Level of Importance of Performance-based Tender Evaluation Indicators

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Abstract

Objectives: The objective of this paper is to identify level of importance of performance-based tender evaluation indicators required to stimulate the effectiveness of current tendering practice in Malaysian Public Sector. **Methods/Statistical Analysis:** This paper presents a case study conducted at Public Works Department (PWD) of Malaysia. The Quantity Surveyors are examined with a concern of the implementation of performance-based tender evaluation indicators. The research also questioned the level of importance of 11 past performance indicators and 11 potential performance indicators. The quantitative research method was adopted by developing a questionnaire survey and data collection in PWD. **Findings:** Evaluating contractor based on performance has positively help to select the right contractor. This study aims at finding out drawbacks on current tender evaluation practice, developing the performance-based indicators, identify level of importance of each indicators and seeking opinions of PWD. Relatively, the setbacks have been observed in their criteria of tender evaluation with the lack of past performance and potential performance being measured. Ironically, the findings indicate that the quality of workmanship on past project and customers' satisfaction are the most important indicators but none of the indicators are considered in the current tender evaluation practiced by PWD. The result of this study provides an important contribution as a guide that helps the public sector to select a competent contractor based on performance indicators. Measuring performance based contractor selection is rather new and implementation is still limited. **Application/Improvements:** Comprehensive contributing factors of performance indicators developed in this research may help the client to improve their contractor selection by using the performance indicators identified.

Keywords: Contractor Evaluation, Level of Importance, Performance-based, Performance Indicators, Tender Evaluation

1. Introduction

The common practice of selecting a contractor based on the lowest price bid has long been evaluated by many researchers[1–3]. According to them, a contractor bidding at a very low bid price who eventually wins the tender may find the bid amount unsustainable to deliver the project successfully. Such contractor often faces various project delivery problems, such as serious time and cost overruns, quality problems and increased number of litigations[4]. In[5,6] conducted investigations of contractor selection practice in the UK construction industry and both found significant findings that past work performance is the most reliable indicator in the contractor selection process. Contractor selection in Malaysia is always influenced by bid price and financial soundness of contractor, but the industry often suffers project delivery delays caused by the contractor[7]. Therefore, this paper explored the current tender evaluation practiced by Public Works Department (PWD) of Malaysia. In this context, the PWD is the agency acting as the technical advisor to the government, developing guidelines and Standard Operation Procedure (SOP) of tendering, responsible for the implementation of development projects and maintenance of infrastructure assets in Malaysia[8]. The Quantity Surveyors (QS) in PWD were selected as a sample for this research due to their well-experience

on tender evaluation practice. We enquired about the PWD tender evaluation system determine the level of importance of performance indicators and the concern for the use of performance-based tender evaluation in the construction industry.

2. Performance Indicators

Numerous studies that focused on determining performance indicators in tender evaluation and contractor selection were identified. Early research in the UK found that the foremost features of contractor selection were past failures, experience, financial status, credit ratings, financial stability, ability, management knowledge and management personnel; generally influenced contractor performance in terms of time, cost and quality. Further study in[9], identified a framework for performance indicators in the UK, which is in accordance to project phase and stakeholders for the success of the construction project performance. The finding indicates that seven out of ten parameters used for benchmarking projects consisted of performance indicators. These consisted of construction time, construction cost, predictability of cost and time, defects and client satisfaction with the product and services. Additionally, there are three company performance indicators; namely safety, profitability and productivity. Findings from in[9], represent a good reference for developing performance indicators in contractor selection; but the most important one has not been identified by the researcher. Supposing that project success is repeatable, a clear understanding of contractors' performance and contractors' existing knowledge may lead to construction project success[10]. In investigated performance indicators in the UK via a post construction evaluation; they suggested that quality policy, size of past projects completed, adequacy of labor and plant resources, turnover history, waste disposal and company image are the most significant factors affecting project success.

Another study in Hong Kong, in[11] determined indicators to rank the selected contractors by 5 experts; namely past performance, past experience, past relationship, current workload, tender price, financial capability, resources and safety management. Research in[12], in a comparison of Japan, UK and USA contractor performance revealed that the contractor performance is dependent on past performance on similar projects, sub-contractors relationship, lifetime employment, time

performance and the number of design variations that arose during construction. In order to improve overall contractor performance, contractors need to improve time performance, establish long-term partnership with sub-contractors, and maintain a stable and well-trained workforce[12]. In[13], investigated opinions of Singapore's construction practitioners regarding the importance of contractor selection criteria in assessing performance capabilities of contractors. Findings from the study suggest that contractor selection criteria seen as the most important include project manager's qualifications and level of experience, experience on similar types of project, technical staff's qualifications and level of experience, management staff's qualifications and level of experience and attitude towards correcting faulty work and current commitments. As can be observed, most of the criteria reflect past and potential performance categories. It is an indication that further consideration is needed in evaluating contractors according to their past and potential performance, which is the aim of this research.

