



Research paper

Validity and reliability testing of the questionnaire used to finalize criteria for the evaluation of the contractor's performance

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Abstract: The paper aims to determine the criteria and sub-criteria for evaluating the contractor's performance and finalize a master list of the criteria and sub-criteria to be used for evaluating contractor's performance with their respective weights. The method is incorporated in the framework proposed for the evaluation of the contractor's performance during the execution phase. An exploratory study has been opted, using a structured, close-ended multiple-choice questionnaire survey approach. The questionnaire survey was conducted in two phases, i.e. validation survey, and reliability survey. Fifteen experts responded to the validation survey, and thirty experts to the reliability survey. The experts were from Government and public sectors in India, working at various senior levels. The weights of criteria and sub-criteria were calculated from data collected in the survey, relative importance was calculated through the relative importance index and criteria were ranked. The paper provides criteria and sub-criteria which were finalized through a questionnaire survey by classification of criteria identified in literature and tender review. The respective weights were finalized, which can be measured while evaluating contractors' performance. The weights assigned to criteria through the survey are; health and safety is 13.19%, followed by finance 11.93%, time 11.93%, quality 13.38%, client satisfaction 12.42%, environmental safety 12.32%, productivity 12.51% and regulation 12.32%. The paper provides the criteria and sub-criteria with their weights needed for evaluating the performance of contractors during the project execution phase. This research can lead to a culture of continuous measurement of performance for the satisfactory completion of projects.

Keywords: construction, questionnaire survey, approach, process, methodology, management

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1. Introduction

The Changing needs of the construction industry to achieve quality excellence leading to customer satisfaction by providing goods and services to the standards have necessitated continuous monitoring of the contractor's performance to manage a project. The contractor's functioning is an important aspect in the execution of projects as their performance has a direct bearing on project deliverables. Continuous evaluation of contractor's performance is critical to the success of the successful completion of a construction project. The clients execute the works through contracts thereby passing on the risks to the contractor, some of which include risks of project finance, residual risk design, construction cost overrun, time delay, and material and labor availability, etc. Hence, the contracts need to be monitored for the successful completion of the project and this can be achieved by evaluating the performance of the contractor in the execution phase with respect to the criteria that affect the project performance and risks for the project. Thus, contractor performance evaluation is critical to the success of the project.

This study is carried out to determine the criteria and sub-criteria for evaluating the performance of the contractor during the execution stage post-award of the contract. It was conducted in two parts to know the current practices followed, and criteria used by the clients for evaluating the performance of construction contractors, part one of the studies involved a review of tender documents in use by various client organizations, and the second part involved a literature review based on the national and international journals.

There are many methods of tendering systems used in the construction industry. Nowadays the e-Tendering system is widely used in government and private organizations. E-tenders allow these organizations to reach vendors throughout the world and get the best solutions to address their issues. Some common types of tenders include open tenders, selective tendering, and negotiation tendering. The tendering authority publishes the advertisements for tender on the official website. After determining the tender process, the organization prepares a request for tender that includes some common elements, the deliverables, deadlines, timelines, technical specifications, outcomes of the project, Eligibility criteria, and the conditions to qualify for the tender, etc. After the deadline to submit the tenders is over, the issuing organization checks each offer for compliance with the guidelines and evaluates it based on the evaluation criteria. The tenders are shortlisted, and the vendors are notified- based on the eligibility criteria. The criteria mentioned under the eligibility clause in different e-tenders were, work experience, bid capacity, availability of key equipment, qualification, and experience of key personnel, information on litigation history, conflict of interest, technical capacity, financial capacity, working capital, net worth, profit after tax, the experience of having successfully completed contract during last five years, statutory license/registration, ownership pattern, proposed methodology, and work plan, turn over, servicing of loan/credit limit, profitability, etc. Provisions are also made in contracts for the evaluation of the progress of work with reference to a schedule, quality, safety, and cost parameters.

