

Project Performance Indicators for Measuring Construction Performance in Mumbai

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Abstract:- The aim of the study is to evaluate and rank a range of performance indicators that industrial experts regard as important, with the key identified indicators being those associated with the overall project characteristics. This paper presents the result of survey of indicators for measuring the performance of construction projects in Mumbai. A list of performance indicators is prepared based on a comprehensive literature review. These indicators grouped under 11 categories denoted as Key Performance Indicators are used to develop a survey questionnaire and RII is subsequently used to analyze the survey results and determine the relative importance and rankings of various PIs. The results reveal that the top Key Performance Indicators to evaluate the success of construction projects (in descending order) are- cost, time, safety, productivity, satisfaction, quality, knowledge and service.

Keywords— Performance Indicators; Project monitoring; Key performance indicators; cost; Quality; Relative importance index.

1. INTRODUCTION

Performance measurement is integral to any project and provides a basis for continuous improvement in performance. Highly competitive nature of the construction industry and profound technological changes are forcing construction executives to continuously improve the performance of their projects. It is commonly accepted that project success is measured by the performance of a project in terms of cost, time and quality [1].

The construction sector is labour-intensive, including indirect jobs, provides employment to millions of people. Considering the variety of construction projects across various sectors of economy like energy, housing, transport etc., it is necessary to identify a set of common indicators and develop a measurement scale to standardize the measures of construction project performance.

2. OBJECTIVE OF RESEARCH

The aim of the research presented is to assess the project performance process for its efficiency. This study will forward references for improvement of process based on conclusions of the study. Key Performance Indicators (KPI) are identified from the research work considering the working of Indian construction industry. The study also provides indications to effect improvements in the existing work patterns.

According to [2], “performance measurement is the heart of ceaseless improvement. As a general rule, benchmarking is

the next step to improve efficiency and effectiveness of products and processes.” Previous studies by [3], [4], [5],[6] describes project success and associated key performance indicators. However, a pertinent question is how success/performance can be measured to effectively test the validity of proposed performance measurement system. This is because of the long timescales involved in real-life projects and possible influence of control actions taken by project management between the various processes [7].

A Key Performance Indicator is the measure of performance of an activity that is crucial to the success of an organization. They are compilation of data measures used to assess the performance of a construction process [8].

The purpose of KPI is to deliver projects: on time, on budget, free from defects, efficiently and safely by profitable companies. [2] has identified seven indicators of performance – capital cost, construction time, predictability, defects, accidents, productivity and turnover & profits.

[9] developed KPIs Framework for the UK construction industry with seven groups. These are: time, cost, quality, client satisfaction, client changes, business performance and health & safety. [10] identifies eight KPIs for all construction as follows: (1) client satisfaction - product, service and value for money(2) defects; (3) predictability (cost and time); (4) profitability; (5) productivity; (6) safety; (7) construction cost; and (8) construction time. [11] investigated project management (PM) practices adopted by Singaporean construction firms. The study finds that certain practices do affect project performance. The most important of these are the practices relating to scope management, such as controlling the quality of the contract document, quality of response to be perceived, variations and extent of changes to the contract.

Performance measurement is integral to performance management and provides a basis for performance improvement programs. To improve performance, organizations should both measure their performance and compare with benchmark [12]. Performance measurement however does not automatically result in improved performance. These are approaches to determine if a process has obtained the desired result. Performance measurement enables organizations to identify areas in their operations where improvements are needed.

3. METHODOLOGY

For the current study, performance indicators (PI) were pooled together from the literature review. Subsequently they were rationalized by merging some of them together, deleting some as they were described in different terms and some of them were split to improve accuracy of measurement. The 59 PIs were reduced to 40 for the purpose of the current study. These performance indicators were classified under 11 performance perspectives (KPIs) namely; cost, time, satisfaction, quality, people, legal, knowledge, safety, productivity, service and risk by conducting a preliminary survey from five construction industry experts including project managers, engineers and academicians. The classified 40 PIs (as shown in Table 1.1) formed the basis of questionnaire survey

The questionnaire is divided into four major parts. The first part contains questions about the details of construction firm and the respondent. The second part consists of questions pertaining to the extent, importance and mechanism of applying PIs in construction projects and the respondents were asked to rate each PIs on a five points Likert scale based on its influence on project performance. The third part contains additional comments and in fourth part, ranking the KPIs for bench marking the construction projects in Mumbai.

A total of 110 questionnaires were delivered to building construction contractors in Mumbai for the purpose of survey. Out of which 22 responses were received. Mean, standard deviation, variance and Relative importance index (RII) and the ranking of 40 performance indicators are shown in Table 1.2. Variance of each indicator was relatively small enough to conclude and the respondents agreed on its importance.

4. RESULTS AND DISCUSSIONS

All PIs met the requirement of reliability based on Cronbach's alpha value. Cronbach's alpha value ranging from 0.944 to 0.948 and small variances indicate that the opinions of the survey are highly consistent.

In order to identify the order of KPIs for project performance measurement, mean of PIs grouped under each KPIs were calculated and arranged in its descending order as shown in Table 1.3. Top eight KPIs were selected on the

basis of cumulative percentage of its weightage. It is commonly accepted that project success is measured by the performance of a project in terms of cost, time and quality [13]. In the present study, quality is ranked as sixth important KPI.