In Malaysia, contractor selection practiced by the PWD has two stages. Each stage comprises sets of criteria and different assessments; in stage one contractor is evaluated on the submitted documents and in stage two the contractors' financial and technical capability are evaluated. Existing practice shows a good tender evaluation process but the contractor selection emphasizes on tender price[14] and financial capability[15] rather than technical capabilities. Technical capability consists of the evaluation of contractor experience on similar project for the past 5 years, technical staffs' qualifications, list of owned plant and equipment. Evaluation on a contractor's past work experience depends a lot on the intuition and subjective judgment of the previous project manager. With the gap in the lack of past performance evaluation considered in tender evaluation and dependency on subjective judgment, the result can be subject to biased and fraudulent reports. The implication of this has led to the current tender evaluation struggling in selecting the right contractor and the industry is plagued with delays in project delivery[16]. The Malaysian government needs to take appropriate actions to overcome numerous limitations in the public procurement activities to ensure a more transparent and efficient system[17]. In making transparent decisions and to promote healthy competition in tendering, there is a need for flexible guidance tools to support decision making, which can better evaluate contractors based on their past and potential performance

and result in greater objectivity.

Table 1. Past performance indicators

Past Performance		
Main Criteria	**Definition/Explanation**	**References**
Type and scale of the projects completed in the past 3-5 years.	Availability of information on previous completed project for the past 3-5 years.	18, 19, 20
Quality of workmanship on past project.	By notice of clients/regulatory bodies, level of satisfaction with the past workmanship quality work by contractor.	21, 22, 20
Percentage of previous work completed on schedule in the past 3-5 years.	Availability of information on previous completed project for the past 3-5 years.	18, 19, 20
Frequency of previous failure to perform contract on time or fail to complete on time.	Project Participation in previous projects has been terminated and number of previous projects on Liquidated Ascertained Damage (LAD).	1, 23
Standard of subcontractors' work.	Degree of subcontractor qualifications, experience, skills, and standard of practice.	12, 24,25
Attitude in correcting faulty work.	By notice about level of satisfaction with the contractor maintenance service during defect liability period, number of defects and type of defects reported.	13, 26, 20
Relationship with past owner/client.	Number of repeated owner/clients who worked with the contractor previously.	27, 28, 29, 30
Relationship with past subcontractor.	Number of repeated subcontractor who worked with the contractor previously.	11
Relationship with past supplier.	Number of repeated suppliers who worked with the contractor previously.	11, 31
Debarment and/or demerit point of past project.	Previous punishments records on the contractors.	13, 27
Customer satisfaction.	Customer satisfaction survey and staff allocated for customer service.	32, 33

Therefore, this research has opted to identify the relevant performance indicators were selected from various researches and divided into two main category; past performance and potential performance. Definitions of the two main categories are based on a study in as follows: Past performance is defined as criteria to assess the level of expertise offered by the contractor

and potential performance is defined as evaluating the availability of resources and experience level of the contractor in a similar type of project. There are 11 sub-criteria in each of the categories. Table 1 shows the past performance indicators and its definitions according to various researchers.

Table 2 shows the potential performance indicators and definitions of each indicator that have been identified based on various researchers.

Table 2. Potential performance indicators

Potential Performance		
Main Criteria	**Definition / Explanation**	**References**
Depth of experience on similar type of project.	Similar type of projects previously conducted, completion of the project in time and cost.	18, 19, 34
Qualifications and experience of management staff.	Degree of education, experiences, capabilities and competencies, skills of management staff.	13, 27, 34
Qualification and experience of technical staffs.	Degree of education, experiences, capabilities and competencies, skills of technical staff, special qualification of key personnel.	13,27, 34, 35
Manpower resources.	Adequacy of labor resources (local and foreign workers).	11, 36, 10
Availability of owned plant and equipment.	The ratio of owned major plant and equipment to the whole plant and equipment required for construction.	37, 38, 20, 27
Present/current workload.	Number of project the contractor working on currently.	13, 27
Quality control and assurance program.	Availability of a quality assurance/quality control program outline.	18, 39, 40
Specialized construction knowledge.	Classification of contractor specialization and number of specializations registered.	9, 27, 10, 29
Quality recognition.	Types of quality recognition received.	18, 39, 40
Quality Training.	Evaluation of quality training and number of employees attending the quality training program.	18, 39, 40
Safety and Health record.	Availability of safety measures on site, health and safety information chart for employee. Availability of accident book and records, compilation of accidents records, records of accident rate in past 5 years.	26, 20,10, 27