A literature survey of national and international Journals was carried out relating to contractor performance and factors affecting the progress of the project. The various criteria found in the literature survey were listed as, mobilization, progress, quality, engineering

technology, documentation, billing, statutory compliance, safety health and environment compliance, labour and staff, equipment, material, cooperation with other agencies, financial health, claims, disputes, subcontracting, market.

After collecting data from the Tender documents and Literature survey, data classification was done and a questionnaire was prepared incorporating the classified data. Then a questionnaire survey was conducted to finalize the criteria and sub-criteria to be considered for evaluation during execution. The weights of criteria and sub-criteria were calculated based on survey data and the relative importance index of criteria with each other was checked.

2. Discussion of previous studies and contributions of this study to the literature

Maria Creuza and Luciana Hazin, 2016 [13] developed a model using the ELECTRE TRI method for the evaluation of contractor performance. The contractor's classification had been suggested based on their performance as good, moderate, or bad using the ELECTRE TRI method and that will be as basis for hiring contractors for future projects. A. Mahmoudi and S. Ahmed, 2022 [14] done a study on post-selection performance evaluation of construction project outsourcing firms using the ordinal priority approach (OPA). In this, the decision-makers were allowed to estimate the weights of the evaluation criteria, the subcontractors to be evaluated, and the experts who evaluated them simultaneously. A relative performance index was proposed to standardize the performance evaluation system. The case study was done on a construction company of residential buildings from Iran. The criteria and their rank were collected from the experts from outside consultants. The OPA was used for the estimation of criteria weights. The subcontractors were categorized as high performance, medium performance, and low performance based on relative performance index.

M.A. Momen et al., 2022 [15] determined the most important performance indicators to evaluate the performance of construction companies from the perspective of owners and consultants. T. Hai, 2023 [29] explored the factors that could determine the success of public-private partnership projects, data collected through a questionnaire survey and analyzed using regression analysis. Petr Trtílek and Tomáš Hanák, 2022 [30] revealed the importance of criteria used in performance measurement, data was collected through a questionnaire survey, analyzed and quantified in terms of the frequency of occurrence and relative importance index. Cost and time are still the most important criteria in performance measurement. Van Son Nguyen, et al., 2023 [31] determined the factors responsible for delays in the construction of irrigation and hydropower projects, the causes were identified from a literature survey and severity was defined through a survey.

Nidal Adnan Jasim, 2021 [8] proposed a framework for the evaluation of contractors' performance in Iraqi construction projects using the Multiple Criteria Complex Proportional Assessment Method (COPRAS) to give suggestions and recommendations for the effective performance of the contractor. The criteria were collected from the literature survey, opinions taken on the importance of criteria from experts through questionnaire

survey, and personal interview and then analyzed and finalized by Rank Order Centroid method. The COPRAS method was then applied to access the performance of contractors.

K. Gunasekara et al., 2021 [4] A Contractor-Centric Construction Performance Model developed using non-price measures for evaluating construction contractors' performance based on directly attributable measures. The literature review was done to identify different categories of measures of performance (MoP) and corresponding critical measures of performance (CMoP). Through a series of Delphi-based expert forums, the set of measures was fine-tuned and shortlisted. Fuzzy analytic hierarchy process-based comparisons were used for developing a contractors' performance model to quantify their level of performance based on a limited set of organization-specific and project-specific measures.

K.Z.M. Arof et al., 2018 [3] In the Malaysian construction Industry contractor's performance appraisal system is used which is well established and followed, benefiting the contractors. The criteria used in the performance appraisal system were 22.

K. Goepel, 2018 [5] implemented a free, web-based AHP online system for the detailed analysis of decision problems. The article described the basic concept and structure of the software and the underlying mathematical algorithms and methods. Challenges and practical experiences during the implementation, validation, and productive phase of the software were highlighted.

F. Jacob [16] A performance-based maintenance contract system is used in awarding AMC in Florida. It is transparent and useful for performance-based maintenance contract systems, studied and analyzed using content analysis.

