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Conceptual framework for evaluation of performance indicators in Construction Projects.

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Abstract: **-- The Construction Industry is one of the very fast growing industries but it also faces many problems which impinge on the performance of their projects. The aim of this study is to identify the factors affecting the local construction projects and analyze them. A questionnaire is prepared from literature review. A comprehensive literature review was deployed to generate a set of factors believed to affect project performance. The questionnaire contains two parts; part A dealing with the general information of the company and the respondent and Part B is subdivided again into different factors like cost, time, quality, client satisfaction, People factors, health and safety, innovation and learning and environment, project related, organization related, project manager and project team related and last is external environment related. The questionnaire was distributed in Mumbai construction industries. Each respondent was asked to rank the factors in a range of one to five in likert scale. The analysis of the response was done using the ranking method. The top 5 factors affecting the performance of projects were identified from the factors like average delay because of closures and materials shortage, availability of personals with high experience and qualification, belonging to work, learning from best practice and experience of others, economic environment, cash flow of project, availability of resources as planned through project duration, application of health and safety factors in organization, climate condition in the site, the size and the value of the project, Liquidity of organization and escalation of material price.**

K Index Terms— Construction industry, performance, questionnaire. (keywords)

I.INTRODUCTION

Construction industry plays foremost role in improvement and accomplishment of the target of society. Construction industry is one of the largest and it adds to about 10% of the gross national product (GNP) in industrialized countries. Construction industry is complex in its nature as it involves large number of parties such as clients, contractors, consultants, stakeholders, shareholders and regulators. The construction industry is generally considered to have underperformed compared to other industry. Not only that, some construction industry has been criticized for not performing at the same level as that of other developed countries. In relation to this, working groups on key performance indicators (KPI) have identified ten parameters for benchmarking projects, in order to achieve a good performance in construction industry.

Performance is associated with several factors such as time, cost, quality, client satisfaction, productivity and safety. There are other genuine reasons like closures, modification of drawings and changes of the design. Other grounds affecting construction projects performance are poor management and guidance; inapt participants; poor relations and coordination; lack of motivation, insufficient infrastructure, political problems, cultural problems and economic conditions. Iyer and Jha (2005) identified many factors as having influence on project cost performance, these include: project manager's competence, top management support, project manager's coordinating and leadership skills, monitoring and feedback by the participants, decision-making, coordination among project participants, owners' competence, social condition, economic condition, and climatic condition. Coordination among project participants, however, was identified as the most significant of all the factors, having maximum influence on cost performance., recognized coordination among participants, leadership skills and coordination of project managers, project manager's competence, support of the top management, economic and climatic condition, social condition, participant's coordination, decision making as key factors.

In this study, factors affecting the performance of construction projects in the regions of Mumbai will be

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analyzed. Performance indicators are used to measure performance in construction projects. Then these indicators will be used as, a key element of any organizations step in achieving best practice so as to conquer the performance problem. However, this study aims at identifying the factors which are affecting the performance of construction projects and the analysis of the factors using the ranking method with likert scale and finding the ranking positions of factors accordingly.

II. AIM AND OBJECTIVE

The aim and objective of the study is to find the factors which affects the performance of the construction projects in and around the regions of Mumbai.

- To find the factors influencing the performance of construction projects.
- Evaluation of the factors and ranking the factors according to the ranking position.
- To give suggestions and recommendations to mend the performance of the industry.

III. STATEMENT OF THE PROBLEM

One of the most significant problems facing construction projects in developing countries is the lack of consideration and planning in the pre-implementation stage, as well as the failure of projects during their execution. As a result, the desired goals are neither achieved nor integrated with the general developmental or economic strategy of the country. Whilst there is also a lack of methods and mechanisms to monitor and control projects, as can be the case in developed countries, some research has been undertaken in developed countries regarding how to control and measure the performance of construction projects. Therefore, these are investigated to select suitable methods and appropriate mechanisms that can be applied to address the poor performance of construction projects. However, a PMS is anticipated to address and remedy these issues involving institutional aims, plans, goals and strategies.