The questionnaire survey was designed to support in identifying the level of importance of past performance and potential performance according to quantity surveyors' perspective in PWD.

3. Methodology Adopted for Present Study

The study implemented a case study approach within QS in the PWD organization which is mostly involved in public projects in Malaysia. The identified group of Quantity Surveyors of PWD was contacted and their participation requested in the survey via email.

The development of the questionnaire involved five stages process, namely define the problem, determine performance indicators, develop and evaluate the questionnaire and finally, apply the questionnaire.

The questionnaire consists of two parts. The first part of the questionnaire collected the descriptive data about respondents' background information such as the designation, years of work experience in tender evaluation and type of firm/organization. In the second part of the survey, consists of 11 past performance and 11 potential performance indicators from peer reviewed publications and the respondents was asked to rate the level of importance of each performance indicator. The level of importance is measured on a 5 score of Likert scale; 5 denotes most important, 4 important, 3 quite important, 2 not quite important and 1 not important at all. Blank spaces are provided for respondent if they had their own opinion on potential(s) and implication(s) of the performance-based contractor selection. Before conducting an actual survey, a pilot study was undertaken to pre-test and to evaluate the questionnaires. 15 responses (10 quantity surveyors in PWD and 5 contractors) were invited to examine the questionnaire. Their concerns subsequently used to modify and improve the questionnaire before being finalized, reproduced and distributed.

The survey was emailed and delivered to 217 QS who were currently working with PWD in Malaysia. Online questionnaires were distributed to respondents via email.

For this study, an online survey using Google Form was used to facilitate the ease of survey distribution and for faster survey results. The survey received 46 responses (out of 217), which is a 21.2% response rate. It is acknowledged that this sample size is relatively small but the detailed answers are considered to have provided substantive information that may be generalized and able to gain an understanding of the general situation of the case study[41]. The data was stored and analyzed using Microsoft Excel.

4. Discussion

4.1 Descriptive Statistic of Data Collected

46 completed questionnaires were received from 217 emails that were distributed. Five categories relating to respondents' years of work experience were used in the study; namely less than 3 years, 3 to 6 years, 7 to 10 years and greater than 10 years. Respondents with less than 3 years of experience constituted approximately 3%. Of the remaining respondents, 67% had 3 to 6 years of experience; 22% had 7 to 10 years of experience and 8% represented respondents with more than 10 years of experience.

4.2 Level of Importance of Performance-based Indicators

The result of past performance indicators indicate that the quality of work in past project has the highest level of importance with a mean score of 4.54, followed by frequencies of previous failure of past project with a mean score of 4.24 and customer satisfaction with a mean score of 4.17. The least important of all is the relationship with past owner/client. Figure 1 shows results of the level of importance of past performance indicators. Based on Figure 2, the most important potential performance indicator is depth of experience on similar types of projects with the highest mean score of 4.54, followed by manpower resources with a mean score of 4.37 and qualification and experience of technical staff and present/current workload shared the same mean score of 4.33. Finally, safety and health record had the least important score with 3.59.
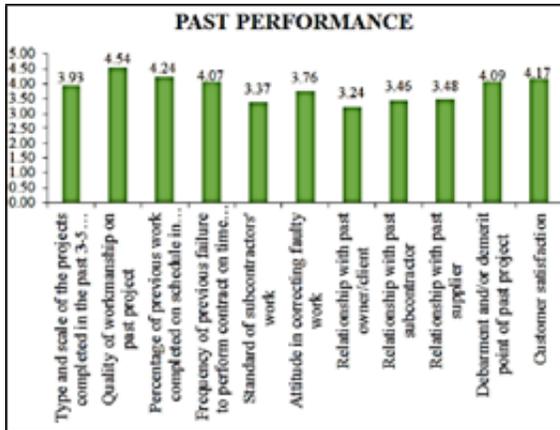
Figure 1. Level of importance of past performance.
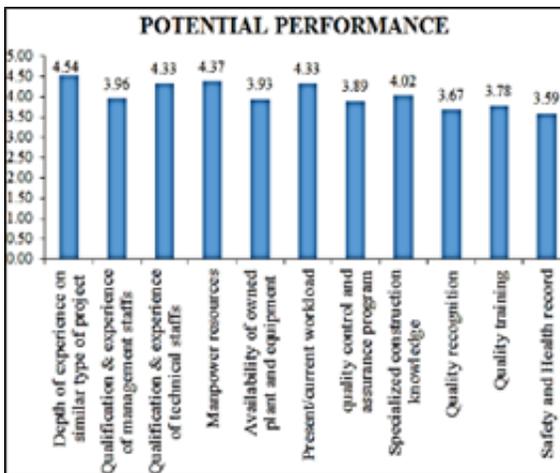
Figure 2. Level of importance of potential performance.