Prediction of contractor performance is difficult, but it is essential in terms of project success. W.C. Hong [7] used client's tender evaluation preferences from 48 projects and developed a model for predicting contractor performance using a logistic regression approach, used further for predicting projects' success or failure. It was validated in 20 independent cases with an accuracy of 75%. The input required here for the evaluation of performance in the model is contractor early performance data with respect to evaluation criteria. The selected contractor's performance will be 'poor' or 'good' which is predicted with this model at the contractor selection stage itself.

Y.S. Firuzam et al. [11] reports a contractor quality performance evaluation model for an impartial, transferable, reproducible, and consistent contractor evaluation to rate contractor's quality performance. The Delphi method was used to achieve the consensus of a group of experts for finalizing issues for quality and function deployment matrices. The model requires collecting more than 500 pieces of information from every expert on the Delphi panel which will be a challenging task. However, it provides a better understanding of a contractor by providing an evaluation of quality performance which can be used along with technical and financial performance.

M. Sergio et al. [25] used brainstorming sessions, questionnaire surveys, and focus group sessions to learn about problems faced while working with the prequalification and evaluation system already in use. Evaluation criteria are selected based on the measurement culture of the organization. Evaluations are proposed to be periodic and dialogue instances are provided to foster continuous improvement on critical issues. Tools for visualization and dissemination are also included to promote competition and prompt reaction to poor

evaluation. However, for successful implementation, general contractors must be rigorous, persevering, and fair.

Mosley and Budshait [17] have presented a comparison of the performance of international and local with reference to Saudi Arabia based on 13 project performance indicators which included three objectives (cost, schedule, and change order) and remaining subjective. The findings indicated that the performance of local and international contractors is mixed with respect to different indicators. J. Zhigang et al. [28] developed a practical framework for measuring the performance of construction firms, based on the balanced scorecard (BSC), a framework with 27 detailed performance measures, investigated, and tested using a three-step research design. R. Mladen et al. [20] have identified 133 different success criteria through a literature survey from engineering projects and which were analyzed to develop an integrated framework.

G. Arslan et al. [12] proposes a web-based sub-contractor evaluation system to help general contractors (GC) to select the most appropriate sub-contractors. The criteria for evaluation have been decided based on a study with a GC over a three-year period. Cost, quality, time, and adequacy are the criteria used with sub-criteria for each of them. Each sub-criterion is scored on a 1 to 10 scale and the weights of sub-criteria and main criteria are assumed to be equal. N. Abdollah et al. [1] have proposed a supplier evaluation process for changing the operating environment between projects, in three characteristics groups using a data envelopment analysis tool.

Quality control plays an important role in project deliverables, controls rework and shows contractor performance was good or bad. E. Ahmed et al. [2] have focused on quality control parameters from past quality control testing results from a number of similar projects and formed an equation to predict the contractor's performance in quality control. The model predicts the expected quality performance of the contractor by analyzing the past performance of the contractor in a similar job with the factors used in the equation and helps for a further selection of contractor [22].

Contractor performance has a direct relationship with the project completion and schedule overrun of the project. Various factors have been identified that affect project schedules and cost performance by various researchers from the construction industry [18, 24].

Y. Wen-Der et al. [26] report a pre-tendering contractor selection analysis model based on historical procurement data. Y.N. Labib et al. [27] have introduced a project performance index model that provides factual evidence of the performance of a project under various delivery methods and bidding systems and guidance toward implementations to increase the project's success. H. Qinghua et al. [23] identified key performance indicators to assess the success of the construction of Megaprojects. The indicators were collected from 129 pieces of information from three groups of respondents from the construction industry.

3. Finalization of criteria for evaluation

The various criteria for evaluation found in the literature were regrouped into eight criteria and included in the questionnaire. Sub-criteria for these were also listed. The

criteria, sub-criteria, and the data points based on which criteria and sub-criteria could be evaluated are also indicated in Table 1.

