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Evaluation of Quality Management System of Bridge Construction Projects

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***Abstract*— Bridge construction project is an intigral part of modern transportation system and regional transport connectivity. Also, it has a great effect on the development of modern society. Quality management for this type of project has significant implication from an economic view as well as social point of view. Bridge construction project is located mainly on local road networks focus on many problems and complex issues among which can be effectively over run by quality management process. The objective of this research is to identify the best system for quality management in bridge construction project. This study is based on the questionnaire survey and statistical tools using Mean, The Questionairy survey has been carried out in the present study by consulting contractor, Govt. Engineers, Site engineers, labours. Pilot study has been carried for preparing questionaires based on the quality aspect. Standard Deviation and Relative Importance Index (RII) for the quality management system and help to improve the quality system of bridge construction project. It focuses to provide a tool and idea for quality management improvement for the bridge construction faternity.Keywords—component; formatting; style; styling; insert**

Key words: Bridge Construction Project, Quality Management System, Quality Analysis, Relative Importance Index

I. INTRODUCTION

An efficient transport system is a pre-requisite for the sustainable development of a country. Which plays a very important role in the speedy and economic growth of a country. India has the second largest road network in the world, spanning a total of 5.89 million kilometers (kms). This road network transports 64.5% of all goods in the country and 90% of India's total passenger traffic uses road network to commute. Road transportation has gradually increased over the years with improvement in connectivity between cities, towns and villages in the country. To avoid physical barriers in transport connectivity bridges play key role for same. So, for this quality become important issue in the bridge construction industry. Quality and quality management systems are the research topics which have been receiving attention in developing countries because govt spending huge amount of public money for construction of bridges for maintining regional connectivity. Modern bridge construction projects are complex in nature and subjected to frequent quality failures or non -conformance to quality resulting in increase in project cost, decrease in the efficiency of the project and affecting the overall performance of the construction industry. In developing countries like India, quality did not reach the sufficient level of acceptance and face many obstacles due to the complex nature of the construction industry.

A. Problem Statement

In varies projects the quality of the project mainly affected by the management reasons like individual leadership, less quality awareness, poor inspection lack of technical force investment, violation of construction procedures and bidding system is not perfect, operation is not standardized, lack of engineering supervision system, lack of supervision, violation of laws and regulations, illegal subcontracting.

Also quality of project is affected due to varies construction issue like improper construction which is not in accordance with the standard norms and design requirements of the construction, use of substandard materials to reduce the cost and employ large number of low quality construction workers for maximize the profits. Hence quality management system in infrastructure projects is required.

B. Aim of the Study

To evaluate the suitable Quality management system for the Bridge Construction project.

C. Objectives of the Study

Following are the objectives for the fulfillment of this study: -

- To study the quality management system of Infrastructure project.
- To evaluate the suitable quality management system through pilot study.
- To give suggestion or recomandation for improve the quality management system based on analystical analysis.

II. DATA ANALYSIS

The quality is a key function in all infrastructure development environment like cost and time. It becomes one of the vital factor in any construction project. Quality is one of the important key performance indicators of a construction project which may cause cost overrun and time delays. Quality control (QC) and quality assurance organizations are established only as a result of prescribed requirements. construction sector quality control can be looked upon as client satisfaction, relation with cost, and enough time to obtain anticipated quality. A quality assurance system has been developed by an international standard organization (ISO) for improving quality and overcoming the quality related problems. For quality ISO 9001 series have been availability of construction materials, political environment, site staff experience and proper documentation. For good

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performance in quality of construction projects following factors are necessary, joint working, mutual objective, no blame culture, introducing quality assurance methods, effective management team of contractors, no enforcement of bureaucracy and politics.

So based on the litature available, the following quality management systems were identified.

1) Quality Control Measures
2) Quality Management Tool
3) Quality Performance
4) Inspection & Testing of Executed work

There is are the main quality management method or we can say system. That were taken and finalized by taking pilot study. As per suggestion given by expert in the pilot study. Pilot study also attached in annexure and following table shows the list of expert form who I conduct the pilot study.

Each Quality management system has theirs sub factors. Based on that sub factors, Quality management system gave performance. So these sub factors are also identified from available litetures and finalized it by taking pilot study.

So following Table 2-1 give the understanding about the compairiosion of pilot study and questionaries' survey. Based on the pilot study the following are the main factors that's are finalized by the expert for taking questionaries' survey.As per expert recommendation, some factors are excluded from questionaries' survey and expert finalized the questionaries'.