TABLE 1.1 Classifications of KPIs.

Sr. No.	KPIs	Performance Indicators
1.	Cost	Total construction cost Profitability Variance cost
2.	Time	Total project duration Schedule/Time performance
3.	Safety	Health and safety Recordable accident rate Labour safety management Lost workday case incident
4.	Productivity	Productivity Supplier performance Resource management
5.	Satisfaction	Client satisfaction Contractor satisfaction End-user satisfaction Project team/ participant satisfaction
6.	Quality	Quality control Quality management Number of non-conformities
7.	Knowledge	Staff experience Contractor experience Innovation and improvement/learning Project management
8.	Service	Environmental performance Sustainability Functionality Site management Extent of sub-contracting
9.	People	Motivation Communication/Effective communication Trust and respect Harmonious working relationship Employees attitude Decision effectiveness Long-term business relationships Professional image establishment Top management support
10.	Risk	Effectiveness of risk management
11.	Legal	Claim avoidance Litigation avoidance

TABLE 1.2 Ranking of PIs

Sr. no.	Performance Indicators	Mean	Std. dev.	Variance	RII %	Rank
1	Total Project Duration	4.68	0.57	0.32	93.64	1
2	Project management	4.68	0.65	0.42	93.64	2
3	Health and safety	4.64	0.79	0.62	92.73	3
4	Client satisfaction	4.55	0.80	0.64	90.91	4
5	Quality control	4.55	0.80	0.64	90.9	5
6	Total Construction Cost	4.50	0.60	0.36	90.00	6
7	Labour safety management	4.50	0.91	0.83	90.00	7
8	Variance Cost	4.45	0.80	0.64	89.09	8

9	Quality management	4.41	0.85	0.73	88.18	9
10	Communication/ Effective communication	4.36	0.90	0.81	87.27	10
11	Recordable accident rate	4.36	0.90	0.81	87.27	11
12	Resource management	4.36	0.73	0.53	87.27	12
13	End user satisfaction	4.32	0.89	0.80	86.36	13
14	Decision effectiveness	4.32	0.84	0.70	86.36	14
15	Top management support	4.32	0.95	0.89	86.36	15
16	Supplier performance	4.32	0.89	0.80	86.36	16
17	Site management	4.32	0.95	0.89	86.36	17
18	Profitability	4.27	0.83	0.68	85.45	18
19	Productivity	4.27	0.83	0.68	85.45	19
20	Functionality	4.23	0.75	0.56	84.55	20
21	Staff experience	4.14	0.89	0.79	82.72	21
22	Project team/ Participation satisfaction	4.09	0.87	0.75	81.81	22
23	Innovation and improvement learning	4.09	0.81	0.66	81.81	23
24	Professional image establishment	4.05	1.21	1.47	80.90	24
25	Environmental performance	4.05	0.72	0.52	80.90	25
26	Effectiveness of risk management	4.00	0.87	0.76	80.00	26
27	Sustainability	4.00	0.93	0.86	80.00	27
28	Contractor experience	3.95	0.95	0.90	79.09	28
29	Claim avoidance	3.95	0.84	0.71	79.09	29
30	Extent of subcontracting	3.95	0.95	0.90	79.09	30
31	Long term business relationships	3.91	1.06	1.13	78.18	31
32	Schedule/ Time performance	3.91	1.06	1.13	78.18	32
33	Motivation	3.86	1.08	1.17	77.27	33
34	Trust and respect	3.82	1.05	1.11	76.36	34
35	Lost workday case incident rate	3.82	1.22	1.49	76.36	35
36	Harmonious working relationships	3.82	1.05	1.11	76.36	36
37	Number of non-conformities in audits	3.82	0.91	0.82	76.36	37
38	Litigation avoidance	3.73	1.12	1.26	74.54	38
39	Contractor satisfaction	3.73	0.94	0.87	74.54	39
40	Employees attitude	3.68	1.17	1.37	73.63	40

TABLE 1.3 Ranking of KPIs

KPIs	Mean	% weightage	Cumulative weightage	Rank
Cost	4.40	9.516	9.516	1
Time	4.37	9.450	18.966	2
Safety	4.33	9.364	28.330	3
Productivity	4.31	9.321	37.651	4
Satisfaction	4.27	9.234	46.885	5
Quality	4.24	9.170	56.055	6
Knowledge	4.15	8.975	65.030	7
Service	4.15	8.975	74.005	8
People	4.11	8.888	82.893	9
Risk	4.07	8.802	91.695	10
Legal	3.84	8.304	99.999	11
Sum	46.24	99.999		

5. CONCLUSION

The study indicates that the performance measurement though essential is not an easy task for construction projects considering the number of indicators involved and data that needs to be collected on continuous basis for reasonable and acceptable levels of accuracy. Based on ranking of KPIs, only few of the top ranking indicators can be used to assess the performance to make the task easier. Considering importance of each of these indicators, a weighed indicator can also be developed to indicate the performance in one single number. Individual indicator level measurements will help to make corrective actions to keep project on track.

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