Table 1. Criteria and sub-criteria for evaluation

Criteria	Sub Criteria	The basis for the evaluation of sub-criteria
Finance	Monthly Labour Payment	Declaration/details submitted along with R.A. Bill
	Timely Supplier payment	-do-
	Timely Statutory payment	Documentary evidence along with R.A. Bill
	Payment outstanding with the client	Billing and receipt statement
	Fund shortage due to negative cash flow	Monthly cash flow statement
	Timely submission of R.A. Bill by the contractor	Billing record
	Delay in the processing of R.A. Bill by Client	Billing record
Time	Completion of Milestone as per baseline program	Project Schedule plan and progress as of the date
	Delivery of Bought out items as per schedule	Bought out item Supply schedule and the actual delivery
	Work execution as per construction methodology for achieving the schedule plan	Project Plan
	Deployment of adequate resource	Project resource plan
	Notifying clients regarding any delays attributable to them or other external sources which is likely to affect or delay any project activity.	Project diary
Quality	Number of Non-compliance	<ul style="list-style-type: none"> – Quality statistics report – Internal audits report – external audits report – Maintain Non-conformances register
	Number of reworks	<ul style="list-style-type: none"> – Quality statistics report – Maintaining records in the site diary – Defects at the point of handover or end of liability period
	Number of RFI (Request for Inspection) rejected	Quality statistics report

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Table 1 – *Continued from previous page*

Criteria	Sub Criteria	The basis for the evaluation of sub-criteria
Quality	Construction quality within the acceptable limit of the quality plan	Quality assurance plan
	Material supply as per the contract document and within the acceptable limit of the quality plan	Quality assurance plan
Productivity	Optimum utilization of equipment	Equipment utilization norms
	Labour work output	– As per rate analysis/productivity norms – Maintaining data in the planning dept.
Client Satisfaction	Adherence to raised RFI	RFI documents
	Adherence to contract specification/ document	Client correspondence
	Completion of activities as per schedule	Project Schedule Plan
	Taking feedback from clients on a monthly basis	Customer feedback mechanism
Regulation	Monthly statutory and legal compliances	Documentary evidence
	Events of non-compliance with regulations	Documentary evidence
Health and Safety	Adherence to safety norms	Project Safety Plan/safety audit report
	Number of reportable LTI (lost time injuries)	– Monthly Safety Report – Maintaining data at EHS dept.
	Severity rate (SR)	– Monthly Safety Report – Maintaining data at EHS dept.
	Number of fatalities	– Monthly Safety Report – Maintaining data at EHS dept.
	Safe man-hours	– Monthly Safety Report – Maintaining data at EHS dept.
	Near miss incident	– Monthly Safety Report – Maintaining data at EHS dept.
	Number of health-related cases reported and their severity	– Monthly Safety Report – Maintaining data at EHS dept.
	Daily TBT (toolbox talk) stand-up meeting	– Monthly Safety Report – Maintaining data at EHS dept.

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Criteria	Sub Criteria	The basis for the evaluation of sub-criteria
Environmental Safety	Disposal of waste generated from the site	<ul style="list-style-type: none"> – Monthly audit – Maintaining data at environment dept.
	Maintenance of air quality	<ul style="list-style-type: none"> – Maintaining data of air quality tests through Equipment – Measuring the carbon footprint
	Maintenance of noise level	<ul style="list-style-type: none"> – Maintaining data on noise level through Equipment

4. Questionnaire design

This questionnaire is designed to capture the data on the importance of each criterion and sub-criteria in the evaluation of contractor performance, practices followed to measure the performance of the contractor, and key performance criteria used to measure the performance of the contractor. The questionnaire design is intended to be as simple as possible yet comprehensive. The questionnaire design is structured as close-ended multiple-choice questions, with space provided for respondents to give more details, if necessary. Information capturing the details of respondents, their organization, and the performance evaluation approaches practiced by their organization is also obtained by simply ticking on structured questions.