Table II-1 Compairiosion of Pilot Study factors and Questionaries' sub factors

Sr No.	Pilot Study	Factor and method finalized by expert for Questionary Survey
I.	**Quality control measures**	**Quality control measures**
1	Correct sampling and testing	Correct sampling and testing
2	Study duties and responsibilities	Study duties and responsibilities
3	Available quality control lab at site	Available quality control lab at site
4	Coordination with the project purchase department	Coordination with the project purchase department
5	Quality of skill construction movement	Quality of skill construction movement
6	Follow the prescribed treatment and deportation rules	Follow the prescribed treatment and deportation rules
7	Sequence of work in Construction	Sequence of work in Construction
8	Review meeting with staff at site location	Review meeting with staff at site location
9	Daily site observation schedule	Daily site observation schedule
10	Extra component and materials are available for laboratory equipment	Extra component and materials are available for laboratory equipment's
11	Regular maintain the schedule	Regular follow the schedule
II.	**Quality Management tool**	**Quality Management tool**
1	Pareto analysis(80-20 rule)	N.A.
2	Ishikawa diagrams	N.A.
3	Flow diagram	Flow diagram
4	Check lists	Check lists
5	Histogram	N.A.
6	Tally Sheet	N.A.
7	Statistical analysis	N.A.
8	Control Charts	N.A.
9	Scatter diagram	N.A.
10	Organizational Structure	N.A.
III.	**Quality Performance**	**Quality Performance**
1	Management infallibility	Management infallibility
2	Individuals shirking their duties	Individuals shirking their duties
3	Poor leadership performance	Poor leadership performance
4	Lack of customer focus	lack of visibility of plan
5	work load	work load
6	Lack of poor training	Lack of poor training
7	Competitive markets	Lack of task skill
8	Teamwork with all activities	Teamwork with all activities
9	Proper order of construction drawings	Proper order of construction drawings
10	Review meetings	Review meetings
11	Acceptation fulfill of customer	Acceptation fulfill of customer
12	Acceptation fulfill of Clint	Acceptation fulfill of Clint
13	Acceptation fulfill of stakeholders	Acceptation fulfill of stakeholders
14	Human resource	Human resource
IV.	**Inspection & Testing of executed work**	**Inspection & Testing of executed work**
1	Physical Testing	Physical Testing
2	Test reports from supplier	Test reports from supplier
3	Timely Inspection of works	Timely Inspection of works
4	Third Party Inspection	Third Party Inspection

On the basis of previous studies on factors influencing quality performance in bridge construction projects 31 factors were identified for questionaries' survey by the expert suggestion. To easily compare these factors with international standards and with global construction parameters, the stastical method is used. The first step towards analysis is to evaluate and assess the data, for that reason RII statistical method is used. For application of this statistical method, the three case site or case study selected. Following is the list of cas study for applying these factors and stastical method.

1) Bridge on Vyara-Kherwada road at chainage 13/150
2) Bridge on Mandvi-Serulla Road at chainage 18/500
3) Bridge on Godssamba- Karvalla Road at chainage 0/2 to 0/4

The queationary survey done from the stockholders, site engineers, consultancy, government engineers working on these three site. The following table 2-2 gives ideas about the percentage of distribution of questionnaire survey form among them. And the table 2-3 gives the idea about their experience in the construction fraternity. About to 37 questionaries' form was distributed among them. After that response was analyzed through RII method. This research is based entirely on the responses received from the selected bridge construction contractors, engineering experts and stockholders.

Table II-2 Distribution of Questionaries' Survey Form

Sr No.	Occupancy	No Of Occupanc	%
1	CONTRACTOR	8	21.62162162
2	SITE ENGINEER	9	24.32432432
3	CONSULTANT	2	5.405405405
4	ENGINEER	9	24.32432432
5	STAKEHOLDERS	9	24.32432432
	Total	37	

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Table II-3 Experice of Stakholders

Experience	5>Year	5-10year	10-15year	15-20year
No Of Experience In Occupancy	20	9	6	3

The sampling technique for this study was randomly done but for the purpose of the study, it was limited to professionals engaged by small scale contractors To easily compare the factors with international standards and with global construction parameters, the weighted mean method is used. The first step towards analysis is to evaluate and assess the data, for that reason Relative Response method is used. The study enjoyed a hundred percent responds rate as questionnaires were administered and collected the same day when completed.