Our results were compared with previous studies and current tender evaluation practiced by PWD. Number of similarities and contradictions were identified. This study revealed that the overall ranking of the six highest scoring are; 1. Quality of workmanship on past projects, 2. Depth of experience on previous similar type of projects, 3. Manpower resources, 4. Present/current workload, 5. Qualification and experience of technical staff, and 6. Previous work completed on schedule. The result contradicted by the study conducted in[42] in UK, who considered present/current workload as the highest

scoring, followed by contractor past experience in terms of size of projects completed and contractors' management resources. Another study in identified depth of experience on previous similar type of project, qualification of project managers and management staffs, previous project completed and qualification of technical staffs as being the most important criteria. Comparing our findings with the criteria identified in PWD tender evaluation, contractor experience on similar project for the past 5 years, technical staffs' qualifications, list of owned plant and equipment are the criteria being measured. However, this confirms that the depth of experience on similar type of project, qualifications of technical staff, current workload and organizational experience on similar types of projects were consistent. However, our study revealed that the quality of workmanship on past project and customers' satisfaction is also considered as the most important for assessing the capabilities of contractors in Malaysia. Therefore, the quality of workmanship on past project and customers' satisfaction can be considered and incorporated into the PWD tender evaluation in future. Planning preventive measures is the first step that PWD need to do to for restructuring the tendering process in order to solve the main issue[43], to enhance the performance of construction project by selecting the right contractor.

92% of the respondents agreed on the implementation of performance-based contractor selection in the public sector and the remaining 8% disagreed. Some of the comments on potential and implication of this performance-based tender evaluation received from respondents are shown in Table 3.

The improvement of construction project performance may be influenced by selecting the right contractor based on his best performance and strings with lean construction adopted by the construction companies. Study done in[44] suggested that contractor need to train through lean concepts, communicate effectively among construction participants, team work, focus on client's need and standardize construction elements for effective execution of construction project.

Table 3. The potential and implication of performance-based tender evaluation

Potential	Implication
• Ensure selected contractor is good and capable of completing good quality of work.	• New company may face hard time.
• Fair.	• Selection criteria may be too rigid if contractor does not understand or is not exposed to the evaluation process.
• High performing contractor can be chosen.	• Same contractors always get the job.
• Reduce abandoned projects in Malaysia.	• New contractor with no experience facing difficulty in getting jobs.
• Predict project performance.	• Too subjective.
• Financial management/standing and quality of work important in evaluating contractor performance.	
• The government can be assured job is undertaken by reputable contractor.	
• Promote transparency in tender evaluation.	
• The well experienced contractor meets client's needs on that project. For example, specialized works.	
• Increase contractor quality of work.	
• Promote professionalism and avoid misuse of license.	
• May prevent failure in future projects.	

5. Conclusion

By critically reviewing literature reviews and conducting a questionnaire survey among Quantity Surveyors in PWD, this paper has identified the importance of performance-based contractor selection criteria. The results identified that past quality performance, depth of experience on similar types of projects, previous failures record, qualification and experience of technical staff, manpower resources and present/current workload are amongst the most important selected by the quantity surveyors, while the relationship with past owners, standards of subcontractor's work and relationship with past subcontractor were considerably less important.

The result of this study provides an important contribution as a guide that helps the public sector to select a competent contractor based on performance indicators. Measuring performance based contractor selection is rather new and implementation is still limited. Therefore, comprehensive contributing factors of performance indicators developed in this research may help the client to improve their contractor selection by using the performance indicators identified. The use of an automated system in tender evaluation and contractor selection that will help to compensate for human error in the system is also recommended and this suggestion makes a further contribution to the literature regarding methods to improve the public tender evaluation in Malaysia.