The questionnaire was divided into four parts; Part one: to gather basic information about respondents, Part two: to gather the importance of sub-criteria for contractor evaluation, Part three: to gather details of practices followed in their organizations, and Part IV: to gather data regarding criteria.

K. Gunasekara et al., 2021 [4], the issue of sample size is vague in non-probability sampling and has flexible rules. Since generalization is made to theory, unlike to a population, the logical relationship between sample selection and the focus of the research is more important.

The questionnaire survey is conducted in two phases – validation survey and reliability survey. Thirty experts were sent the questionnaire for the first survey out of which fifteen responded. Whereas a total of 100 experts were contacted for the second survey out of which 30 have responded. Respondents included officials from Government and public sector units in India and working at various senior levels.

5. Questionnaire validation

Initially, the questionnaire was sent to 30 experienced professionals in the field via email to validate the same. 15 of the experts responded to the same. 80% of the respondents had experienced between 10 to 30 years whereas 7% had experience of more than 30 years.

About 50% of the respondents had experience in road construction while the remaining had experience in industrial projects, bridges, and buildings.

The respondents did not suggest any new criteria; however, they suggested 9 more sub-criteria for better evaluation of certain criteria. Table 2 shows the sub-criteria suggested and actions taken for improving the questionnaire for the next survey.

Thus, the questionnaire was validated, based on the feedback received in the validation survey.

Table 2. Sub-criteria suggested and action taken

Criteria	Sub-criteria suggested	Actions taken for improvisation
Finance	The clarity in the definition of scope to the contractor and its impact on delivery to customers	This should be addressed during the pre-bid meeting itself. Hence it has not been included.
Time	Notifying clients regarding any delays attributable to them or other external sources which is likely to affect or delay any project activity.	Sub-criterion suggested here is measurable and it has importance in contractor performance evaluation. Hence this sub-criterion has been included.
Quality	Educating clients regarding the latest methods /codes in vogue	Sub-criterion suggested here is not directly measurable with respect to contractor evaluation. Hence it has not been included.
Productivity	Labour hygienic accommodation	This sub-criterion comes under health safety criteria and is already taken under "Number of health-related cases reported and their severity".
Productivity	Labour transportation	The suggested sub-criterion is part of the Labour work output sub-criteria and it is already included.
Client's satisfaction	Taking feedback from clients on a monthly basis	client's satisfaction is measurable through the sub-criterion suggested here and hence it has been included.
Health and safety	Daily TBT (toolbox talk) standup meeting	Criteria, "Health and Safety" is measurable through the sub-criterion suggested here, hence it has been included.
	Bi-Weekly physical exercise for all	Implementation of the sub-criterion suggested here is not feasible at the project site since working hours vary as per the exigency of activity. Hence it has not been included.
Environmental safety	The plantation must be made mandatory to counterbalance carbon emission	Sub-criterion suggested is important as far as environmental safety is concerned but does not have a direct impact on contractor performance. Hence it has not been included.

6. Pilot survey – reliability study

The questionnaire was revised to include the sub-criteria suggested during the validation survey. The revised questionnaire was then emailed to 100 experts in the field, out of which 30 responded. 80% of the respondents had experienced between 10 to 30 years whereas 7% had experience of more than 30 years. About 50% of the respondents had experience in road construction while the remaining had experience in industrial projects, bridges, and buildings. The details of the respondents are given in Table 3.

Table 3. Summary of respondents' profile

Experience in Years		Contract size handled		Types of projects	
Less than 10 years	13%	Less than 500 Cr	50%	Roads	53%
Between 10 to 30 years	80%	Between 500 to 2000 Cr	20%	Bridges	17%
More than 30 years	7%	Between 2000 to 4000 Cr	17%	Industrial Projects	7%
		More than 4000 Cr	13%	Buildings	10%
				Heavy engineering	13%

The response of respondents regarding the importance of criteria and sub-criteria based on the Likert scale of 1 to 5 with descriptors as very low, low, moderate, high, and very high is collected as shown in Table 4.