A. Relative Importance Index

The relative importance index (RII) used to indicate the relative importance of each variable contributing to the poor quality performance of small scale contractors was calculated with the formula below:

Relative Importance Index = $\frac{(5n1 + 4n2 + 3n3 + 2n4 + n5)}{5(n1 + n2 + n3 + n4 + n5)}$

Where;

n1 = number of respondents who answered "Very Strong"

n2 = number of respondents who answered "Strong

n3 = number of respondents who answered "Moderate"

n4 = number of respondents who answered "Less"

n5 = number of respondents who answered "Very less"

Sr. No.	FACTORS CAUSING DELAY IN CONSTRUCTION PROJECTS	RELATIVE IMPORTANCE					R.I.I	Ranking
		VERY STRONG (N1)	STRONG (N2)	MODERATE (N3)	LESS (N4)	VERY LESS (N5)		
		5	4	3	2	1		
I	Quality Control Measures							
1	Correct Sampling And Testing	0	23	14	1	0	0.715789474	14
2	Study Duties And Responsibilities	8	21	9	0	0	0.794736842	8
3	Available Quality Control Lab At Site	10	7	12	9	0	0.694736842	17
4	Coordination With The Project Purchase Department	10	21	6	1	0	0.810526316	6
5	Quality Of Skill Construction Movement	12	18	7	1	0	0.815789474	5
6	Follow The Prescribed Treatment And Deportation Rules	15	16	6	1	0	0.836842105	3
7	Sequence Of Work In Construction	21	11	6	0	0	0.878947368	1
8	Review Meeting With Staff At Site Location	13	13	10	1	1	0.789473684	9
9	Daily Site Observation Schedule	13	22	3	0	0	0.852631579	2
10	Extra Component And Materials Are Available For Laboratory Equipment's	2	3	23	8	2	0.573684211	25
11	Regular Follow The Schedule	7	25	3	2	1	0.784210526	10
II	Quality Management Tool							
1	Flow Diagram	2	11	19	6	0	0.647368421	20
2	Check Lists	2	15	20	1	0	0.694736842	17
III	Quality Performance							
1	Management Infallibility	0	24	13	1	0	0.721052632	13
2	Individuals Shirking Their Duties	11	21	5	1	0	0.821052632	4
3	Poor Leadership Performance	9	23	4	2	0	0.805263158	7
4	Lack Of Visibility Of Plan	10	11	12	5	0	0.736842105	12
5	Work Load	0	1	18	18	1	0.5	28
6	Lack Of Poor Training	0	13	19	5	1	0.631578947	22
7	Lack Of Task Skill	0	2	13	20	3	0.473684211	29
8	Teamwork With All Activities	0	21	16	1	0	0.705263158	15
9	Proper Order Of Construction Drawings	3	23	11	0	1	0.742105263	11
10	Review Meetings	4	24	9	0	1	0.589473684	24
11	Acceptation Fulfill Of Customer	1	13	23	1	0	0.673684211	18
12	Acceptation Fulfill Of Clint	0	12	21	5	0	0.636842105	21
13	Acceptation Fulfill Of Stakeholders	1	1	18	16	2	0.510526316	27
14	Human Resource	15	19	3	1	0	0.852631579	2
I	Inspection & Testing Of Executed Work							

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V								
1	Physical Testing	0	3	26	9	0	0.568421053	26
2	Test Reports From Supplier	1	11	23	3	0	0.652631579	19
3	Timely Inspection Of Works	2	9	13	14	0	0.594736842	23
4	Third Party Inspection	6	12	7	12	1	0.652631579	19

III. CONCLUSION

Good quality performance makes the construction project successful. The performance can be increased by studying and improving the factors that affect the quality significantly. In this research, we have identified these factors and took feedback via questionnaires from construction practitioners.

To this extent, the paper has identified: Sequence Of Work In Construction, Daily Site Observation Schedule and; Follow The Prescribed Treatment And Deportation Rules as rank as the first three factors that affected the quality of bridge construction project.

Hence, addressing the research objectives and drawing on the research findings, with it wider implications for the quality practices in thebridge construction project. It is therefore suggested that policy makers, researchers and practitioners look at improving the human resource base through continuous professional and project management skill development.Monitoring systems should be improved and need to draw kind attention of government engineer for the daily site visiting schedule with the aim of ensuring maximum quality achivement .

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