IV. METHODOLOGY

- From the literature reviews, factors concerning the performance of the projects were collected and the questionnaire was prepared.
- The questionnaire included questions from cost, time, quality, client satisfaction, People factors, health and safety, innovation and learning and environment, project related, organization related, project manager and project team related and last is external environment related.
- The questionnaires were distributed to contractors. Mainly the regions covered were Mumbai.
- Respondents were asked to rank the questions from one to five based on their importance like very low, low, medium high and very high.
- Based up on the responses received the questionnaire analysis was done by ranking method. Relative importance index was used to determine the relative significance and ranking of the causes.
- Relative importance index RII is calculated as follows

$$RII=\Sigma W \div (A*N)$$

Where, W= weightage given to each factor by the respondent.

A= highest weightage given

N= total number of respondents.

The questionnaires were distributed to thirty contractor's organizations among them only fifteen contractors gave the response. The respondents were organization manager, site engineer, and contractor. The main survey was conducted through semi-structured questionnaire; it was utilized to obtain data from performers and practitioners in the construction projects. These data and information were collected for developing performance measurement framework. The questionnaire was developed and derived

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based on in-depth literature review and interviews.

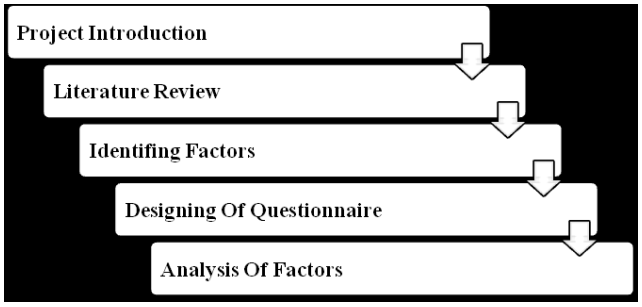

Figure 1: Chart showing Methodology

V. DATA ANALYSIS PROCEDURE

Objective: Determine the performance measurement process, CSFs, and PMs and PSMs in the implementation of municipal construction projects, and problematic areas.

Procedure: Describe the data by means of various statistical analyses as the data is mostly ordinal in nature. These included descriptive statistics to analyze the trends in perceptions/opinions, e.g., score distribution, measures of relative importance index, measures of dispersion; and, inferential statistics to analyze ratings/rankings. These techniques reduced a large number of overlapping measured variables to a much smaller set of factors.

Process: All data was tabulated and initially analyzed in MS Excel and RII with ranking was also analyzed in MS Excel.

Output: Trends in respondents' perceptions, satisfaction levels, formulation of performance measurement framework.

Example: Main Factor- Cost Factor.

Sub Factor- Cash Flow of Project.

Therefore,
The summation of weight age = 69

Now, RII=ΣW/A*N

Where: W is the weight given to each factor by the respondents and ranges from 1 to 5 = 69,

A = the highest weight = 5,

N = the total number of respondents= 15

RII = 69/5*15 = 0.920

Thus the RII for cash flow of project factor equals to 0.920.

Table no. 1: Summary of relative importance index and rank for factors affecting the performance of construction projects

Sr. No.	Identified Factors	RII	Factor wise rank	Overall Rank
	(1) Cost Factors			
1	Market share of organization	0.480	9	27
2	Liquidity of organization	0.853	4	9
3	Cash flow of project	0.920	2	5
4	Profit rate of project	0.653	6	20
5	Overhead percentage of project	0.520	8	25
6	Material, labour and equipment cost	0.933	1	4
7	Project overtime cost	0.547	7	23
8	Escalation of material prices	0.907	3	6
9	Cost control system	0.720	5	16
10	Waste rate of materials	0.400	10	28
	(2) Time Factors			
11	Planned time for project Construction	0.720	5	16
12	Percentage of orders delivered Late	0.747	4	14
13	Average delay in payment from owner to contractor	0.787	3	13
14	Time needed to rectify defects	0.333	6	29
15	Availability of resources as planned through project duration	0.893	2	4
16	Average delay because of closures and materials shortage	0.973	1	1
	(3) Quality Factors			
17	Conformance to specification	0.867	2	8
18	Availability of personals with high experience and qualification	0.973	1	1
19	Quality training/meeting	0.440	5	27
20	Quality assessment system in Organization	0.493	4	26
21	Quality of equipments and raw materials in project	0.800	3	12
	(4) Client Satisfaction factors			
22	Information coordination between owner and project parties	0.680	3	19