Table 4. Importance of criterion and sub-criterion

Scale of Importance	Level of significance
1	Very low
2	Low
3	Moderate
4	High
5	Very High

The responses were analyzed using SPSS software. Mean responses on the criteria and sub-criteria are the indicators of the effectiveness of the attributes. The Cronbach's alpha value for the pilot study is 0.925, which is higher than 0.7 which indicates high internal consistency in the questionnaire's set of data. Therefore, data gained from the pilot study indicate that it is reliable and the questionnaire can be retained in continuing this study.

The weights of criteria and sub-criteria obtained in the pilot study and the relative importance index of criteria are computed and are shown below in Tables 5 and 6. The relative importance index of criteria is calculated as per the equation shown below.

$$(6.1) \quad \text{Relative importance index (RII)} = \sum I_e / (5n)$$

where: I_e – the importance of criteria given by experts, n – number of experts

Table 5. Weightage and relative importance index of criteria

Respondent No	Finance	Time	Quality	Productivity	Client Satisfaction	Regulation	Health and Safety	Environmental safety
1	5	5	5	5	5	5	5	5
2	4	5	5	4	5	5	5	5
3	5	5	5	5	5	5	5	5
4	4	5	5	5	5	5	5	5
5	4	5	5	4	5	5	5	5
6	3	4	4	4	4	4	4	4
7	5	4	5	4	5	4	4	4
8	4	4	5	5	4	4	4	4
9	4	3	4	5	4	4	3	3
10	3	3	3	4	4	4	3	3
11	5	5	5	5	5	5	5	5
12	3	3	3	5	4	3	3	3
13	5	5	5	4	4	4	4	4
14	5	4	4	4	5	4	5	4
15	4	4	5	4	4	4	5	5
16	4	4	5	4	4	4	5	5
17	4	4	5	5	4	5	5	4
18	4	4	5	5	4	5	4	5
19	4	4	5	4	4	4	5	4
20	4	4	5	4	4	4	5	4
21	4	4	5	4	4	4	5	4
22	4	4	4	4	4	4	4	4
23	4	4	4	4	4	4	5	5
24	4	4	5	4	4	4	5	4
25	4	4	5	4	4	4	5	4
26	5	4	5	5	5	5	5	5
27	4	4	5	4	4	4	5	4
28	4	4	5	4	4	4	5	4
29	4	4	4	4	4	4	4	4
30	4	4	4	4	4	4	5	4
Average	4.13	4.13	4.63	4.33	4.30	4.27	4.57	4.27
Weight of Criteria	11.93	11.93	13.38	12.51	12.42	12.32	13.19	12.32
RII	0.83	0.83	0.93	0.87	0.86	0.85	0.91	0.85
Rank	6	6	1	3	4	5	2	5

Table 6. Weightages of sub-criteria

Criteria	Sub Criteria	Weightage of sub-criteria wrt respective criterion
Finance	Monthly Labour Payment	16%
	Timely Supplier payment	15%
	Timely Statutory payment	15%
	Payment outstanding with the client	13%
	Fund shortage due to negative cash flow	13%
	Timely submission of R.A. Bill by the contractor	15%
	Delay in the processing of R.A. Bill by Client	13%
Time	Completion of Milestone as per baseline program	20%
	Delivery of Bought out items as per schedule	21%
	Work execution as per construction methodology for achieving the schedule plan	21%
	Deployment of adequate resource	21%
	Notifying clients regarding any delays attributable to them or other external sources which is likely to affect or delay any project activity.	17%
Quality	Number of Non-compliance	20%
	Number of reworks	18%
	Number of RFI (Request for Inspection) rejected	17%
	Construction quality within the acceptable limit of the quality plan	23%
	Material supply as per the contract document and within the acceptable limit of the quality plan	22%
Productivity	Optimum utilization of equipment	51%
	Labour work output	49%
Client Satisfaction	Adherence to raised RFI	26%
	Adherence to contract specification/document	26%
	Completion of activities as per schedule	27%
	Taking feedback from clients on a monthly basis	22%
Regulation	Monthly statutory and legal compliances	53%
	Events of non-compliance with regulations	47%
Health and Safety	Adherence to safety norms	15%
	Number of reportable LTI (lost time injuries)	12%