The level of importance identified in each criterion can be used as guidance to develop weighting schemes in contractor selection, in order to select the right contractor based on their performance. The study reveals the level of awareness among quantity surveyors in Malaysia on the importance of past contractor performance which leads to quality aspects of current work. As such, we acknowledge the existence of limitations in this study. First, the findings are not necessarily representative of any specific contractor or different parties in the construction industry. Second, this is a descriptive analysis; suggesting that further studies may develops a Multi Criteria Decision Making model (MCDM) in order to evaluate the experts' perceptions. Furthermore, the weighting factor of these indicators may help the development of a performance-based tender evaluation prototype using a Decision Support System application.

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applicable in tender evaluation for contractor selection in the public sector.

7. References

1. Hatush Z, Skitmore M. Evaluating contractor prequalification data: Selection criteria and project success factors. Construction Management and Economics. 1997; 15(2):129–47.

2. Stein A, Hawking P, Wyld DC. The 20% solution? A case study on the efficiency of reverse auctions. Management Resources News. 2003; 26(5):1–20.

3. Koushki PA, Al-Rashid K, Kartam N. Delays and cost increases in the construction of private residential projects in Kuwait. Construction Management and Economics. 2005 Mar; 23(3):285–94.

4. Abedi M. Effects of construction delays on construction project objectives. The First Iranian Students Scientific Conference in Malaysia; 2011.

5. El-Abassy MS, Zayed T, Ahmed M, Alzraiee H, Abouhamad M. Contractor selection models for highway projects using integrated simulation and analytic network process. Journal of Construction Engineering and Management. 2013 Jul; 139(7):755–67.

6. Holt GD, Olomolaiye PO, Harris FC. A review of contractor selection practice in the U.K. construction industry. Building and Environment. 1995 Oct; 30(4):553–61.

7. Shehu Z, Endut IR. Factors contributing to project time and hence cost overrun in the Malaysian construction industry. Journal of Financial Management of Property and Construction. 2014; 19(1):55–75.

8. JKR Malaysia. 2016. Available from: https://en.wikipedia.org/wiki/JKR

9. Takim R, Akintoye A. Performance indicators for successful construction project performance. 18th Annual ARCOM Conference; University of Northumbria. 2002 Sep 2. p. 545–55.

10. Alzahrani JI, Emsley MW. The impact of contractors' indicators on construction project success: A post construction evaluation. International Journal of Project Management. 2013; 31(2):313–22.

11. Cheng EWL, Li H. Contractor selection using the analytic network process. Construction Management and Economics. 2004 Jan; 22(10):1021–32.

12. Xiao H, Proverbs D. Factors influencing contractor performance: An international investigation. Engineering, Construction and Architectural Management. 2003 Oct; 10(5):322–32.

13. Singh D, Tiong RLK. Contractor selection criteria : Investigation of opinions of Singapore Construction Practitioners. Journal of Construction Engineering and Management. 2006 Sep; 132(1):998–1008.

14. Ramanathan C, Potty NS. Arazi B. Analysis of time and cost overrun in Malaysian construction. Advanced Materials Research. 2012 Jan; 452-453:1002–8.

15. Othman R, Zakaria H, Nordin N, Shahidan Z, Jusoff K. The Malaysian public procurement's prevalent system and its weaknesses. American Journal of Economics and Business Administration. 2010 Jan; 2(1):6–11.

16. Muhamad Halil F. Contractors' perceptions on the use of statistical approach in the tender evaluation at the Public Work Department, Malaysia. American Journal of Applied Sciences. 2007 Dec; 4(12):1084–9.

17. Jaafar M, Abdul Aziz AR, Ismail A. Non Price Factors (NPF) and contractors' selection: An application in the Public Sector Malaysia. Proceeding of 5th IEEE International Conference of Cognitive Informatics; 2006. p. 1–5.

18. Doloi H, Iyer KC, Sawhney A. Structural equation model for assessing impacts of contractor's performance on project success. International Journal of Project Management. 2011 Aug; 29(6):687–95.

19. Mills JA. The impact of client attitudes on the selection of contractors. Malaysian Construction Research Journal. 2011; 8(1):88–102.

20. Yilmaz A, Ergonul S. Selection of contractors for middle-sized projects in Turkey. Gazi University Journal of Science. 2011 Feb; 24(3):477–85.

