Solving	Team Development Skill	Management Knowledge	Resource Management	Organizational Management	Planning
McCaffer [28]	✓	✓		✓	✓		
Lam et al. [35]				✓			✓
Abiola [27]	✓	✓			✓	✓	
Fong and Choi [20]		✓					
Wong et al. [19]	✓	✓	✓	✓			
Wong [23]	✓	✓	✓	✓		✓	
Turskis et al. [22]		✓					
Plebankie wicz [14]				✓			
Aje et al. [18]	✓	✓	✓	✓	✓	✓	
Huang [15]	✓		✓	✓	✓		✓
Total citation	6	7	4	7	4	3	2

The expert survey was conducted with 20 directors of top construction consulting firms in Malaysia. The directors were the key members of the firms to be involved in the selection of eligible contractor to award the contract. These individuals have, on average, more than 30 years' experience in supervising contractors' performance. The consulting firms are the representative of client for the prequalification contractor selection process [29]. The companies have been accredited with the prestigious MS ISO 9001 certification by the Standards and Industrial Research Institute of Malaysia (SIRIM) for the provision of consultancy services in the design and supervision of civil and building works. From the expert survey questionnaire, the experts were asked to rate the importance of each criteria from (5) "absolutely important" to (1) "the least important". The importance index of the individual criteria was calculated using equation 1 [30].

$$Eqs(1) \rightarrow RII = \frac{\sum_{i=1}^n W_i}{A * N}$$

Where, RII is Relative Important Index, Wi is Weight of the criteria (i) given by respondents ranged between

1 to 5, A is the Maximum weight given by respondents and N is the Number of respondents. Based on equation (1), the relative important index (RII) can be calculated ranging from 0 to 1. For data analysis, the importance of each criterion from the expert survey was investigated. From these analyses, a conclusion was drawn.

2.0 RESULTS AND DISCUSSION

In this part, the data obtained from a questionnaire survey distributed among the top management team of the construction consulting firms in Malaysia were analysed. The relative importance of each prequalification criterion for contractor selection and current evaluation of management capability as the critical prequalification criteria at the prequalification stage were investigated.

Prequalification Criteria for Contractor Selection:

The aim of the question is to investigate the importance of each prequalification criterion. Respondents were requested to rate the degree of importance of the five prequalification criteria currently used for contractor selection in Malaysia through selecting one of the following terms: extremely important, very important, important, not important, and extremely not important. Table 4 illustrates a summary of relative important index (RII) of each prequalification criterion.

As can be seen in Table 4, financial standing was considered as the important criteria during the prequalification process followed by technical ability and management capability with 97%, 94% and 85% important index respectively. Contractor reputation and health and safety performance were ranked lowest although performed as one prequalification for contractor selection.

Current Evaluation for Management Capability: The aim of this question is to examine the current evaluation for management capability. Respondents were requested to rate the degree of importance of the five criteria currently used for the evaluation of management capability through selecting one of the following terms: extremely important, very important, important, not important, and extremely not important. The five sub-criteria were highlighted in

Table 4 Relative Important Index of Each Prequalification Criterion

Prequalification Criteria	Importance Index	Rank
Financial standing	97%	1
Technical ability	94%	2
Management Capability	85%	3
Reputation	54%	4
Health and safety	54%	4

Table 5 Relative Importance Index of Each Management Capability Evaluation Criteria

Evaluation of management capability	Importance index	Rank
Past performance (time and cost overrun)	91%	1
Experience of technical personnel	85%	2
Quality control policy	71%	3
Attitude towards claim	68%	4
Management knowledge	51%	5

Table 5 shows that time and cost performance of a contractor in a project is the favorite indication used to evaluate management capability of a contractor. As was discussed in the literature, causes of time and cost overrun is usual and can be the result of other stakeholder's faults. Therefore the current method of evaluation of management capability is inappropriate and it is important to evaluate the management capability based on the relative variables rather than time and cost only. In addition, the contractor or subcontractor can become more motivated in performing their job since their performance is monitored more completely.

Various prequalification models for contractor selection have been identified however two important inadequacies of these models regarding the evaluation of subjective management capability were identified which are as follow. First, the models are not comprehensive since all the variables relating to the management capability are not included. Secondly, the models have focused almost exclusively on time and cost performance as outcome variables, which may not be enough to evaluate the management capability of contractors. Although it has been confirmed by Aje et al. [18] that the management capability has the highest impact on time and cost performance, it does not necessarily mean conversely that overruns in time and cost are indicative of bad management performance of the contractors. For example, in Assaf and Al-Hejji [31] study, 76% of the contractors and 56% of the consultants indicated that the average overrunning time was between 10% and 30% of the original duration. [32; - 34]. Assaf and Al-Hejji [31] mentioned that the most common cause of delay identified by all the three parties (contractor, client, and consultant) is "change orders", which is most often initiated by the client. Therefore measuring the management capability of contractors only through time and cost performance is inappropriate. Management capability has both subjective and objective variables embedded in its meaning. However, the evaluation of subjective variables used in the prequalification models are

therefore ambiguous and subject to multiple and even competing, interpretations.

As a result, a genuine concern arises in linking this cause (management capability) to inadequate or only partial effects – schedule and cost. Better evaluation methods have to be developed to assess the management capability prequalification criterion for two reasons. First, it has a major impact on time and cost performance. Second, it can support the identification, evaluation and screening of other prequalification criteria approved by the client. To illustrate with an example: an important management capability is being equipped with the resources and tools to ensure the prequalification of strong technical ability that can be monitored by the resource management.

4.0 CONCLUSION

Prequalifying contractors is a critical element in project planning because it can have a huge impact on the final outcomes of the project. While screening potential contractors' management capability is an important feature of prequalifying, current evaluation of management capability in contractor prequalification selection are often inadequate since they are mainly related to the time and cost performance of the contractor. Although time and cost performance are important elements in identifying competent contractors, solely relying on these metrics may give an incomplete picture of their performance capability, particularly when time or cost overruns occur for reasons outside of the contracts' control. Looking at the fact presented, it is crucial to exercise due care in the evaluation of management capability for contractors in construction project to reach the desired performance in terms of time, cost, and quality. Therefore future study must be conducted to develop a model that evaluates the management capability of contractors based on the relative variables for the purpose of improving current prequalification selection.

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