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Table 6 – Continued from previous page

Criteria	Sub Criteria	Weightage of sub-criteria wrt respective criterion
Health and Safety	Severity rate (SR)	12%
	Number of fatalities	14%
	Safe man-hours	14%
	Near miss incident	12%
	Number of health-related cases reported and their severity	10%
	Daily TBT (toolbox talk) stand-up meeting	12%
Environmental Safety	Disposal of waste generated from the site	35%
	Maintenance of air quality	34%
	Maintenance of noise level	32%

The weight of criteria is obtained by dividing the average importance of criteria given by experts by the sum of the average importance of total criteria multiplied by 100.

$$(6.2) \quad \text{Weight of criteria } W_c = \left(\text{Average (Ie)} / \sum \text{Average (Ie)} \right) \times 100$$

7. Survey findings

The findings derived from the questionnaire survey are as follows. In practices followed by the client, to measure the contractor's performance such as safety, quality, time, and cost management, it was found that; In safety management practices, various methods and tools are used to monitor, report and control the safety parameter, and are being listed in safety plan submitted by the contractor as per tender safety clause. Those are as follows; monthly safety report, periodic safety audit, daily toolbox talk, weekly safety meetings, safety walkthrough with in-charges, monthly safety meetings at the corporate level, safety manuals and checklists. In quality management practices, the method and tool used to monitor quality parameters are mainly as per the quality assurance plan submitted by the contractor in line with the tender specification. The method used for inspection and clearance of construction activity is a quality checklist and RFI (request for inspection).

In Time management practices; project scheduling assessment is done monthly by 73% of clients, activity scheduling assessment is done monthly by 63% of clients, and progress report submission is done monthly by 57% of clients. Microsoft Project and Primavera are the most widely used software to manage the progress of project activities and the method used to report the work progress is by circulating it in excel format weekly through email.

In cost management practices, methods used to monitor cost are internal technical audit, checking cost with the approved budget, and validation of the BOQs by joint measurement with the contractor. The method used to verify payments made by contractors related to

labour, supplier and statutory was conventional where the bill is circulated to various dept and majorly this is verified at the accounts and admin department. contractors should submit, an actual wage sheet as proof of payment made to labours, paid challan as proof of statutory compliance and undertaking letter as proof of payment done to the supplier. The method used to monitor bill submission and its certification is done manually, bill is submitted monthly in a prescribed format and is recorded in the measurement book through joint inspection, however, payment and cash flow are maintained in different software as well as in an excel sheet.

8. Conclusions

The main contribution of this research is the identification and finalization of criteria for the evaluation of performance (along with the respective weights) that can be measured when evaluating contractors' performance. Based on this survey the weightages that can be assigned to the evaluation criteria are as follows; health and safety criterion is 13.19%, followed by finance 11.93%, time 11.93%, quality 13.38%, client satisfaction 12.42%, environmental safety 12.32%, productivity 12.51% and regulation 12.32%. The relative importance index of criteria is also computed based on which the criteria are ranked in following order; first is quality, second is health and safety, third is productivity, fourth is client satisfaction, regulations and environmental safety have an equal rank of fifth, and time and finance have sixth. It is observed from the survey that the respondents were from different types of projects, but they were almost unanimous in assigning the highest importance to the Quality and health and safety.

The performance evaluation framework to be proposed based on this study can be used to quantify the performance of an individual contractor working on a specific ongoing project. The ease of the identified criteria and sub-criteria measures of performance makes the framework more usable without the need for complex analytics. The developed performance framework allows the contractors to self-evaluate their level of performance. On the other hand, clients can review contractors' performance easily based on readily available data. Ultimately, the outcome of this research can lead to a culture of continuous measurement of performance to keep improving the same for satisfactory completion of projects.

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