21. Yasamis F, Arditi D, Mohammadi J. Assessing contractor quality performance. Construction Management and Economics. 2002; 20(3):211–23.

22. Elyamany A, Abdelrahman M. Contractor performance evaluation for the best value of Superpave Projects. Journal of Construction Engineering and Management. 2010 May; 136(5):606–14.

23. Salama M, Aziz HA, El Sawah H, El Samadony A. Investigating the criteria for contractors' selection and bid evaluation in Egypt. Proceedings 22nd Annual ARCOM Conference; 2006 Sep. p. 531–40.

24. Choudhry RM, Hinze JW, Arshad M, Gabriel HF. Subcontracting practices in the construction industry of Pakistan. Journal of Construction Engineering and Management. 2012 Dec; 138(12):1353–9.

25. Ko C. Predicting subcontractor performance using web-based evolutionary fuzzy neural networks. The Scientific World Journal. 2013 Jun; 2013:1–9.

26. Toor SR, Ogunlana SO. Beyond the iron triangle: Stakeholder perception of key performance indicators (KPIs) for large-scale Public Sector Development projects. International Journal of Project Management. 2010 Apr; 28(3):228–36.

27. Abu Nemeh MH. Multi-criteria decision making model for the selection of a construction contractor in Saudi Arabia. [Master Thesis]. King Fadh University of Petroleum and Minerals; 2012. p. 1–186.

28. Horta IM, Camanho AS, Lima AF. Design of performance assessment system for selection of contractors in construction industry e-market places. Journal of Construction Engineering and Management. 2013 Feb; 139(8):910–7.

29. Xu J, Liu Y, Luo L. A trust-based method in construction industry. Applied Mechanics and Materials. 2014 Jul; 539:762–8.

30. Nanda Kumaar A, Deventhiran K, Santhana Kumar M, Manoj Kumar M, Suresh R. A study on targeted relationships between contractors and consultants in construction industry. Indian Journal of Science and Technology. 2016 Apr; 9(16):1–7.

31. Costa AA, Tavares LV. Advanced multi-criteria models to promote quality and reputation in public construction e-market places. Automation in Construction. 2013 Mar; 30:205–15.

32. El-Mashaleh M, Minchin R, O'Brien W. Management of construction firm performance using benchmarking. Journals of Management Engineering. 2007 Jan; 23(1):10–7.

33. Yang J, Peng S. Development of a customer satisfaction evaluation model for construction project management. Building and Environment. 2008 Apr; 43(4):458–68.

34. Tao L, Kumaraswamy M. Unveiling relationships between contractor inputs and performance outputs. Construction Innovation: Information, Process, Management. 2012 Jun; 12(1):86–98.

35. Bradshaw J, Chang S. Past performance as an indicator of future performance: Selecting an industry partner to maximize the probability of program success The 9th Annual Acquisition Research Symposium; 2012 Sep. p. 1–24.

36. Florez L, Castro D, Medaglia AL. Maximizing labor stability as a sustainability performance indicator in project scheduling. Construction Research Congress; 2012. p. 465–74.

37. Wong CH. Contractor performance prediction model for the United Kingdom construction contractor: Study of logistic regression approach. Journal of Construction Engineering and Management. 2004 Oct; 130(5):691–8.

38. Khoshgoftar M, Bakar AHA, Osman O. Causes of delays in Iranian Construction Projects. International Journal of Construction Management. 2010; 10(2):53–69.

39. Yasamis-Speroni F, Lee DE, Arditi D. Evaluating the quality performance of pavement contractors. Journal of Construction Engineering and Management. 2012 Oct; 138(10):1114–24.

40. Jafari A. A contractor pre-qualification model based on the quality function deployment method. Construction Management and Economics. 2013 Sep; 31(7):746–60.

41. Fellows R, Liu A. Research methods for construction. 3rd ed. Chichester: Wiley-Blackwell; 2008 Aug.

42. Holt GD, Olomolaiye PO, Harris FC. Factors influencing UK construction clients' choice of contractor. Building and Environment. 1994 May; 29(2):241–8.

43. Esetova AM, Pavliuchenko EI, Ismailova CT, Levitsky TY. System restructuring as a factor of increasing management efficiency in construction. Indian Journal of Science and Technology. 2015 Dec; 8(S10):1–9.

44. Dineshkumar B, Dhivyamenaga T. Study on lean principles application in construction industry. Indian Journal of Science and Technology. 2016 Jan; 9(2):1–5.