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23	Speed and reliability of service to owner	0.733	1	15
24	Number of disputes between owner and project parties	0.720	2	16
	(5) Health and Safety factors			
25	Application of Health and safety factors in organization	0.933	4	4
26	Easiness to reach to the site (location of project)	0.707	17	17
27	Reportable accidents rate in project	0.547	23	23
	(6) Innovation and learning factors			
28	Learning from own experience and past history	0.853	2	9
29	Learning from best practice and experience of others	0.960	1	2
30	Training the human resources in the skills demanded by the project	0.693	3	18
	(7) Project Related Factors			
31	The size and the value of the project	0.933	1	4
32	The density of project network	0.627	4	21
33	Project life cycle	0.813	3	11
34	The urgency of a project outcome.	0.840	2	10
	(8) Project Manager And Team Related Factors			
35	Ability to delegate the authorities.	0.720	5	16
36	Ability to coordinate	0.840	2	10
37	Perception of role and responsibilities	0.733	4	15
38	Trouble shooting	0.787	3	13
39	Communication skill	0.893	1	7
	(9) Factors Related To Organization			
40	Top management support	0.867	1	8
41	Project organizational structure	0.533	3	24
42	Functional manager's support	0.573	2	22
43	Economic environment	0.947	1	3
44	Political environment	0.680	5	19
45	Technological environment	0.693	4	18
46	Climate condition in the site	0.893	2	7
47	Wastes around the site	0.733	3	15

V. RESULT AND DISCUSSION

The factors which are ranked as number 1 with RII being 0.973. Delay caused due to closures and material shortage are ranked top by the all organizations as materials are the most basic things required to complete a project. Highly experienced personnel will carry out the work with great efficiency. Also, in order to improve one's working technique, it is essential to be able to grasp important skills and qualities from best practices performed in the industry. Also among the factors associated with the external environment, economic environment has great impact on the project performance of a company.

Project cash flow is very important in determining the level of performance as the entire working of the project activities is centered on cash inflow and outflow. Among all the surveyed companies, only the newly developed Construction organizations have rated cash flow as medium important factor. Availability and cost of resources such as materials and equipment are also major factors deciding the execution process of the project as the project can only carry on if the resources are available at planned time and also with reasonable cost fitting into company's budget.

Some other important and majorly effective factors as ranked by the companies are liquidity of organization, escalation of material prices, communication skill, conformance to specification, etc. Here, liquidity of organization refers to organization's ability to convert assets into cash and maintain an uninterrupted cash flow. Thus it will clearly affect the performance to a considerable extent and thus, is rated as important by the respondents. Another important factor is escalation of prices in the market which needs to be taken into consideration while planning and scheduling the project as well as at the time of procuring required materials. Regarding the quality aspect, it is necessary for the outcome or the end result of each milestone of the project matches with the specifications determined in the planning phase. Also, another major factor responsible for healthy working environment and thus leading to satisfactory project performance is the communication skills of the entire project staff including higher authority or management personnel as well as site workers.

Sr. No.	Factors	RII	Overall Rank
1	Average delay because of closures and materials shortage	0.973	1
2	Availability of personals with high experience and qualification	0.973	1
3	Learning from best practice and experience of others	0.960	2
4	Economic environment	0.947	3
5	Material, labour and equipment cost	0.933	4
6	Availability of resources as planned through project duration	0.933	4
7	Application of Health and safety factors in organization	0.933	4
8	The size and the value of the project	0.933	4
9	Cash flow of project	0.920	5

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VI. CONCLUSION

This study will give an overview of several factors affecting the performance of a project, with the help of PMS (Performance Measurement System) and will help to determine the most critical factors affecting the success of a construction company regarding satisfactory performance.

Delay caused due to closures and material shortage, Availability of personnel with high experience, belonging to work, learning from best practice and experience of others, Economic environment are the factors identified as the most critical factors for performance of the construction projects in Mumbai region.

From the data from all the 6 surveyed companies, it can be seen that the factors associated with quality and client satisfaction are rated at considerably lower positions. However, I would suggest that more importance be given to these factors as according to our basic framework regarding the problems associated with the construction industry. The resolution of these problems ultimately is aimed towards client satisfaction which is again concerned with the quality of the finished product.

Basically, it can be briefly concluded that for successful completion of a construction project, various factors are responsible which need to be considered for developing a proper performance measurement system. Out of these factors, most critical ones have to be attended to with great care. And by understanding the relationship between all these critical factors, necessary changes should be made in the working strategy of the company in order to achieve a greater level of success with a better project performance.

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